GENERAL RECOMMENDATIONS CONCERNING USING EARTH-LEAKAGE RELAYS AND CIRCUIT BREAKERS (PRELIMINARY)

- To ensure compliance with the European Directive for EMC (Electromagnetic Compatibility), almost all inverters require an EMC filter which utilizes Y capacitors to earth. This results is a substantial earth-leakage current depending on the supply voltage symmetry and on the length and type of cable to the compressor motor. This almost always exceeds the trip level of a typical earth-leakage relay or circuit breaker.

- It is not permissible to use standard earth leakage circuit relays or circuit breakers (Type AC or A) because these will not detect earth leakage reliably if there is a dc fault component present. This can reduce the safety level of the system because any dc fault current can saturate the magnetic components of the earth-leakage relay or circuit breaker. **THIS CAN REPRESENT A LETHAL HEALTH HAZARD**.

- The best solution is to NOT TO USE earth leakage relays or circuit breakers . In Europe earth leakage breakers are RARELY USED in installations where frequency inverters are used. All inverter manufacturers advise customers NOT TO USE earth leakage relays with inverters. The reason is that, if an EMC filter is fitted, then there will be reduced reliability due to continuous or spurious tripping.

- The best solution to ensure human safety is to use REINFORCED EARTHING ($\geq$ 10 mm² copper) or DOUBLE EARTHING instead of an earth-leakage relay or circuit breaker. This is the method described in EN50178 which is the EUROPEAN SAFETY STANDARD for using FREQUENCY INVERTERS and similar power electronic equipment.

- If a customer insists on using earth-leakage relays or circuit breakers, then it is essential that only a special type called an "All current sensitive" type (TYPE B) is used. Information on suitable types from SIEMENS and MOELLER is attached. Similar types are also available from HAGER and other switchgear manufacturers.
  These earth-leakage relays and circuit breakers should have an integrated trip delay to ensure that the charging current of the Y capacitors does not trip the earth leakage circuit breaker.

- The following safety concept for the electrical wiring is typical for refrigeration installations in Europe:
  - Electrical supply to the electrical power enclosure utilizes a protective earth cable of at least 10 mm² copper or two independent protective earth connections
  - Groups of display cases protected with standard earth-leakage circuit breakers.

Note:
Comparison with wiring regulations for PEN/PE earthing to follow.