Harpster Trip Summary – August 2, 2017

Following The Logic:

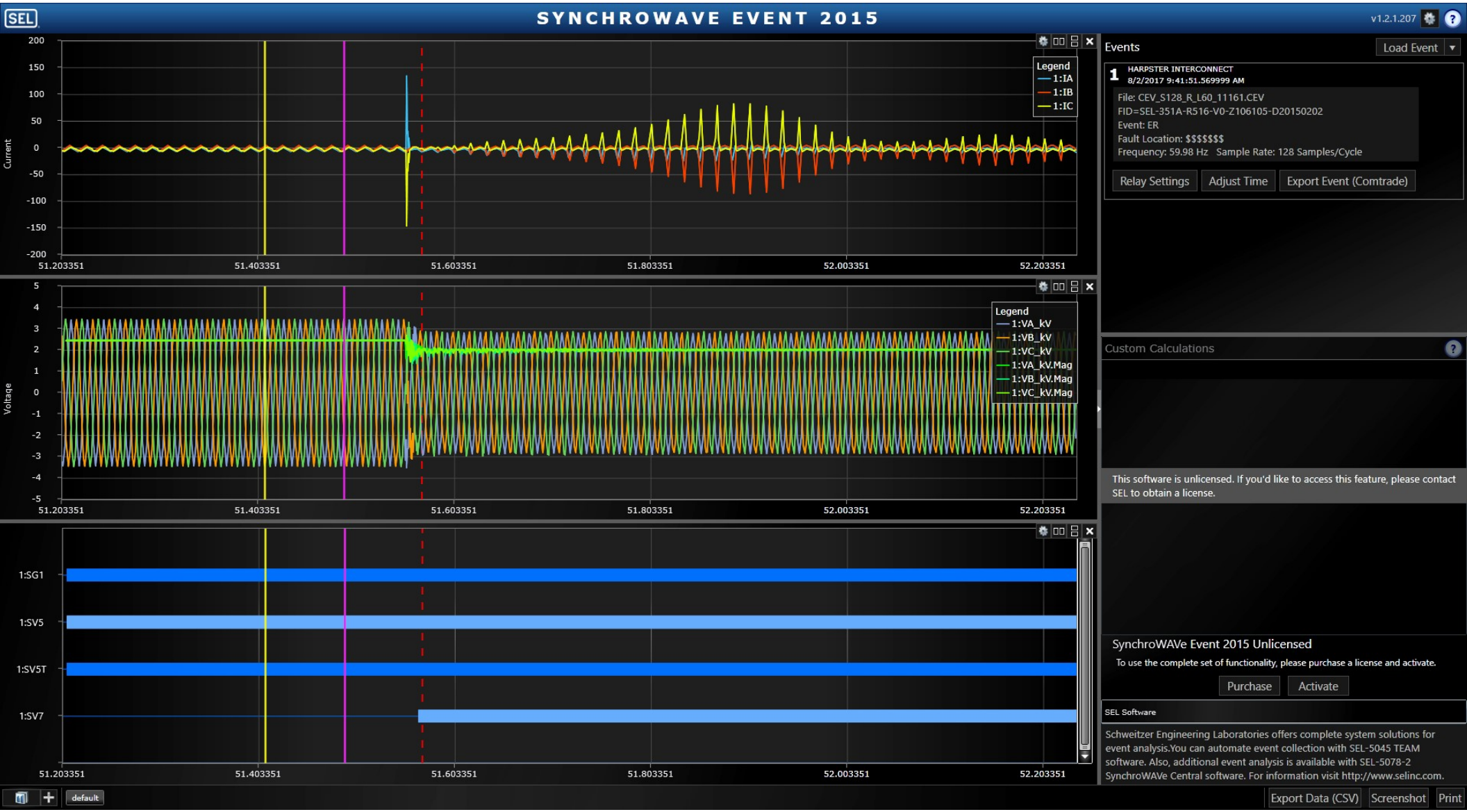
- SV7 causing the fault
  - Rate-of-Rise Relay: A relay that functions on an excessive rate-of-rise of current.
- Relay Settings
  - SV7 = 27A2 + 27B2 + 27C2
  - 27: Under-Voltage Relay: A relay that operates when its input voltage is less than a pre-determined value.
  - Voltage Element 27A2 → 27P2P Pickup Setting/Range (351A manual)
  - 27P2P = 105.60V (out of 120V)
  - SV7PU = 120 Cycles (60 cycles / second)

What's Happening:

- Before reviewing the fault files we need to calculate the P2P under-voltage specific to the Harpster grid, grid voltage is 4.16kV.
  - $Voltage\ per\ Phase = \frac{4.16kV}{\sqrt{3}} = 2.40kV$
  - Grid specific under-voltage → $\left(\frac{105.60}{120.00}\right) * 2.40kV = 2.11kV$
- Phase A drops below the 2.11kV threshold first followed by Phase B and Phase C.
- SV7 is triggered about 0.01 seconds after Phase A drops.
- All three phases oscillate dramatically for about 0.02 seconds and settle around 2kV.
- SV7 runs for 2 seconds (SV7PU = 120 cycles) before tripping, voltage remains around 2kV.

Recommendations:

- Extending PU will likely not fix the issue, PU change from 60 to 120 did not and voltage doesn't increase above 2.11kV threshold during 60 or 120 cycles.
- Decrease under-voltage relay setting to absolute min
  - Absolute min = 1.36kV
  - $27P2P = \left(\frac{1.36kV}{2.40kV}\right) * 120 = 68.00V$
- Decrease under-voltage relay to just below settling voltage
  - Settling voltage = ~2.00kV → Use 1.90kV
  - $27P2P = \left(\frac{1.90kV}{2.40kV}\right) * 120 = 95V$


SEL
SYNCHROWAVE EVENT 2015
v1.2.1.207
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Legend
1:IA
1:IB
1:IC
Voltage
Legend
1:VA_kV
1:VB_kV
1:VC_kV
1:VA_kV.Mag
1:VB_kV.Mag
1:VC_kV.Mag
1:SG1
1:SV5
1:SV5T
1:SV7
51.203351
51.403351
51.603351
51.803351
52.003351
52.203351
Events
Load Event
1 HARPSTER INTERCONNECT
8/2/2017 9:41:51.569999 AM
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FID=SEL-351A-R516-V0-Z106105-D20150202
Event: ER
Fault Location: $$$$$$
Frequency: 59.98 Hz Sample Rate: 128 Samples/Cycle
Relay Settings
Adjust Time
Export Event (Comtrade)
Custom Calculations
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Export Data (CSV)
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Print

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1:SV5
1:SV5T
1:SV7
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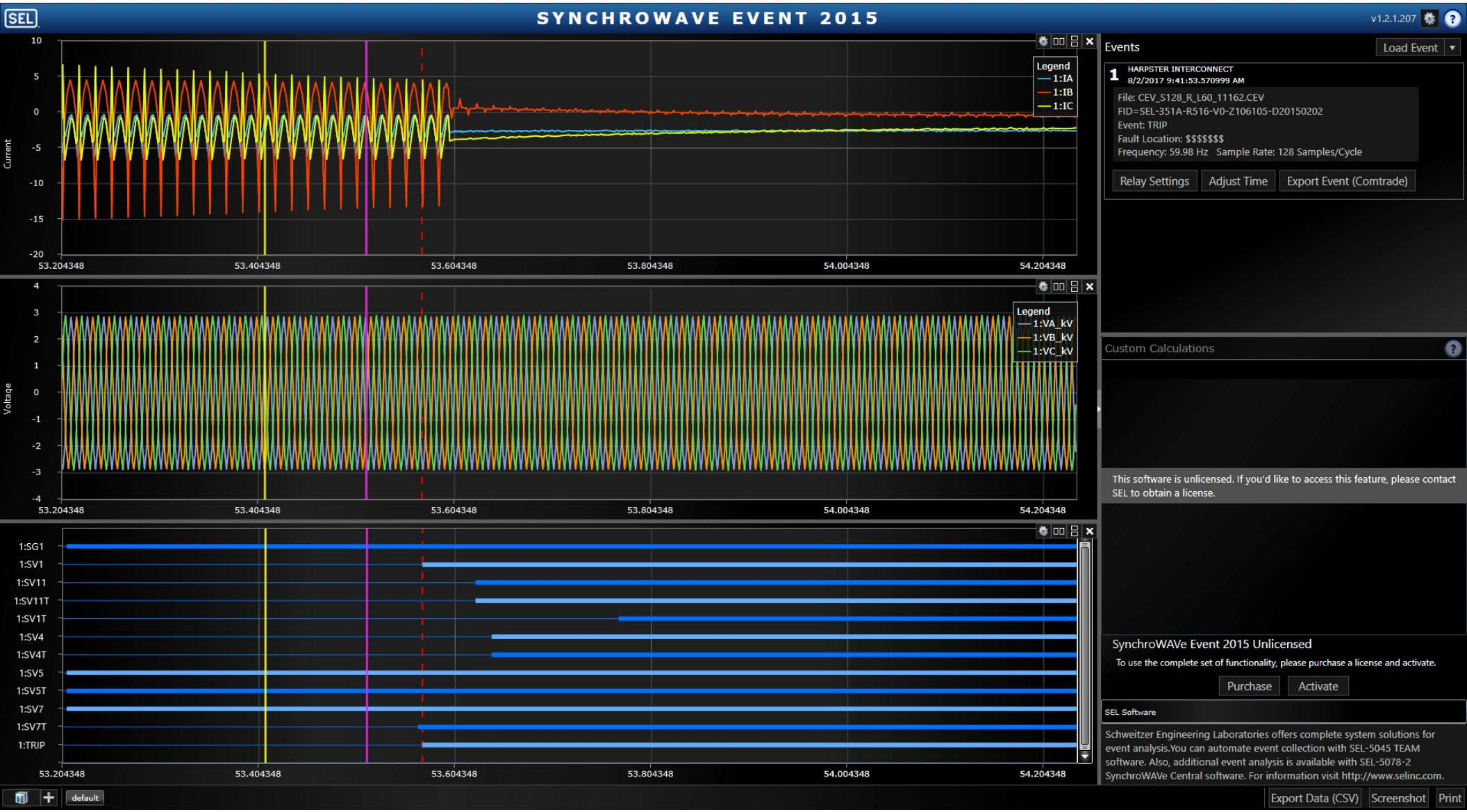
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1:SV11T
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1:SV4
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1:SV7
1:SV7T
1:TRIP
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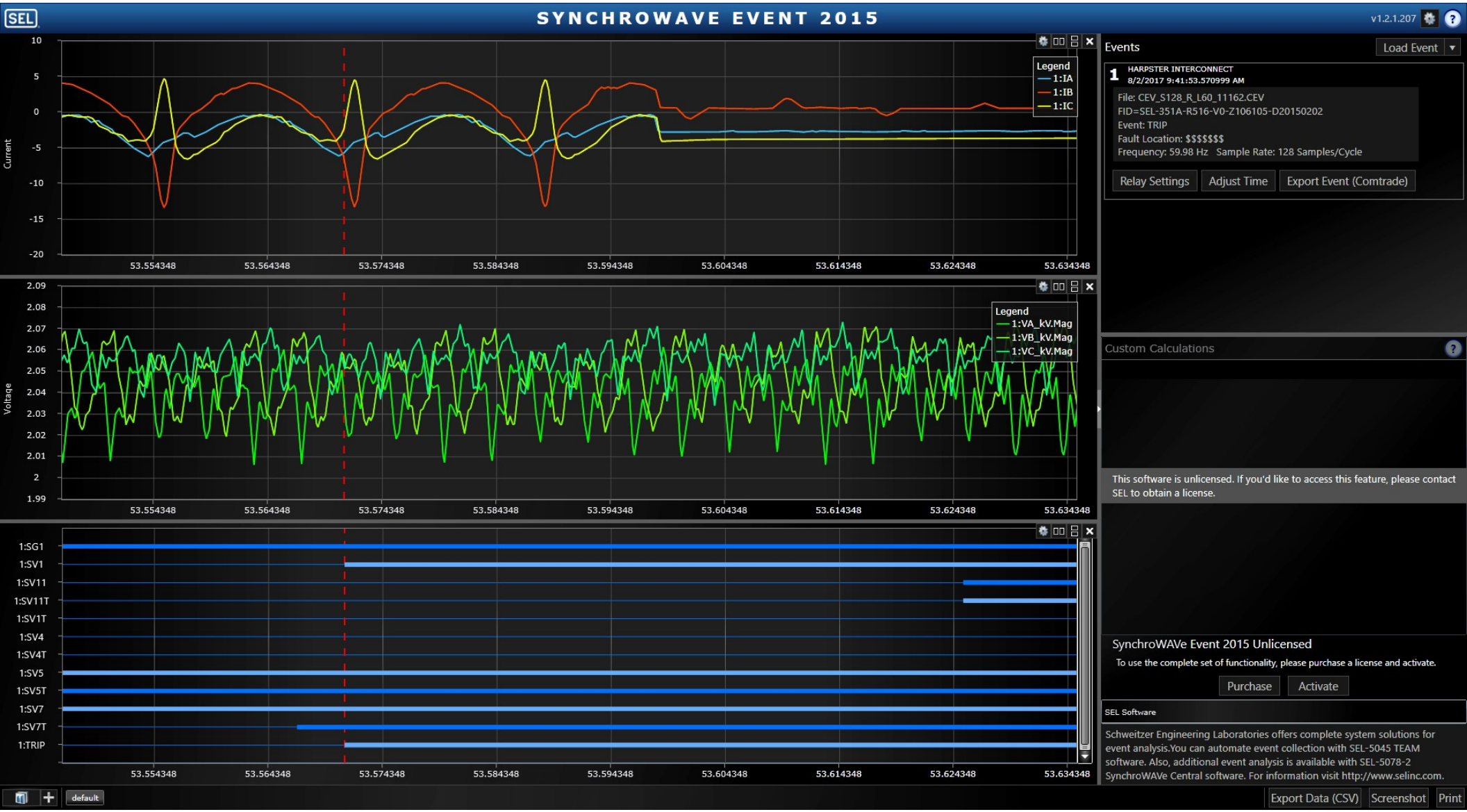
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1:SV4T
1:SV5
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