Automated Fault Location Analysis – Analytics Update II

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Objective

- **Reduce the time to determine where a fault** has occurred with **sufficient certainty** to **begin sectionalizing** the transmission network and **begin restoring customers** in areas not directly affected by the faulted line section.

Investigate the ability to automate the protection engineers fault location process

Approach

- Currently 2 programs developed
  - Program actively **polls fault records and tripped line status**.
    - Once a new event happens the program moves over recent event files and preprocesses them for the analysis application
    - Also moves out historical records to make them no longer valid for analysis.
  - Program runs the **analysis application** on the recent event record
    - Application will parse out the fault information (magnitude and type), start-up analysis program, call upon a fault location macro, parse the output of the macro and e-mail the results to specified e-mail group.
    - Application moves this studied fault record to a historical folder so that each fault record is only studied once.

Data Sources and Format

Digital Fault Record

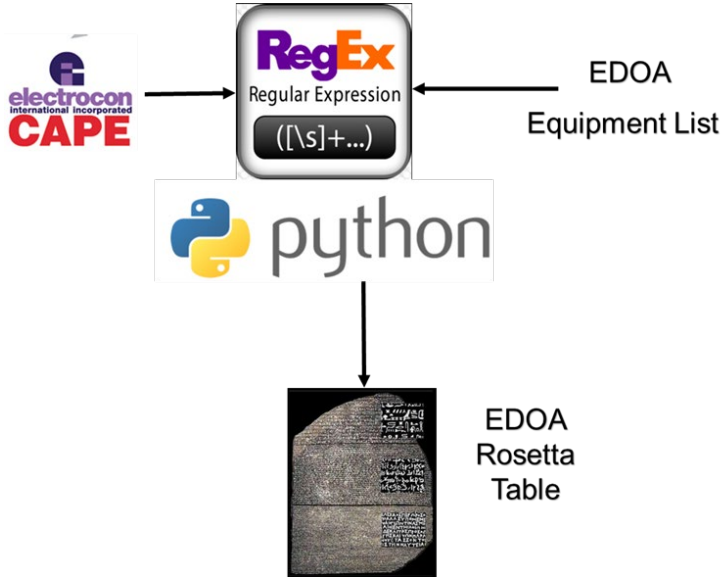
```
channel analogue   1        "kV"     80.00   254.500  0   0.000  AC
channel analogue   2        "kV"     80.00   254.500  0   0.000  AC
channel analogue   3        "kV"     80.00   254.500  0   0.000  AC
channel analogue   4           80.00   15155.000  0   0.000  AC
channel analogue   5          "A"    240.00   45418.000  0   0.000  AC
channel analogue   6          "A"    800.00   30226.000  0   0.000  AC
channel analogue   7          "A"    800.00   31593.000  0   0.000  AC
channel analogue   8          "A"    240.00   45472.000  0   0.000  AC
channel analogue   9          "A"    1200.00   47536.000  0   0.000  AC
channel analogue  10          "A"    1200.00   45460.000  0   0.000  AC
channel analogue  11          "A"    240.00   45533.000  0   0.000  AC
channel analogue  12          "A"    1200.00   45411.000  0   0.000  AC
channel analogue  13          "A"    1200.00   47311.000  0   0.000  AC
channel analogue  14          "A"    160.00   30274.000  0   0.000  AC
channel analogue  15          "A"    800.00   30266.000  0   0.000  AC
channel analogue  16          "A"    800.00   31558.000  0   0.000  AC
channel analogue  17             "A"    120.00   22724.000  0   0.000  AC
channel analogue  18            "A"    120.00   22700.000  0   0.000  AC
```

Cross Reference Tables

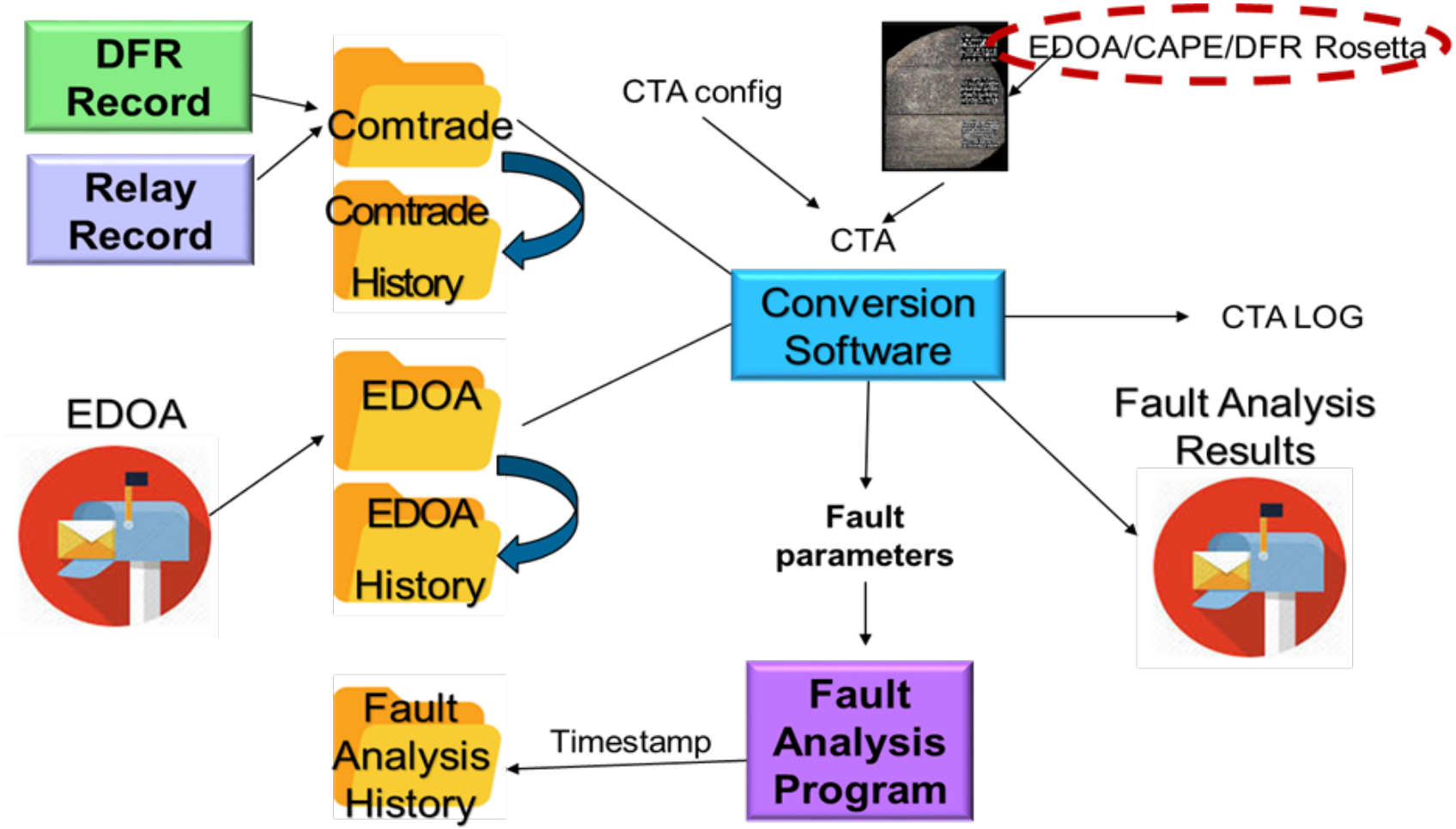
- Most naming conventions are not standardized between applications and devices.
- The name of the line in fault analysis program, and the corresponding COMTRADE file line/location names may be different.
- Sometimes the names are abbreviated or a dash replaces a blank or the suffix “LINE” is appended to the name.

The result is a data join with the following column headings:

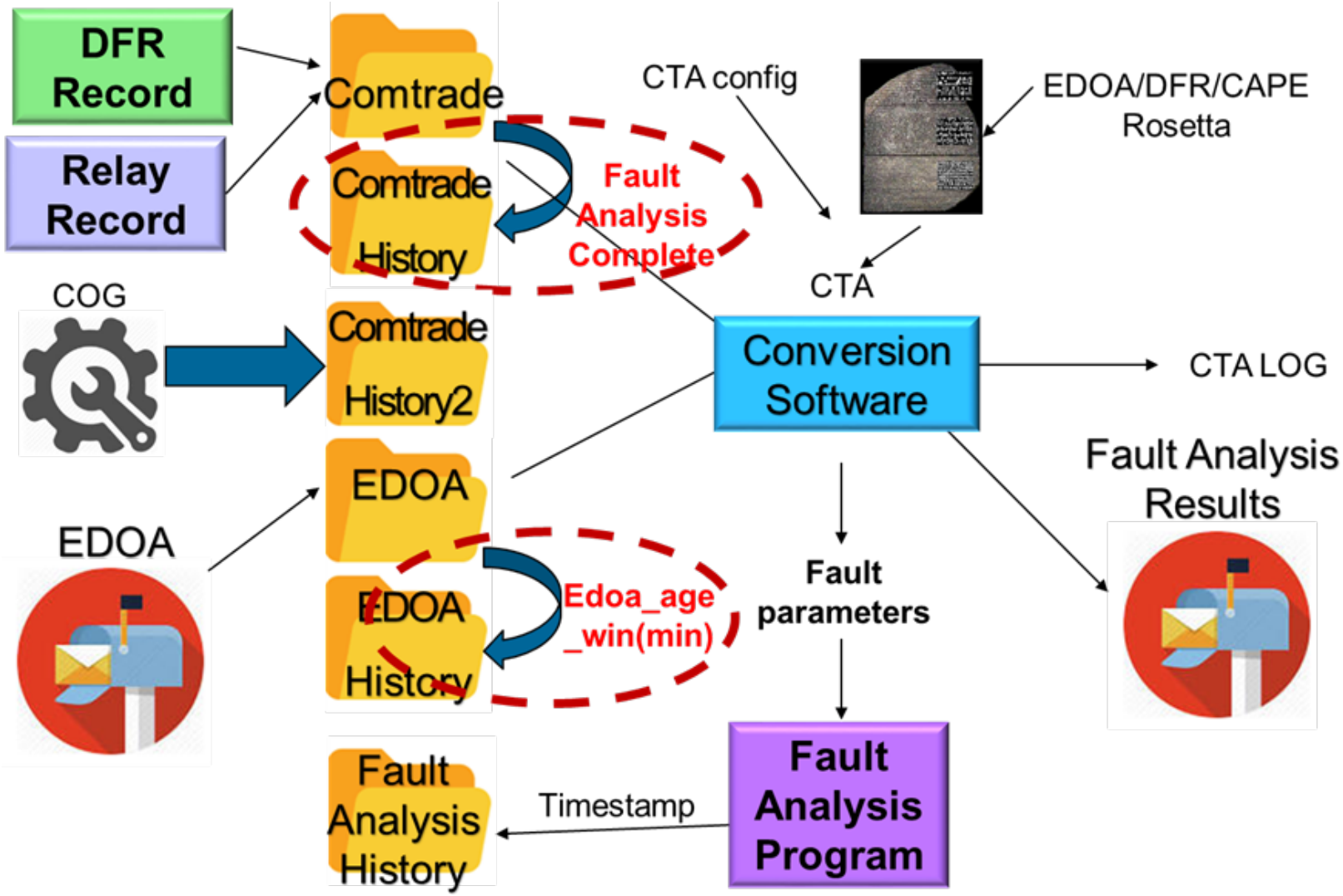
- Line Name
- From Bus Number
- From Bus Name
- To Bus Number
- To Bus Name
- Circuit Number Line Length
- From Sub Number
- From Sub
- To Sub Number
- To Sub



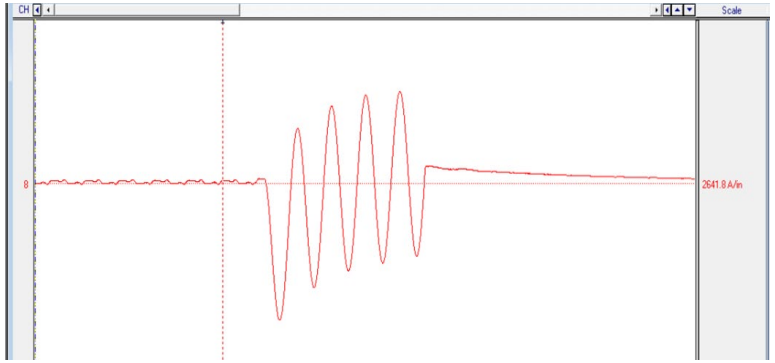
COMTRADE Analyzer Automation



EDOA Request Age Window

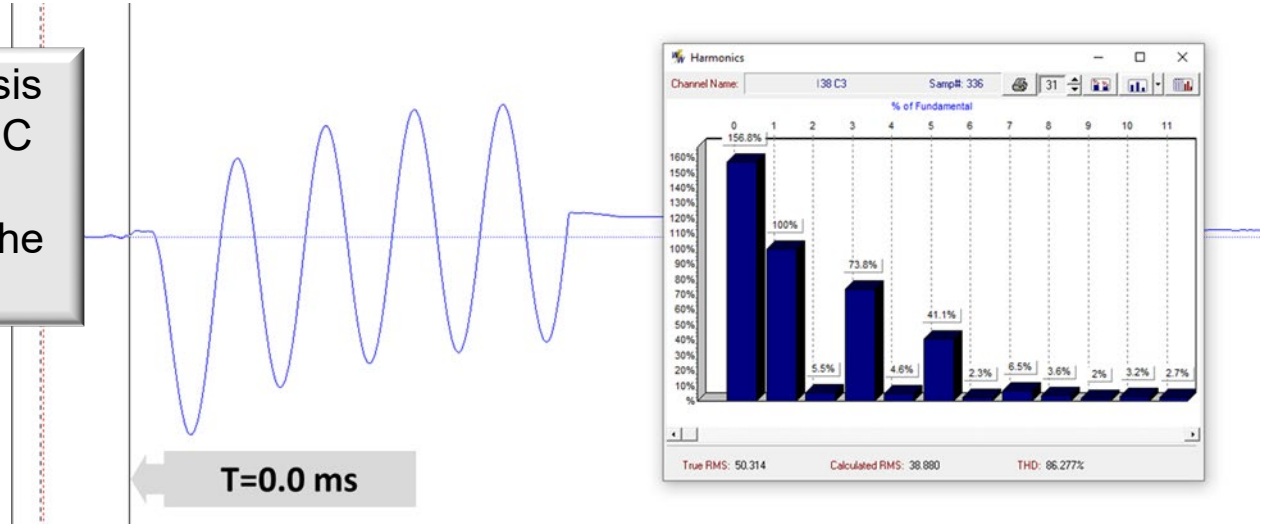


Waveform Analysis - DC Offset Adjustment

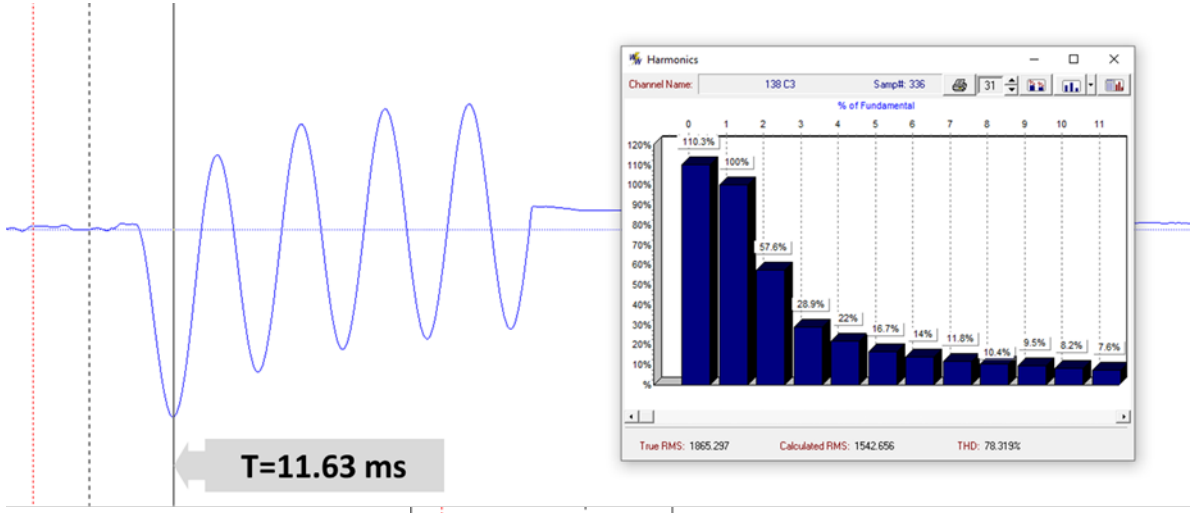


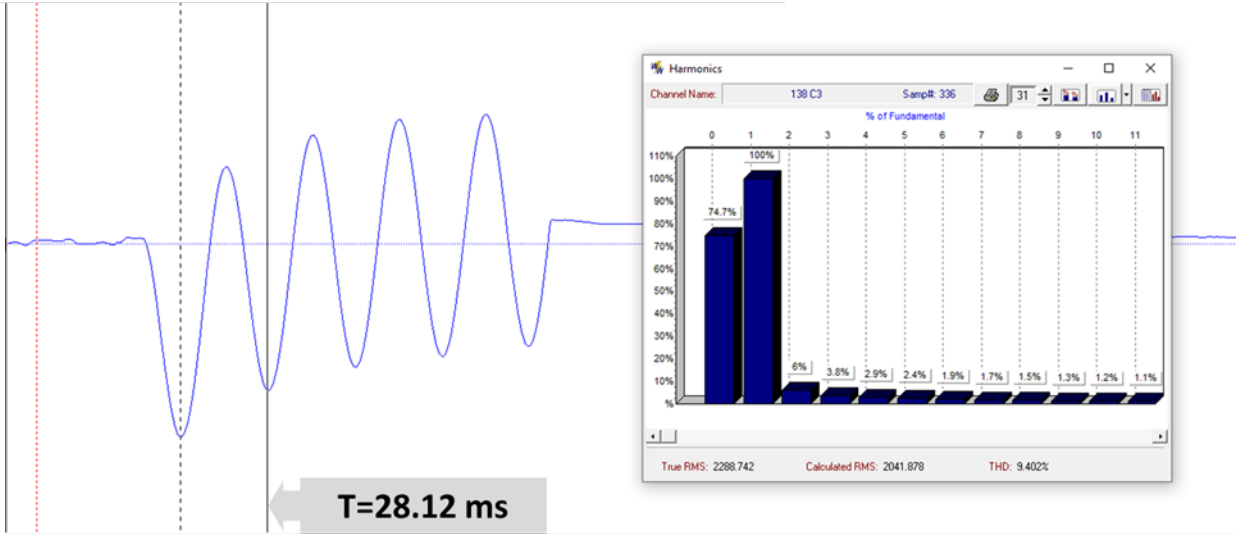
In the manual process the protection engineer determines the fault magnitude. Engineer needs to take into account the DC offset and adjust for the amount of offset

Applying harmonic analysis to determine when the DC offset has diminished sufficiently to determine the fault magnitude.

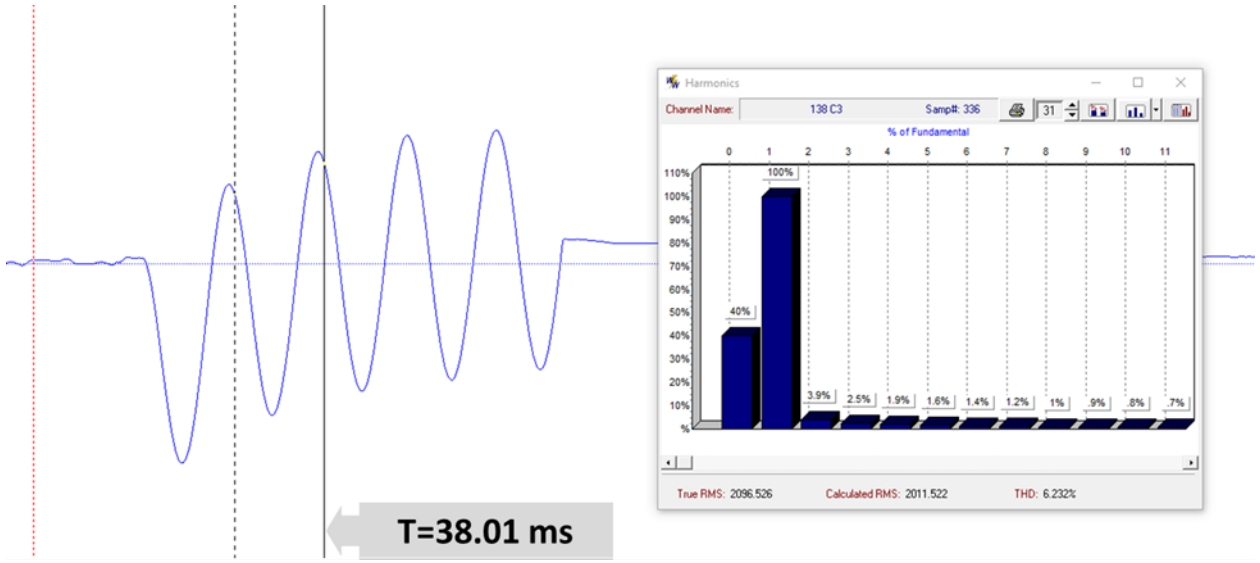


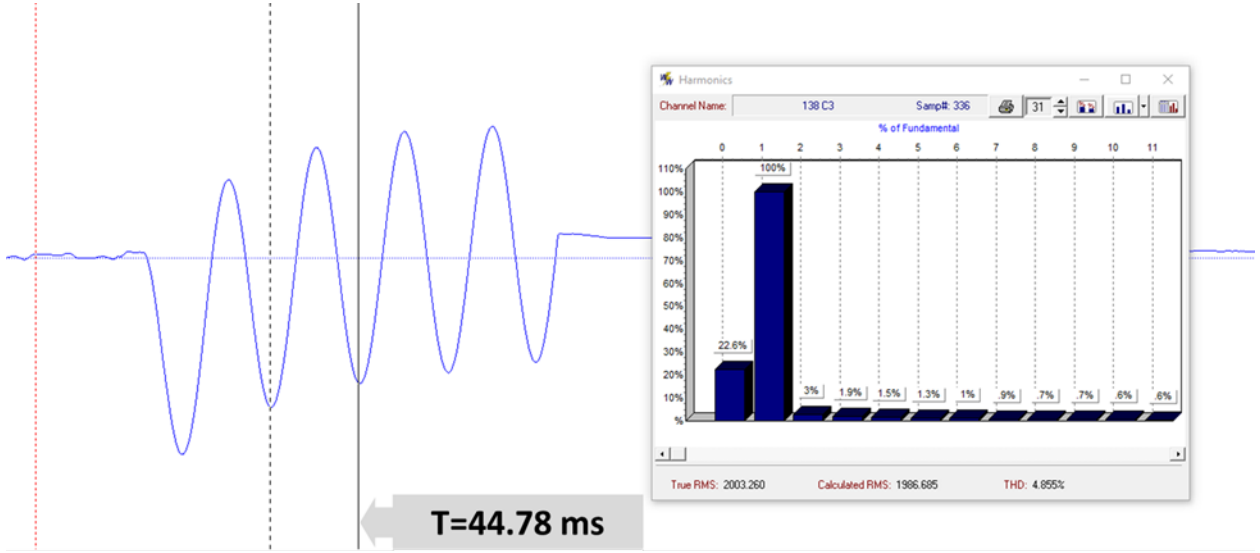
Harmonic Analysis





Harmonic Analysis





Conclusion

- Automatically extract data from three sources of event data.
- Event record processing performing quite well
- Still have a mysterious process shutdown problem that is being investigated
- Fault location process is working and also notification process but still need to implement “closing the loop” with Tx Ops
- Harmonic analysis of fault waveform appears to be a solid approach to determine the fundamental frequency fault current magnitude

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