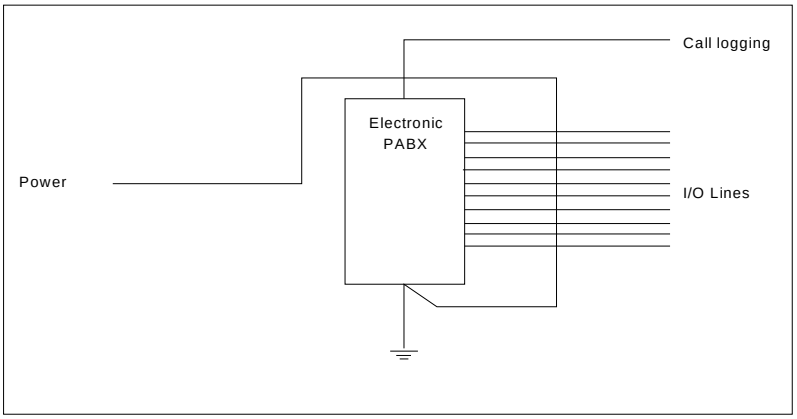
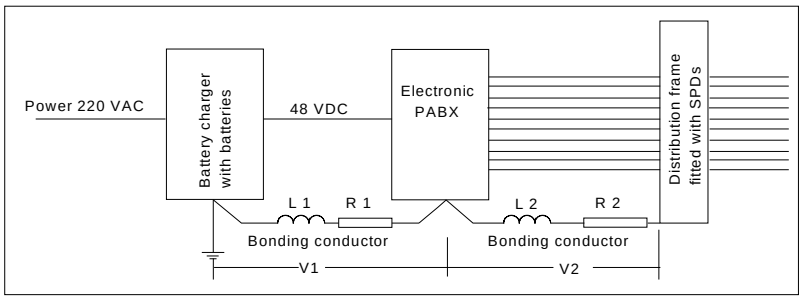
Improving PABX protection performance

Modern digital PABX equipment has vastly reduced in size over the last decade, but due to this miniaturisation, has also become increasingly more susceptible to outside interference emanating from induced currents due to lightning and also electrical noise. As the voltage withstand levels on equipment have reduced dramatically, it has become necessary to pay particular attention to the installation of protection equipment.



Ideal protection systems

The ideal protection system would involve strapping all incoming and outgoing lines together and connecting it to an earth system. In this configuration there would be no potential differences between any of the incoming or outgoing lines and the equipment would be fully protected. The only problem is that the equipment cannot function.
If we try and simulate this ideal protection systems using surge protection devices we have an additional problem due to the lead lengths of the bonding wires bet ween the surge protection devices and the system ground



Typical PABX installation

In the typical installation, the distribution frame is located some distance away from the PABX and the power source of some distance away from the power supply/charger system. We assume that the surge arresters have been fitted in the distribution frame and 220VAC supply leads. Even if sizable bonding conductors have been used between the power source, PABX and it's distribution frame, substantial voltages may be developed across the bonding leads. (Consider the previous figure).

For ease of calculation, we assume 1kA surge current at 1 micro second rise time is applied to the telephone cables entering at the distribution frame. The cables each have a 2 micro Henry inductance and 10 milli-ohms resistance. The voltage developed across the bonding conductors between the power source, PABX and distribution frame may be calculated as:

$$V1 + V2 = \left[IR1 + 1 \frac{di}{dt}\right] + \left[IR2 + 2 \frac{di}{dt}\right]$$

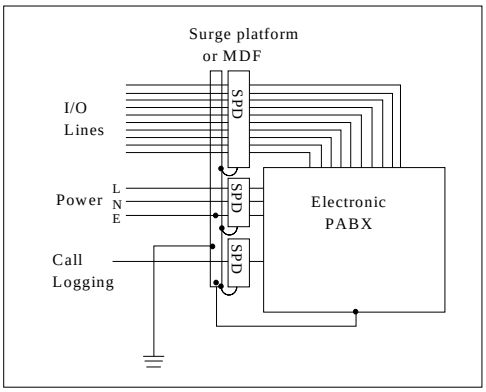
$$= \left[(1000 \times 0.1) + (2 \times 10^{-6} \times \left(\frac{1000}{1 \times 10^{-6}}\right)\right]$$

$$+ \left[(1000 \times 0.1) + (2 \times 10^{-6} \times \left(\frac{1000}{1 \times 10^{-6}}\right)\right]$$

$$= 10 + 2000 + 10 + 2000$$

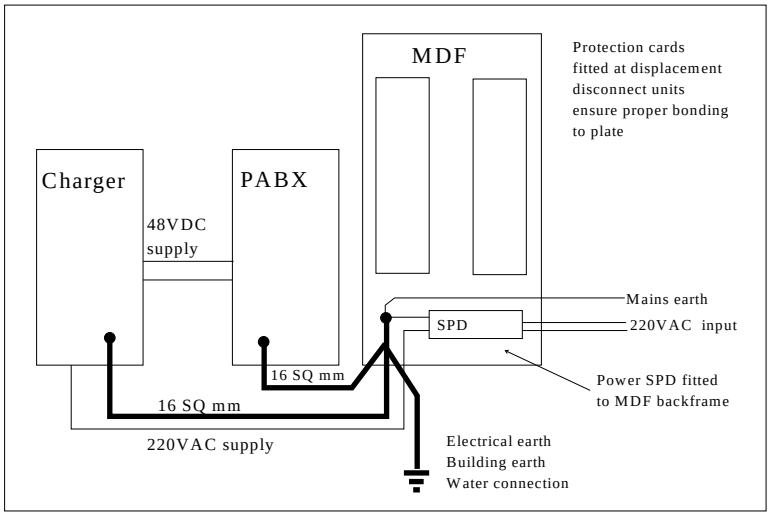
$$= 4020 \text{ Volts}$$

This voltage will appear between the data side of the PABX and the power supply unit input, causing equalization to take place via the PABX electronics, causing damage. One immediate solution that comes to mind would be to increase the bonding conductor size - thereby decreasing the inductance.
Unfortunately we are still faced with the problem that 1 meter of cable, whether it be 1mm squared or 70mm squared, still exhibits an inductance of approximately 1 micro-Henry per meter.

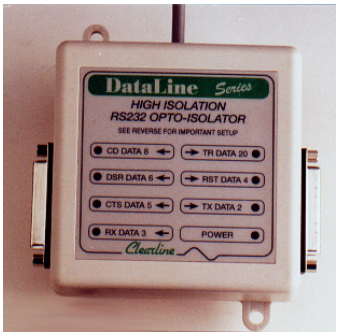


A much better solution is the creation of a surge platform where an exchange can take place without compromising the protection system. Consider the diagram on the left. Using this method, all bonding wires are kept very short and surge currents are exchanged on the surge potential platform without affecting the PABX. The length and inductance of the bonding wire to the earth grid will not come into the equation as the complete system will simply float above V under transient conditions with no damage occuring to the equipment. The reason for this is that all I/O lines are tied to a common point with no large differences in potential between these lines

For small systems, Clearline has developed cost effective platforms which can be used in place of standard termination boxes and include a power filter, displacement connectors for protection modules and a call logging protector. These platforms are available in 60 to 640 ports. For larger systems using a separate distribution frame, the following installation could be used.

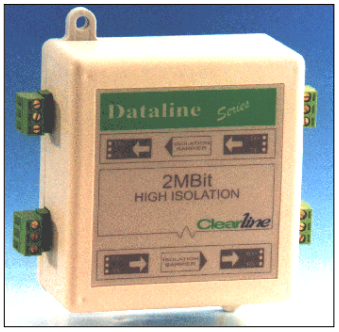


The distribution frame is used as the surge potential platform where the interchange of currents takes place. Even if the PABX unit is some distance away, it will be unaffected by surge currents, providing that all the inputs and outputs to the PABX pass through the distribution frame.



Call logging computers

Damage to call logging computers and the PABX serial port is normally encountered where the computer is positioned some distance away from the main PABX systems. Usually in the managers office. When induced energy is arrested correctley by the PABX surge protection the earth reference rises at the PABX and could be substantially higher than the earth reference at the logging computer which would normally be connected to a different earth. Equalization then takes place via the communication cable, resulting in blown ports. By fitting suitable surge protection on the ports would eliminate this problem. Clearline has developed a range of short circuit and isolation protection devices may be placed at the PABX or logging computer.



2 Mbit line card

A new development from Clearline has been the isolation protection device for all 2Mbit line cards. Up to 20kV isolation is obtained with absolute transparency to data. When this devices is fitted between the Telkom interface and the PABX, equalization currents cannot flow and reliability of both Telkom and the user's PABX is improved dramatically.

Cable routing

Finally, care should be taken to separate incoming and outgoing cables to the PABX. This can be done easily in the planning stage but difficult to introduce as a retrofit operation. In the installation on the left, high currents at fast rise times induced in the incoming cables will couple into the protected lines rendering the protective devices ineffective. The desired situation is shown on the right. Clearline also offers training courses for those interested in practical aspects of surge and lightning protection.