The PD handhelds revolution: from beermat sketch to supersmart applications

By Neil Davies, EA Technology

Back in the 1960s and 70s, when **EA Technology** had its origins as the R&D arm of the UK electricity industry, one of its core missions was to understand how and why HV assets failed and how this could be detected without taking equipment out of service: because, it was argued, if we could observe failure processes, we could intervene before failures occurred.

The breakthrough moment in this quest came when Dr John Reeves identified and named Transient Earth Voltages (TEVs) as one of the phenomena caused by partial discharge – a key factor in the degradation process: small discharges which would develop over time and eventually cause assets to break down. Partial discharge emitted electromagnetic radiation which could be measured, so the first generation of TEV instruments was developed: big, clunky and relatively expensive.

Fast forward to 2003 and a near miss involving insulation failure at one of our clients, when personnel had been in a substation that was alive with undetected PD activity. A flash-over occurred just after the substation visit and this brought safety firmly to the front and centre of mind particularly as recent fatalities had occurred with people working on switchgear.

(Dr John Reeves)

Case Study

EA Technology was asked to look at the causes of the near miss failure and procedures for assessing switchgear before live operation to enhance safety.

More research and growing knowledge revealed that the types of PD activity that affected switchgear had multiple causes but could be divided into two main categories: internal and surface. Internal activity, such as those caused by voids in insulation, could best be measured in terms of TEVs – electromagnetic emissions. Surface PD could best be assessed as noise, using ultrasonic instruments. Early versions of the latter were developed, but they were similarly a long way from being easy or cheap to deploy.

Whilst waiting for a ferry back to the UK from a business trip in Ireland, I along with my colleague Colin Vickers, stopped at a pub and, over a pint of Guinness, drew a sketch on a beermat.

It was for a simple handheld instrument that would alert the user to critical levels of PD – using both ultrasonic and TEV methods. The UltraTEV Detector was born small, battery-powered and handy enough to be carried by any operator.

First smart PD handheld

The original UltraTEV was simple in form, but like the first iPhone, launched in 2007 it was the progenitor of the increasingly smart versions that have followed.

The original UltraTEV (left) the first iPhone (right)

In its first iteration, there was no graphical display (that would arrive later with the UltraTEV Plus). In its place was a traffic light system – green, amber and red, indicating levels of both ultrasonic and TEV discharges that were either OK, warranting further investigation or more urgent attention. The smartest part of the package was that we calibrated the trigger levels with great care, using a database of measured PD activity in thousands of HV assets that we had been building for decades.

The first UltraTEV Detector went beyond its original objective as a safety device, detecting PD activity that suggested further investigation: but its greatest limitation was that such investigations required the deployment of other, more sophisticated instruments to locate, measure, record and analyse PD activity in ways that would provide more useful information for the actual management of assets i.e. how and when they were likely to fail, and whether/when to service, repair or replace them.

Getting smarter

The subsequent UltraTEV Plus provided a major leap forward, with multiple screens offering a wealth of clearly displayed information and a range of accessories that enhanced its capabilities e.g. extension microphones and probes. In parallel with developments in handhelds, instruments such as our UltraTEV Monitor have continued to provide ever-greater abilities to monitor the condition of whole arrays of assets and help avert failures.

But let us fast forward again to the latest development in handhelds: the UltraTEV Plus². Because by comparison with its predecessors, it is very smart indeed.

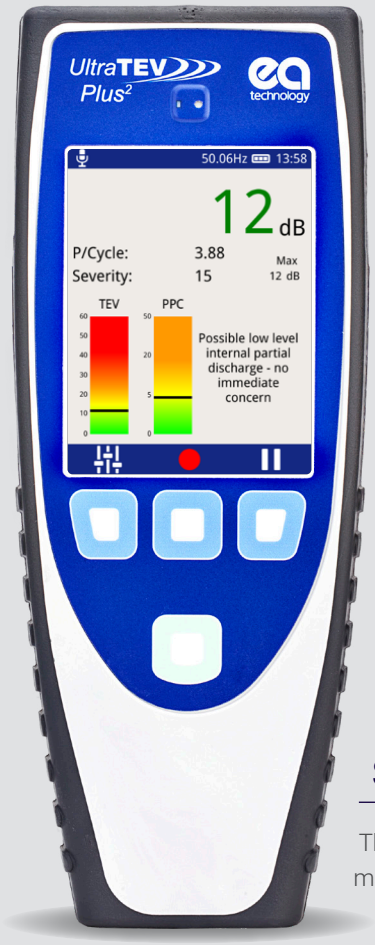
From smart to supersmart

What's so smart about UltraTEV Plus²? Above all, it's the algorithms that lie behind the information on display. They ensure consistent quality of data, whoever is using the instrument: and consistent quality of data is the absolute precondition for making intelligent management decisions, based on accurately measured asset condition. In short:

GOOD TOOLS
=
GOOD DATA
=
GOOD DECISIONS

Multiple screens display PD activity in terms of ultrasonic and TEV activity. Perhaps even more importantly, it analyses and interprets the data to provide immediately useful information and suggested actions. The screen *(main image)*, for example, advises that the internal PD activity in this case is no immediate cause for concern:

Unlike the first Detector, where engineers had to use their skills and experience to decide if a red light meant meaningful PD or something else, the UltraTEV Plus² can discriminate automatically between meaningful PD activity and a variety of noise, interference and environmental effects, which are clearly displayed as phase resolved and waveform plots.



Similarly, the UltraTEV Plus² will help identify different causes of PD activity, for example floating metalwork, or voids in insulation, because it recognises and interprets specific signals in each case.

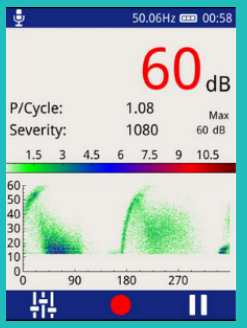
The intelligence built into the UltraTEV Plus² is based on **EA Technology's** 40+ year experience of studying PD in thousands of assets – what causes PD, how PD emissions differ from other forms of noise, whether PD is serious or not, and whether it indicates the need for remedial action.

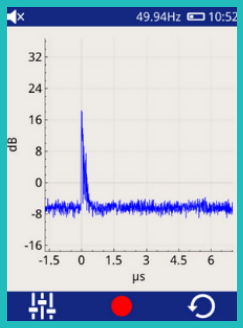
Smart data gathering

The UltraTEV Plus² does more than provide information for the user in the field. It is WiFi-enabled and includes a micro SD card slot, so unlimited information can be captured, stored and communicated to a PC. The data is available for further analysis and interpretation offline, and can be added to databases as part of a condition-based asset management regime. It also means that the person using the instrument does not necessarily need to be the one who will use the data – which brings us neatly to the question of people and resources.

Smarter use of people

The bottom line is that smart instruments make people more productive. Fewer skilled people are needed, because an UltraTEV Plus² can deliver high quality, consistent data on the condition of assets, without the person using it needing to be highly skilled.
That said, an experienced engineer equipped with such an instrument, and the abilities to use all its features, has some serious firepower at their fingertips.





Can a smart instrument replace highly skilled engineers and asset managers?

Absolutely not. But it can make their lives easier and equip them to make smarter decisions, based on consistently good information.

Most importantly, it can free a company's best people from the task of physically collecting data about asset condition, so they can use their time more productively to consider the data and take decisions at a higher strategic level i.e. prioritising maintenance, repairs and investment.

Given the trend for contracting out engineering and maintenance services, the need for consistent quality of information about asset condition is more critical than ever. People can be inconsistent in their commitment as well as skills, whether they are on the payroll or work for contractors. But if they are equipped with smart instruments and a clearly defined set of tasks, plus their managers' ability to see the data they are collecting, there is less scope for inconsistency.

Conclusion

Just as it is hard to remember life before smart phones and the internet, it is difficult to recall when the only effective way to assess the condition of most power assets was to take them offline and strip them down. Smart phones have changed the way many of us live: and smart PD instruments have changed the way many of us work with power assets.

Smart instruments will keep getting smarter, for sure. But equally certain is that the skills and experience of engineers and asset managers will be in greater demand than ever, to ensure that ever-better data is used intelligently to make ever-smarter decisions.

EA Technology provides a comprehensive suite of Partial Discharge products and solutions for HV assets to help prevent failure, increase safety and save cost.

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Case Study