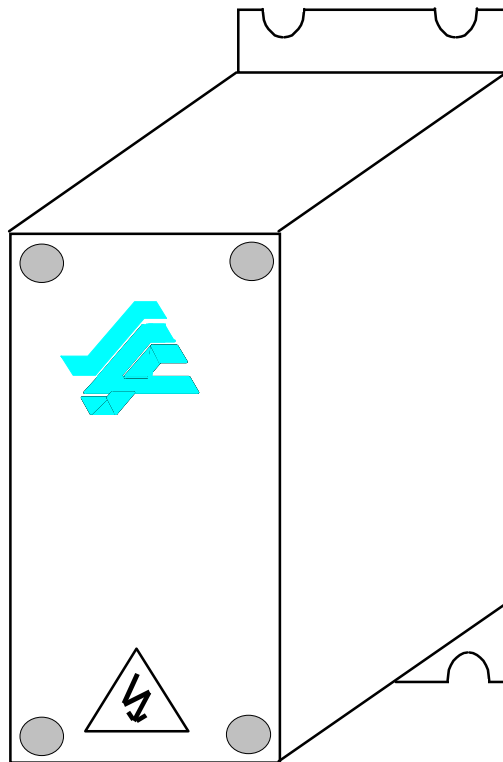




**UFS 15-22-40-110**  
**UFS15J-22J-40J**



**BRAKING UNIT**

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## 0. WORK SAFETY

### STATEMENT

This braking unit was designed, based on the EEC directives applicable to it, that is to say:

- Low voltage directive No. **73/23 - 93/68**
- Machine directive **89/392 - 91/368 - 93/44**

### **UL - CSA compliance**

All braking unit models (listed below) are built in compliance with UL – CSA safety standards (UL **508-C**: file n. **E213814**).

Product Covered: UFS15 - UFS15J - UFS22 - UFS22J - UFS40 - UFS40J – UFS110

This is a complex component aimed at being integrated into the equipment by skilled staff only. This equipment can be used in industrial areas only.

It must be connected to the relevant inverter. It can cause troubles to radio-frequencies.

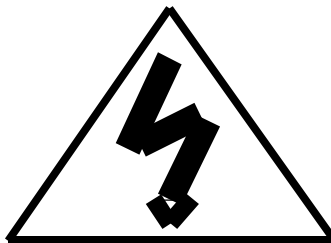
This equipment must be used, installed and managed by skilled and qualified staff, familiar with its application and working. The usage will be compliant with provisions stated in:

- PRODUCT STANDARDS (if set)
- BASIC CEI EN 60204-1 STANDARD
- RUNNING LAWS
- THIS MANUAL

To the safety purpose, some basic provisions should be recalled:

- ALWAYS FORESEE A SECTIONING MEAN FROM THE POWER SUPPLY NETWORK
- PROVIDE ELECTRIC AND NON-ELECTRIC GUARDS TO PREVENT DAMAGES TO PEOPLE AND GOODS IN CASE OF EQUIPMENT FAILURE.

SCS rejects any responsibilities for direct and indirect damages linked to the improper usage of this option.



## **DANGER: ELECTRICAL SHOCKS**

**NOTE:** The contents of this manual when printing it, is to be considered as correct. However the manufacturer is entitled to change its contents without any notice.

## **0.1 EMC Requirements**

Even if SCS considers this product as a complex component this braking unit was designed to match requirements as per provisions in CEI EN 50081-2 standard (Emission) and CEI EN 50082-2 standard (Immunity). It was tested in an independent laboratory and trials gave a positive outcome. Consequently, the CE mark on the product serial number label is valid both for the CE LVD 73/23 93/68 directive (low voltage, safety) and for the EEC EMC 89/336 directive (electromagnetic compatibility).

This equipment is an outside option for inverter and works in a strict coordination with its related inverter from which it receives control and power supply.

Since there is no direct connection with the power supply network, this equipment contribution to EMC emissions is negligible since these latter are fully absorbed by the inverter power supply filter (refer to the inverter user's guide).

Mount the braking unit close to its relevant inverter, minding to create with this a mutual low impedance and high frequency earthing (ex. the surface of the mounting plate). The connection to the braking resistor must be as short as possible and will be performed using a braided or shielded cable. Braking resistor will have a metal screen or will be armoured in order to filter emissions. To have further execution detail, please apply to our guide NT247.

The end verification in the conformity of emission and immunity EMC standard for the specific product and/or to the full installation applicable to it, are under the manufacturer's and/or the end installer's province.

## 1. WORKING DESCRIPTION

The UFS braking units are conceived to be joined with the Mitsubishi inverter, *FREQROL* and *MELTRAC* series. However, they can be used with inverters or converters equipped with BUS-DC.

These packages aim at dissipating, through a control chopper, the energy coming from the load (kinetic energy during the braking phase). Normally, this energy produces a rise of the inverter Bus DC and this value cannot exceed a given limit. The instantaneous power that can be absorbed is sent to a group of power resistors. Every group is self-supplied by the inverter Bus DC.

The UFS braking units are equipped with circuit for synchronization (through the two-wire cable connection) for the Master/Slave connection of more parallel units. By means of this circuit it is possible to increase the total brake power, connecting more units – also of different sizes - to the same BUS-DC, provided that each unit is connected to the resistor group that is specific for that UFS size.

In order to protect the external braking resistors, on the UFS standard unit a suitable electro-mechanical thermal relay is mounted with insulated auxiliary contacts which are available to operate the alarm sequences.

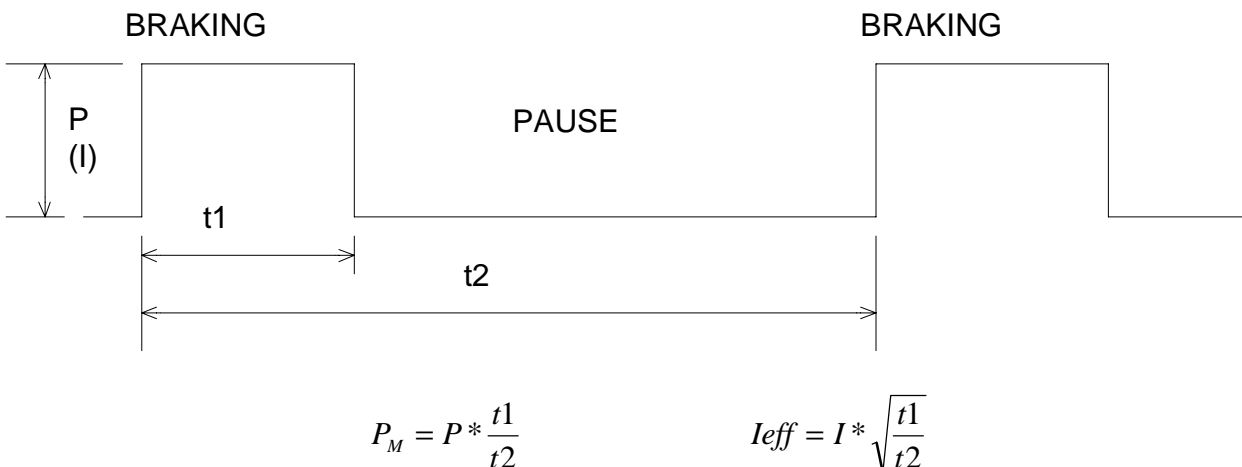
For the brake unit protection, on the heat sink a bimetal thermostat is mounted and internally connected, whose intervention causes the temporary deactivation of the unit.

The braking power is to be dimensioned in function of the actual braking cycle, considering pauses. The braking power is given by:

$$P = \frac{1}{2} J W^2 * \frac{1}{t_{\text{brake}}} \quad (1 \text{ rad/sec} = 9,55 \text{ rpm})$$

Power 'P' in watt, speed 'W' in rad/sec, time 't' in sec., moment of inertia 'J' in Kg\*m<sup>2</sup> to the motor axis.

Obviously, the stated power is to be reduced by the power necessary for the working. This latter contributes to brake the load. In its turn, the motor thermally absorbs 10% approx. of the nominal power, due to its inside leaks. Considering pauses, the mean power will become:



Used resistors must be able to dissipate at least the continual service power. The power values shown on the table provide for a quite hard engagement (braking for 15 seconds approx. and 150 seconds pause). These can be reduced provided that the application requires it. In this event, the thermal relay is to be delayed in function of the maximum power that every resistor can dissipate.

$$I = \sqrt{\frac{Pr*0,8}{R}}$$

### **1.1 Alarm leds**

The green 'ON' led, states that the braking unit is supplied by the DC source. Usually, it is lighted. The red 'BR' led lights on when the unit transfers energy coming on the load on resistors. Usually it is switched off, but it blinks when the unit is working.

### **1.2 Switching ON and OFF**

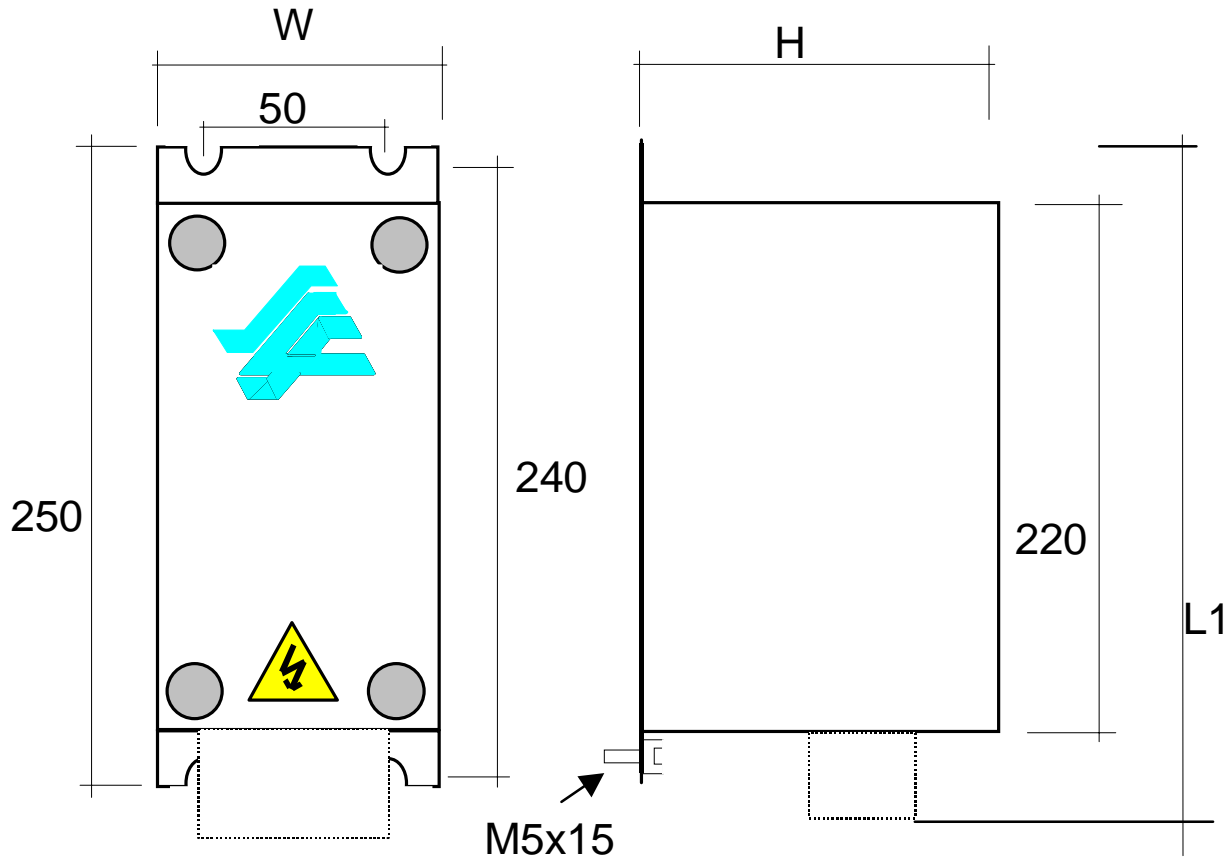
The unit is equipped with a circuit which directly takes the power supply from the BUS-DC to which it is connected (P and N terminal boards). In order to avoid spurious switching ON of the braking circuit, the inside enabling is delayed by 1 sec versus the step voltage arrival of the BUS-DC voltage to the nominal value.

This delay is not working in case of very short power failures (1,5 sec) or if the rise of the same is very low.

## 2. MODEL AND DIMENSIONS

### 2.1 Outline dimensions

UFS15 / 15J / 22 / 22J / 40 / 40J – UFS110



Variable dimensions according to size				Weight
Model	Quote			
	W	L1	H	
UFS15,22,40 UFS15J,22J,40J	100	/	175	2.5 Kg
UFS110	107	270	195	3.9 Kg

### 2.2 Wiring terminals

- **UFS15,UFS22,UFS40,UFS15J,UFS22J,UFS40J**

Outside terminal 2,5 sq.mm.

3 = thermal relay common

4 = NA inside thermal relay contact

5 = NC inside thermal relay contact

Outside terminal 6 sq.mm.

P/P1 = Positive terminal of Bus-DC

N = Negative terminal of Bus-DC

F = Braking resistors terminal

G/Y = yellow/green terminal for power earth **PE**

Inside terminals can be reached by removing the product transparent cover

M1 terminal on the printed circuit board

M1-1 = Connection inside thermostat

M1-2 = Connection inside thermostat

M4 terminal on the printed circuit board – synchronism command input

M4-1 = INA

M4-2 = INB

M5 terminal on the printed circuit board – synchronism command output

M5-1 = OUTA

M5-2 = OUTB

- **UFS110**

Outside terminal 16 sq.mm.

P/P1 = Positive terminal of Bus-DC

N = Negative terminal of Bus-DC

F = Braking resistors terminal

G/Y = yellow/green terminal for power earth **PE**

Inside terminals can be reached by removing the product transparent cover

M1 terminal on the printed circuit board

M1-1 = Connection inside thermostat

M1-2 = Connection inside thermostat

M4 terminal on the printed circuit board – synchronism command input

M4-1 = INA

M4-2 = INB

M5 terminal on the printed circuit board – synchronism command output

M5-1 = OUTA

M5-2 = OUTB

The contacts of the inside thermic can be reached by removing the product transparent cover

97-98 = NO contact of inside thermic

95-96 = NC contact of inside thermic

### **2.3 Installation**

- The units are designed to work under natural ventilation. When installing the unit, please provide for a sufficient area to make the air circulate. Then match with an assembling pitch by 150 mm. (horizontal) and 400 mm. (vertical).

If the units are installed next to other heat generating units, verify that the air temperature does not exceed the maximum working temperature stated at the paragraph on technical features.

- In case they are installed near other apparatuses which emanate heat, please ensure that the air temperature does not exceed the max. operating temperature, which is indicated in the technical features paragraph.

- The UFSxxx units are not protected against short circuit or against wrong connections. A wrong connection of the P, N, terminals, of the resistors, or a wrong value of the same, or the setting of a brake threshold not suitable for the application, can irreparably damage the unit itself or the inverter.



### 3. CONNECTIONS

#### 3.1 Connections UFSxx/UFSxxJ

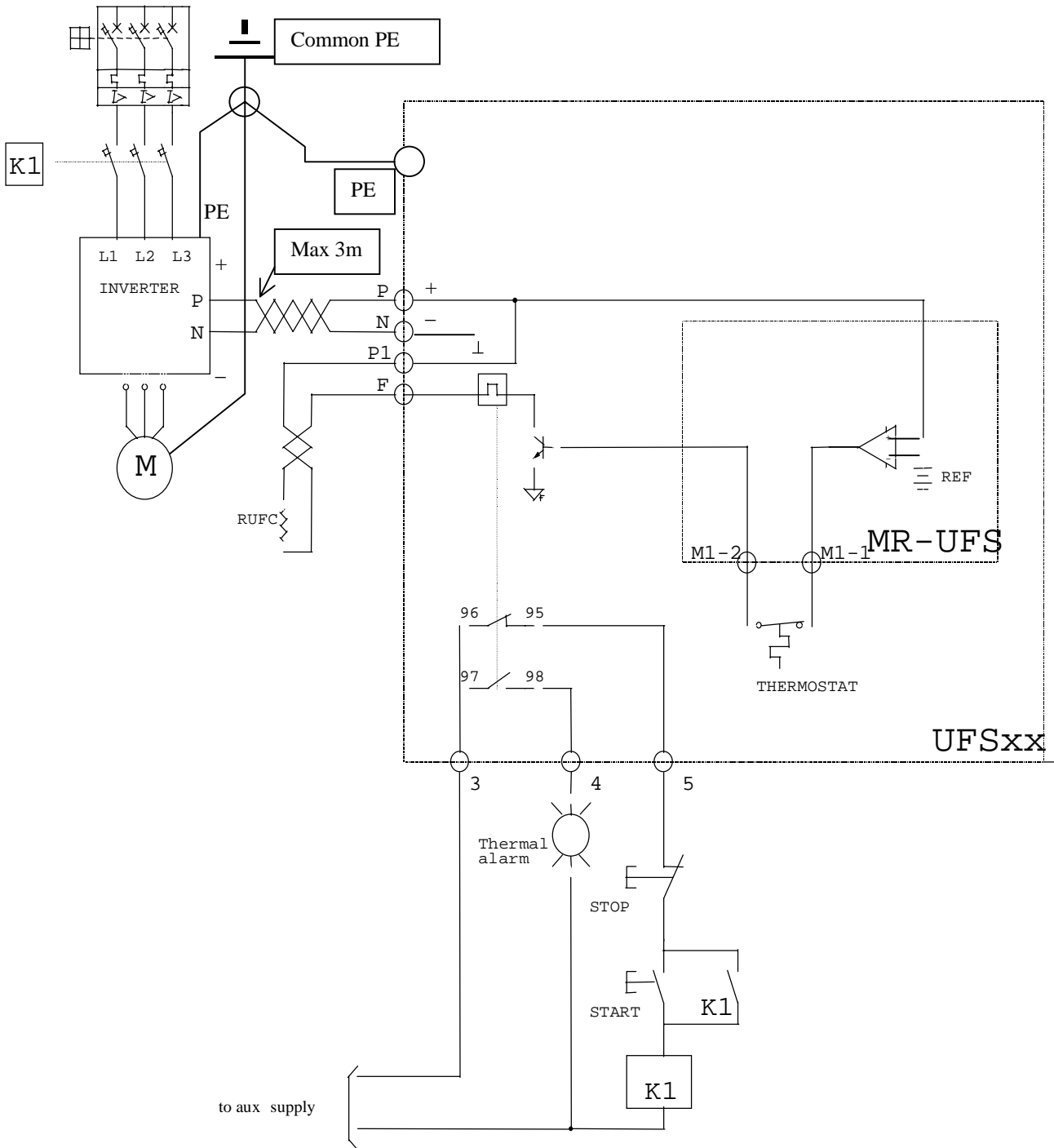


Figure 4.1 UFS **standard** connection

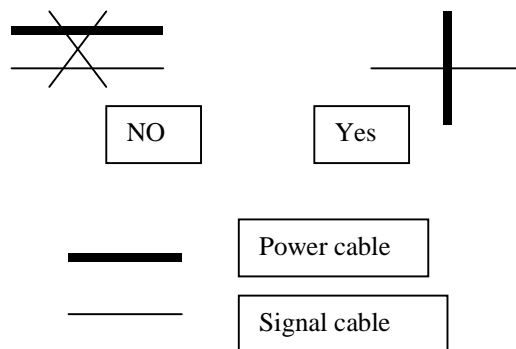
**Note:** In the UFS110, contacts of thermic relay are not reported in outside terminals, but can be acceded by removing the product transparent cover.

### 3.2 Assembly in the electric cabinet

The units must be connected using the shortest possible cables. The max. absolute length of the P, N, power cables is 3 meters.

The max. length of the connections of the P1, F, resistor is 5 meters.

The P, N, connections must be carried out using braided cables; they must not be inserted very close (min 150mm) to signal cables which are sensitive to EMC troubles. In case of practical problems, square crossings (at 90° degrees) between power and signal cables are allowed.



The same rules are valid also for the connection cables of the brake resistors.

The connection of the earth cable (PE) must be branched, (star type branch), from one single spot (earth bar) together with all the PE connections of the network, of the motor, of the EMC filter, of the inverter, etc.

## 4. FEATURES AND PERFORMANCES

### 4.1 General Technical Features

- Tolerance on the intervention voltage: 0.8%
- Hysteresis : about 2%
- Ambient temperature 0°C ÷ 40°C
- Maximum braking time = 10s
- Protection degree IP20
- Thermal guard with manual / automatic reset

### 4.2 Features of UFSxx version

- Power supply voltage 450Vdc-678Vdc
- Maximum voltage 800Vdc

Unit	Braking voltage	Maximum peak current IP (A)	Maximum instantaneous power Pmax (KW)	Standard lth (A)	%ED Max	RF(Ω) min.
UFS15	745	18	14	4÷6	10%	>40
UFS22	745	34	25	7÷11	10%	>22
UFS40	745	55	41	12÷18	10%	>13,5
UFS110	745	140	105	23÷32	5%	>5,3

Used resistor models must allow a very-high over-chargeability (20/1). *Cement-made corrugated belt* models are the best.

**N.B.** The resistors values indicated, are referred to the units setted on the standard threshold voltage (SW-4 = ON = 745V)

### 4.3 Dissipated power by UFSxx versions

- Power dissipated with the unit in stand-by mode @678Vdc: 27W
- Power dissipated when braking; @745V ;  $I = I_{max}$  ; d.c. = 10% \*

UFS15	UFS22	UFS40	UFS110
33W	37W	42W	48W

**P.S.:** The stated dissipated powers do not include the power dissipated by external braking resistors.

\* **d.c. = 5% for UFS110**

#### 4.4 Exclusion of the thermal relay and continual service working

If the thermal relay (external or internal) is unconnected, the braking package can work in *continual service* at the IC. current. In this event, the outside resistors will be value modified in order that they cannot exceed the IC. Their minimum values will be those shown on the following table:

Unit	Resistor for continual service	IC (A)
UFS15	50 $\Omega$ - 14KW in die cast or tungsten	15
UFS22	33 $\Omega$ - 20KW in die cast or tungsten	22
UFS40	25 $\Omega$ - 33KW in die cast or tungsten	30
UFS110	17 $\Omega$ -42KW in die cast or tungsten	44
UFS15J	25 $\Omega$ - 7KW in die cast or tungsten	15
UFS22J	17 $\Omega$ - 10 KW in die cast or tungsten	22
UFS40J	13 $\Omega$ - 15 KW in die cast or tungsten	30

**Note:** Value of resistors in the table, are valid only for the units setted at the standard braking threshold (**SW-4 = ON = 745V**).

See note par. 7.5

The exclusion of the inside thermal relay in the UFS unit includes the changing in the wiring of such relay. The elements of the thermal relay are to be short-circuited using cables of the same section than those present in the unit. The outside resistors are to be guarded with fuses or automatic magneto-thermal switches fit to mounted resistors, and at least with the same IC current, if they are used under this condition.

Use the signaling contact of the internal or external temperature relay, to interrupt the power supply of the inverter and of the unit. See the indicative diagram at par. 3.1



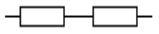
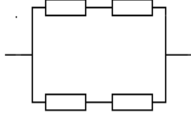
## 5. STANDARD APPLICATION TABLE

In the below table is reported an indicative pairing, obtained from the motor power and from the braking torque percentage in comparison with the rated torque. The pairing is only indicative and, to be sure that the braking units application will not cause problems, it is necessary to check the machine while operating or to calculate exactly the regenerative energy during the braking phase.

Braking torque	Motor power (kW)																	
	5,5	7,5	11	15	18,5	22	30	37	45	55	75	90	110	132	160	220	280	
150 % - 5 sec.	UFS 15			UFS 22			UFS40			UFS110			2 x UFS110			3 x UFS110		
100% - 15 sec.	UFS15/UFS22			UFS22			UFS40			UFS110			2 x UFS110					
50% - 15 sec.	UFS15					UFS22		UFS40			UFS110				2 x UFS110			

### 5.1 Standard braking resistances (SCS KIT)

Since many applications require a working cycle with a braking time shorter than 2s and a pause time at least of 40s (E.D. =5%), braking units UFSxx are provided with standard resistors that, if used according to the following directions, allow to dissipate the energy coming from the motor.

Unit	SCS kit		Connection	Overall Resistance	Overall power continuous duty S1	Overall power intermittent duty S3 %ED 5% (Max 2s cont.)	Dimensions 1 pc L/W/H.
UFS15	RUFC15	1 pz. x 40Ω 1200W		40Ω -0%+10%	1,2 kW	14kW	310/100/75
UFS22	RUFC22	1 pz x 24Ω 2000W		24Ω -0%+10%	2 kW	25kW	365/100/75
UFS40	RUFC40	2 pz. x 6,8Ω 2000W		13,6Ω -0%+10%	4 kW	41kW	365/100/75
UFS110	RUFC110	4 pz. x 6,8Ω 2000W		6,8Ω -0%+10%	8 kW	82kW	365/100/75

**NOTE:** The UFSxx units can tolerate working cycles harder than the one described for the SCS kit. Thus, if necessary, it can use the braking units with resistors different from those given in the SCS kit. When using other resistor values, NEVER use ohm values lower than those stated at the paragraph 4.2, since this can damage the unit.

## 6. BOARD THERMAL DIMENSIONING

At the end of the braking stage, the RF resistor can reach even very high surface temperatures (max. 450°C). Place them in danger-free areas and far from products which could be interested in the heat flow. The energy absorbed by the resistor is the following one:

$$E = P_{\max} \cdot t \quad E = \text{in Joule} \quad P_{\max} = \text{in watt} \quad t = \text{in seconds}$$

Remember that 1K calory is equal to 4187 Joules, or  $1,16 \cdot 10^{-3} \text{KW/h}$  ( $1\text{KW} = 860\text{Kcal}$ ), and these latter are to be considered for the heat disposal and the dimensioning of the ventilation in the electrical board. One can consider a mean power in function of the processing cycle that, in the worst case, is equal to the maximum P power of the resistor stated in the table, for the RF standard version.

The necessary ventilation, considered in the board thermal exchange, is given by:

$$Q = \frac{P \cdot 50}{\Delta T^{\circ}}$$

Q = cubic meters/hour P = power in KW,  $\Delta T^{\circ}$  = environment/board thermal drop (generally 3÷5°C).

## 7. VARIANTS AND CONFIGURATIONS

### 7.1 Technical features of the UFSxxJ version

The "J" version is identical to the previous one but the standard level threshold is 375V. It is suitable for mains voltages  $200\div 240V \pm 10\%$ . See par. 7.6, 7.7

- Power supply voltage  $234Vdc\div 372Vdc$
- Max. voltage 400Vdc

Unit	Braking voltage	Max, peak current IP (A)	Max. instantaneous power Pmax (KW)	Ith (A) standard	%ED	RF( $\Omega$ ) min.
UFS15J	375	18	6,7	4÷6	10%	>21
UFS22J	375	34	12,7	7÷11	10%	>11
UFS40J	375	55	20	12÷18	10%	>6.8

N.B. The resistors values indicated, are referred to the units setted on the standard threshold voltage (SW-4 = ON.= 375V)

### 7.2 Max. dissipated power – UFSxxJ version

- Dissipated power (unit in stand-by mode) @ 372Vdc: 14W
- Dissipated mean power during braking; @375Vdc :  $I = I_{max}$  ; d.c. = 10%




UFS15J	UFS22J	UFS40J
18W	22W	28W

### 7.3 Standard applicative table for UFSxxJ

In the below reported table an indicative coupling is shown, obtained from the motor powers and from the braking torque percentage in comparison to the rated torque. Such a coupling is only indicative, and to be sure that the application of the brake units will not cause problems, it's necessary to carry out a check on the machine operation, or a precise calculation of the energy which is regenerated during the braking phase.

Brake torque	Motor power										
	5,5	7,5	11	15	18,5	22	30	37	45	55	
150% - 5 sec	UFS15J		UFS22J		UFS40J		2xUFS40J				
100% - 15 sec.	UFS15J / UFS22J			UFS22J		UFS40J		2xUFS40J			
50% - 15 sec.	UFS15J				UFS22J	UFS40J		1UFS40J+ 1UFS15J			

#### 7.4 Standard brake resistors for UFS xx J

Unit	SCS Kit		Connection	Total resistance	Total power S1 continuous service	Total power S3 cyclic service %ED 5% (Max 2s continuous)*	Dimensions 1 piece L/W/H.
UFS15J	RUFC 15J	1 pz. x 24Ω 800W		24Ω -0%+10%	0.8kW	6kW	240x100x75
UFS22J	RUFC 22J	1 pz x 12Ω 1200W		12Ω -0%+10%	1.2 kW	12kW	310x100x75
UFS40J	RUFC 40J	1 pz. X7.5Ω 2000W		7,5Ω -0%+10%	2kW	19kW	365x100x75

**NOTE:** When using different values for resistors, NEVER use ohm values lower than those shown at the paragraph of the technical features, because this can damage the unit.

#### 7.5 Configuration of the UF braking voltage by means of the DIP-SW

The unit is equipped with 8 microswitches, by which it is possible to set a braking value different from the standard one, as indicated in the following table. In the table, to clarify as much as possible, the voltage values for the activation and deactivation (SLAVE) of the unit are reported.

SW1								UFSxx		UFSxxJ	
1	2	3	4	5	6	7	8	Braking on	Braking off	Braking on	Braking off
on	off	off	off	off	off	off	off	778	764	390	384
off	on	off	off	off	off	off	off	770	757	386	380
off	off	on	off	off	off	off	off	754	740	379	371
off	off	off	on	off	off	off	off	745	730	375	367
off	off	off	off	on	off	off	off	726	710	364	357
off	off	off	off	off	on	off	off	703	690	353	346
off	off	off	off	off	off	on	off	690	677	347	340
off	off	off	off	off	off	off	on	slave	slave	slave	slave

SW1 – 4 (S1) = ON standard position.



**Warning!** Setting a braking threshold higher than standard (745V/375V), it's necessary to change the homing and power values of the braking resistors in order to prevent any damage to the resistors and to the braking units..



**7.6 Suggested settings for standard mains voltages (dip-switch SW1)**

Supply mains +/-10%	BUS DC with mains +10%	Standard brake voltage Vbr	Dip switch SW1 standard Position = ON	Dip switch SW1 Position Min	Dip switch SW1 Position Max
UFSxxJ					
200	311	347	7	7	5
210	326	353	6	6	4
220	342	375	4 ⊗	5	3
230	357	375	4 ⊗	4	2
235	365	386	2	3	2
240	373	390	1	2	1
UFSxx					
380	591	745	4 ⊗	7	4
400	622	745	4 ⊗	7	4
415	645	745	4 ⊗	6	3
420	653	745	4 ⊗	5	3
440	684	745	4 ⊗	4	3
460	715	754	2	4	2
480	746	778	1	2	1

Note: ⊗ Standard position as from delivery ex works

**7.7 Min. brake resistance values with SW1 in various positions**

SW1- Position	Vbr UFSxx	UFS15	UFS22	UFS40	UFS110	Vbr UFSxxJ	UFS15J	UFS22J	UFS40J
		<i>l<sub>pk</sub></i> = 18A	<i>l<sub>pk</sub></i> = 34A	<i>l<sub>pk</sub></i> = 55A	<i>l<sub>pk</sub></i> = 140A		<i>l<sub>pk</sub></i> = 18A	<i>l<sub>pk</sub></i> = 34A	<i>l<sub>pk</sub></i> = 55A
		RF braking min. value (ohm)					RF braking min. value (ohm)		
1	778	43.2	22.9	14.1	5.55	390	21.7	11.5	7.1
2	770	42.7	22.6	14.0	5.5	386	21.4	11.3	7.0
3	754	41.8	22.2	13.7	5.38	379	21.1	11.1	6.9
4	745	41.4	21.9	13.5	5.32	375	20.8	11.0	6.8
5	726	40.3	21.3	13.2	5.18	364	20.2	10.7	6.6
6	703	39.0	20.7	12.8	5.02	353	19.6	10.4	6.4
7	690	38.3	20.3	12.5	4.93	347	19.3	10.2	6.3
8	x	x	x	x	x	x	x	x	x

*l<sub>pk</sub>* max. peak current (A)

Vbr rated intervention voltage (Vdc)

RF min. total resistance (Ohm)

Note: The min. RF values indicated in the table are given for SW1 positions (S1), considering the  $I_{pk}$  max. peak current, and brake voltage  $V_{br}$  indicated in tables of the par. 7.6, and 7.7 according to the formula

$$RF \min = \frac{V_{br}}{I_{pk}}$$

Example: for UFS15,  $I_{pk} \max = 18A$   
For SW1 = ON = 4 ,  $V_{br} = 778V$

$$RF \min = \frac{778}{18} = 43,2ohm \Rightarrow R_f = 43 ohm$$

## 8. CONNECTION TO MORE BRAKING UNITS ON AN INVERTER

In case the power of a single braking unit should not be sufficient any longer for the foreseen application, it is possible to connect more braking units to the same BUS-DC.

To do this it's necessary to use one standard UFS, which operates as MASTER unit, and other UFS units, configured as SLAVE units.

The only operation that is necessary to carry out on the standard UFS units, in order to configure them in the SLAVE mode, is that of deactivate the autonomous braking (**turn the switch N°8 of the Dip-Switch SW1 to the "ON" position**).

The UFS units are provided with two output terminals, to propagate the brake command to other UFS units, and with two input terminals which accept command coming from the MASTER unit or from a SLAVE unit preceding it. Please see the connection diagram hereafter reported. The brake command is delayed for about 30uS, and remains active for approx. 450uS when command is over.

This allows to attenuate the switching disturb which would occur when switching contemporarily all the UFS units connected to the same BUS-DC, and it's a negligible time lag considering the normal operating cycle of the drive.

**The max. number of UFS that can be connected in this way is 5 (1 MASTER and 4 Slave).**

It's possible also to connect different UFS sizes (i.e.: 1 UFS110 and 1 UFS40), provided that each unit is connected to the brake resistor which is suitable for that size, using for example the kit supplied by SCS. The UFS units are not protected against short-circuits and therefore if a resistor is not properly connected, this can seriously damage the unit and the inverter.

### 8.1 Connections of more units in synchronism (master/slave). Application notes

When more interlocked master/slave units are used, the P,N, connections must be all branched from the same source, P (+), N (-) inverter terminals or BUS-DC with cables having the same length, and braided each other in pairs. The connections of the respective resistances must be independent.

The best connection is obtained with all units mounted one close to the other (horizontal pairing side by side).

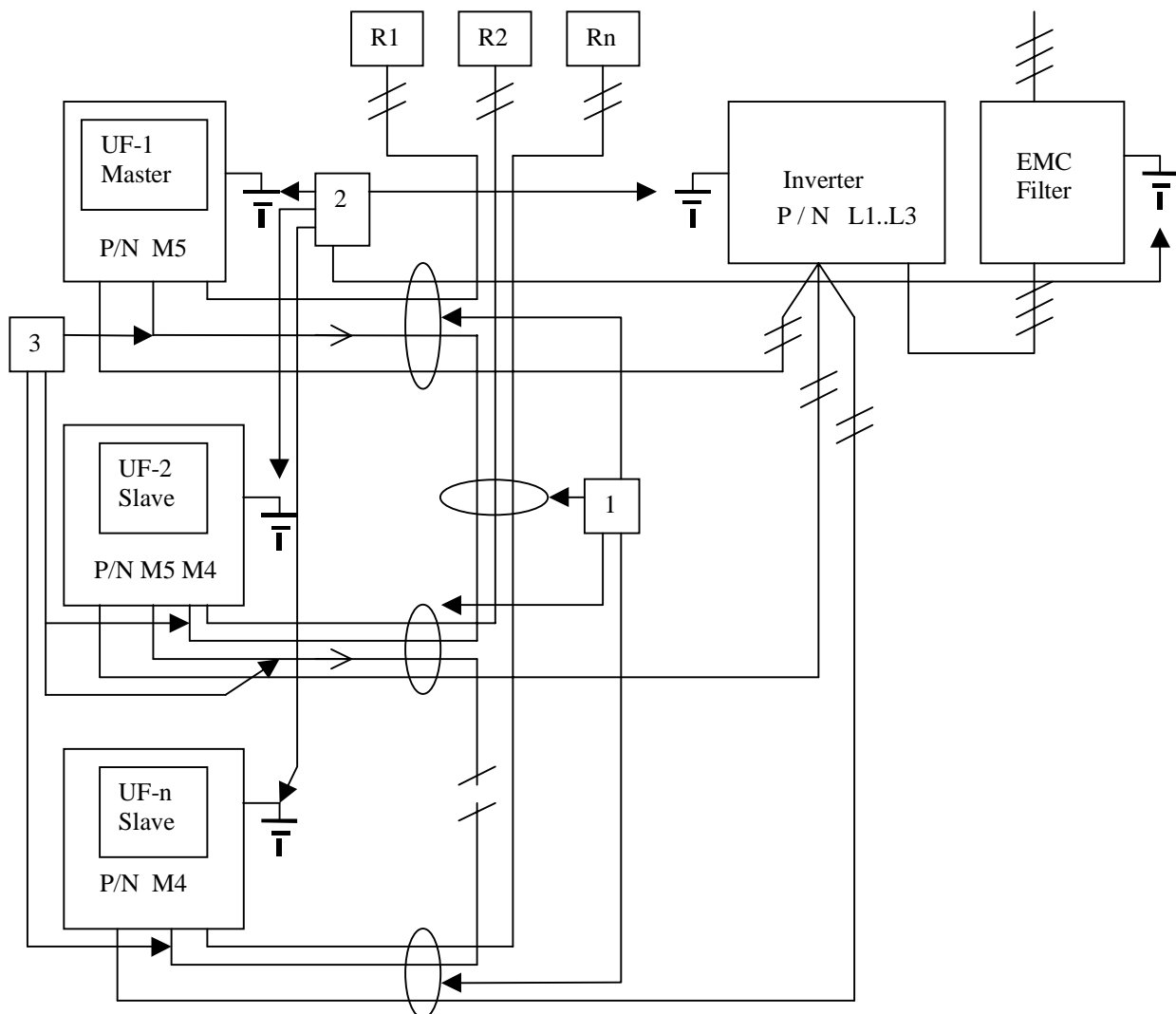
The vertical assembly (piling up in columns) is unfavourable, and usually it causes problems due

to noises, that can lead to an irregular unit operation, because of EMC harmful couplings on the synchronism cables.

The cable that transmits the synchronism command from the "master" unit (M5-1 and M5-2 terminals) to the "slave" unit (M4-1 and M4-2 terminals) and to the subsequent one, is a signal connection that can be sensitive to the EMC noises.

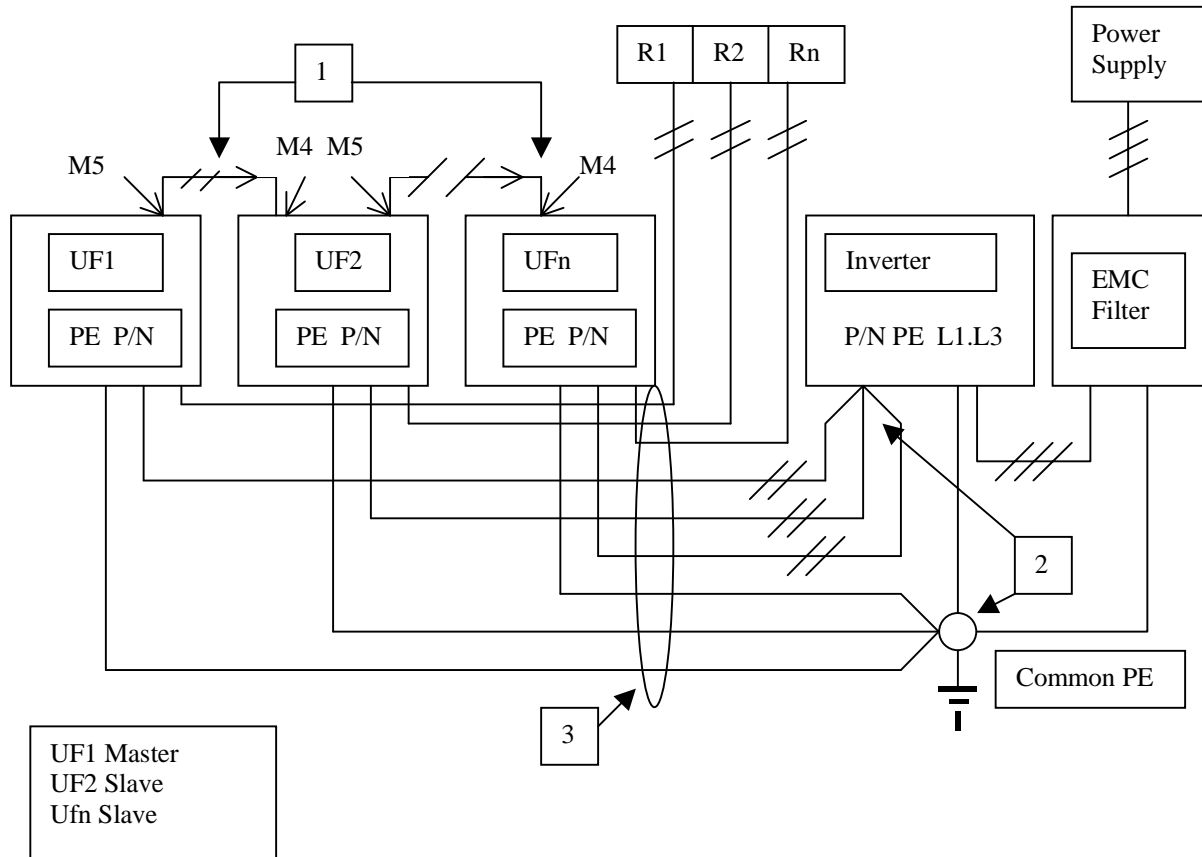
The connection must be made with a braided pair of very short cables (max 0,3 meters) having a section of 0,25 ...0,5 mm<sup>2</sup> (AWG24....20); It is peremptorily necessary to avoid any coupling with other cables that are a source of EMC troubles (power cables, mains cables, connections to EMC filters, motor-cables, P, N, connections, connections to the brake resistor, and so on).

One connection of the synchronism cable raised from the plate, without any passage in the cable-duct is usually an effective protection against the EMC noises.



### Wrong connections.

- 1 Harmful EMC couplings
- 2 Accidental PE connections
- 3 Long M/S synchronism connections



**Correct connections**

- 1 Separated and short signal cables
- 2 Star-shaped PE connections
- 3 Separated and independent cable paths

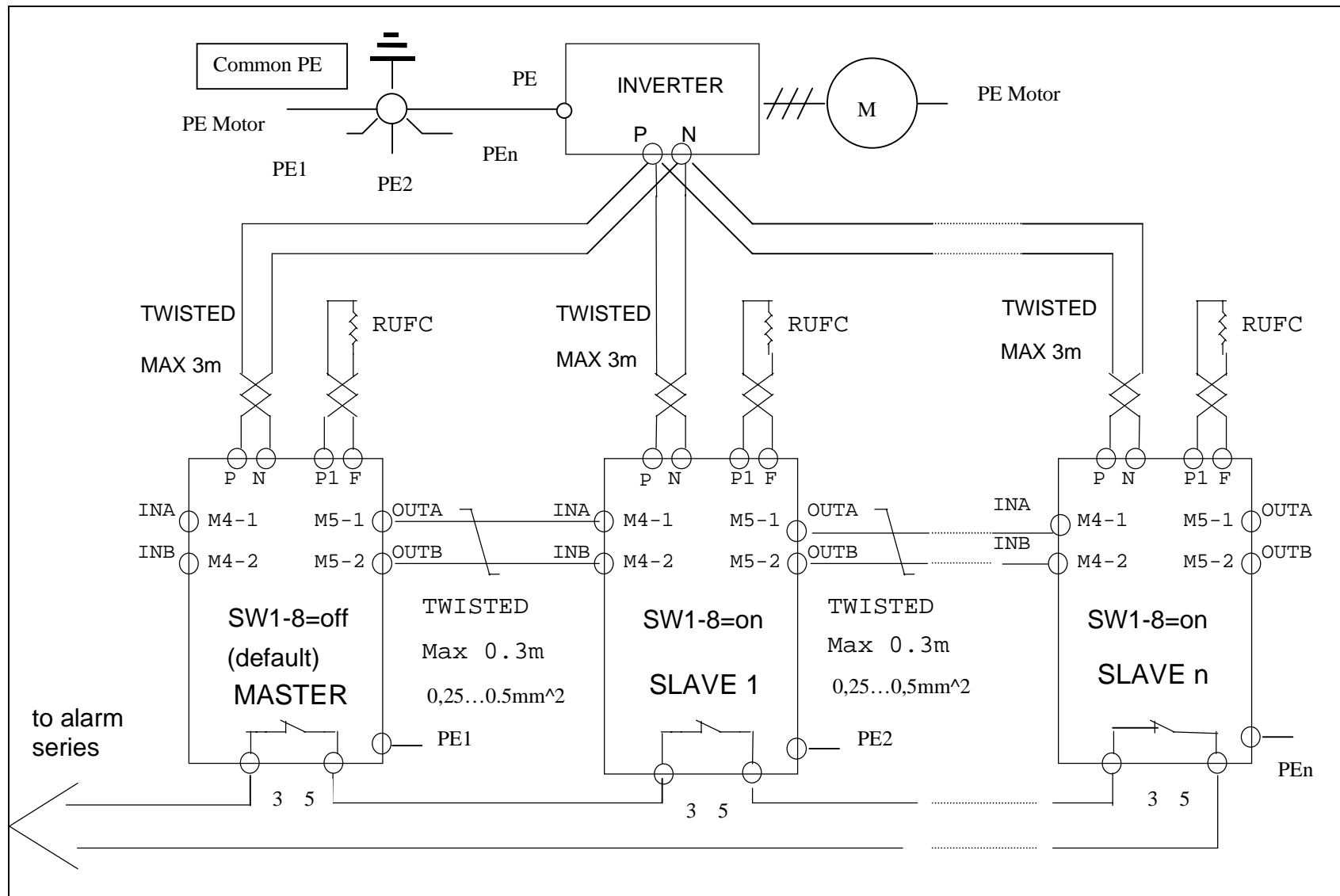


Fig. 8.1 UFS connections under MASTER/SLAVE configuration