Diagnostic Cards
-
ABB UC - models B, C, D, G and L

Version 0 **Rev.0**

December 17, 2009

Cette version est une version préliminaire et temporaire pour **diffusion très limitée**.
Cette version fait référence au logiciel DIAC dont le développement est arrêté par Hydro-Québec.

Le logiciel OpenZen - Zensol (issu de nos logiciels existants CbaWin, GenWin, CbvWin, etc., copyright 1992 à 2009) remplacera DIAC totalement à court terme.

Il sera donc nécessaire de réviser et de corriger cette version, en supprimant notamment toutes les références à DIAC et en les remplaçant par les références équivalentes à OpenZen.

Merci de me contacter directement pour tout commentaire (bon ou mauvais), toute nouvelle idée, ainsi que toute suggestion d'amelioration de ce document ou du logiciel OpenZen et ces documents associés, dans le but ultime de l'obtention d'un logiciel et d'une documentation claire et pratique pour vous et tous nos utilisateurs. Tous vos retours d'information seront très appréciées.
Vous remerciant par avance pour votre collaboration,

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This version is a draft and temporary version for **limited distribution ONLY**.
This version refers to DIAC software whose development by Hydro-Québec is stopped.

The OpenZen – Zensol software (based on our existing softwares CbaWin, GenWin, CbvWin, etc., copyright 1992-2009) will completely replace DIAC in the short term.

This version needs to be reviewed and corrected by Tap-Changer specialists. Among other things, all references to DIAC software will be replaced by their equivalents in the OpenZen Software.

Text in red requires special attention and will be corrected.
If you want the original version of this text, please download the French document.

Please do not hesitate to contact me directly for any comment (good or bad), any new idea, or any suggestion regarding the improvement of this document or the improvement of the OpenZen software and any of its related documents, in order to ultimately obtain clear and useful documentations for you and all of our users. All of your feedbacks will be appreciated.

Thank you for your cooperation.

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-
ABB UC - models B, C, D, G and L

The diagnostic cards that follow focus on the symptoms of major problems of tap changers (OLTP) of the ABB UC family, models B, C, D, G, and L, as seen by their acoustic signatures. It is important to note that several of the anomalies illustrated do not show up in the tabular report of the DIAC software.

The cards are prepared as a support for the visual analysis of the signature; they are complementary tools to the report available in DIAC. Each card shows the anomaly as seen on the signature, the malfunction of the OLTP associated with this trace, and the necessary adjustment for compensation.

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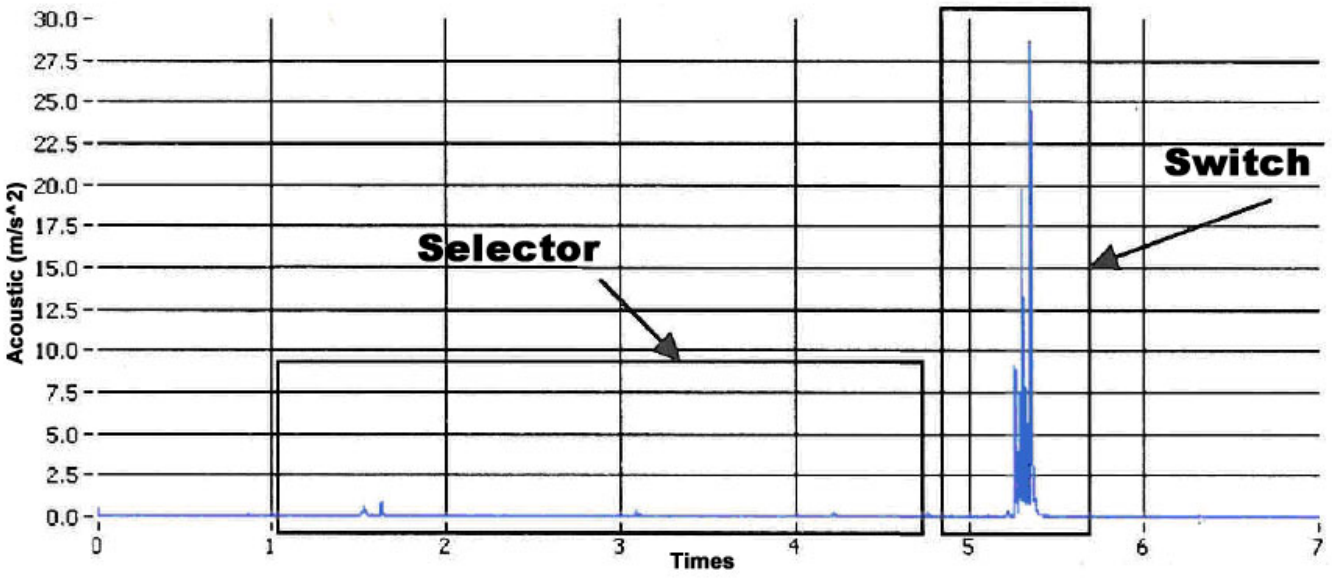
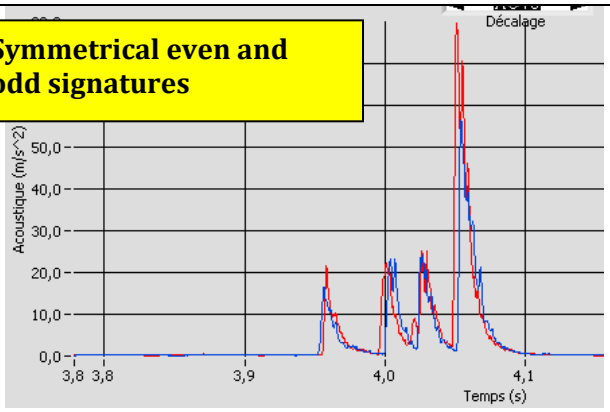
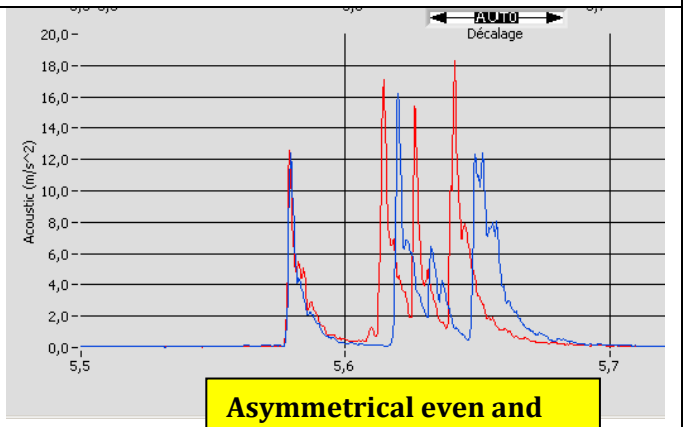
Card 1: Asymmetry of signatures switching	Models : All





Symmetrical even and odd signatures



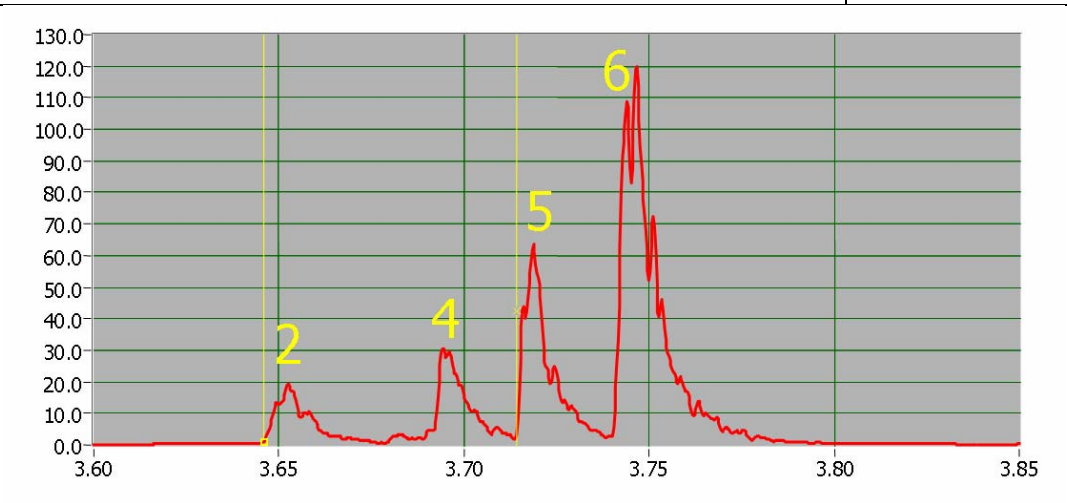
Asymmetrical even and odd signatures

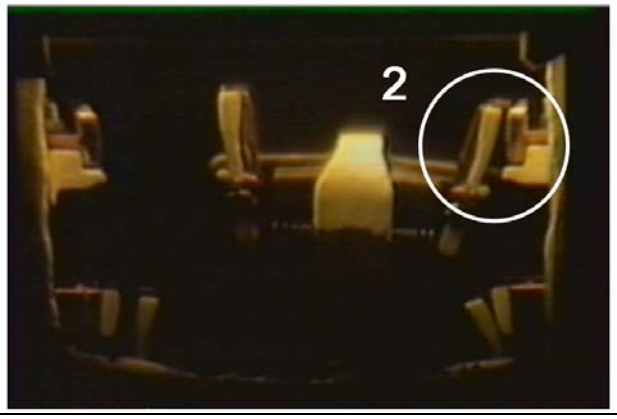
To check the symmetry of the switch, you must graphically superimpose the signature of an even operation to an odd one.

The probable causes of this asymmetry are:

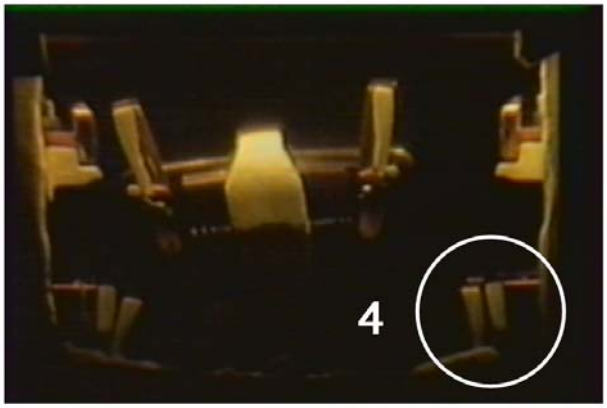
- ✓ The excessive wear of the driving wheel of the switch
- ✓ A bad adjustment of the switch (adjustment screw – pass-through bolts)
- ✓ An uneven wear of contacts between the even and odd sides

Card 2: Calculation of the transition time	**Models :** All

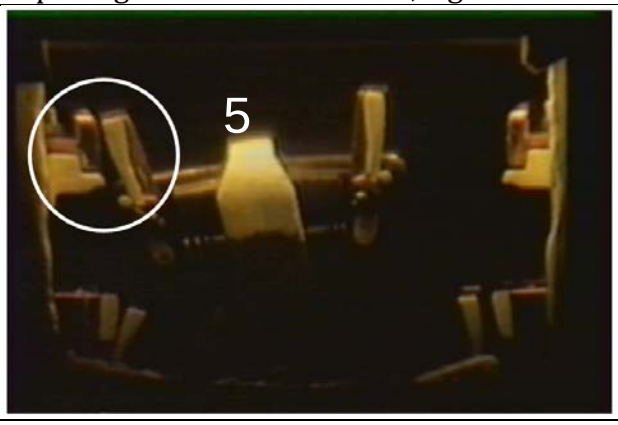




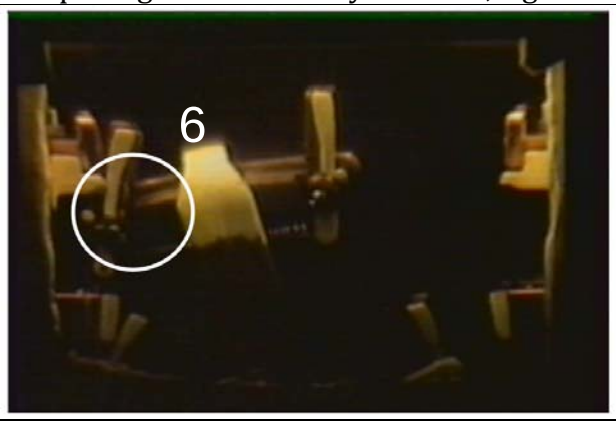
Opening of the main contacts, right side



Opening of the auxiliary contacts, right side



Closing the main contacts on the left side

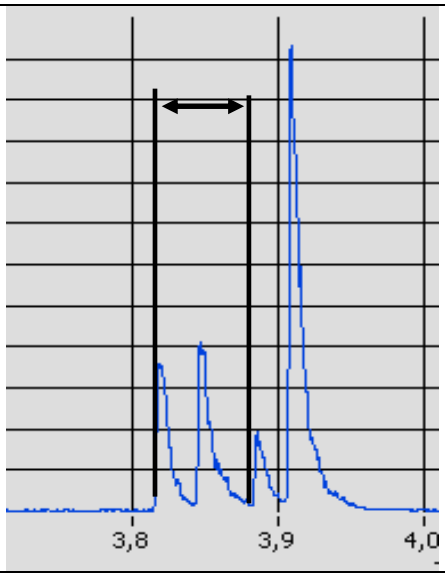


Stop at the end of the limit switch

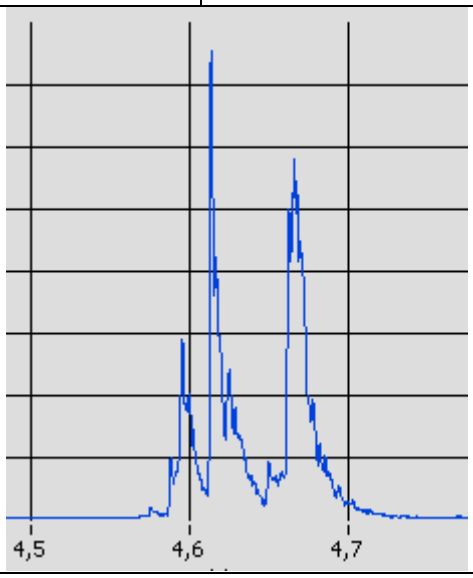
The switching of ABB-UC has 6 stages, which has distinctive acoustic signatures for a switch in good condition, 4 contacts events to assess the transition time (duration of insertion resistance) by the difference defined by steps 2 and 5 identified above. Values may vary depending on the switch but are typically between 40 ms (e.g.: UCB) and 70 ms (e.g.: UCC).

Card 3: Time of transition not perceptible

Models : All



Time of transition well identified

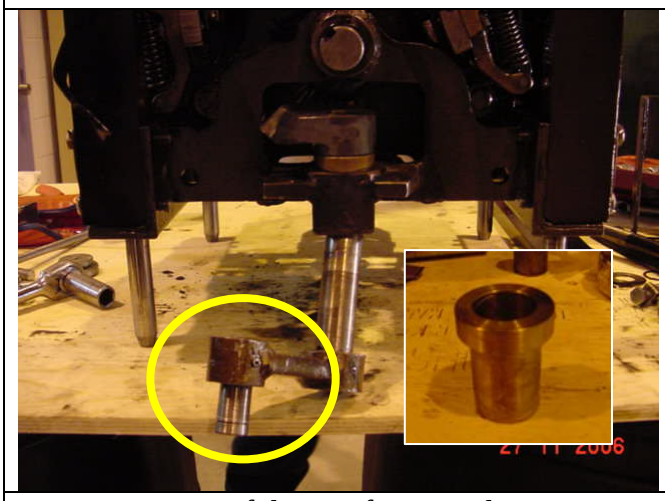


Time of transition barely perceptible

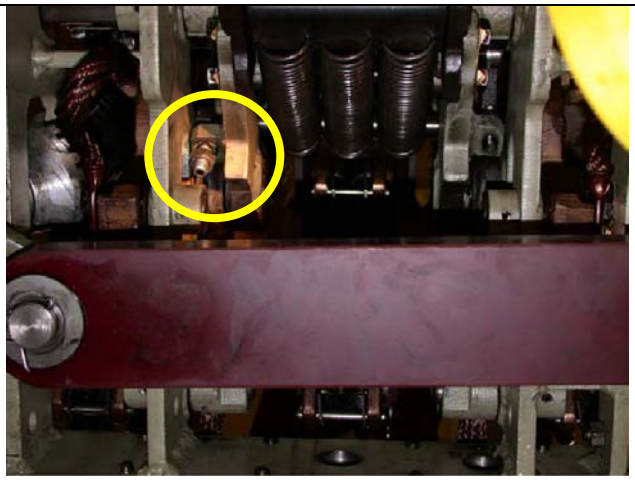
When the transition time is barely perceptible by a visual examination of the acoustic signature, the most likely causes are:

- ✓ Misalignment of the mechanism (pass-through bolts)
- ✓ Wear of the mechanism
- ✓ Wear of the driving ring

These anomalies are followed by an asymmetry between even and odd operations. Contacts badly worn may also complicate the identification of the 3rd pic, but without causing an asymmetry.

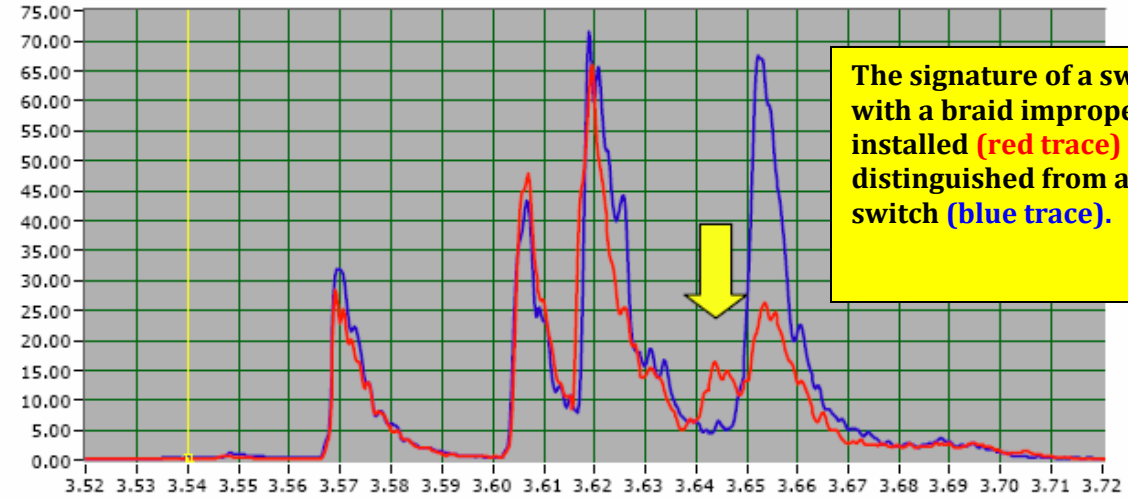


Wear of driving finger and ring

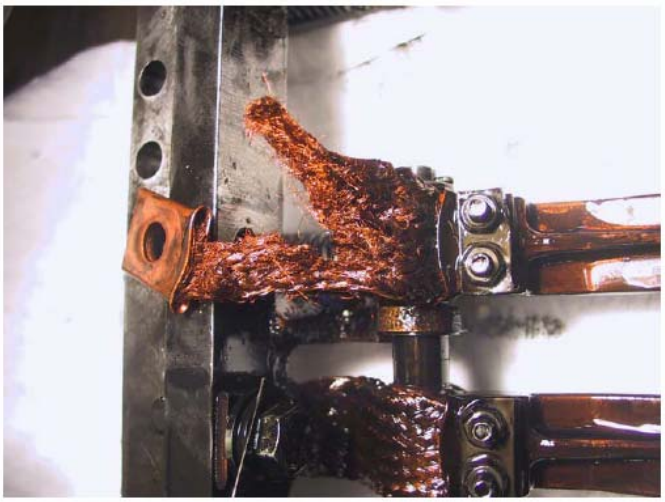


View of the screw under the switch

Card 4: Braid improperly installed	**Models :** All



The signature of a switch with a braid improperly installed (red trace) is easily distinguished from a normal switch (blue trace).

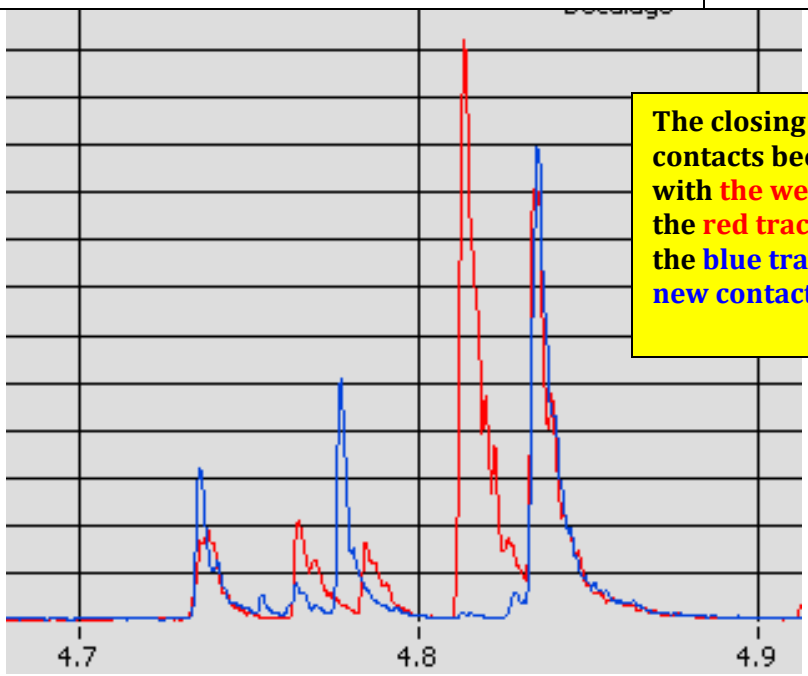


Braid connecting the moving contacts

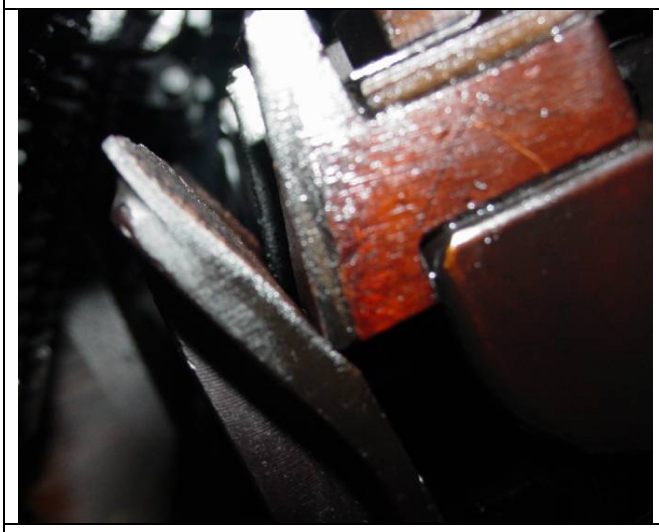
Braid placed at the corner

An improper installation of the braid may interfere with the operation of the mechanism and eventually cause its failure.

Card 5: Wear of the arcing contacts	**Models :** All



The closing of the main contacts becomes very weak with the wear of contacts on the red trace compared to the blue trace (OLTP with new contacts).

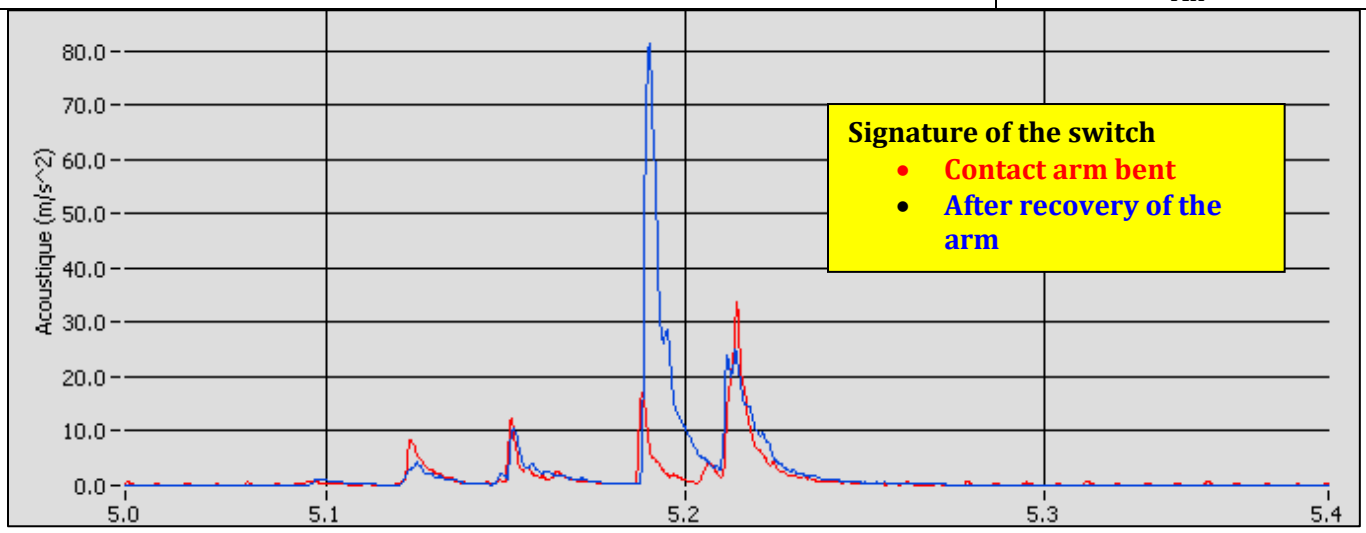


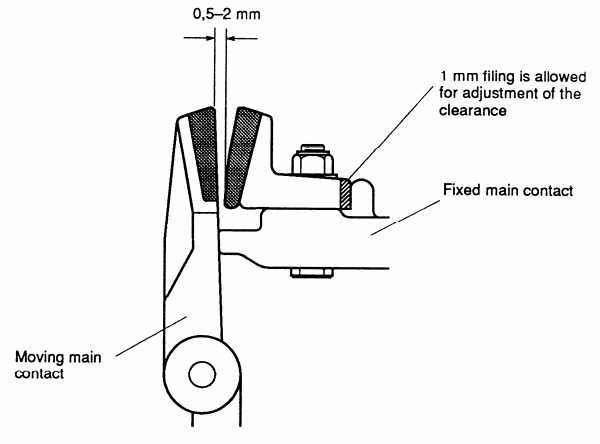
Worn contacts (before repairs)

New contacts

The loss of material caused by the wear of the driving contacts, for inertial effect, a variation in the sequence and a reduction of the impact noise of the main arc contacts.

Card 6: Bending the arms of mobile contacts	**Models :** All



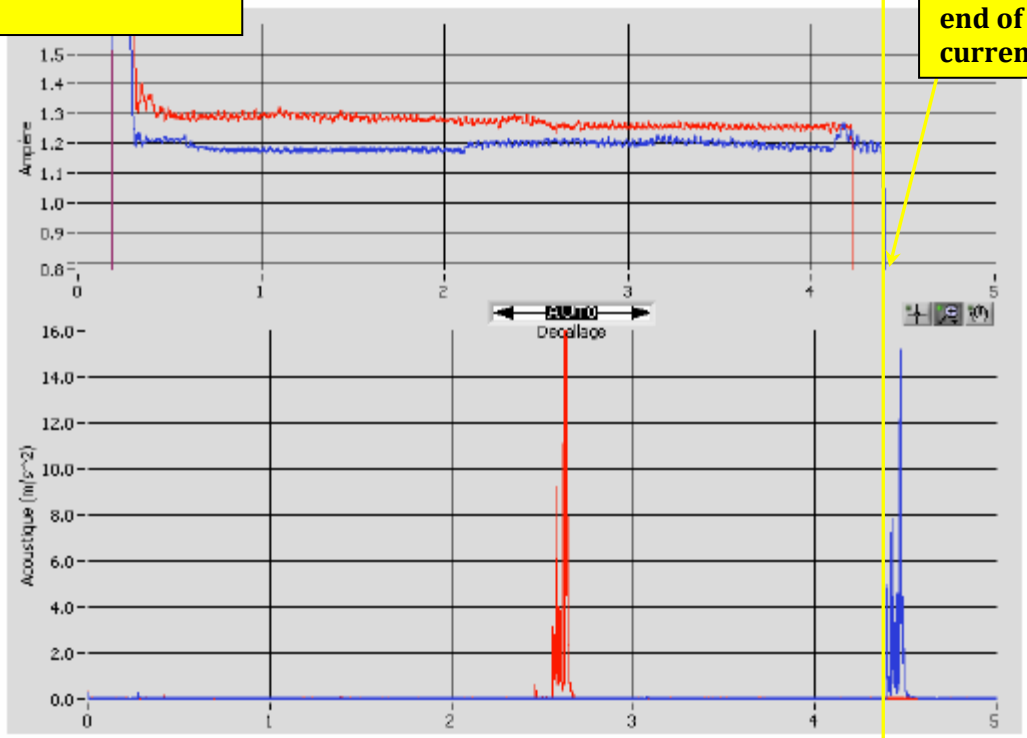


As a result of repeated impacts during normal operations, the copper arm of the mobile contacts is bent and the minimum distance between mobile and fixed points of tungsten (0.5 mm) is no longer respected. This anomaly may cause local overheating due to the lower conductivity of tungsten. This anomaly is visible on the noise impact of arcing contacts. To discern the phenomenon of wear, you can note that the bowing of the arm contacts does not alter the sequence.

Card 7: Switching synchronization	**Models :** All

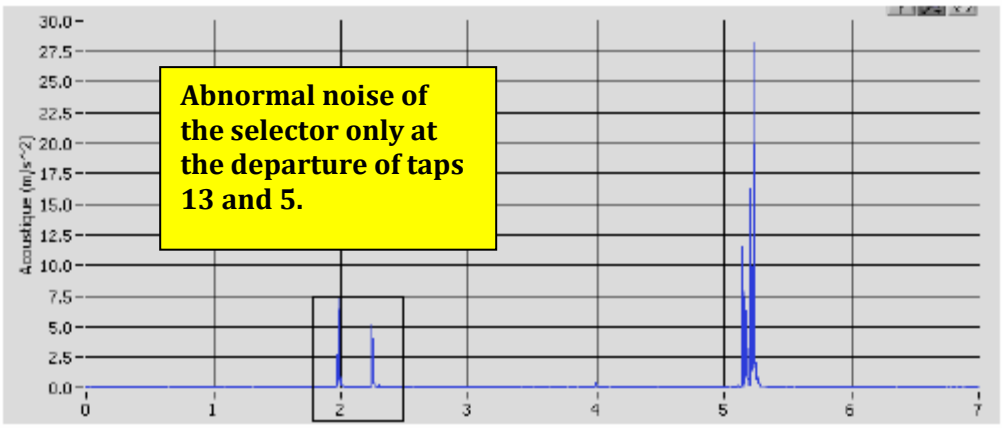
The switching occurs too early on the red trace (downward operation) and too late on the blue trace (upward operation).

The rise of the switching occurs after the end of the motor current!



Following repairs, or adjustments in the driving mechanism, it is possible that the switching is out of sync. In these models, this anomaly can be demonstrated by comparing the upward and downward operations. In order to correct the adjustment, we must rebuild the shaft coupling at the output of the control box.

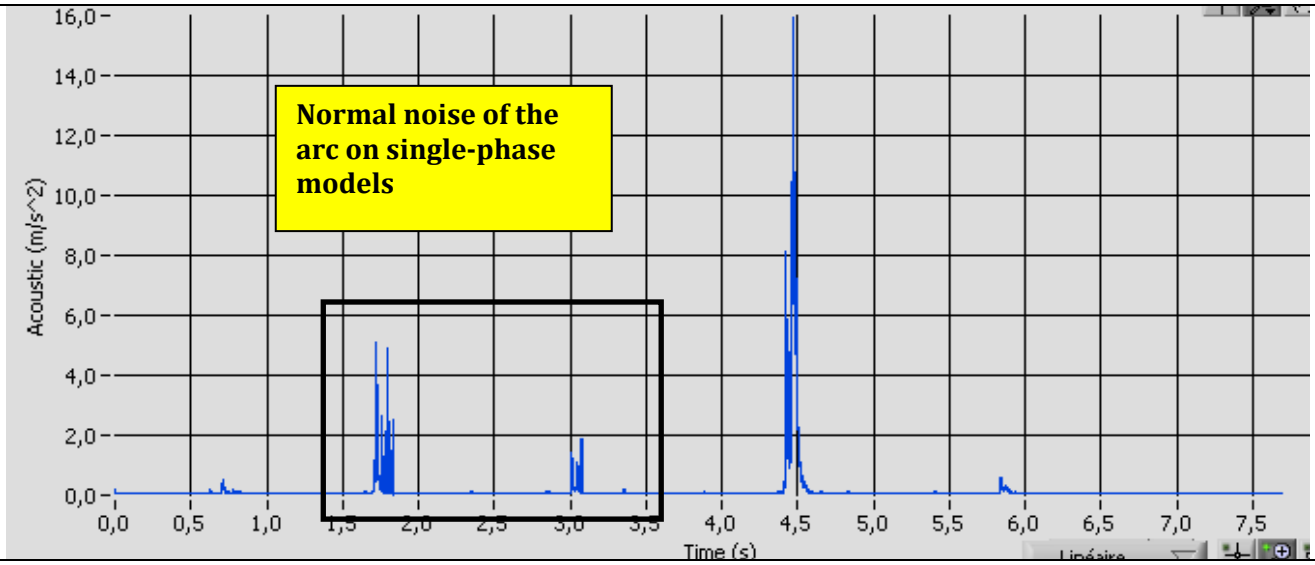
Card 8: Aligning the contacts of the selector	**Models :** All models.



Abnormal noise of the selector

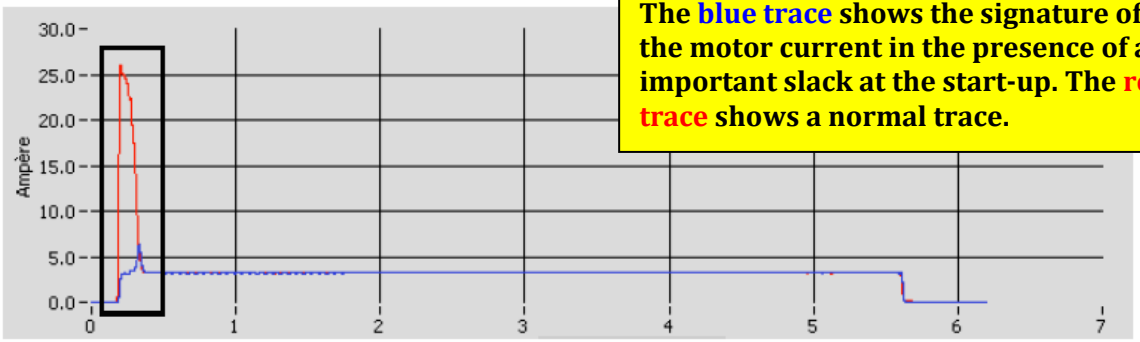
A misalignment of the selector contacts can cause abnormal noise during its operation. For a model with inverter (or pre-selector) that noise will be observed in the two operations corresponding to the same tap as shown above. In this example, there is a noise at the departure of the taps 5 and 13 only, which corresponds to the same fixed contact.

Note: For single-phase models, this noise can be confused with a normal arc noise when the test is performed under voltage (see figure below). These arc noises can be observed both at departure and arrival of the selector. The amplitude is usually a little higher at the daparture of the selector when the movement remove the turns of regulation and vice versa for the arrival. For these models, the misalignment of contacts can be observed only if the test is performed disconnected from voltage.



Normal noise of the arc on a single-phase model (UCBRT)

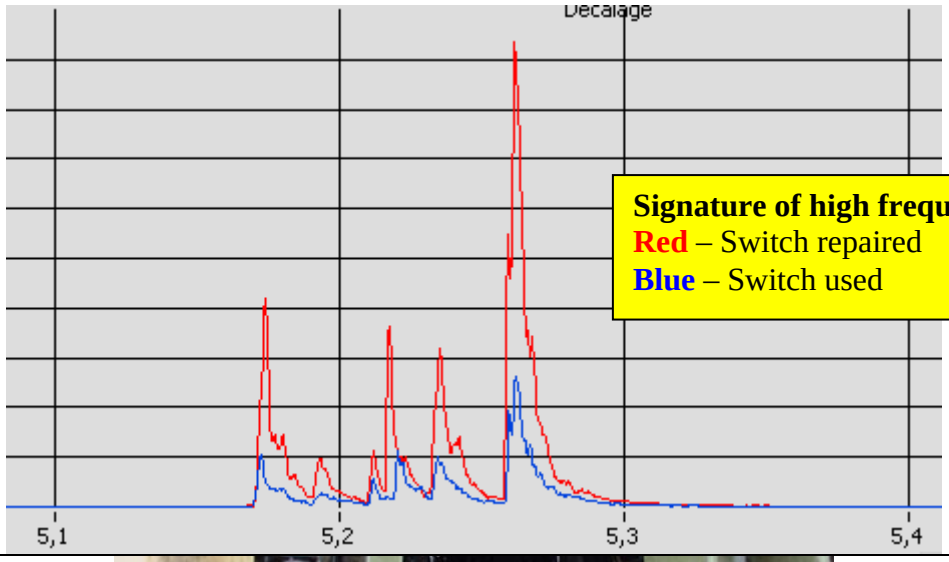
Card 9: Slack in the control rod	**Models :** All



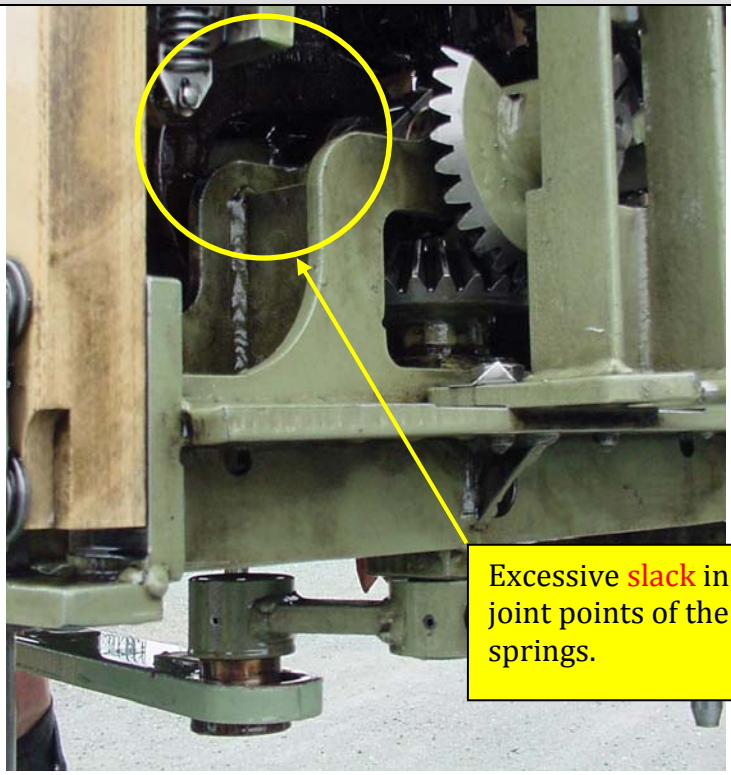
The blue trace shows the signature of the motor current in the presence of an important slack at the start-up. The red trace shows a normal trace.

An important slack in the control rod can be shown in the signature of the motor current as shown above. When the motor starts to reduce, the amplitude of the inrush current can be significantly reduced.

Card 10: Advanced wear of the wheel switch	**Models :** UCC



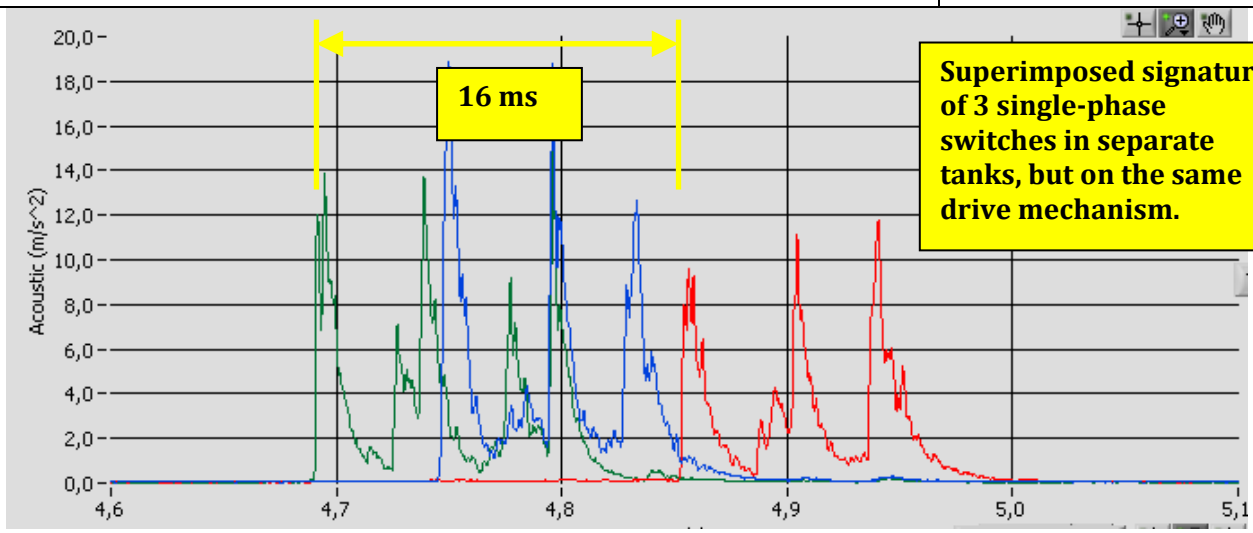
Signature of high frequencies
Red – Switch repaired
Blue – Switch used



Excessive slack in the joint points of the springs.

The slack caused by a very advanced wear of the wheel switch (the unit shown above had accumulated 400,000 operations) may cause the blocking of the mechanism, a loss of synchronization with the switch that can cause an arc across the terminals of the selector in the tank. This degradation is easily noticeable on the acoustic signature by a significant decrease of amplitudes with the wear.

Card 11: Desynchronization between switches	**Models :** All

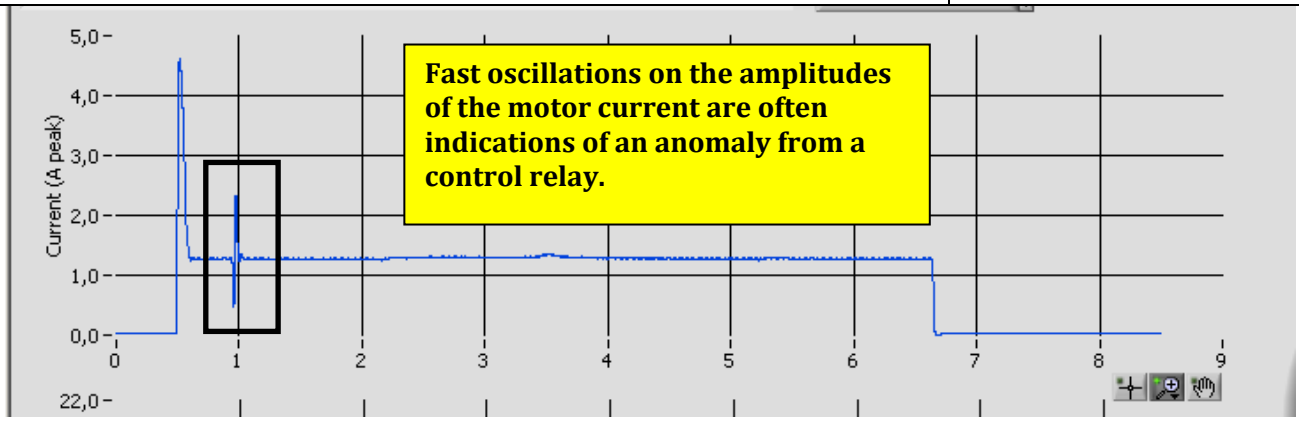


Synchronization between single-phase switches can be accurately verified especially when they are in separate tanks but on a single mechanism as shown above. By performing the measurement with 3 accelerometers, the signatures of the 3 switches occur simultaneously and the timing is measured directly. If the manufacturer does not specify a maximum offset, the adjustment (coupling shafts) can usually be made so that the offset does not exceeds 25 ms.

In case of multiple switches in a common tank, the signatures of the switches are superimposed and the evaluation of synchronization becomes more approximate.

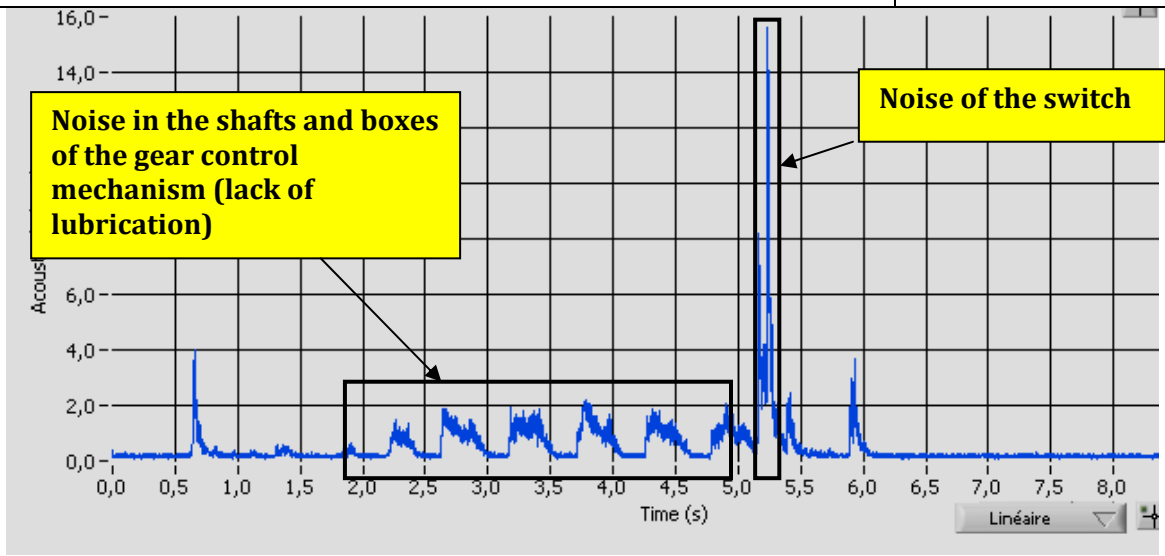
When each switch is equipped with its own drive mechanism, the synchronization verification can be achieved by alternating the points of current measurement and the acoustic signature between phases (e.g. measuring current on phase A and acoustics on Phase B).

Card 12: Faulty control relay	**Models :** All



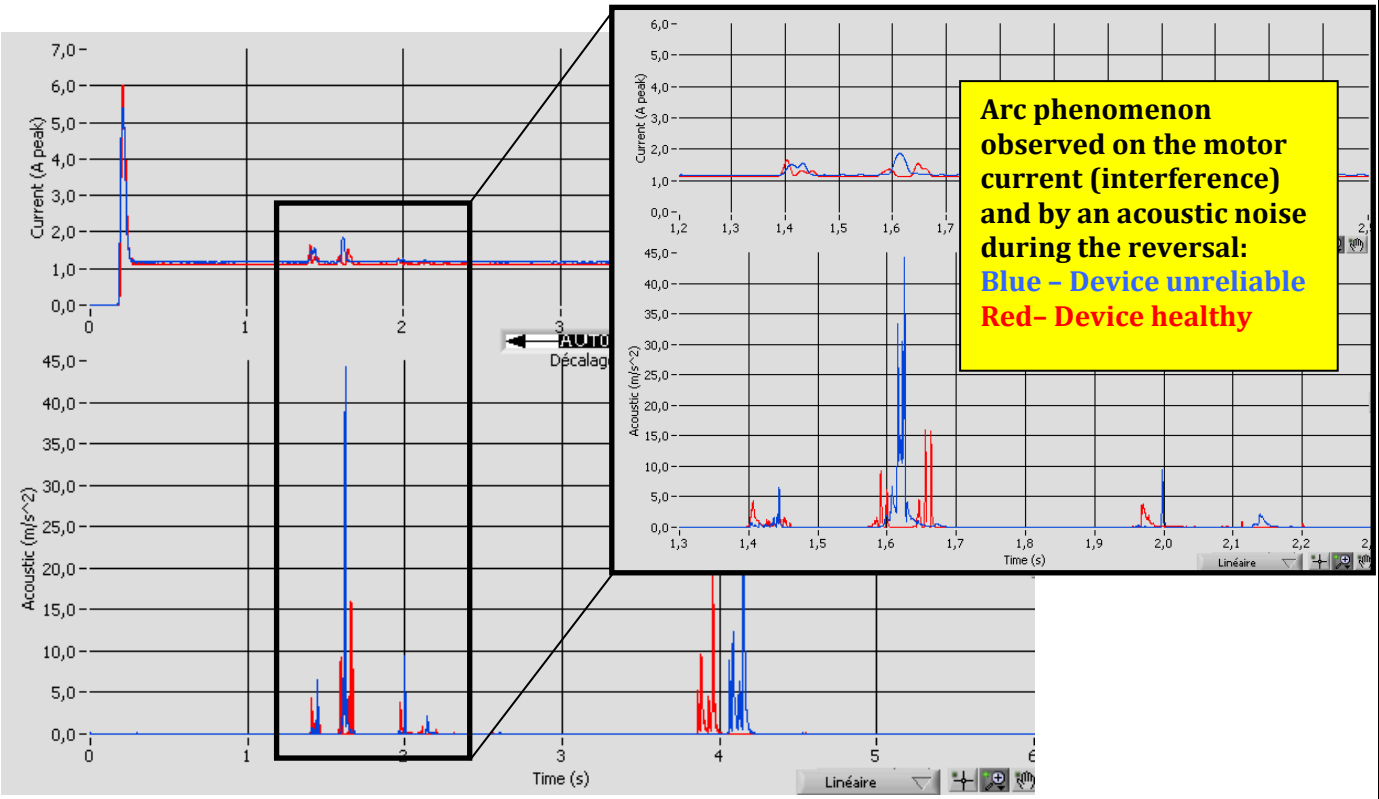
Anomalies of operation or of adjustment of control relays (upward, downward, maintenance, etc.) can often be observed by rapid fluctuations of the current. These anomalies are usually benign but still indicate a deterioration of the device which can ultimately lead to a refusal to operate; the operations are jerky or jumping to a position other than the set point. From the point of operation, this behavior explains the reports of lag control

Card 13: Lack of lubrication of the control gear	**Models :** All



A lack of lubrication of the gear drive mechanism may affect the acoustic signature as shown in this example. This phenomenon is highlighted in particular in the signature of the lower frequencies.

Card 14: Anomaly in the voltage limiter device	**Models :** Depending on the voltage level



The operation of the inverter under voltage causes a low-intensity arc, which is picked up by the current clamp (for electromagnetic interference) by means of the acoustic noise of the spark. It can often be observed at the time of the contact separation, a few alternations to 120 Hz corresponding to voltages peaks.

Depending on the voltage level, some manufacturers install voltage limiter devices to reduce this phenomenon. In case of failure of this device, one can observe that the amplitudes of the noise increases as shown in the figure above. And the phenomenon can also be maintained over a longer period (not in this example).

The long-term consequences of such anomalies are not well known.