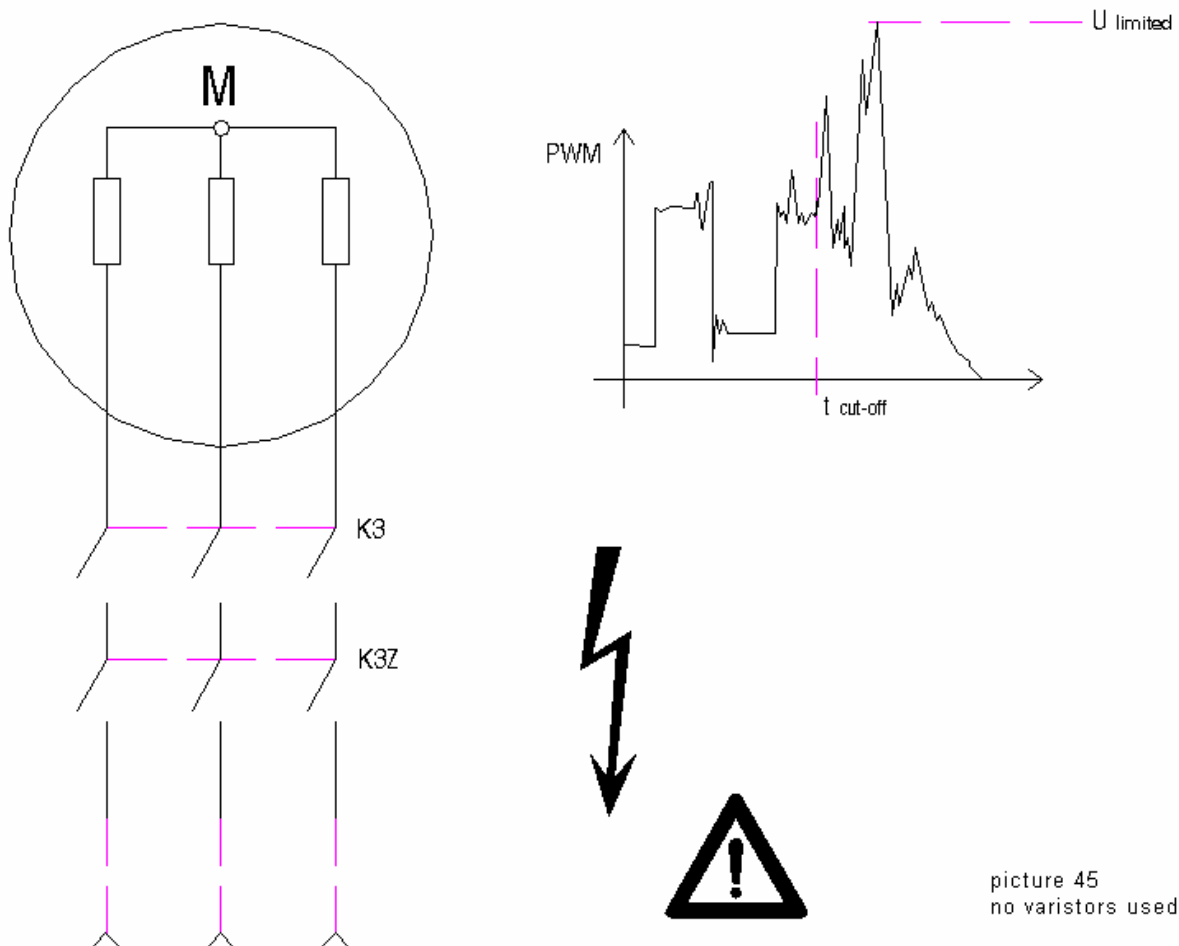
 - for Liftreport and our customers -	<b>Technical Customer Information</b>	<b>KI0204e0</b>
	<b>Occurrence and avoidance of damage to elevator motor windings during inspections</b>	2002-2008 page: 1 of 4

## Mechatronics for elevator installers and drive technicians, part 11 14


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By prescribing a procedure which was actually carried forward from days gone by, an antiquated safety regulation in some case imposes considerable loads on motor windings; this results from continuous switching of the safety circuit during inspection operations. Particularly in conjunction with modern relays which respond very quickly and synchronous gearless drives with low loss values, unfavourable electrical disconnection of windings while under power can, under certain circumstances, result in high voltages at the drive motor terminals. This motor voltage is shown in **picture 45**; this voltage level can be induced in the windings when current is separated even though usually, and virtually simultaneously, the output stage of the upline frequency inverter is switched off by way of auxiliary contacts. The reason is – as a rule – the lack of “lead” at the auxiliary contacts for used to disconnect power.

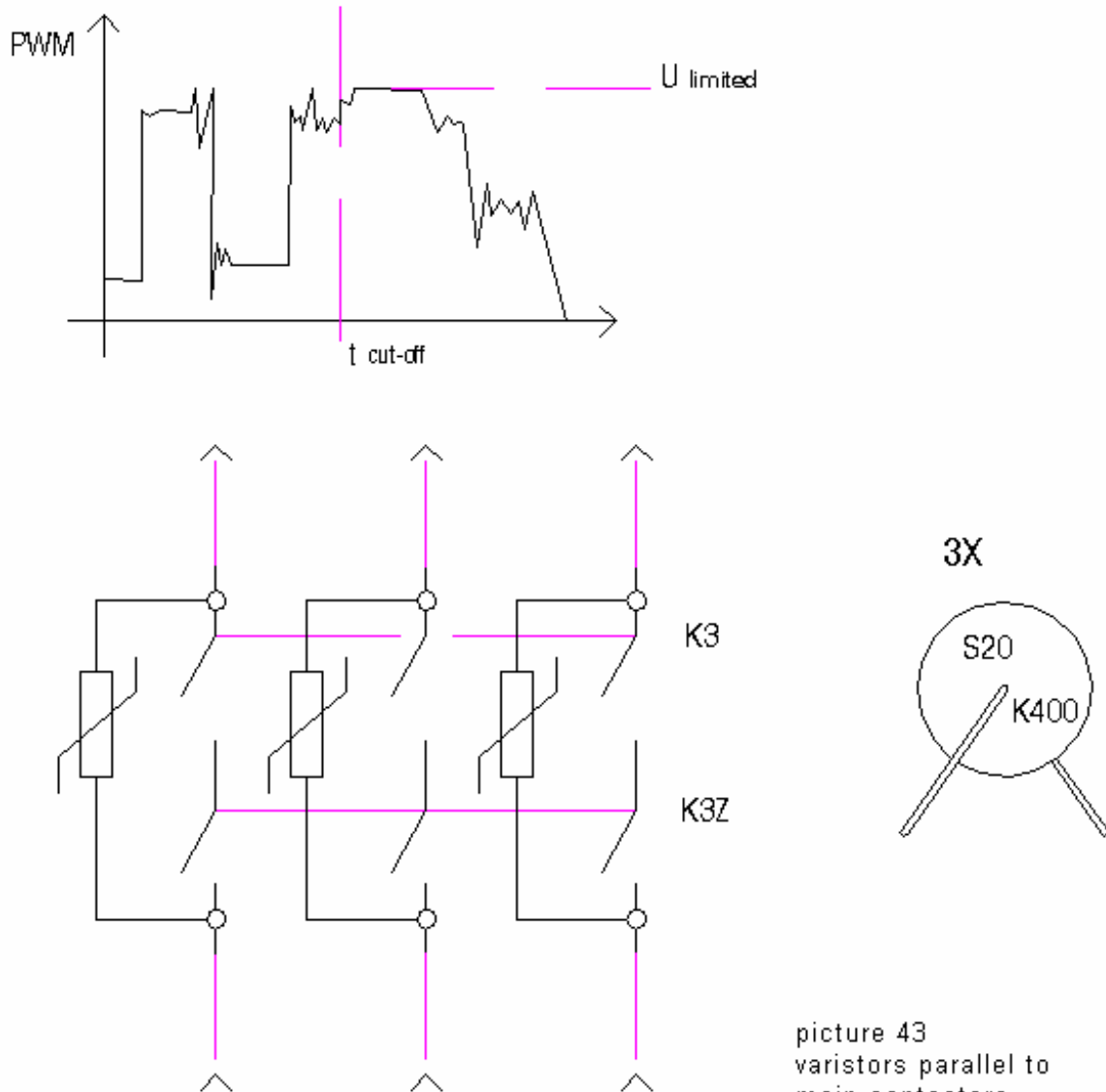


picture 45  
no varistors used

We see here that, over a period of several milliseconds, voltages up to 10kV can occur, at a  $dU/dt$  ratio of as much as  $10kV/\mu s$ . Situations such as this can damage the motor's windings over the long term. This may be aggravated by pre-existing damages resulting from excessive winding heating and/or high impulse frequencies without the appropriate  $dU/dt$  protection. The service life of the motor's windings is thus shortened considerably if such voltage peaks occur frequently (and this is regrettably the case during inspection operations).


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There are three different ways to avoid this effect. The first is shown in **picture 43**, though it should be noted here that this circuitry concept is not permissible for passenger elevators since "positive disconnection" does not actually exist. This circuitry is nonetheless very effective and very simple. The voltage is returned through the varistors to the free-wheeling diodes at the inverter and is thus reduced in an effective fashion.

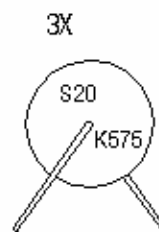
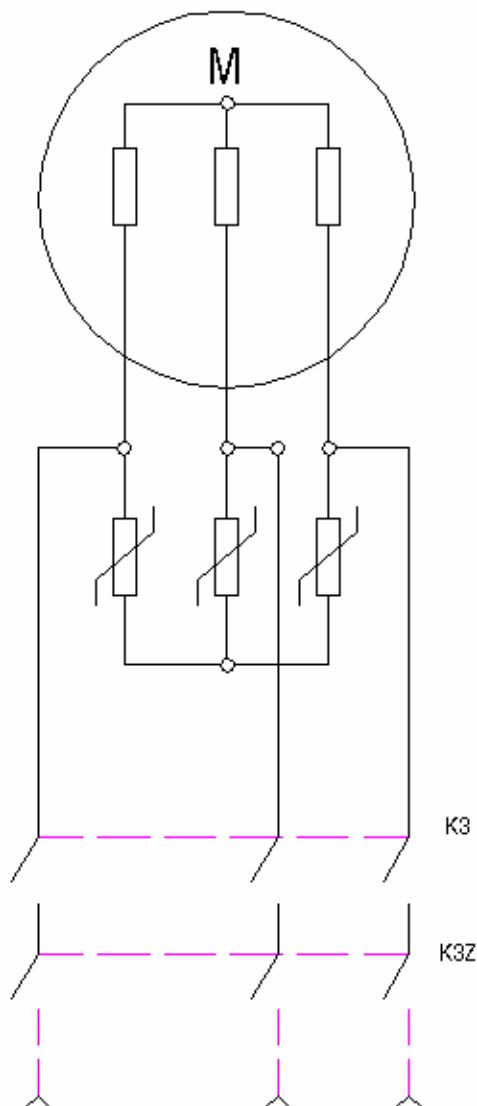


picture 43  
varistors parallel to  
main contactors

Since the option shown in **picture 43** is not always permissible, only the second alternative can, as a rule, be considered. Here the varistors are mounted directly at the motor's winding. We see in **picture 44** how the three varistors are connected to the motor terminals. The varistors carry very high voltages and are, in addition, arranged in a "star" configuration. The reason is to maintain the greatest possible clearance to the excess voltages which naturally occur as a phenomenon concomitant to pulse width modulation. The circuit shown here is suitable for use with a typical 400-volt network, where peaks up to 2kV may occur. A "modern" winding should in any case be able to withstand as much as 4kV. There should be no problems with the notified bodies in regard to the circuit shown below, but we should nonetheless discuss a third option in which the problem does not arise at all.


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In this concept either no motor contactor is used at all (which, however, would once again violate applicable regulations) or separation is only from the network (which would either damage the inverter or extend the starting period considerably). A special "emergency stop relay" is used in industrial systems (high-rise warehouses). This relay incorporates auxiliary contacts which opens with a slight lead, making possible an "electrical stop" within a specified period of time; only after this period has elapsed is the motor or inverter positively separated from current. This solution is, indeed, somewhat more expensive but does offer clearly defined (and nonetheless quick) stopping while, at the same time, the mechanical and electrical components are not subjected to unnecessary strain resulting from frequent emergency stopping. Some elevator companies have solved this problem by installing an additional button (NC contacts) at the car. When it is actuated, this button effects an electrical stop. Thus the user presses the "UP" or "DOWN" button and then in addition - to stop the car - the "STOP" button. This trick makes it possible not only to position the car more exactly, but also satisfies prevailing regulations: If the user lets go off all the buttons in a hazardous situation the safety circuit will - as usual - be interrupted and the mechanical brakes bring the car to a stop.



picture 44  
varistors parallel  
to motor coils



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The concept which uses the "STOP" button in conjunction with the varistor circuitry, as shown in **picture 44**, not only offers ideal protection for the motor and mechanical components, but also makes for convenient operation during inspection. Interrupting the safety circuit will no longer result in unacceptable loading at the relay contacts, motor windings and inverter and at the same time – and as an extra benefit - suppresses the popping interference generated when the contacts open.