



NOGRR255, IEEE2800 & PRC082-1

Event Reporting

Presented by Scott Karpel - Principal Applications Engineer, SMA America
March 8, 2024

Should the inverter oscillography be required to be turned on?



- Yes, but the sampling rate can be slower and time synchronization can have a lower tolerance than the equipment at the POI / POM.
- The voltage and current at the inverter terminals will be different than measured at the POI / POM due to impedances in the collection circuit, medium voltage transformer and the high voltage transformer.
- This will aid in the analyses of the inverter's behavior during the event.
- Does not have to be every IBR Unit, but IBR Units that are furthest 10% of each collection circuit for each model of inverters (Aligning with PRC028-1).

Example of SMA Oscillagraphy Yesterday and Today

Authored by:
Peter King
Principal Applications Engineer
SMA America

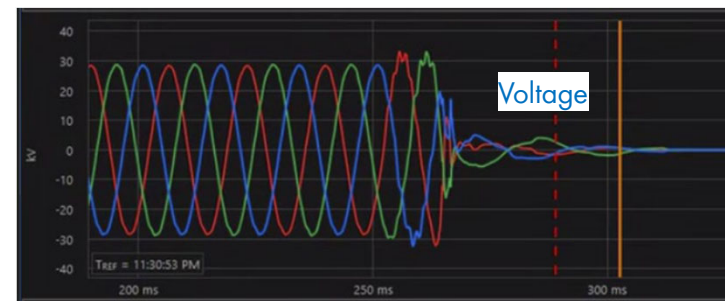
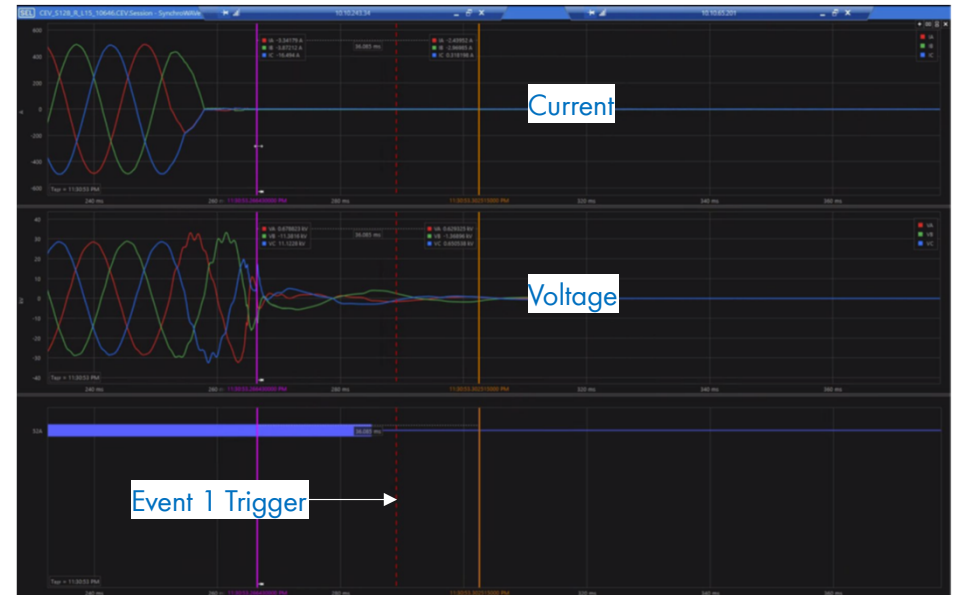


- **SMA inverters have the capability to store the onboard oscilloscope data, at a 3kHz sampling rate. This data is captured 1000ms before and 5000ms after a fault. The data is stored on a 13GB CF card and will be available for at least 30 days. Older SMA CP Series may not retain the data for 30days if multiple events and errors occur since it is “rolling” memory retention.**
- **Four generations of SMA Central Inverter products, dating back to 2011, have had this on-board recording system to help with failure analysis. The Inverter will capture the oscilloscope data if the fault type requires it, and create an encrypted file called a FLR file. These types of files can only be open by SMA Service personal.**
- **SMA can achieve time synchronization in the 25 to 100msec range contingent upon the accuracy of the time server used, the network traffic, and the number of connected NTP clients.**

Example of SMA Oscillagrophy Continued



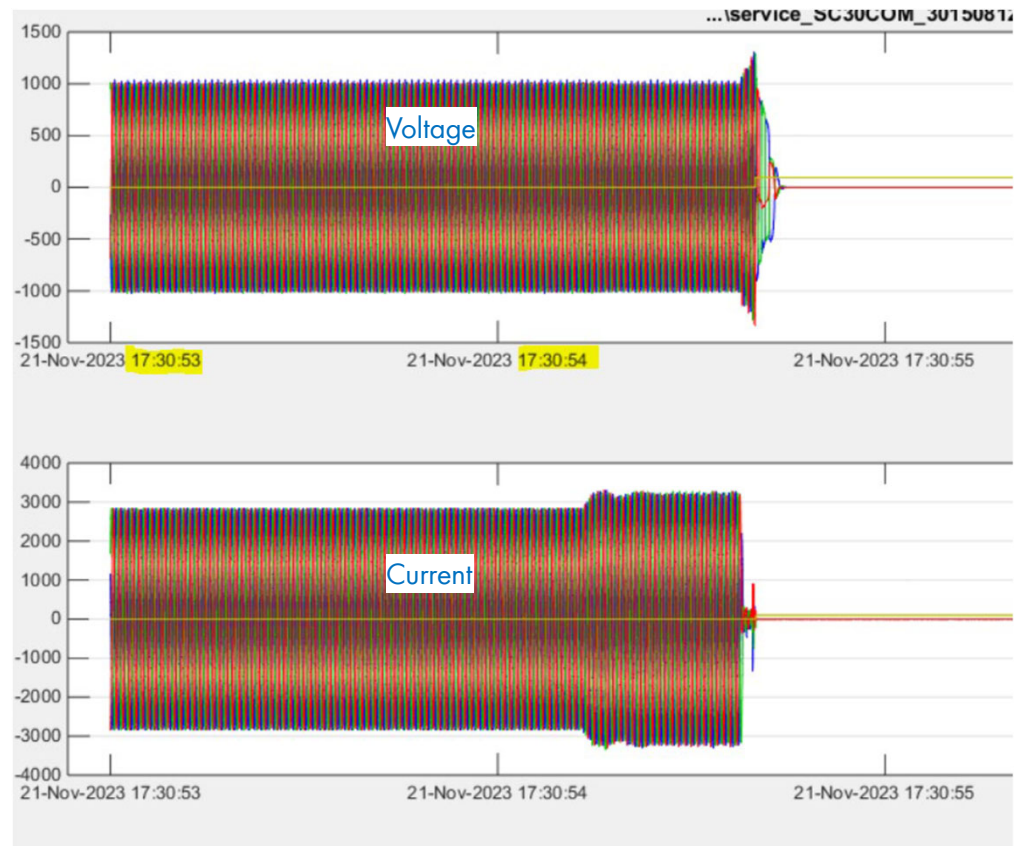
- As an example of this data recording and how SMA Central Inverters can meet these tough data recording requirements, we have taken an example from a recent event in ERCOT territory.
- At 11:30:53.28 there was a fault at a BESS plant MV substation in Texas as captured by the Plant Relay.



Example of SMA Oscillagrophy Continued



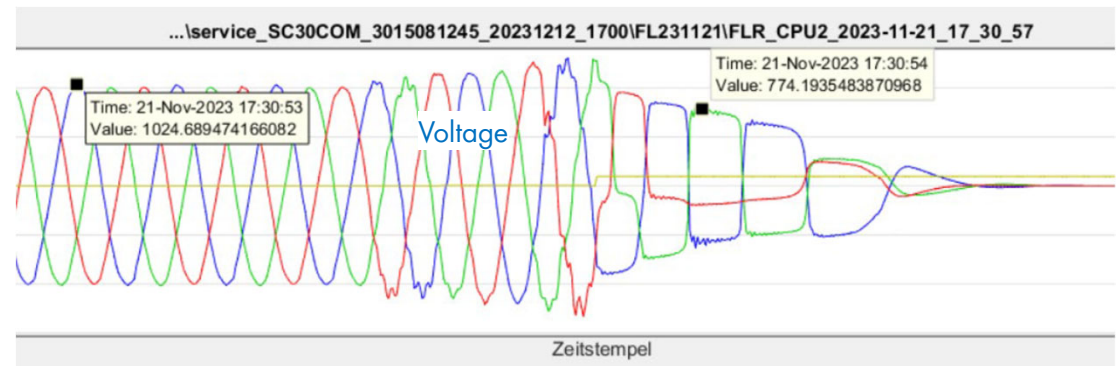
- The 34.5kV substation breaker tripped and the SCS3950-UP inverters went offline at almost the same time. The timestamp from the FRL file shows the SC-UP inverter captured the complete event.



Example of SMA Oscillagrophy Continued



- Looking closer into the voltage waveform data we can see that the required resolution is available to analyze the fault. Aligning with the 11:30.53.28 captured by the Relay.
- Inverter NTP parameters may need to be enabled at existing sites.



Should data be required to be exportable in a universal format?



- Yes, data should be exportable in a universal format to ensure the data is easily retrievable and usable for fault analyses and aligning with other standards.

Type	IEEE 2800	PRC028
Service of Event Recording	CSV	CSV
Fault Recording	CSV	CSV or COMTRADE
Dynamic Disturbance Recording	CSV	CSV or COMTRADE
Naming	No Requirement	COMNAME

- SMA currently has the capability of exportable data but has proprietary encryption that can only be deciphered by SMA Service and then converted to .CSV.

Summary of IEEE2800 Table 19 Measurement data



Only items pertinent to the IBRUnit are shown and discussed.

Provision Data Type	Measurement / Data Points	Recording Rate	Retention	Duration	Measurement	SMA Response
Plant SCADA Data	IBR Units active and reactive power output	Variables like commands may be only recorded when the value is changed and not at a specified sampling rate.	1 year	1 Year	Subclause 4.4 Table 1	Inverter tracks operation data but needs to be pulled by SCADA for retention
Unit Functional Settings *	IBR Unit autonomous functions parameter settings	Static, as changed	1 year	N/A	N/A	Inverter tracks operation data but needs to be pulled by SCADA for retention

* For IBR units that use standardized settings specified in IEEE Std 1547-2018, the IEEE 1547.1/EPRI specified “Common File Format for DER Settings Exchange and Storage” [B18] may be used.

Summary of IEEE2800 Table 19 Continued



Provision Data Type	Measurement / Data Points	Recording Rate	Retention	Duration	Measurement	PRC028-1 Requirement (Draft)	SMA Response
Inverter fault codes and dynamic recordings (CSV file and tabular log file)	For grid BPS faults/events which trigger ride-through operation of an IBR unit or cause it to trip, the following information shall be recorded at IBR units for analysis:	Many kHz, triggered	90 days	5-s data, (split between pre-fault and post-fault data needs to be mutually agreed upon with the TS owner/TS operator)	Stated by IBR owner	68 Samples per cycle	Performed at 3kHz
	All major and minor fault codes					New & Existing If Capable	Comply
	All fault and alarm status words					New & Existing If Capable	Comply
	Change of operating mode					Removed	Comply ¹
	High- and low-voltage ride-through					New & Existing If Capable	Comply
	High- and low-frequency ride-through					New & Existing If Capable	Comply
	PLL loss of synchronism					No Requirement	Comply
	DC current and voltage					Removed	Comply ²
	AC phase currents and voltage					All Plants New and Existing	Comply
	Pulse width modulation index (if applicable)					No Requirement	Comply
	Control system command values, reference values, and feedback signals					Removed	Comply

¹Retention of change of Operating mode will need to be pulled by SCADA

²DC Voltage recorded at a rate of 100Hz.

IEEE 2800 Section 4.4 Measurement Accuracy



Table 1 – Measurement and derived quantities accuracy requirements for Clause 11 – steady state time frame ^f		
Parameter	Minimum accuracy ^a	Range
Voltage ^{c, d}	± 2.5%	0.5 per unit (p.u.) to 1.2 p.u.
Current ^{c, d}	± 2.5%	0.2 p.u. to 1.2 p.u.
Frequency ^b	± 0.010 Hz	0.80 p.u. to 1.1 p.u. ^g
Active power ^e	± 5%	0.2 p.u. < P < 1.0 p.u.
Reactive power ^e	± 5%	0.2 p.u. < Q < 1.0 p.u.

^a Measurement accuracy requirements specified in this table are applicable for voltage THD < 2.5% and individual voltage harmonics < 1.5%. The THD calculation method is based on IEEE Std 519™-2014.

^b Accuracy requirement is applicable only for fundamental frequency and when the positive-sequence voltage is greater than 10% of the nominal positive-sequence voltage.

^c Measurement accuracy requirement for power quality terms are specified in Clause 11

^d Accuracy requirement is expressed as percent of nominal rated value, not of measured value.

^e Accuracy requirements for active and reactive power are expressed as percentage of fundamental frequency nominal apparent power in either direction over the specified range.

^f Accuracy requirements may be useful for applications such as voltage control and SCADA.

^g 48 Hz to 66 Hz for 60 Hz systems, 40 Hz to 55 Hz for 50 Hz systems.

SMA Inverters meet or exceed these requirements.

**Thank
you for
listening!**

SMA Solar Technology



SMA America

3925 Atherton Rd
Rocklin, CA 95765

Tel. (916) 625-0870
www.sma-America.com