
Redundant Magnet System

1. What's redundancy?

Electrical controls are built using a whole bunch of sub-systems each having a certain potential of failure. To provide safety of the system in case of a single sub-system failure, safety relevant sub-systems are built double, generally referred to be “redundant”.

Two sub-systems work on the same task and also cross-check each other to make sure, both systems work fine. Two redundant systems do not add much to safety, if failure of one system is not detected. Therefore, redundancy, cross-check and safety relevance are core elements of safety class 3 design concept also referred to in international standardization document DIN-EN 954-1.

2. Standard redundant components

The concept of redundancy is a central feature built-in Truninger magnet controller SmartPick™. All safety relevant sub-systems are duplicated according to the safety class 3 standard. The following sub-systems are covered:

- **Two power sources - mains and backup battery**
Backup battery capacity is designed to maintain safe operation for at least 20 minutes in case of mains power failure.
- **Two current sensors - two associated cross-checked signal processing units**
Failure of one sensor will be detected and triggers a switch over to battery operation and system lock (magnet can be switched OFF but no more ON).
- **Two power drives – AC/DC & DC/DC**
One drive dedicated to mains power AC/DC and one drive dedicated to battery power DC/DC. Failure of power electronics in any drive such as IGBT transistors will cause the second drive to take over and also lock the magnet system.
- **Two controllers built in different hard and software**
Any failure of the SmartPick™ main controller will hand over the control task to the slave controller SafePick™.
- **Two low voltage power sources**
Each of the two controllers is equipped with individual low voltage power sources. Such power sources are continuously cross-checked and both are battery backed up.

3. Optional redundant electric circuits

Most often, the power lines from the controller to the magnet are considered safe and therefore not built redundant. However, in some harsh environments, cables and cable drums can not be considered safe.

If required, two independent electric power circuits for one single magnet can be realised. Two cables, two cable drums, two electric coils in the magnet and two power modules PowerPick™ build up such independent electric power circuits. Even a short cut at any location of one circuit will not stop this system from operating.

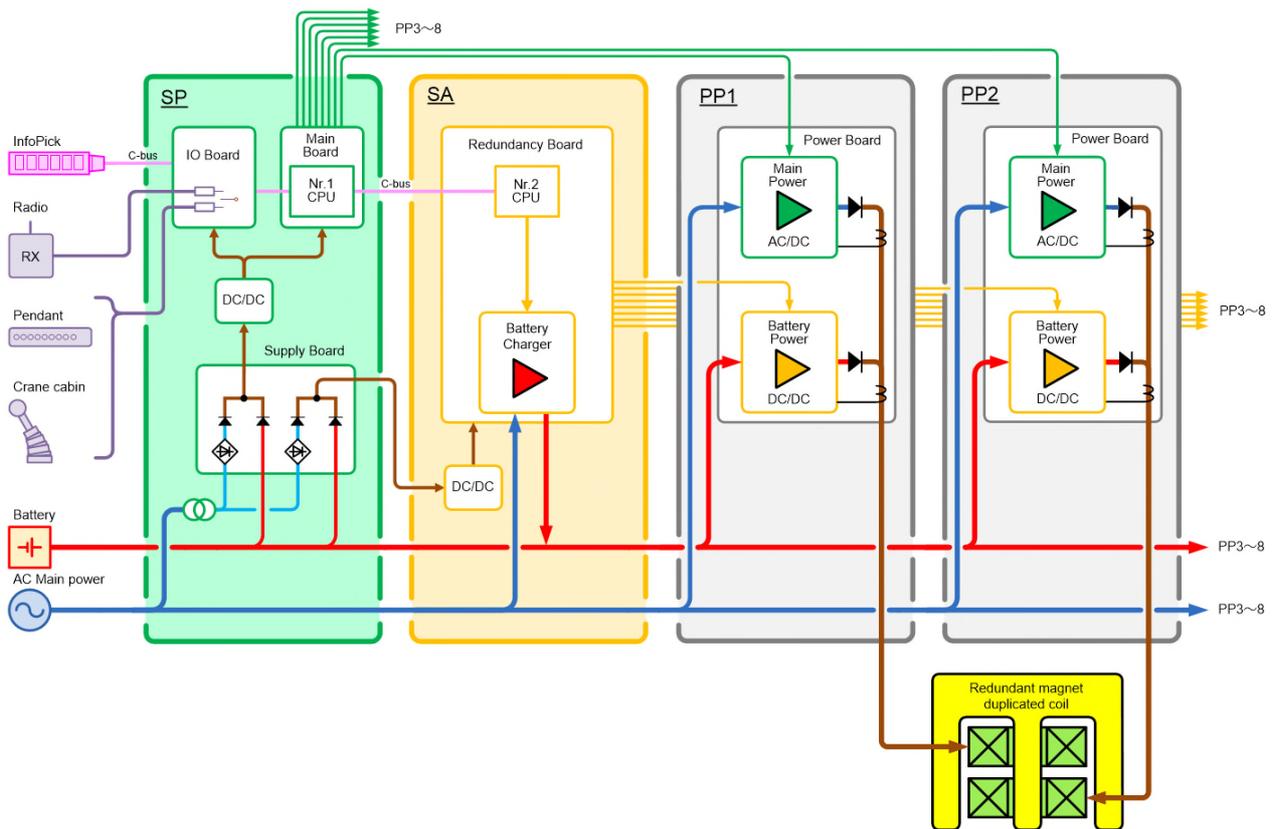


Fig. 1 Redundant magnet controller "SmartPick™"

SP	Module SmartPick (SP), Nr. 1 CPU controlling AC/DC drive, signal inputs, redundant low power supply
SA	Modul SafePick (SA), Nr. 2 CPU controlling DC/DC drive, battery charger, battery supervision / maintenance (automatic capacity test)
PP 1 & 2	Modul PowerPick (PP), generates safe DC Power for magnet uniting mains- and battery power drive
InfoPick	Modul InfoPick, graphic display informing the operator and staff on the ground visually and acoustically about the state of magnet system
Operation	Two operation units can be connected to SP, if one of operation unit fails, another unit can be used as backup
Magnet	Redundant magnet with double coil each connected to one PP module, this results in safe power supply keeping up sufficient magnet force in case of any power circuit failure
Coil	

Table 1 Module description

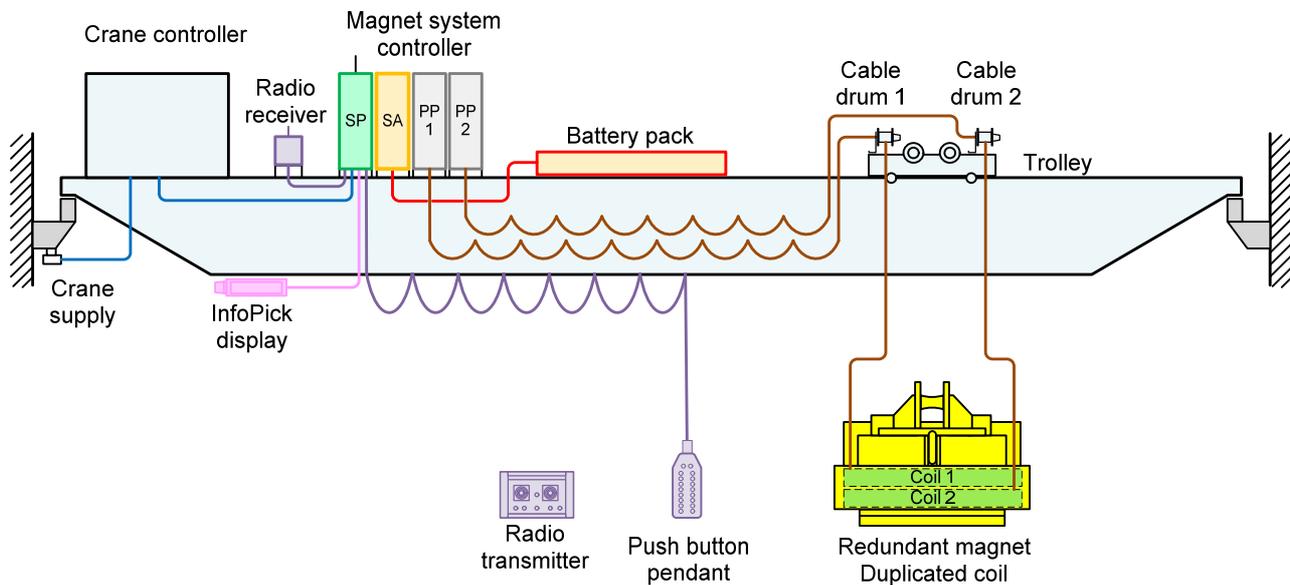


Fig. 2 Magnet system on overhead crane



Fig. 3 Redundant magnet system for bar bundles