ANNEX A

Statistics on Failure Rates of Clock Motors

Clock and Timer Department
General Electric Company

Excerpt of a 1964 declassified General Electric memorandum discussing failure of clock motors

Significance:
Part 3 Recorded occurrences

The memorandum from which this excerpt is drawn was provided to Martzloff in support of his contribution to gathering data on the occurrence of surges in low-voltage ac power systems, for a just-launched IEEE project on the emerging concerns about surge occurrences.

These statistics provide convincing evidence, based on a large number of reported failures, that a correlation exists between the rate of failures and the surge withstand capability of the motor windings.

A design change in this withstand level, from 2 kV to 6 kV produced a 100:1 drop in the failure rate. Interestingly, this 100:1 ratio, when plotted on a chart in which data from other sources were entered, produced a slope in good agreement with these other sources. Thus, the large number of clocks, operating 24/7/365 and unwittingly serving as sacrificial "surge counters" boosted confidence that the limited observations (in duration and in locations) being reported by other researchers were consistent.

Of course, the present-day significance of surge ***voltages*** is affected by the proliferation of surge-protective devices (see pdf file "Galore" in Parts 2 and Part 5), but these data are still useful as an indication of the occurrence of surges, only the voltage levels have changed but presumably the mechanisms, whatever they might be, are still in action.

MEMORANDUM

January 9, 1964

Subject: Surge Information - Clock and Timer Dept. Motor Coil

During the summer of 1953, an increase in defective coil returns to Service Stations became apparent. An investigation showed that the majority of failures were due to surge conditions. A study was made of the coil design at that time and it was found that impulse insulation levels down to 2000V were obtained. In October of 1953, a change was made in the coil design to improve the insulation level at the points of highest potential within the coil. This had an immediate effect of increasing the surge protection of the coil from approximately 2000V to approximately 6000V minimum.

At the same time, a study was undertaken to collect all defective coil returns to the Ashland Service Station. These returns were examined to determine the causes for failure. This study continued for a period of three years during which time 5,254 coils were collected and examined. Approximately 75% of these coils returned failed due to lightning and/or other transient surge conditions. The attached chart shows the number of coils received for surge failure in the field versus their date of manufacture. The large numbers shown, particularly during 1951, can be explained by the fact that our collection of these coils was started in October of 1953. If the study which started in October had been started earlier, the portion of the curve prior to 1951 would have shown a corresponding increase in numbers. It was found in this study that it took approximately 18 months for a clock to find its way from our factory to use in the field.