بهروز BEHROOZ
TOOLS Measuring
B.T.M
تجهیزات اندازه گیری و ابزار دقیق

آموزش

شماره: ۱۷

شرکت تجهیزات اندازه گیری و ابزار دقیق بهروز

عنوان آموزش: کاربردهای مفید دستگاه Power Meter quality Analyzer

دپارتمان آموزش

Case Study 1

Voltage Drop Caused by Cable Impedance

Voltage available to the equipment becomes lower than the outlet when the cable is long.

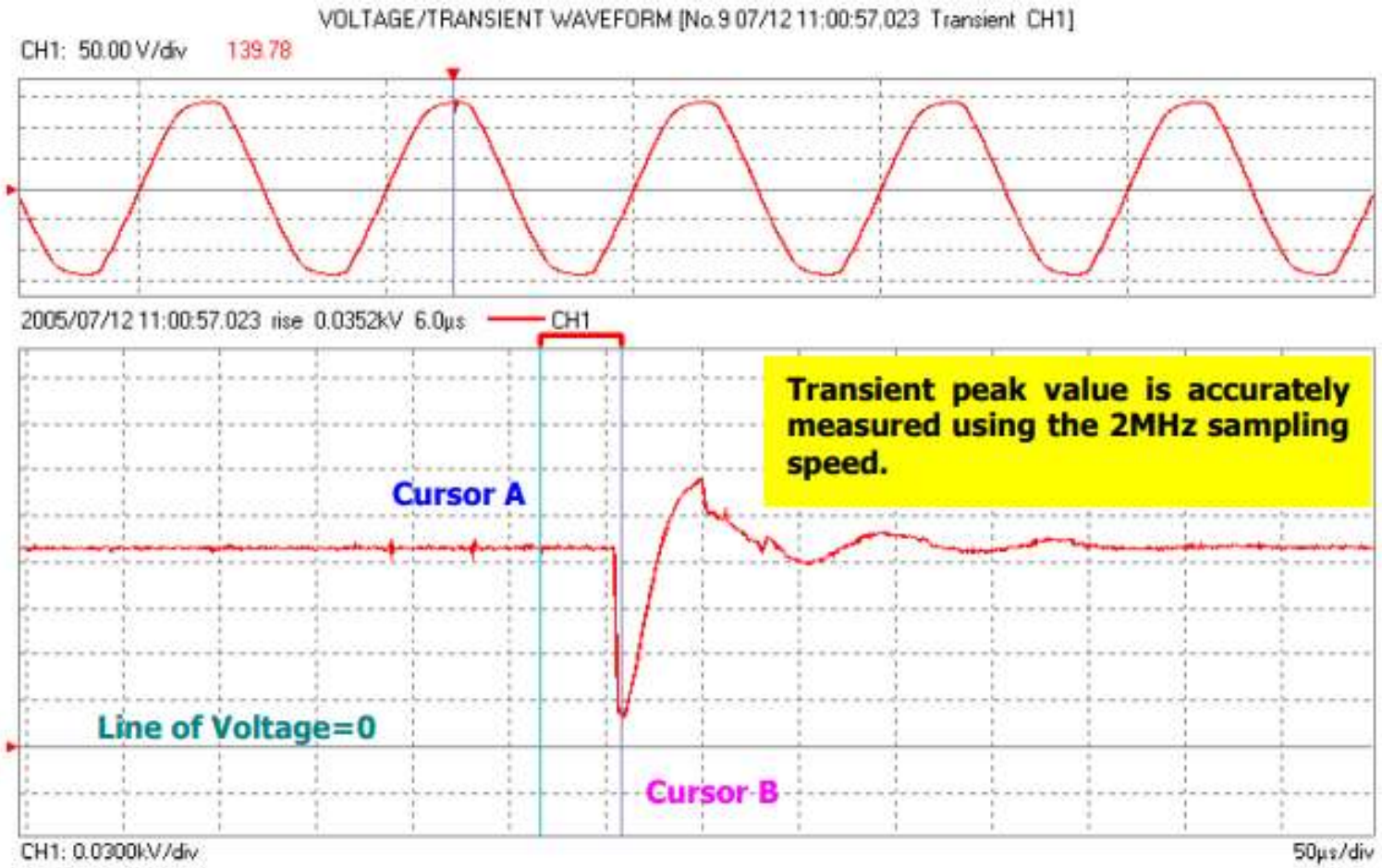
Voltage drop

V = I * R

-10Vrms

Case Study 2

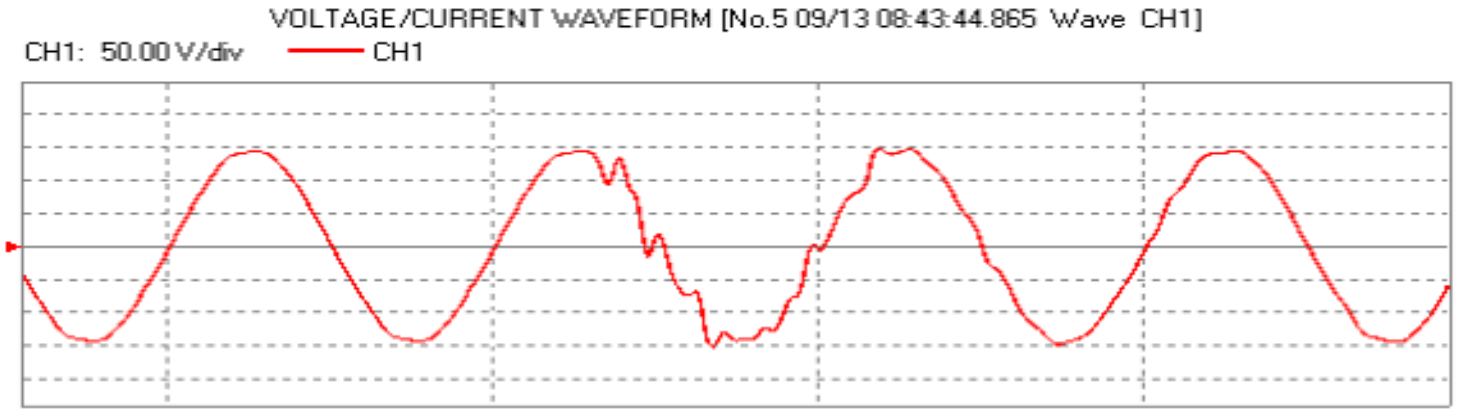
Transient Caused by Glow Fluorescent Lighting



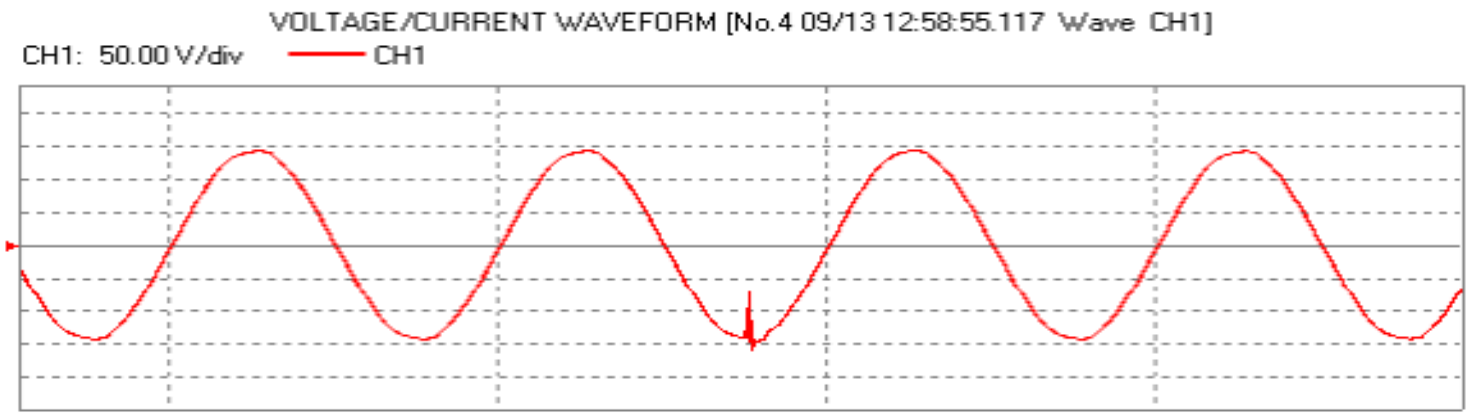
Voltage and Transient Waveforms When Turning On the Fluorescent Light

Case Study 3

Switching of a Power Factor Compensation Capacitor



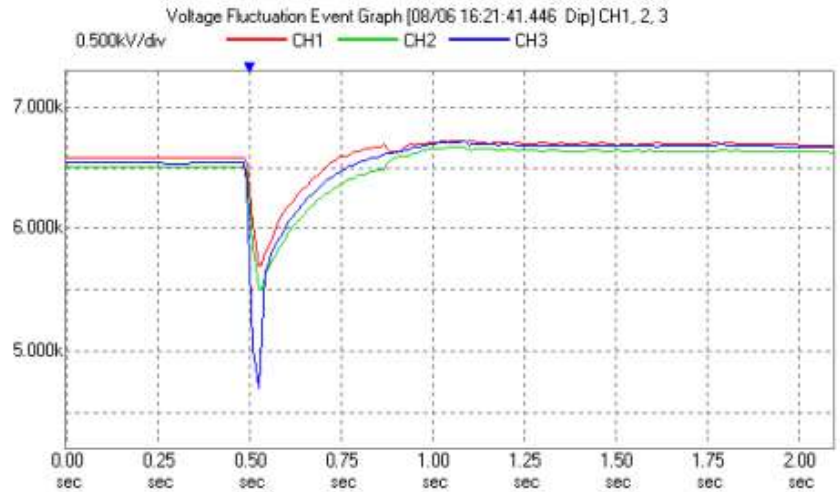
Voltage Noise Waveform 1 (based on the voltage waveform distortion event)



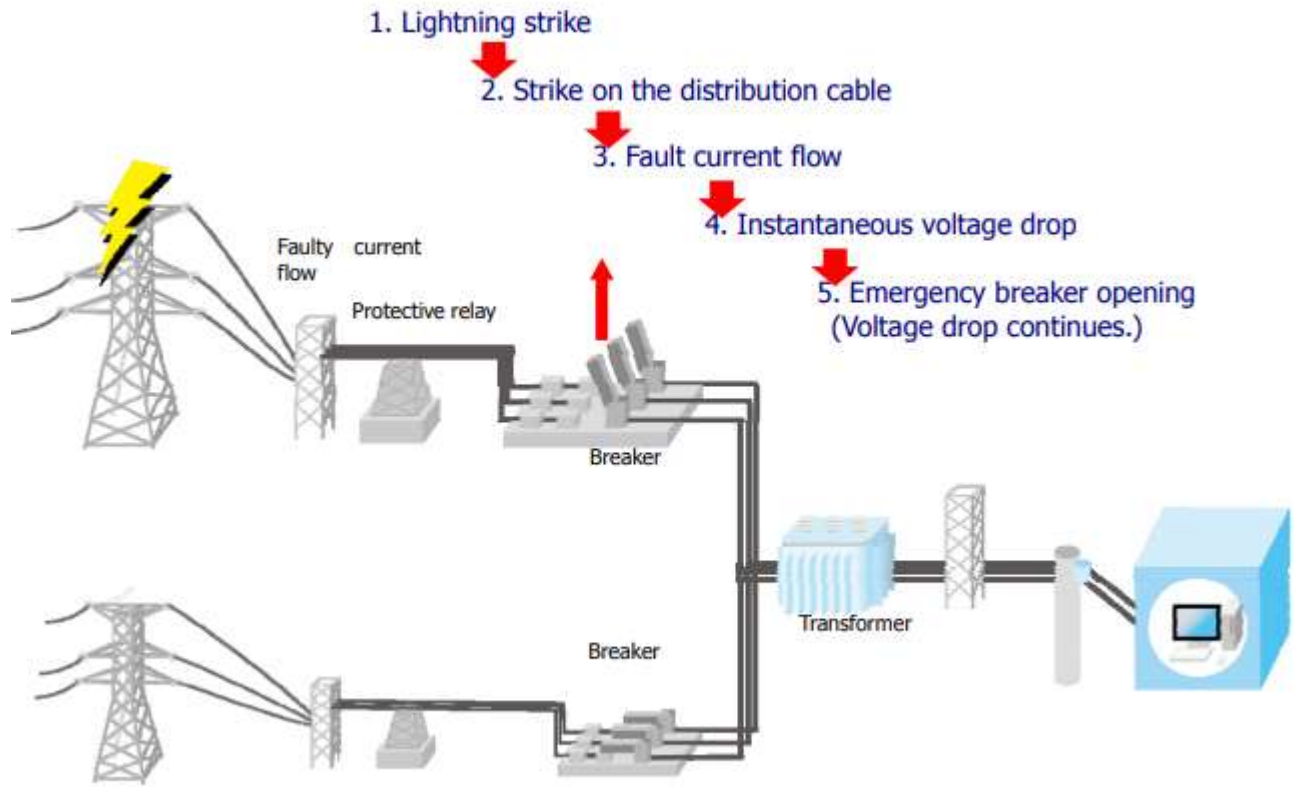
Voltage Noise Waveform 2 (based on the voltage waveform distortion event)

Case Study 4

Voltage Dip caused by Lightning Strikes – at the Receptacle



Event Voltage Fluctuation of the Lowest Residual Voltage and the Shortest Period Voltage Dip

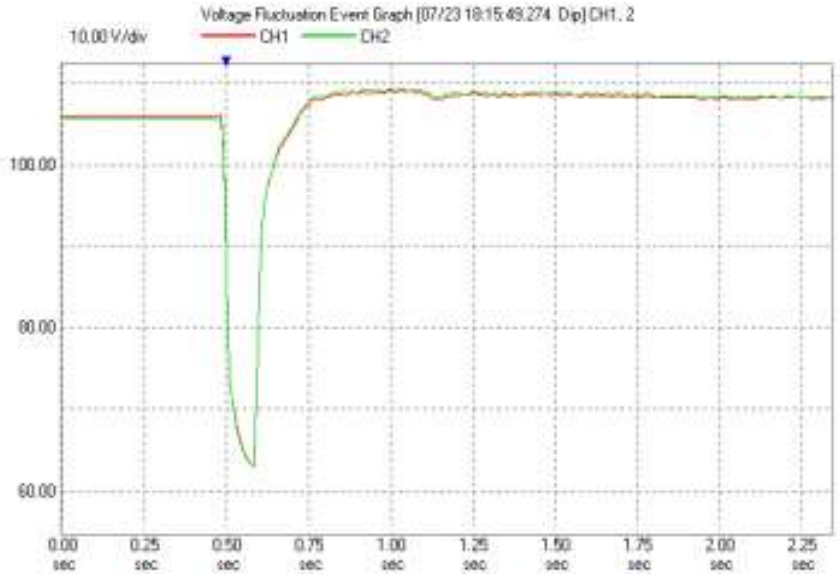


Path of a Voltage Dip

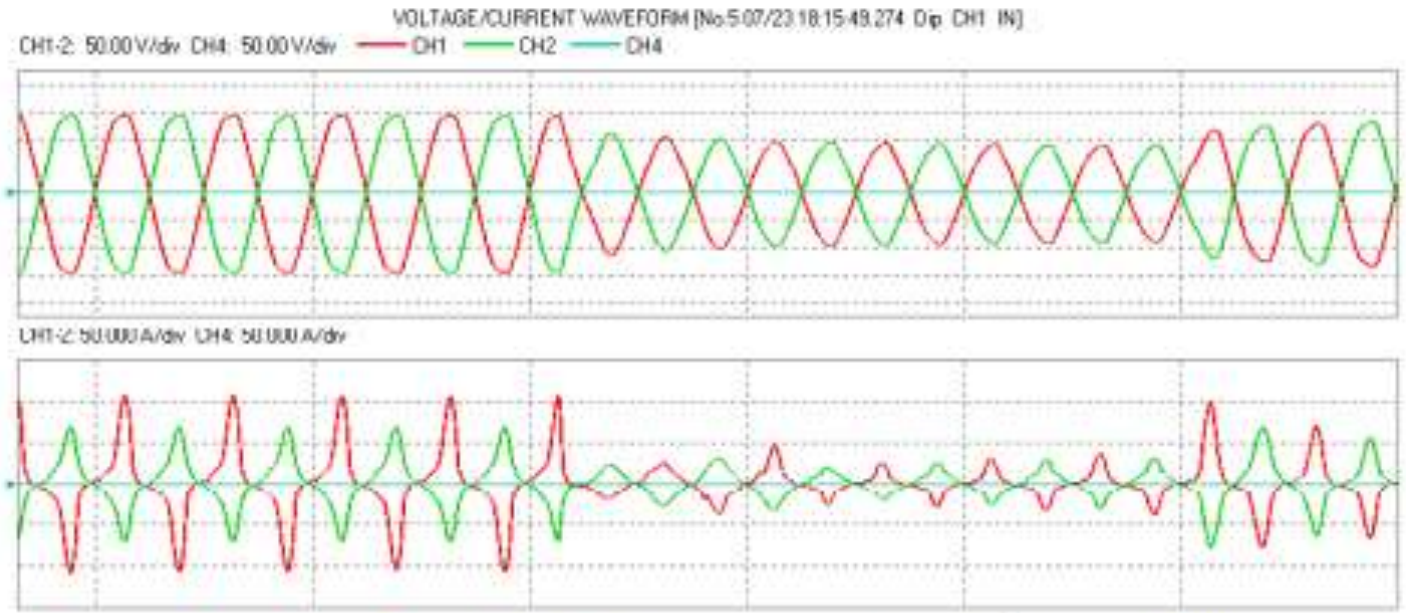
Case Study 5

Voltage Dip caused by Lightning Strikes – at the Distribution Panel

	Residual voltage	Period
1st voltage dip	47Vrms	117ms
2nd voltage dip	63Vrms	109ms
3rd voltage dip	82Vrms	50ms
4th voltage dip	56Vrms	116ms



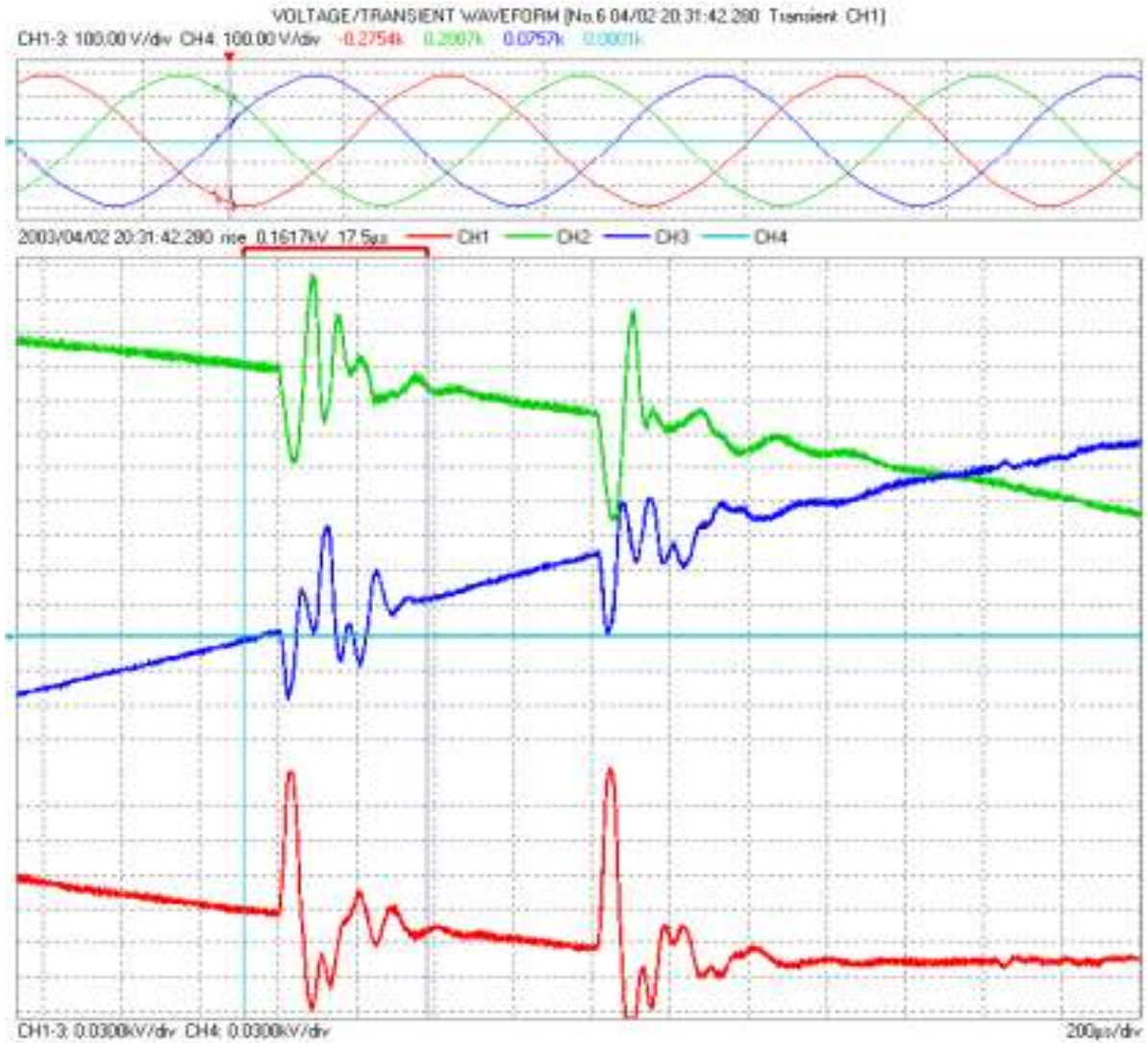
Event Voltage Fluctuation at the 2nd Voltage Dip



Voltage and Current Waveforms at the 2nd Voltage Dip

Case Study 6

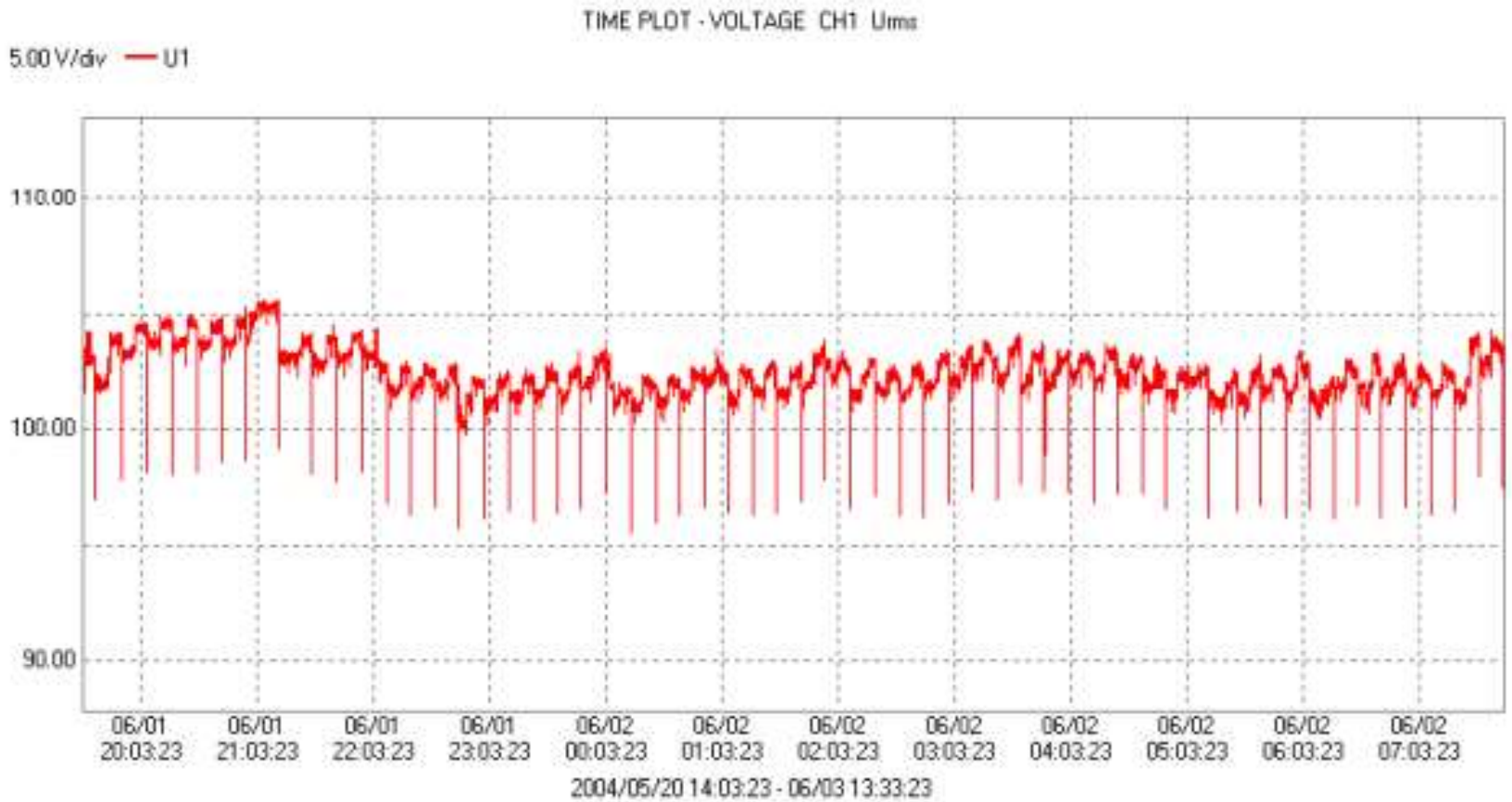
Transient Overvoltage



	U1	U2	U3
Max. value	-116.0V	323.4V	98.4V
Min. value	-329.3V	153.5V	-55.1V
Transient p-p value	**213.3V**	**169.9V**	**153.5V**

Case Study 7

Periodical Instantaneous Voltage Drop

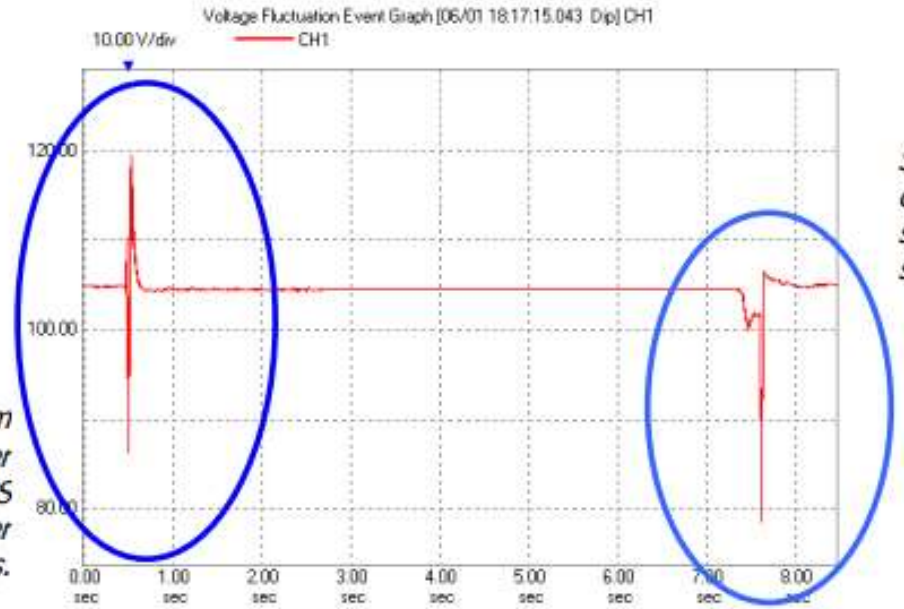


Voltage Fluctuation

Case Study 8

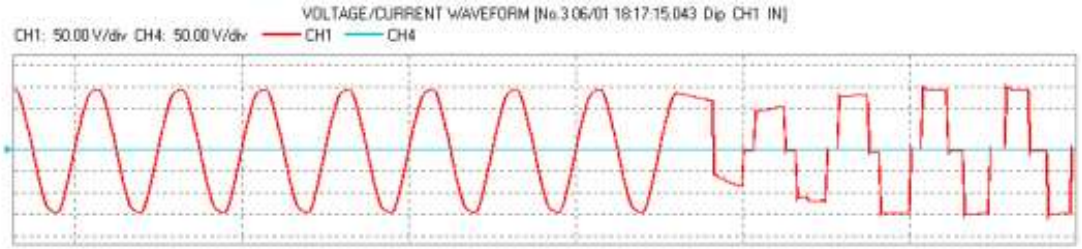
General UPS Switching Waveforms

Switching from commercial power supply to UPS when the power supply drops.



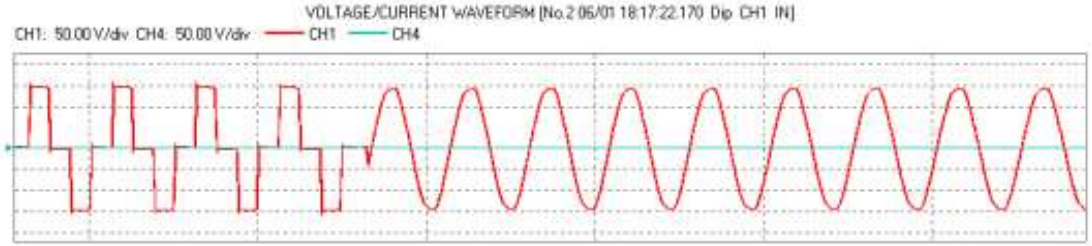
Event Voltage Fluctuation of UPS Output

Switching from UPS to commercial power supply when the power supply recovers



Voltage Waveform when the Power Supply Drops

(switching from commercial power supply to UPS)

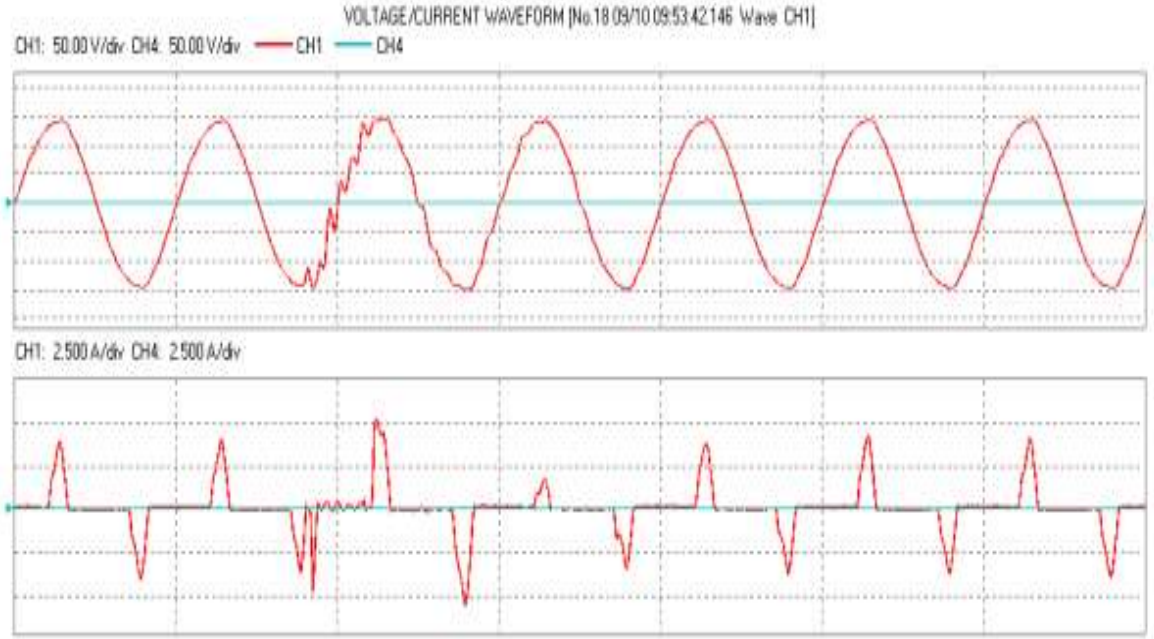


Voltage Waveform when the Power Supply Recovers

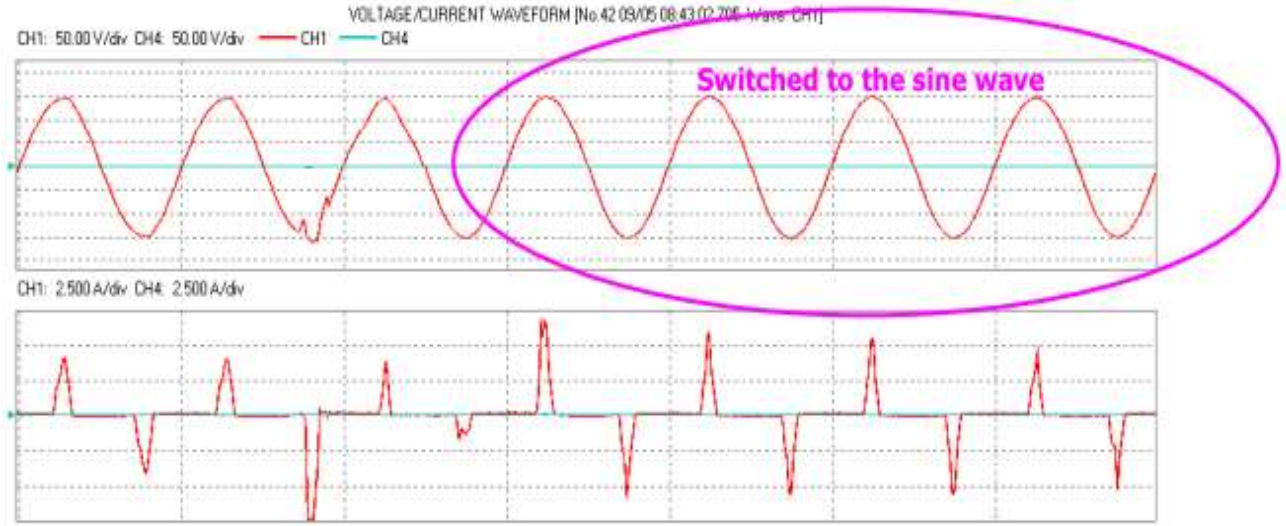
(switching from UPS to commercial power supply)

Case Study 9

Voltage Waveform Noise & UPS Switching



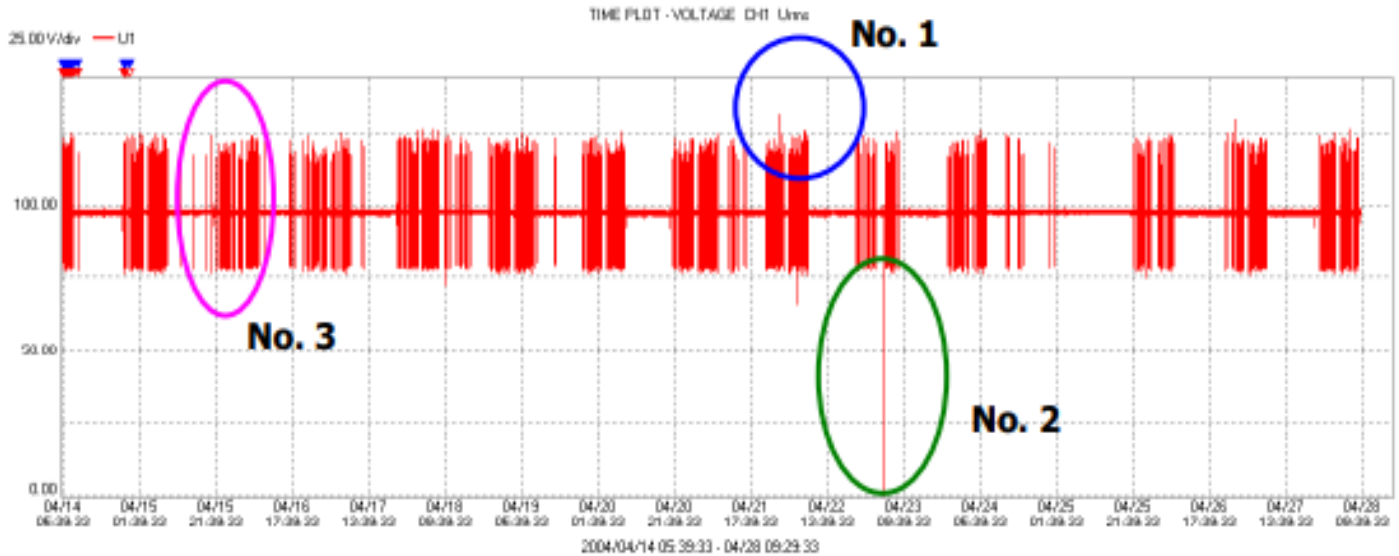
Type 1: Not Switched to the Sine Wave after the Waveform Noise



Type 2: Switched to the Sine Wave after the Waveform Noise

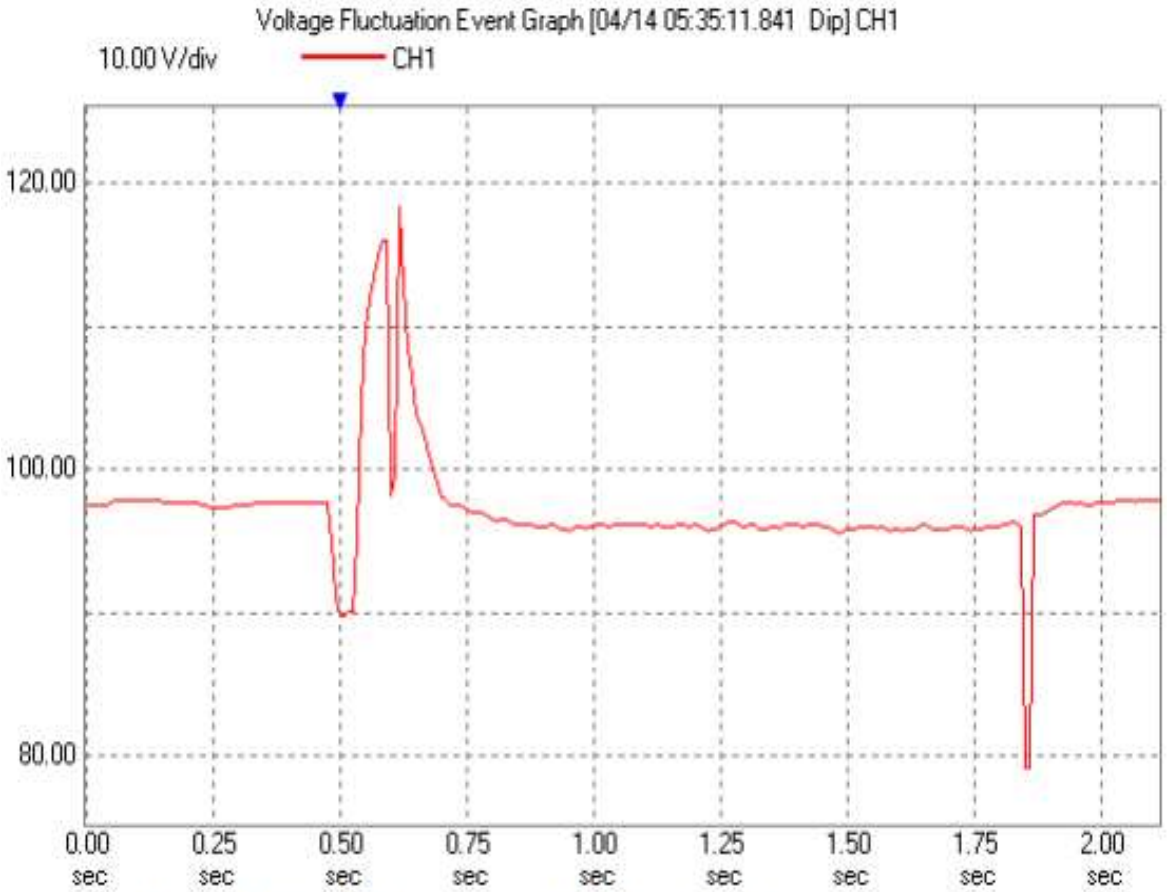
Case Study 10

Voltage Dip at a Factory

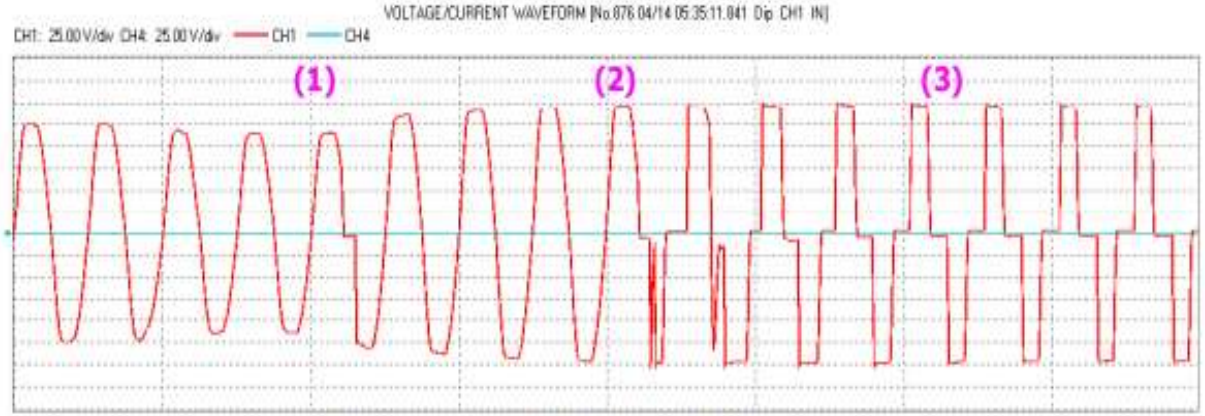


Voltage Fluctuation

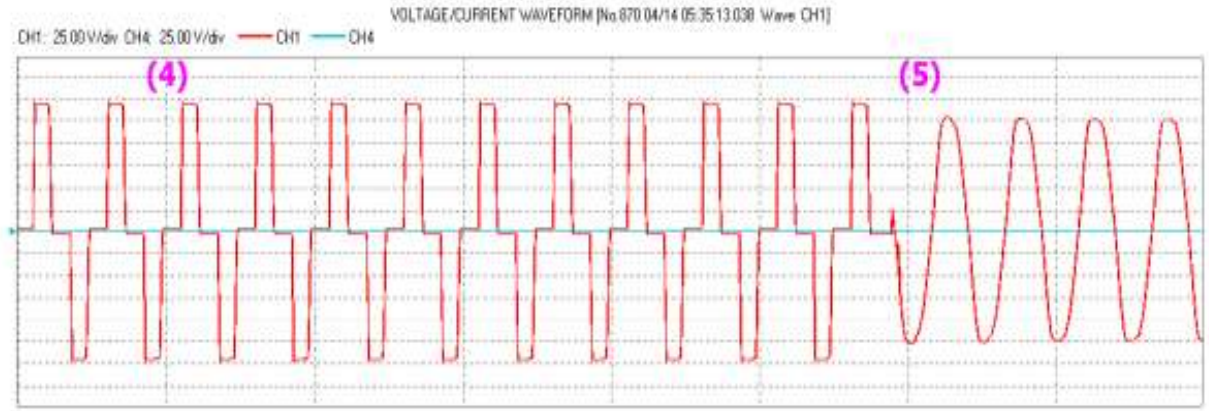
	Supply voltage	Voltage fluctuation graph	Voltage value
1	Maximum	No. 1 (blue)	131.67Vrms
2	Minimum	No. 2 (green)	0.15Vrms
3	Average		98Vrms



Event Voltage Fluctuation at the Voltage Dip Occurrence



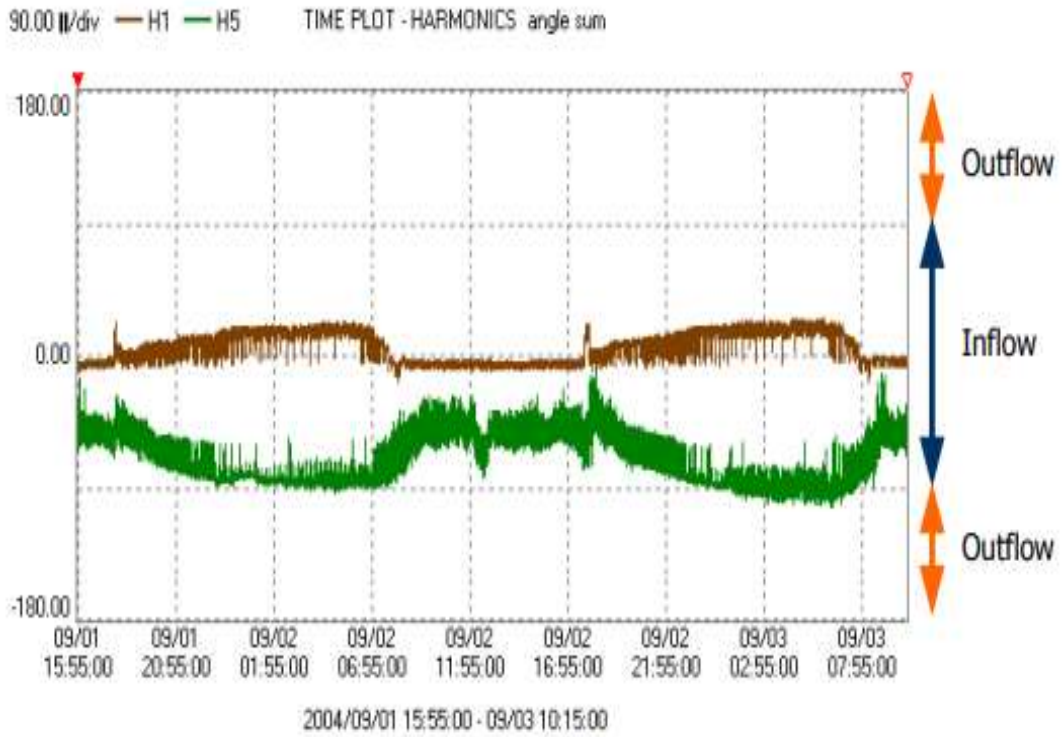
Voltage Waveform at the Start of the Voltage Dip



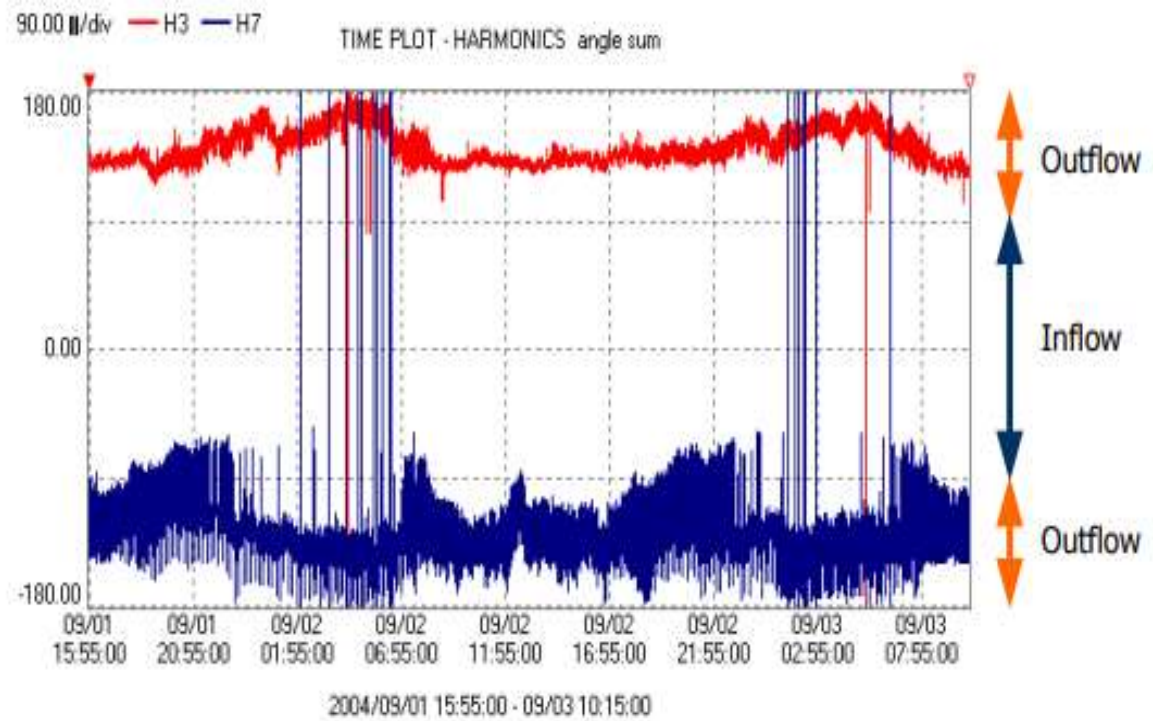
Voltage Waveform at the End of the Voltage Dip

Case Study 11

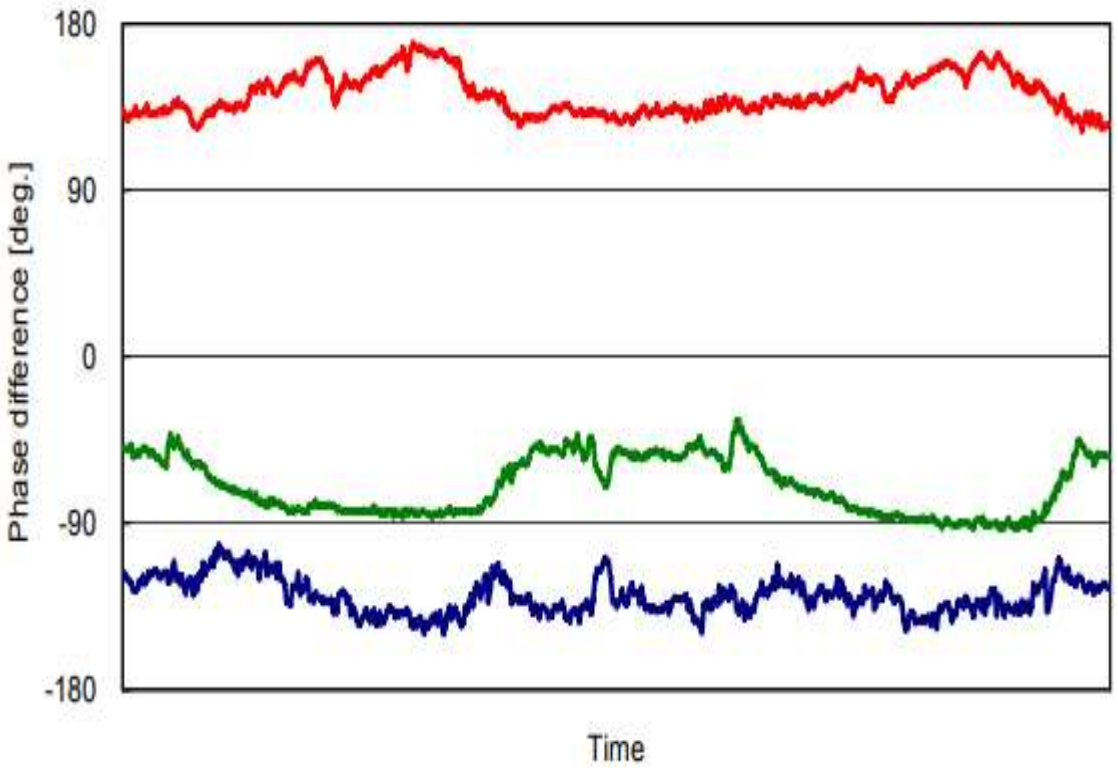
Investigating the Flow of Harmonics



Time Plot of Harmonic Voltage-Current Phase Difference (fundamental and 5th harmonic)



Time Plot of Harmonic Voltage-Current Phase Difference (3rd and 7th harmonics)



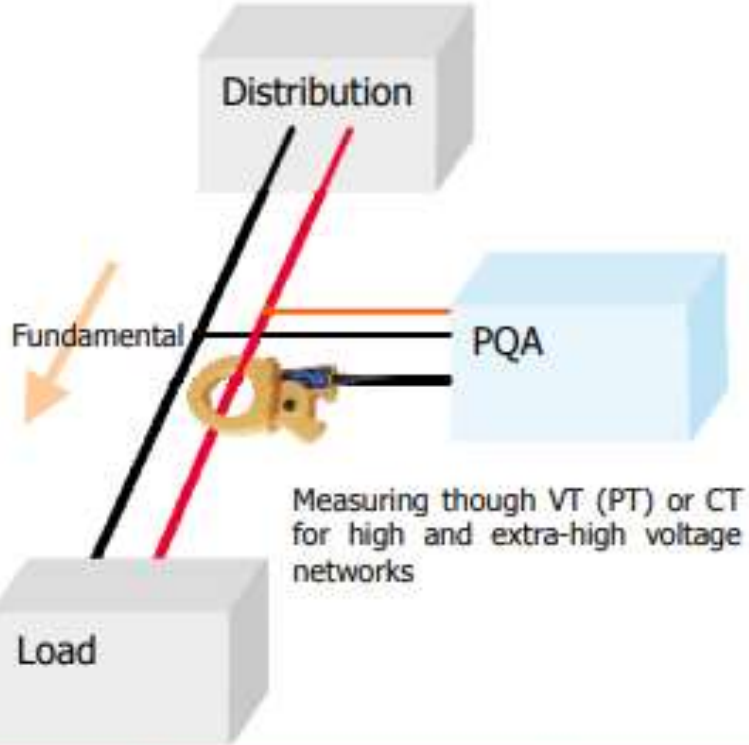
Red: 3rd harmonic, **Green**: 5th harmonic, **Blue**: 7th harmonic

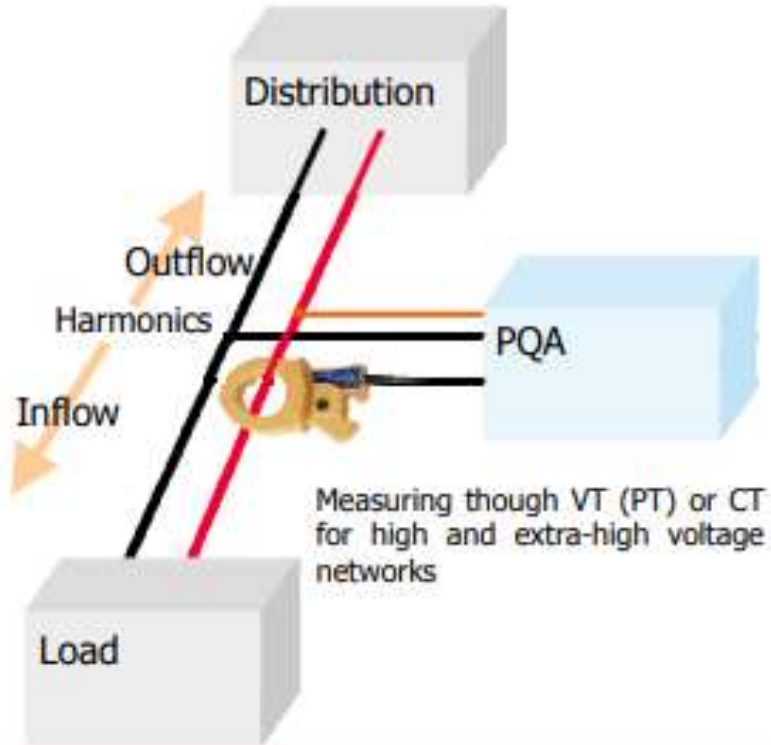
Date	Time	AvePhasesum(5)	Inflow / Outflow
2004/9/3	6:50:00	-93.07	Outflow
2004/9/3	6:55:00	-90.63	Outflow
2004/9/3	7:00:00	-84.20	Inflow
2004/9/3	7:05:00	-89.23	Inflow
2004/9/3	7:10:00	-87.79	Inflow
2004/9/3	7:15:00	-87.42	Inflow
2004/9/3	7:20:00	-87.16	Inflow
2004/9/3	7:25:00	-86.08	Inflow
2004/9/3	7:30:00	-79.51	Inflow
2004/9/3	7:35:00	-84.34	Inflow
2004/9/3	7:40:00	-80.74	Inflow
2004/9/3	7:45:00	-78.41	Inflow

Example of Using MS Excel

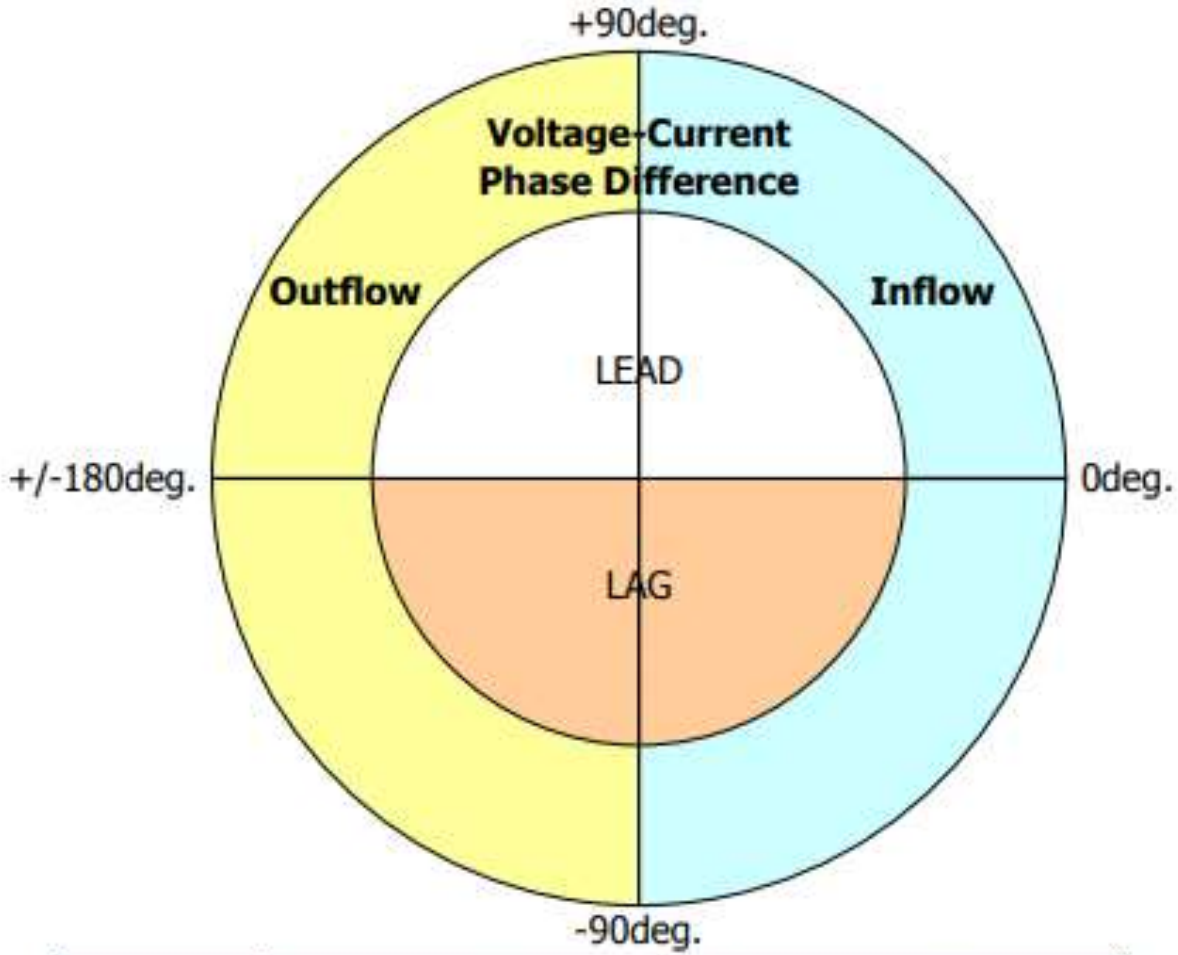
Formula
=IF(ABS(C2)>90,"Outflow","Inflow")

Concept of inflow and outflow of harmonics





	Condition	Cause
Inflow	The harmonics flow from distribution to load.	**The reason is very likely to be attributed to the distribution side** (The harmonics generated by distribution is bigger than the harmonics generated by load.)
Outflow	The harmonics flow from load to distribution.	**The reason is very likely to be attributed to the load side** (The harmonics generated by load is bigger than the harmonics generated by distribution.)

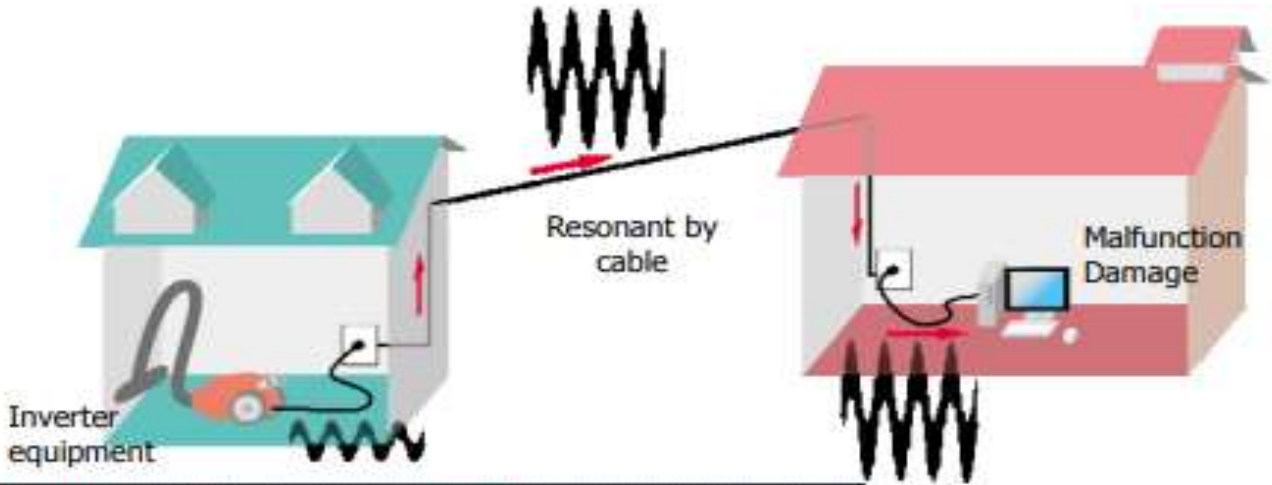


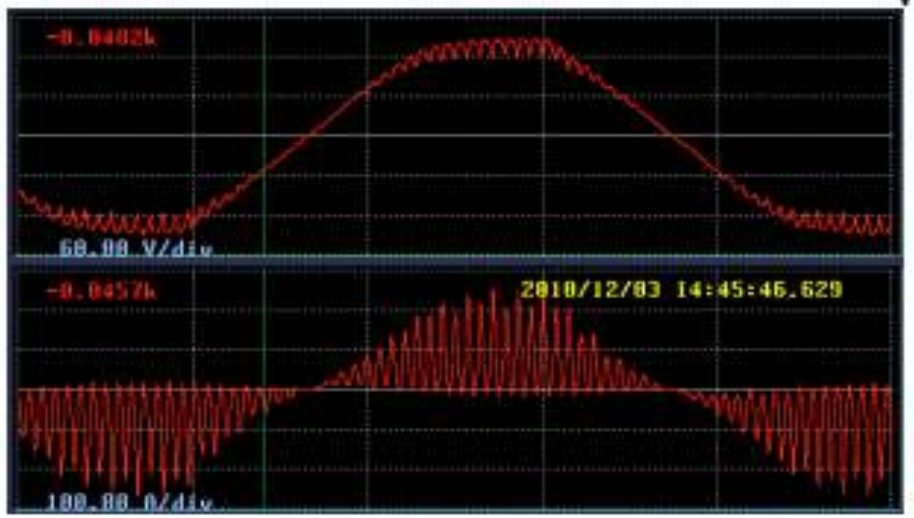
	Harmonic voltage-current phase angle difference
Inflow	+90° to 0° to +90°
Outflow	-180° to -90° or +90° to +180°

Inflow	Harmonic power is + (positive).
Outflow	Harmonic power is – (negative).

Case Study 12

High-Order Harmonics

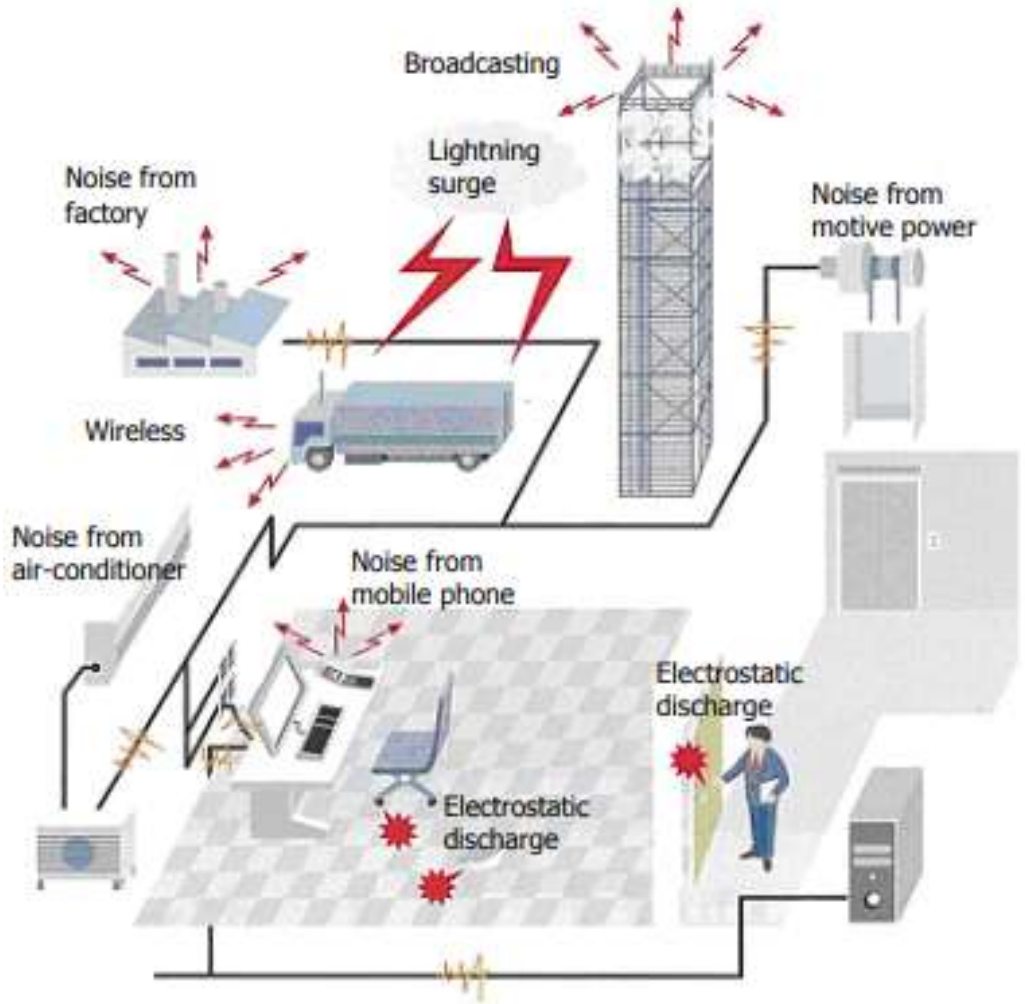




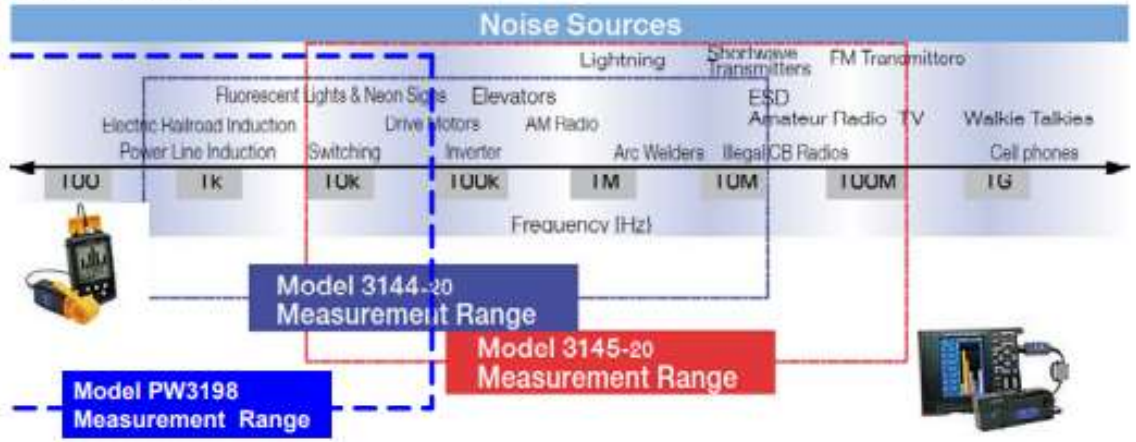
High-order harmonics waveform

Case Study 13

Conductive Noise

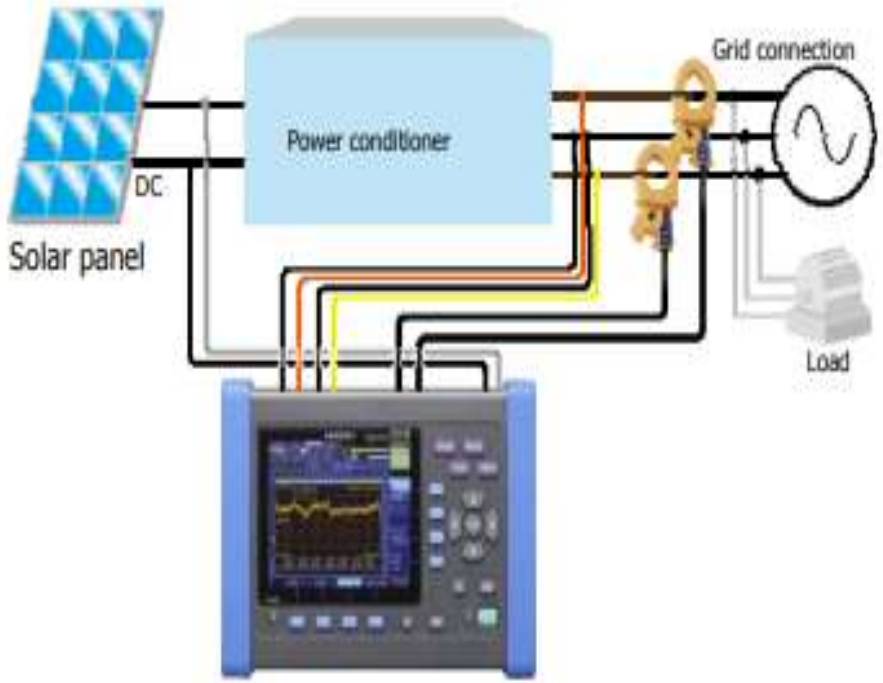


- Transient overvoltage
  Generated by lightning strikes, switching from generation to consumption, grid switching, etc.
  This can cause malfunction to equipment and solar power generation systems, etc.
- Harmonics, High-order harmonics
- Waveform distortion



Case Study 14

Solar Power Generation



Voltage waveform at grid switching

Case Study 15

Wind Power Generation