Application note

November 12th, 2020 – Issue 1.3

DC bus interfacing

1 – GENERAL DESCRIPTION

The DC bus is available on the power connector of any INFRANOR® drive to allow paralleling or external capacitor box connection. The paralleling of drive DC busses or adding of an external capacitor box has many advantages:

- it reduces ripples of the DC bus voltage that can decrease performance in dynamic applications,
- it increases the DC bus capacitors' lifetime,
- it reduces heat dissipation into the braking resistor by storing more energy during deceleration phases,
- it reduces electricity consumption by storing more energy during deceleration phases.

2 – XTRAPULS DRIVE RANGES

All Infranor drives are designed to assume a lifetime of at least 20.000 hours at 40°C without any derating when supplied by three-phase mains.

In single-phase applications, the continuous power must be limited according to the table below:

APPLICATION TYPE	RATING	CONTINUOUS POWER ALLOWED IN SINGLE-PHASE SUPPLY
Standalone XtrapulsCD1™	230V – 2.25A to 10.5A	650 W
Standalone XtrapulsCD1™	230V – 16.5A	1000 W
Standalone XtrapulsCD1™	400V	Single-phase supply is prohibited
Standalone XtrapulsPac™	230V	1000 W
Standalone XtrapulsPac™	400V	Single-phase supply is prohibited
Standalone XtrapulsPacHP™	230V	1000 W
Standalone XtrapulsPacHP™	400V	Single-phase supply is prohibited
CAPABOX 230		$P_{STANDALONE}$ + 2000 W
Paralleled DC bus		$\Sigma P_{STANDALONE}$

In applications with higher power and with 230V single phase mains, an external capacitor box (ref. CAPABOX 230) must be added or the DC busses must be paralleled.

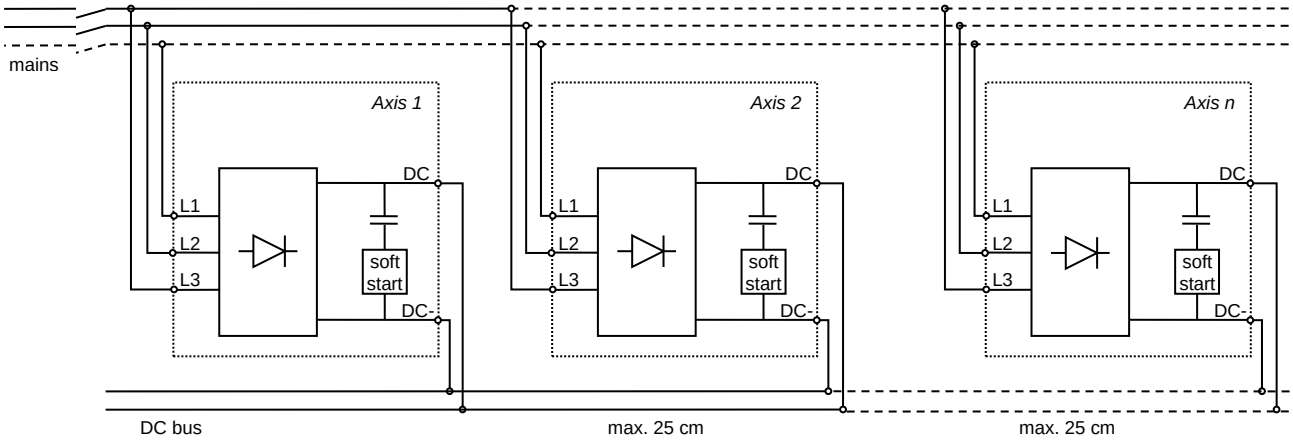
3 – DC BUS PARALLELING

XtrapulsCD1™, XtrapulsEasy™, XtrapulsPac™ and XtrapulsPacHP™ drives have the same topology. So, these ranges can be mixed when paralleling DC busses. However, paralleling DC busses requires some precautions for the installation, in order to remain efficient and safe:

- all drives need to be powered by the mains;
- the same phases must be used on all drives. Especially in single-phase configuration, if drive axis 1 is powered by L1 and L2, the other drives must be powered by L1 and L2 as well;
- all drives must be powered at the same time. It is highly advised to use the same circuit breaker to switch on the power supply;
- In order to prevent EMI problems or loosing the paralleling benefits:
    - the maximum wire length between two drives is 25 cm,
    - large section wires must be used.

When DC busses are paralleled, the total continuous power must be limited at the sum of the continuous powers allowed for each axis.

Block scheme of typical single-phase or three-phase connections for XtrapulsCD1™, XtrapulsEasy™, *XtrapulsPac™, XtrapulsPacHP™:*



4 – ADDING AN EXTERNAL CAPACITOR BOX (CAPABOX)

Direct connection of external capacitors between DC+ and DC- lines is forbidden because the drive soft start system is by-passed. In this case, an important inrush current at the power up can damage the drive.

The available solution consists in an external capacitor box including a soft start system.
This accessory is fully compatible with XtrapulsCD1™, XtrapulsGem™, XtrapulsPac™ and XtrapulsPacHP™ servo drives.

4.1 – ORDERING CODE

CAPABOX - xxx

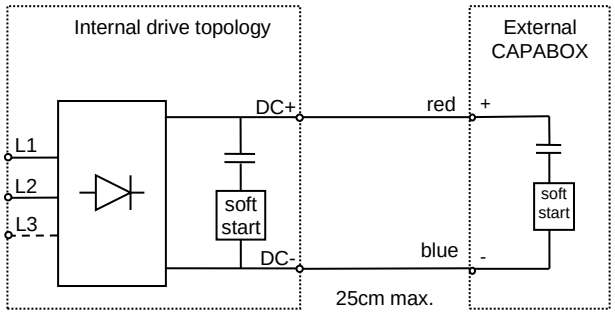
Application voltage: 230 or 400 V_{AC}

4.2 – ELECTRICAL SPECIFICATIONS

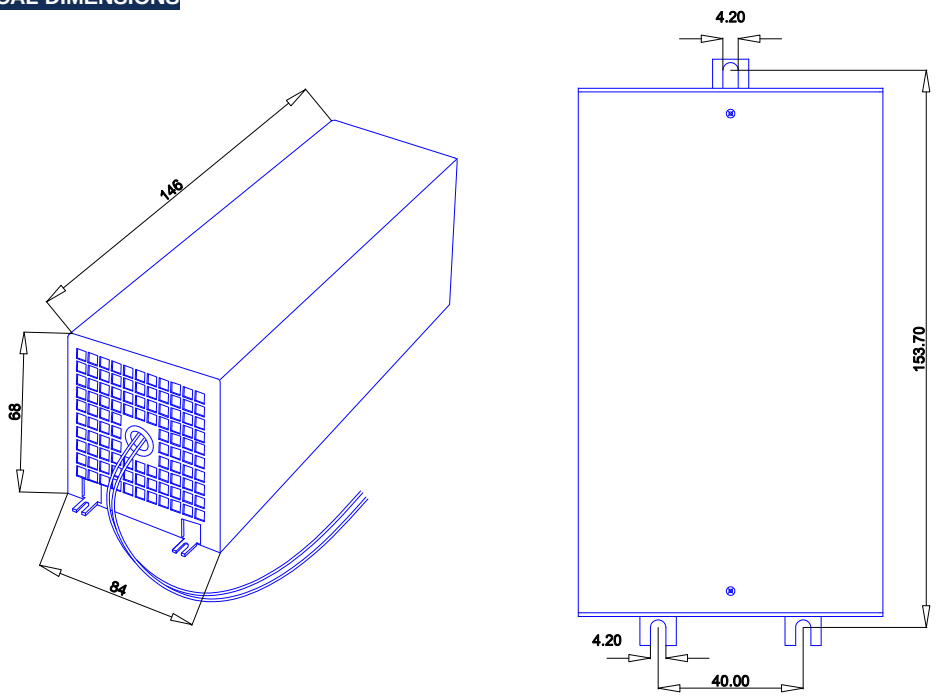
Main features:

	CAPABOX 230	CAPABOX 400
Rated voltage	400 V_{DC}	800 V_{DC}
Capacitive value	1410 µF	705 µF
Cables length	25 cm	25 cm
Cables section	AWG16	AWG16

Electrical topology:



4.3 – MECHANICAL DIMENSIONS



5 – EXAMPLES

5.1 – EXAMPLE 1

Let us have a look at the following single-phase application:

AXIS	DRIVE TYPE	CONTINUOUS POWER REQUIRED BY THE APPLICATION	CONTINUOUS POWER ALLOWED IN STAND-ALONE MODE	CONTINUOUS POWER ALLOWED WITH PARALLELED DC BUS
1	XtrapulsPacHP™-ak-230/05	300W	1000W	3000W
2	XtrapulsPacHP™-ak-230/17	1100W	⚠ 1000W	
3	XtrapulsPacHP™-ak-230/11	1400W	⚠ 1000W	

In stand-alone connection, axes 2 and 3 require more power than the continuous power allowed.
The drives' lifetime, with this topology, would be dramatically decreased.

By paralleling the DC bus, the total required power (2800 W) remains below the total allowed continuous power. ~~allowed~~

5.2 – EXAMPLE 2

In this example, the application is the same than the previous one but the required power for axis 2 is extended to 2000 W.

AXIS	DRIVE TYPE	CONTINUOUS POWER REQUIRED BY THE APPLICATION	CONTINUOUS POWER ALLOWED IN STAND-ALONE MODE	CONTINUOUS POWER ALLOWED WITH PARALLELED DC BUS + CAPABOX
1	XtrapulsPacHP™-ak-230/05	300W	1000W	5000W
2	XtrapulsPacHP™-ak-230/17	2000W	⚠ 1000W	
3	XtrapulsPacHP™-ak-230/11	1400W	⚠ 1000W	

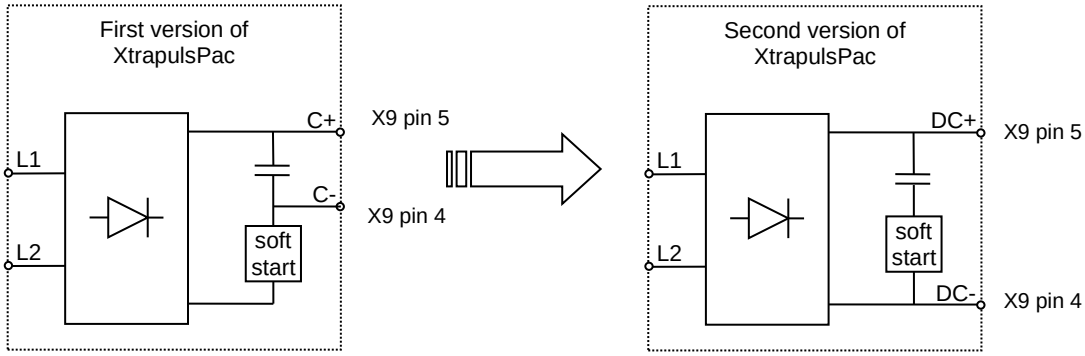
This time, by paralleling the DC bus, the total required power (3700W) is higher than the total continuous power allowed.

The CAPABOX adds a power capability of 2000W to the application.
Consequently, a CAPABOX is required to extend the allowed continuous power to 5000W.

6 – APPENDIX

6.1 – XTRAPULSPAC RANGE COMPATIBILITY ISSUE

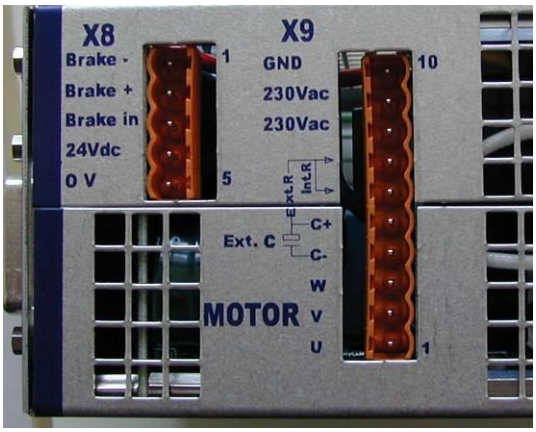
The first delivered XtrapulsPac has got a different topology of the DC bus link. This topology offered the advantage to allow direct connection of external capacitors. However, for compatibility reasons, this topology has been abandoned. The differences are presented below.



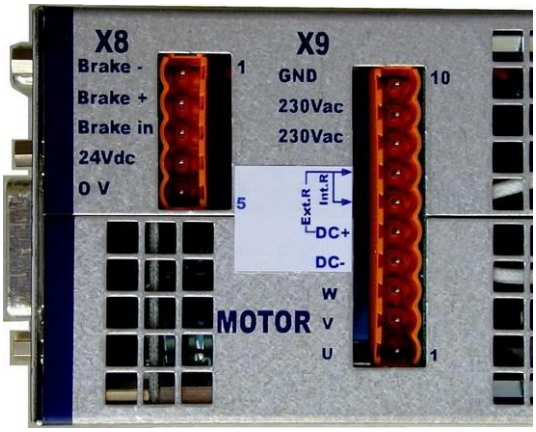
The compatibility issue between the current XtrapulsPac and the old one is summarized below:

Application	Compatibility issue
Single-axis with AC supply	No compatibility problem
Single-axis with AC supply and external capacitors	External capacitors must be replaced by a CAPABOX
Single-axis or multi-axis with DC bus supply	No compatibility problem (improved reliability because inrush current is limited)
Multi-axis with AC supply	No compatibility problem
Multi-axis with AC supply and DC bus paralleling	Mixing current XtrapulsPac and first XtrapulsPac is forbidden. All drives must be replaced simultaneously.

The difference (DC+/- vs C+/-) can be easily identified on the drive housing.
The drive modification index has been incremented to 'I' on the drive label sticker for traceability.
The change is effective in production from serial number 327828 (index "I" on the drive ID sticker).



First X9 connector pinout



Second X9 connector pinout