LINE REGEN

COMBIVERT R4

KEBCO
POWER TRANSMISSION

Line regen instead of resistive braking

When motors are dynamically decelerated or when the load on the motor causes the motor to act as a generator, the energy produced can be utilized by other loads on the machine and in the factory. Using a line regen device to return this energy and make it available for other uses results in a smart, efficient, and economical design. Typically the additional cost of the regen system can be paid for by money saved in energy consumption.

Performance characteristics

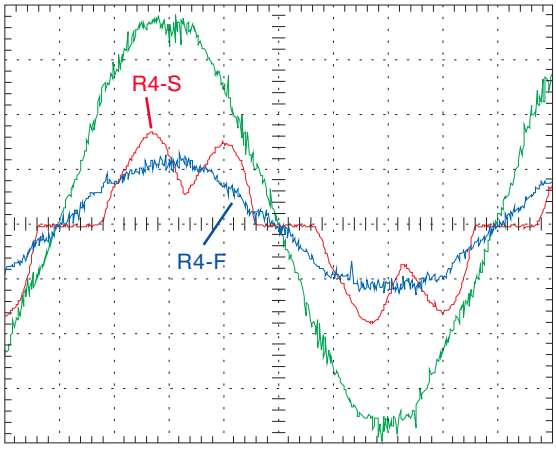


Figure 1: motor operation

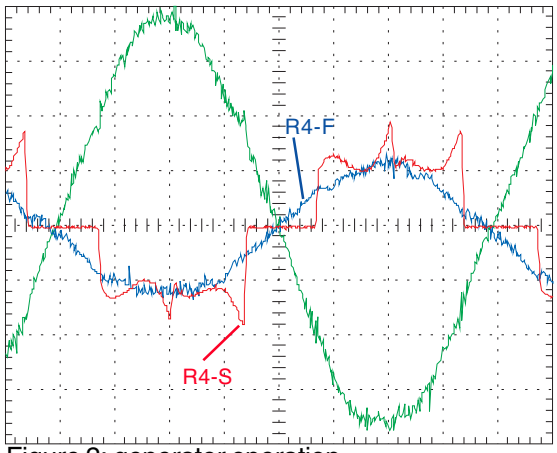


Figure 2: generator operation

The KEBCO R4 regen system not only returns generated energy to the line but also can act as a rectifier supplying energy to inverters with DC inputs. There are two versions available which differ in the harmonic content and distortion of the current waveform.

- **KEB COMBIVERT *R4-S***

Block-shaped regen current which is similar in harmonic content to the current flowing into a standard diode bridge rectifier on an inverter: Highest efficiency, PF = 1 and DPF < 1, and lowest cost.

- **KEB COMBIVERT *R4-F***

Sine wave current waveforms during both motor mode and generator mode. Harmonics are in compliance with the requirements of EN 61000-3-2. Evaluation against IEEE - 519 pending: Lower efficiency, PF = 1 and DPF = 1, and higher cost

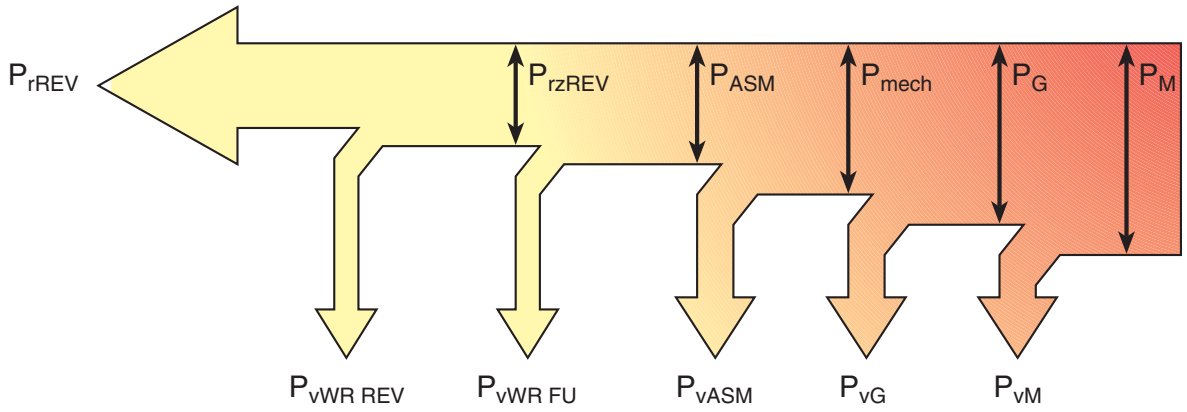
Applications

- Elevators
- Storage/retrieval units
- Transporting equipment
- Web handling
- Escalators
- Punch presses
- Weaving machines
- Eccentric drives
- Wind Generators
- Multi axis servos
- Centrifuges and separators
- Hoists and Cranes
- Gantry Cranes (horizantal drive)

User benefits

- Energy savings - generatred energy can be used by other loads in the machine
- Very low heat loss compared to resistive braking - reduces the size of the control cabinet
- Compact design with small dimensions
- Less weight for moving systems
- Stable inverter-DC Bus voltage leads to longer capacitor life; especially for excentric loads
- Can be linked to a variety of serial networks for total process control: InterBus, Profibus, CAN, LON, KEB DIN 66019
- CE interference suppression to EN 55011, EN 61800-3/Limit A
- Full 4 Quadrant operation of the inverter / motor system
- Large range of system voltages 180...260 VAC or 300… 500 VAC; 50 Hz or 60 Hz
- Easy installation, little adjustment required
- Watchdog function for braking operation - notifys host control of loss of supply votlage
- R4-F provides PF ≈ 1 and displacement PF ≈ 1

Block diagram and energy flow calculation



- P_M = machine power
- P_{vM} = machine losses
- P_{vG} = gearbox losses
- P_{vASM} = losses of three-phase induction motor
- P_{vWRFU} = inverter losses frequency inverter
- P_{vWRREV} = inverter losses regen module
- P_{rREV} = regen power
- P_{mech} = mechanical power

$$P_{rREV} = P_M - P_{vM} - P_{vG} - P_{vASM} - P_{vWRFU} - P_{vWRREV}$$

Dimensioning example

As a hoist lowers its load, energy is generated. This energy can be cost effectively returned to the line through the KEBCO R4-S regen system.

Mechanical efficiency:	$\eta_{vM} = 95\%$
gearbox efficiency:	$\eta_{vG} = 94\%$
Motor efficiency:	$\eta_{vASM} = 92\%$
Inverter efficiency:	$\eta_{vWREV} = 99\%$
KEBCO R4-S efficiency:	$\eta_{vWREV} = 98\%$
Total efficiency:	$\eta_T = 80\%$

Required hoist lowering power $P_H = 42$ kW

Required regenerative power

$$P_{rR} = P_H \times \eta_T^2 = 42 \times 0.8^2 = 26.9 \text{ kW}$$

Selected regen module:	18.R4.S0G-3401 31 kVA, 27 kW 45 A - Continuous 65 A - Peak
Commutation reactor:	00.90.293-1341
EMI filter (if required):	22.R4.T60-1019

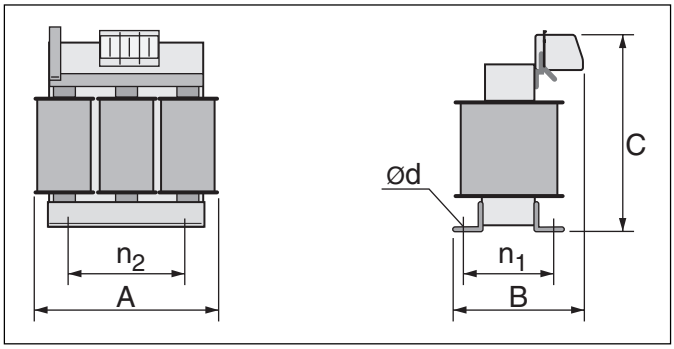
Technical Data

Control Type	R4-S 230V		R4-S 460V			R4-F 460V	
Supply voltage VAC	180…250 3 phase		305...500 3 phase			305…500 3 phase	
Hz	40…60 +/-5%		40…60 +/-5%			40…60 +/-5%	
Rated regen power kW	**5.5**	**11**	**11**	**22**	**70**	**23kVA**	**62kVA**
Peak regen power kW (85 sec. Max. @ 70% duty cylce)	8	19.5	16.5	39	100	37kVA	93kVA
Rated regen current A	19	36	19	36	120	33	90
Peak regen current A (85 sec. Max. @ 70% duty cylce)	27	65	27	65	173	49	135
DC load current A	29	40	29	40	150	-	-
Peak DC load current A (85 sec. Max. @ 70% duty cylce)	49	65	49	65	170	-	-
Power factor	0.86		0.86			1	
Housing size	G	G	G	G	R	G	R
Regen unit model number	**12R4S**	**15R4S**	**14R4S**	**18R4S**	**22R4S**	**16R4F**	**21R4F**
Use commutation choke	1	2	1	2	3	4	5
Use EMI filter [1]	A	B	A	B	C	D	E
Environment							
Housing design / protection class	chassis / IP 20						
Operation temperature	-10 … 45°C						
Storage temp	-25 … 70°C						
Humidity	98% (non condensing)						
Digital input votlage range	13 … 30 VDC						
Internal supply voltage	+18 VDC (300mA) Short circuit proof						
Control relay contact	250VAC or 30VDC @ 1A						

1) For parallel connection consult KEBCO for sizing EMI filter

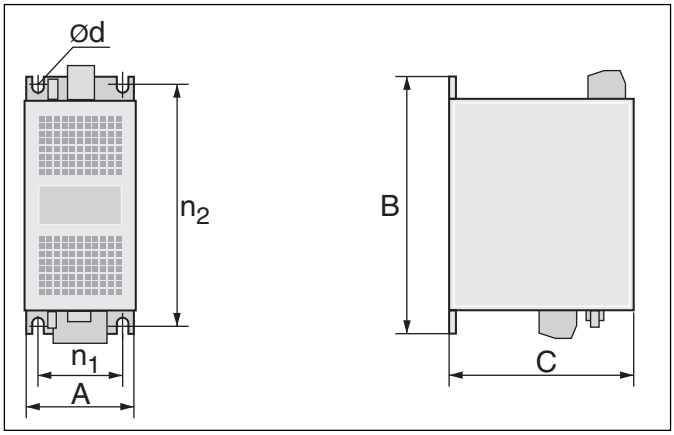
Housing Size	H x W x D (inches)
G	**13.4 x 6.7 x 10.0**
R	**20.5 x 13.5 x 14.2**

Dimensions commutation reactor



	Part number	A	B	C	n_1	n_2	Ø d
1	00.90.292 -1449	6.7	3.3	5.9	2.0	4.4	0.2
2	00.90.293 -1341	9.1	5.9	9.1	4.8	7.1	0.3
3	00.90.296 - 4559	13.9	8.7	5.7	5.7	12.9	0.3
4	16.DR.R08-2250	on request					
5	21.DR.R08-8540	on request					

Dimensions radio interference suppression filter



	Part number	A	B	C	n_1	n_2	Ø d
A	14.R4.T60-1019	3.1	13.4	7.9	2.0	12.6	0.3
D	16.E4.T60-1001*	7.1	16.3	2.2	5.9	15.7	0.3
B	18.R4.T60-1019	4.7	13.4	9.1	3.9	12.6	0.3
E	19.E4.T60-1001*	11.8	17.5	2.6	9.8	16.5	0.3
	21.R4.T60-1019	5.6	18.1	9.2	3.9	17.7	0.3
C	22.R4.T60-1019	on request					
	25.R4.T60-1019	on request					

All dimension in inches
* filter mounts under R4 unit - no additional panel space required

Accessories

PC programming of parameters PC oscilloscope as universal measuring instrument

Display and operator modules

Interface Operator 00.F4.010-1009
Digital Operator 00.F4.010-2009

Fieldbus interface modules

LWL-Operator
Fiber optic operator
00.F4.010-A009

CAN-Operator
00.F4.010-5009

LON-Operator
00.F4.010-4009

BUS-Operator
00.F4.010-7009

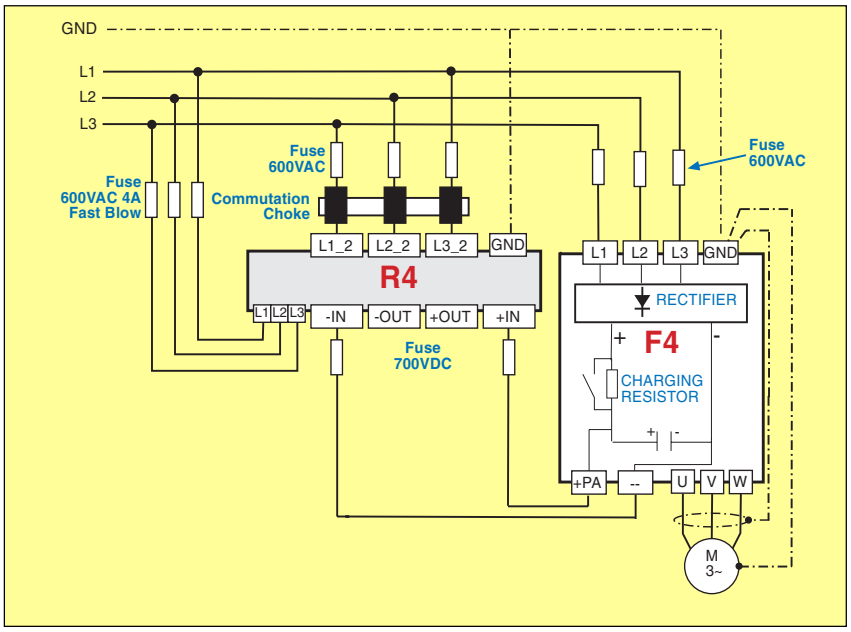
InterBus Loop-Operator
00.F4.010-8009
external
InterBus remote bus terminal 00.B0.0BK-K001

PROFIBUS-Operator
00.F4.010-6018

Connection / wiring schemes

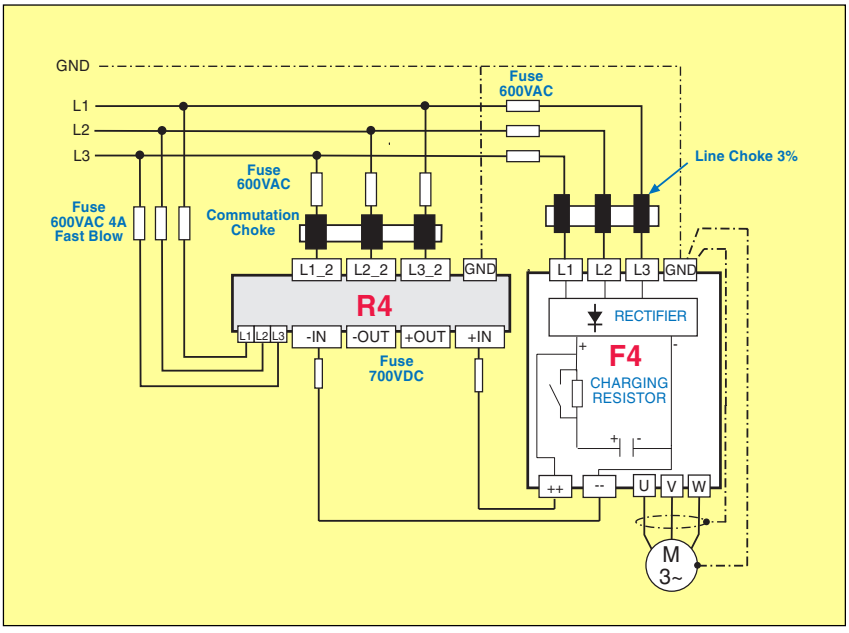
There are two primary connection schemes depending on the construction of the inverter. If the DC bus connection of the inverter is after the charging circuit within the unit, as in the F4 inverters with **(PA+)** terminals, the R4 can be connection as shown in figure 1.

Figure 1



If the DC bus connection of the inverter is before the charging circuit as in F4 inverters with **(++)** terminals, the R4 must be connected as shown in figure 2. In this conifguration it is necessary to install the inverter with a line choke to minimize the charging current when the system is first turned on.

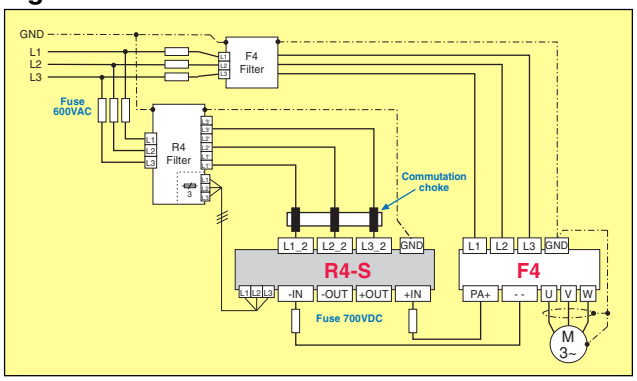
Figure 2



Connection / wiring schemes

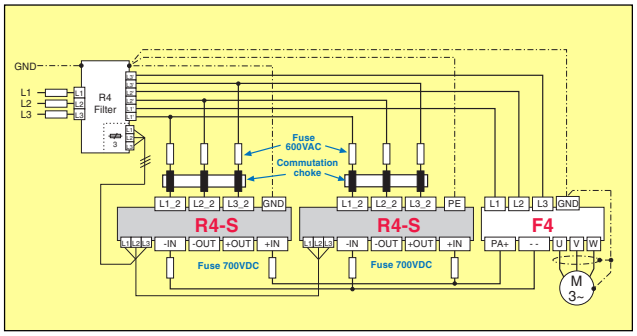
This scheme shows the connection with KEBCO EMI filters. When the inverter load is greater than that of the R4 two separtet filters must be used as shown in Figure 3. When the load of the inverter is less than or equal to that of the R4 the R4 filter can be used for both the R4 and the inverter.

Figure 3



In some cases it may be necessary to regen more power than one unit can safely handle. As aresult units cn be put in parallel to increase the available regen power handling capacity. This connection is shown in figure 4 with one R4 EMI filter for the entire system.

Figure 4



The R4 can also serve as a power supply for DC input inverters. The R4 unit will rectify incoming AC and provide it to the inverters and will regen to the line any energy comming from the inverters. Figure 5 gives an example of this with one R4 unit and two F4 inverters. This is the common connection for the R4F which provides sinusoidal line currents.

Figure 5

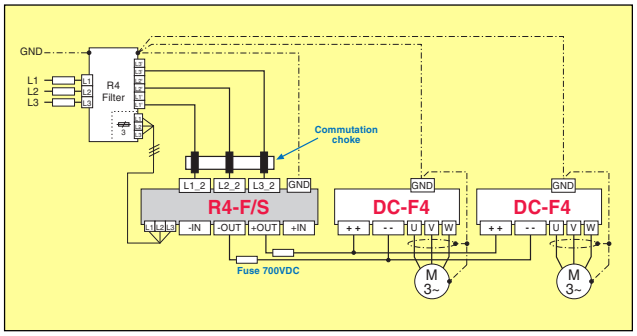
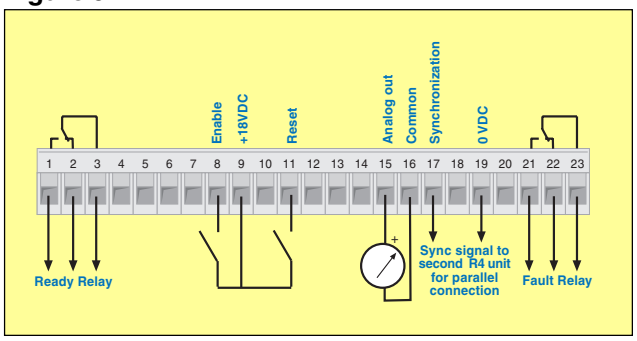


Figure 6 give an example of the control wiring diagram of the R4. An enable signal is all that is require for minimum connection. A fault reset terminal, fault relay, ready relay, and analog output are provided as well. Finally a synchronization signal must be connected to parallel R4 units.

Figure 6



people in motion

KEBCO

POWER TRANSMISSION

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