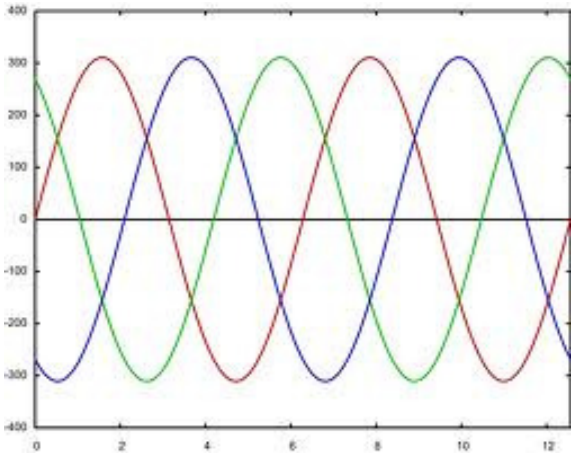
Megger

Testing Three Phase Systems

Application note 81

Three phase systems

A three phase system consists of three single phase AC supplies sharing its return path (neutral conductor). Each of the three phases is separated by 120° (shown below), giving the effect of constant power over each cycle. This results in an overall line voltage (VL) of √3VP, where VP is the voltage of a single phase. Given that the voltage of single phase (VP) is 240 V, VL = √3 x 240 = 415 V. Therefore the running voltage of a three phase system is 415 V.



This system is used to produce more power from a single supply and to save on the amount of cabling required, making it more economical. It is used to supply motors or industrial machinery which require more power than single phase can provide.

Insulation testing

As directed by BS7671, when performing an insulation test on a 415 V circuit, you should select the 500 V range on your insulation tester.

Loop Testing

Firstly, you must establish which type of supply you are testing. Is it 3 wire (3P+E) or is it 4 wire (3P+N+E)?

3 wire

3 wire supplies can be identified by the 4 cables connected to the socket (3 phases and an earth/cpc, hence 3P+E). 3 wire supplies are used to supply balanced loads such as a motor. To measure the earth loop impedance a two wire test must be used and the leads should be connected in the manner shown below (Fig1). A 3 wire loop test would not be suitable as it requires a neutral connection which is not available in this configuration.

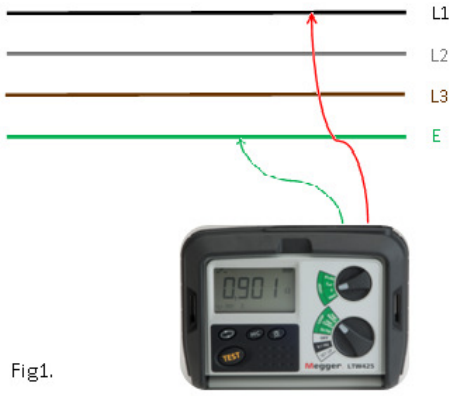


Fig1.

The earth socket of the tester should be connected to the cpc of the system (E) and the live socket of the tester should be connected to each of the lines in turn so that the impedance and the prospective fault current (PFC) of each phase is measured separately. Three measurements are therefore taken; L1-E, L2-E and L3-E. Further measurements can also be taken between phases to find the prospective short circuit current (PSCC).

4 wire

4 wire supplies can be identified by the 5 cables connected to the socket (3 phases, a neutral and an earth/cpc, hence 3P+N+E). 4 wire supplies are used to supply unbalanced loads such as a group of houses. As there is a neutral connection on this type of supply, either a 2 or a 3 wire test would be suitable for testing the earth loop impedance, however, the 3 wire test would not be suitable for testing between phases for the PSCC. The 2 wire test would be taken using exactly the same method as for the 3 wire supply. The 3 wire test would be taken in a similar way, with the only difference being that the third wire would be connected to the neutral (shown below, Fig2). Again, each line would need to be tested individually.

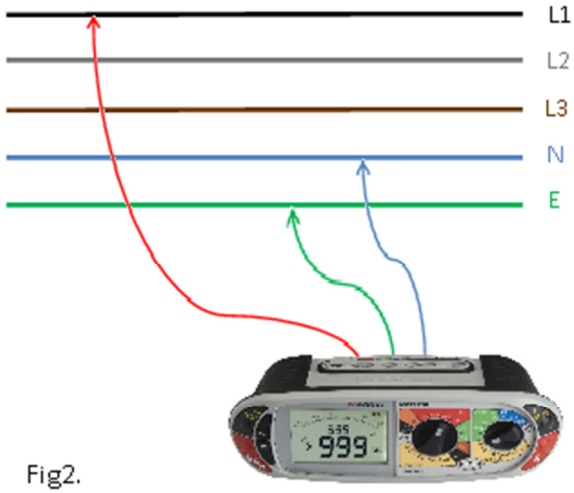


Fig2.

RCD Testing

Testing a three phase RCD would use the same connection method as for a 2 wire earth loop impedance measurement (shown in Fig1), connecting the earth socket of the tester to the cpc of the system (E) and the live socket of the tester should be connected to each of the lines in turn so that the trip time can be measured for each phase in turn.

Phase rotation

The purpose of testing phase rotation is that if phases are wired in the wrong order to a socket, motors will turn in the opposite direction. This may not pose a problem to some machinery, however, if the direction of rotation is integral to the safe running of the machinery, such as when a motor has a brake, incorrect phase rotation can seriously damage the equipment.

Phase rotation is tested by connecting three leads to the separate phases (L1, L2 and L3). The tester will then display the direction of phases.

Instruments suitable for use on 415 V systems:

Insulation Testing:
- MIT200 Series
- MIT300 Series
- MIT400 Series (500 V models only)
- MFT1700 Series

Loop Testing:
- LTW325
- LTW335
- LTW425
- MFT1700 Series (2-wire tests only)

RCD Testing:
- RCDT320
- RCDT330
- MFT1700 Series

Phase Rotation:
- MFT1720/1730
- PSI410

UK
Archcliffe Road Dover
CT17 9EN England
T +44 (0) 1304 502101
F +44 (0) 1304 207342
UKsales@megger.com

UNITED STATES
4271 Bronze Way
Dallas TX 75237-1019 USA
T 800 723 2861 (USA only)
T +1 214 333 3201
F +1 214 331 7399
USsales@megger.com

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