SIEMENS

ACCESS™ Compatible

Power Quality: ACCESS® Meters and EN50160

EN50160 is a European standard that defines the voltage characteristics of the electricity supplied by public distribution systems. It provides the limits within which any customer can expect voltage characteristics to remain.

9610 meters with the EN50160 ordering option have a default configuration that measures the supply voltage and presents EN50160 statistics according to a set of guidelines defined by Eurelectric (UNIPEDE). ION 8500 meters provide values for the Flicker component of EN50160 only.

Visit the following link for a copy of the Measurement Guide for Voltage Characteristics:
http://www.eurelectric.org/CatPub/Document.aspx?FolderID=1536&DocumentID=5585

The 9610 meter's front panel and Vista diagrams display a range of EN50160 statistical information by default. The meter also provides many EN50160 parameters for Modbus systems. Refer to the *9510 / 9610 User Guide* for more information on these parameters and their Modbus addresses.

This technical note summarizes the EN50160 data and statistics measured by the ACCESS meters that comply with the EN50160 standard. A description of the EN50160 counters and external controls is also provided.

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Default EN50160 Measurements

The EN50160 standard divides voltage characteristics into 10 distinct components. Each component has operating conditions and requirements for "valid" samples (such as a measured voltage between ±15% of nominal).

The factory configured meter uses a counter-based (N, N_1, N_2...) scheme to evaluate the compliance of each component within a defined observation period. Counter statistics are provided for current and previous observation periods; a brief description of each counter is also provided. The Data Logging section for each component provides a number of data log viewers for counter and parameter data. The following sections describe the data and statistics provided for each EN50160 measurement.

NOTE

Refer to "EN50160 External Controls" on page 23 for details on enabling EN50160 parameter data logging.

Power Frequency

The frequency measurement is a mean value over fixed 10-second intervals. The nominal value for frequency is 50 Hz (or 60 Hz, depending on model number).

- Observation period of one week with fixed steps of 10 seconds.
- **N** = number of 10-second intervals in which the supply voltage is within ±15% of nominal.
- **N_1** = number of intervals in which the frequency differs more than 0.5 Hz from nominal and the supply voltage is within ±15% of nominal.
- **N_2** = number of intervals in which the frequency is +2 Hz or -3 Hz from nominal and the supply voltage is within ±15% of nominal.

Power frequency complies with the standard if $N_1/N <= 5\%$ and $N_2 = 0$ during the observation period (1 week by default).

EN 50160 data (current observation period): The meter generates the N, N_1 and N_2 counts described above. These counters reset at the beginning of the next observation period.

EN 50160 data (previous observation period): The meter stores the N, N_1 and N_2 counter values at the end of each observation period before these counters are reset. These three registers are also stored in a data recorder for each observation period.

Events: The meter creates a message in the Event log every time the N_1 and N_2 counters increase.

Parameter data: The meter can be enabled to record the 10-minute mean, ½ cycle minimum and ½ cycle maximum values of frequency into a data recorder every 10 minutes.

Power Frequency Default Measurements

Register Label	Source Module Type	Description
Freq N*	Signal Limit Evaluation	number of valid intervals (voltage on all phases within +/- 15% of nominal)
Freq N invld*		number of invalid intervals
Freq N1*		number of valid intervals in which the freq deviates from the nominal by more than +/-1%
Freq N2*		num of valid intervals in which the freq deviates from the nominal by more than +4% or -6%
PO Freq N	Store	Freq N of the previous Observation Period
PO Freq N1		Freq N1 of the previous Observation Period
PO Freq N2		Freq N2 of the previous Observation Period
Freq mean-ep	Sliding Window Demand	average Frequency over 10s (used for display purposes)
Freq mn-op	Minimum	minimum mean Frequency (Freq mean-ep) over 1week (used for display purposes)
Freq mx-op	Maximum	maximum mean Frequency (Freq mean-ep) over 1week (used for display purpose)
Freq N1/N	Arithmetic	N1/N ratio
Freq N2/N		N2/N ratio
PO Freq N1/N		N1/N ratio of the previous Observation Period
PO Freq N2/N		N2/N ratio of the previous Observation Period

* This data is recorded once a week by Data Recorder module 17.

Optionally, the data below can be recorded every 10 minutes by Data Recorder 32.

Register Label	Description
PQ Freq mean	average Frequency over 10minutes
PQ Freq low	minimum Frequency over 10 minutes (HS measurement)
PQ Freq high	maximum Frequency over 10 minutes (HS measurement)

Magnitude of Voltage Supply

Each measurement is the mean of RMS voltage for each phase over fixed 10-minute intervals. The nominal value is defined by the Sag/Swell module's *Nom Volts* setup register.

NOTE

Nom Volts is typically setup when the meter is placed into service; if *Nom Volts* has not been set, enter a value for your system's nominal voltage. This value will be used in all EN50160 compliance calculations.

- Observation period of one week with fixed steps of 10 minutes.
- **N** = number of 10-minute intervals in which the supply voltage is within ±15% of nominal.
- $\mathbf{N_1}$ = number of intervals in which the supply voltage differs more than 10% from nominal and supply voltage is within ±15% of nominal.

Supply voltage complies with the standard if $N_1/N <= 5\%$ during the observation period (1 week by default).

EN 50160 data (current observation period): The meter generates the N and N_1 counts for each phase as described above. These counters are reset at the beginning of the next observation period.

EN 50160 data (previous observation period): The meter stores the N and N_1 counter values at the end of each observation period before these counters are reset. These 6 registers are also stored in a data recorder for each observation period.

Events: The meter creates a message in the Event log every time the N_1 counter for each phase increases.

Parameter data: The meter can be enabled to record the 10-minute mean, ½ cycle minimum and ½ cycle maximum values of supply voltage for each phase into a data recorder every 10 minutes.

Voltage Magnitude Default Measurements

Register	Source Module Type	Description
V1-Mag N*	Signal Limit Evaluation	number of valid intervals (voltage on phase 1 within +/- 15% of nominal)
V1-Mag N invld*		number of invalid intervals
V1-Mag N1*		number of valid intervals in which the voltage deviates from nominal by more than +/-10%
V2-Mag N*		number of valid intervals (voltage on phase 2 within +/- 15% of nominal)
V2-Mag N invld*		number of invalid intervals
V2-Mag N1*		number of valid intervals in which the voltage deviates from nominal by more than +/- 10%
V3-Mag N*		number of valid intervals (voltage on phase 3 within +/- 15% of nominal)
V3-Mag N invld*		number of invalid intervals
V3-Mag N1*		number of valid intervals in which the voltage deviates from nominal by more than +/- 10%
PO V1-Mag N	Store	V1-Mag N of the previous Observation Period
PO V1-Mag N1		V1-Mag N1 of the previous Observation Period
PO V2-Mag N		V2-Mag N of the previous Observation Period
PO V2-Mag N1		V2-Mag N1 of the previous Observation Period
PO V3-Mag N		V3-Mag N of the previous Observation Period
PO V3-Mag N1		V3-Mag N1 of the previous Observation Period
V1 mean	Sliding Window Demand	average voltage on phase 1 over 10m (used for display purposes)
V1 mean mn	Minimum	minimum of average voltage V1 (V1 mean) over 1 week (used for display purposes)
V1 mean mx	Maximum	maximum of average voltage V1 (V1 mean) over 1 week (used for display purposes)
V2 mean	Sliding Window Demand	average voltage on phase 2 over 10m (used for display purposes)
V2 mean mn	Minimum	minimum of average voltage V2 (V2 mean) over 1 week (used for display purposes)
V2 mean mx	Maximum	maximum of average voltage V2 (V2 mean) over 1 week (used for display purposes)
V3 mean	Sliding Window Demand	average voltage on phase 3 over 10m (used for display purposes)
V3 mean mn	Minimum	minimum of average voltage V3 (V3 mean) over 1 week (used for display purposes)
V3 mean mx	Maximum	maximum of average voltage V3 (V3 mean) over 1 week (used for display purposes)
V1-Mag N1/N	Arithmetic	N1/N ratio
V2-Mag N1/N		N1/N ratio
V3-Mag N1/N		N1/N ratio
PO V1-Mag N1/N		N1/N ratio of the previous Observation Period
PO V2-Mag N1/N		N1/N ratio of the previous Observation Period
PO V3-Mag N1/N		N1/N ratio of the previous Observation Period

* This data is recorded once a week by Data Recorder module 17.

Optionally, the data below can be recorded every 10 minutes by Data Recorder 32:

Parameter	**Description**
PQ V1 mean	average voltage on phase 1 over 10 minutes
PQ V1 low	minimum voltage on phase 1 over 10 minutes (HS measurement)
PQ V1 high	maximum voltage on phase 1 over 10 minutes (HS measurement)
PQ V2 mean	average voltage on phase 2 over 10 minutes
PQ V2 low	minimum voltage on phase 2 over 10 minutes (HS measurement)
PQ V2 high	maximum voltage on phase 2 over 10 minutes (HS measurement)
PQ V3 mean	average voltage on phase 3 over 10 minutes
PQ V3 low	minimum voltage on phase 3 over 10 minutes (HS measurement)
PQ V3 high	maximum voltage on phase 3 over 10 minutes (HS measurement)

Flicker

The flicker values Pst (short-term) and Plt (long-term) are generated according to IEC 61000-4-15.

- Observation period of one week with fixed Pst intervals of 10 minutes. A Pst value is considered valid only if the supply voltage is within ±15% of nominal and/or there is no voltage dip >= 15%.
- **N** = number of Plt values collected during the observation period (based on 12 valid consecutive Pst values).
- $\mathbf{N_1}$ = number of intervals in which Plt > 1.

Flicker complies with the standard if $N_1/N <= 5\%$ during the observation period (1 week by default).

NOTE

Flicker is typically caused by rapid repeated application of large loads. This causes a series of small voltage dips which can affect the performance of nearby devices that are voltage sensitive. A voltage flicker problem can often be observed by the naked eye by noticing flickering lights.

EN 50160 data (current observation period): The meter generates the N and N_1 counts for each phase as described above. These counters are reset at the beginning of the next observation period.

EN 50160 data (previous observation period): The meter stores the N and N_1 counter values at the end of each observation period before these counters are reset. These 6 registers are also stored in a data recorder for each observation period.

Events: The meter creates a message in the Event log every time the N_1 counter for each phase increases.

Parameter data: The meter can be enabled to record Pst and Plt values in a data recorder at the interval used to generate these values (10 minutes and 10 x 12 = 2 hours, respectively).

Flicker Default Measurements

Register Label	Source Module Type	Description
V1-Flck Pst	Flicker	Pst value for voltage on phase 1
V2-Flck Pst		Pst value for voltage on phase 2
V3-Flck Pst		Pst value for voltage on phase 3
V1-Flck Plt		Plt value for voltage on phase 1
V2-Flck Plt		Plt value for voltage on phase 2
V3-Flck Plt		Plt value for voltage on phase 3
V1-Flck N*	Signal Limit Evaluation	number of valid intervals (voltage on phase 1 within +/- 15% of nominal and no dip >= 15%)
V1-Flck N invd*		number of invalid intervals
V1-Flck N1*		number of valid intervals in which Plt on phase 1 is greater than 1
V2-Flck N*		number of valid intervals (voltage on phase 2 within +/- 15% of nominal and no dip >= 15%)
V2-Flck N invd*	Signal Limit Evaluation	number of invalid intervals
V2-Flck N1*		number of valid intervals in which Plt on phase 2 is greater than 1
V3-Flck N*		number of valid intervals (voltage on phase 3 within +/- 15% of nominal and no dip >= 15%)
V3-Flck N invd*		number of invalid intervals
V3-Flck N1*		number of valid intervals in which Plt on phase 3 is greater than 1
PO V1-Flck N	Store	V1-Flck N of the previous Observation Period
PO V1 Flck N1		V1-Flck N1 of the previous Observation Period
PO V2-Flck N		V2-Flck N of the previous Observation Period
PO V2 Flck N1		V2-Flck N1 of the previous Observation Period
PO V3-Flck N		V3-Flck N of the previous Observation Period
PO V3 Flck N1		V3-Flck N1 of the previous Observation Period
V1 Pst mn	Minimum	minimum Pst value for phase 1 over 1week (used for display purposes)
V1 Pst mx	Maximum	maximum Pst value for phase 1 over 1 week (used for display purposes)
V2 Pst mn	Minimum	minimum Pst value for phase 2 over 1week (used for display purposes)
V2 Pst mx	Maximum	maximum Pst value for phase 2 over 1 week (used for display purposes)
V3 Pst mn	Minimum	minimum Pst value for phase 3 over 1week (used for display purposes)
V3 Pst mx	Maximum	maximum Pst value for phase 3 over 1 week (used for display purposes)
V1-Flck N1/N	Arithmetic	N1/N ratio
V2-Flck N1/N	Arithmetic	N1/N ratio
V3-Flck N1/N	Arithmetic	N1/N ratio
PO V1-Flck N1/N	Arithmetic	N1/N ratio of the previous Observation Period
PO V2-Flck N1/N	Arithmetic	N1/N ratio of the previous Observation Period
PO V3-Flck N1/N	Arithmetic	N1/N ratio of the previous Observation Period

* This data is recorded once a week by Data Recorder module 18.

Optionally, the data below can be recorded every 10 minutes by Data Recorder 33.

Register Label	Description
V1-Flck Pst	Pst value for voltage on phase 1
V2-Flck Pst	Pst value for voltage on phase 2
V3-Flck Pst	Pst value for voltage on phase 3
V1-Flck Plt	Plt value for voltage on phase 1
V2-Flck Plt	Plt value for voltage on phase 2
V3-Flck Plt	Plt value for voltage on phase 3

Supply Voltage Dips

The voltage dip is based on half-cycle RMS measurements. The duration of the dip corresponds to the period during which the RMS value remains less than 90% of the nominal voltage. The depth of the dip is defined as the difference (expressed in % of nominal voltage) between the minimum RMS voltage over the course of the dip and the nominal voltage.

The observation period is 1 week. No evaluation criteria are suggested by either the EN 501060 standard or the UNIPEDE *Measurement Guide for Voltage Characteristics*; you should apply your own criteria to the data captured by the meter. The table below defines the classification scheme for counters Nij:

Depth (d%) Duration (t)	**10ms <= t <100ms**	**100ms <= t < 500ms**	**500ms <= t < 1s**	**1s < t < 3s**	**3s <= t < 20s**	**20s <= t < 1min**
10 < d < 15	N_{11}	N_{21}	N_{31}	N_{41}	N_{51}	N_{61}
15 <= d < 30	N_{12}	N_{22}	N_{32}	N_{42}	N_{52}	N_{62}
30 <= d < 60	N_{13}	N_{23}	N_{33}	N_{43}	N_{53}	N_{63}
60 < d <99	N_{14}	N_{24}	N_{34}	N_{44}	N_{54}	N_{64}

EN 50160 data (current observation period): The meter maintains the counters listed in the table above for each phase. These counters are reset on a weekly basis.

EN 50160 data (previous observation period): The meter stores the counter values listed in the table above for each phase on a weekly basis before these counters are reset. These registers are also stored in a data recorder on a weekly basis.

Events: The meter creates a message in the Event log every time one of the counters increases.

Parameter data: The meter can be enabled to record the minimum RMS voltage for each phase during a dip, the duration of the dip and the timestamp for when the dip occurred.

Voltage Dips Default Measurements

Values from the current observation period (in the first four columns) are found in Bin modules. They are also logged weekly by Data Recorder modules 19 – 23. Values from previous observation (PO) period are found in Store modules.

Register Labels							
V1-Dip N11	V1-Dip N12	V1-Dip N13	V1-Dip N14	PO V1-Dip N11	PO V1-Dip N12	PO V1-Dip N13	PO V1-Dip N14
V1-Dip N21	V1-Dip N22	V1-Dip N23	V1-Dip N24	PO V1-Dip N21	PO V1-Dip N22	PO V1-Dip N23	PO V1-Dip N24
V1-Dip N31	V1-Dip N32	V1-Dip N33	V1-Dip N34	PO V1-Dip N31	PO V1-Dip N32	PO V1-Dip N33	PO V1-Dip N34
V1-Dip N41	V1-Dip N42	V1-Dip N43	V1-Dip N44	PO V1-Dip N41	PO V1-Dip N42	PO V1-Dip N43	PO V1-Dip N44
V1-Dip N51	V1-Dip N52	V1-Dip N53	V1-Dip N54	PO V1-Dip N51	PO V1-Dip N52	PO V1-Dip N53	PO V1-Dip N54

Register Labels							
V1-Dip N61	V1-Dip N62	V1-Dip N63	V1-Dip N64	PO V1-Dip N61	PO V1-Dip N62	PO V1-Dip N63	PO V1-Dip N64
V2-Dip N11	V2-Dip N12	V2-Dip N13	V2-Dip N14	PO V2-Dip N11	PO V2-Dip N12	PO V2-Dip N13	PO V2-Dip N14
V2-Dip N21	V2-Dip N22	V2-Dip N23	V2-Dip N24	PO V2-Dip N21	PO V2-Dip N22	PO V2-Dip N23	PO V2-Dip N24
V2-Dip N31	V2-Dip N32	V2-Dip N33	V2-Dip N34	PO V2-Dip N31	PO V2-Dip N32	PO V2-Dip N33	PO V2-Dip N34
V2-Dip N41	V2-Dip N42	V2-Dip N43	V2-Dip N44	PO V2-Dip N41	PO V2-Dip N42	PO V2-Dip N43	PO V2-Dip N44
V2-Dip N51	V2-Dip N52	V2-Dip N53	V2-Dip N54	PO V2-Dip N51	PO V2-Dip N52	PO V2-Dip N53	PO V2-Dip N54
V2-Dip N61	V2-Dip N62	V2-Dip N63	V2-Dip N64	PO V2-Dip N61	PO V2-Dip N62	PO V2-Dip N63	PO V2-Dip N64
V3-Dip N11	V3-Dip N12	V3-Dip N13	V3-Dip N14	PO V3-Dip N11	PO V3-Dip N12	PO V3-Dip N13	PO V3-Dip N14
V3-Dip N21	V3-Dip N22	V3-Dip N23	V3-Dip N24	PO V3-Dip N21	PO V3-Dip N22	PO V3-Dip N23	PO V3-Dip N24
V3-Dip N31	V3-Dip N32	V3-Dip N33	V3-Dip N34	PO V3-Dip N31	PO V3-Dip N32	PO V3-Dip N33	PO V3-Dip N34
V3-Dip N41	V3-Dip N42	V3-Dip N43	V3-Dip N44	PO V3-Dip N41	PO V3-Dip N42	PO V3-Dip N43	PO V3-Dip N44
V3-Dip N51	V3-Dip N52	V3-Dip N53	V3-Dip N54	PO V3-Dip N51	PO V3-Dip N52	PO V3-Dip N53	PO V3-Dip N54
V3-Dip N61	V3-Dip N62	V3-Dip N63	V3-Dip N64	PO V3-Dip N61	PO V3-Dip N62	PO V3-Dip N63	PO V3-Dip N64

The following Minimum module output registers are used for display purposes:

Register Label	Description
V1-Dip mn	greatest voltage dip on phase 1 (=lowest voltage) over 1 week)
V2-Dip mn	greatest voltage dip on phase 2 (=lowest voltage) over 1 week)
V3-Dip mn	greatest voltage dip on phase 3 (=lowest voltage) over 1 week)

Optionally, the following data can be recorded at every Dip event by Data Recorder 34.

Register Label	Description
V1-Dip [%]	voltage dip on phase 1
V2-Dip [%]	voltage dip on phase 2
V3-Dip [%]	voltage dip on phase 3
V1-Dip duration	dip duration on phase 1
V2-Dip duration	dip duration on phase 2
V3-Dip duration	dip duration on phase 3

Short and Long Interruptions

Interruption detection is based on half-cycle RMS measurements. The duration of the interruption corresponds to the period during which the RMS value remains less than 1% of the nominal voltage.

The observation period is 1 week. No evaluation criteria are suggested by either the EN 501060 standard or the UNIPEDE *Measurement Guide for Voltage Characteristics*; you should apply your own criteria to the data captured by the meter.

The table below defines the classification scheme for counters Ni:

Duration of Interruptions	**duration < 1s**	**1s <= duration < 3 min**	**duration >= 3 min**
Number of Interruptions	N_1	N_2	N_3

EN 50160 data (current observation period): The meter maintains the counters listed in the table above for each phase. These counters are reset on a weekly basis.

EN 50160 data (previous observation period): The meter stores the counter values listed in the table above for each phase on a weekly basis before these counters are reset. These registers are also stored in a data recorder on a weekly basis.

Events: The meter creates a message in the Event log every time one of the counters increases.

Parameter data: The meter can be enabled to record the duration of the interruption and the timestamp for when the interruption occurred.

Interruptions Default Measurements

Counters from the present observation period are located in BIN modules. They also recorded weekly by Data Recorder modules 24, 25. Counters are from the previous observation (PO) Period are located in Store modules.

Register Label (Current Observation Period)		
V1-Intrpt N1	V1-Intrpt N2	V1-Intrpt N3
V2-Intrpt N1	V2-Intrpt N2	V2-Intrpt N3
V3-Intrpt N1	V3-Intrpt N2	V3-Intrpt N3

Register Label (Previous Observation Period)		
PO V1-Intrpt N1	PO V1-Intrpt N2	PO V1-Intrpt N3
PO V2-Intrpt N1	PO V2-Intrpt N2	PO V2-Intrpt N3
PO V3-Intrpt N1	PO V3-Intrpt N2	PO V3-Intrpt N3

Optionally, the data below can be recorded at every Interruption event by Data Recorder 35:

Register Label	**Description**
V1-Irpt durtn	interruption duration on phase 1
V2-Irpt durtn	interruption duration on phase 2
V3-Irpt durtn	interruption duration on phase 3

Temporary Overvoltages

Overvoltage detection is based on half-cycle RMS measurements.The duration of the overvoltage corresponds to the period during which the RMS value remains more than 110% of the nominal voltage. The magnitude of the overvoltage is defined as the ratio (expressed in %) between the maximum RMS voltage during the overvoltage and the nominal voltage.

The observation period is 1 week. No evaluation criteria are suggested by either the EN 501060 standard or the UNIPEDE *Measurement Guide for Voltage Characteristics*; you should apply your own criteria to the data captured by the meter. The table below defines the classification scheme for counters Nij:

Overvoltages / Duration "t"	**t < 1s**	**1s <= t < 1 min**	**t >= 1 min**
110 < magnitude <= 120 %	N_{11}	N_{21}	N_{31}
120 < magnitude <= 140 %	N_{12}	N_{21}	N_{32}
140 < magnitude <= 160 %	N_{13}	N_{23}	N_{33}
160 < magnitude <= 200 %	N_{14}	N_{24}	N_{34}
magnitude > 200 %	N_{15}	N_{25}	N_{35}

EN 50160 data (current observation period): The meter maintains the counters listed in the table above for each phase. These counters are reset on a weekly basis.

EN 50160 data (previous observation period): The meter stores the counter values listed in the table above for each phase on a weekly basis before these counters are reset. These registers are also stored in a data recorder on a weekly basis.

Events: the meter creates a message in the Event log every time one of the counters increases.

Parameter data: The meter can be enabled to record the maximum RMS voltage for each phase during an overvoltage, the duration of the overvoltage and the timestamp for when the overvoltage occurred.

Overvoltages Default Measurements

The data below is from the present observation period; values are all located in Bin modules. They are also recorded weekly by Data Recorders 25, 26, and 27.

Register Labels				
V1-Ovrvlt N11	V1-Ovrvlt N12	V1-Ovrvlt N13	V1-Ovrvlt N14	V1-Ovrvlt N15
V1-Ovrvlt N21	V1-Ovrvlt N22	V1-Ovrvlt N23	V1-Ovrvlt N24	V1-Ovrvlt N25
V1-Ovrvlt N31	V1-Ovrvlt N32	V1-Ovrvlt N33	V1-Ovrvlt N34	V1-Ovrvlt N35
V2-Ovrvlt N11	V2-Ovrvlt N12	V2-Ovrvlt N13	V2-Ovrvlt N14	V2-Ovrvlt N15
V2-Ovrvlt N21	V2-Ovrvlt N22	V2-Ovrvlt N23	V2-Ovrvlt N24	V2-Ovrvlt N25
V2-Ovrvlt N31	V2-Ovrvlt N32	V2-Ovrvlt N33	V2-Ovrvlt N34	V2-Ovrvlt N35

Register Labels				
V3-Ovrvlt N11	V3-Ovrvlt N12	V3-Ovrvlt N13	V3-Ovrvlt N14	V3-Ovrvlt N15
V3-Ovrvlt N21	V3-Ovrvlt N22	V3-Ovrvlt N23	V3-Ovrvlt N24	V3-Ovrvlt N25
V3-Ovrvlt N31	V3-Ovrvlt N32	V3-Ovrvlt N33	V3-Ovrvlt N34	V3-Ovrvlt N35

The following counters are from the Previous Observation period (PO). These values are all located in Store modules.

Register Labels				
PO V1-Ovrvlt N11	PO V1-Ovrvlt N12	PO V1-Ovrvlt N13	PO V1-Ovrvlt N14	PO V1-Ovrvlt N15
PO V1-Ovrvlt N21	PO V1-Ovrvlt N22	PO V1-Ovrvlt N23	PO V1-Ovrvlt N24	PO V1-Ovrvlt N25
PO V1-Ovrvlt N31	PO V1-Ovrvlt N32	PO V1-Ovrvlt N33	PO V1-Ovrvlt N34	PO V1-Ovrvlt N35
PO V2-Ovrvlt N11	PO V2-Ovrvlt N12	PO V2-Ovrvlt N13	PO V2-Ovrvlt N14	PO V2-Ovrvlt N15
PO V2-Ovrvlt N21	PO V2-Ovrvlt N22	PO V2-Ovrvlt N23	PO V2-Ovrvlt N24	PO V2-Ovrvlt N25
PO V2-Ovrvlt N31	PO V2-Ovrvlt N32	PO V2-Ovrvlt N33	PO V2-Ovrvlt N34	PO V2-Ovrvlt N35
PO V3-Ovrvlt N11	PO V3-Ovrvlt N12	PO V3-Ovrvlt N13	PO V3-Ovrvlt N14	PO V3-Ovrvlt N15
PO V3-Ovrvlt N21	PO V3-Ovrvlt N22	PO V3-Ovrvlt N23	PO V3-Ovrvlt N24	PO V3-Ovrvlt N25
PO V3-Ovrvlt N31	PO V3-Ovrvlt N32	PO V3-Ovrvlt N33	PO V3-Ovrvlt N34	PO V3-Ovrvlt N35

The Maximum module output registers are used for display purposes:

Register Label	Description
V1-Ovrvlt mx	greatest over-voltage on phase 1 over 1 week
V2-Ovrvlt mx	greatest over-voltage on phase 2 over 1 week
V3-Ovrvlt mx	greatest over-voltage on phase 3 over 1 week

Optionally, the data below can be recorded at the end of every Overvoltage event by Data Recorder 36.

Register Label	Description
V1-Ovrvlt [%]	over-voltage on phase 1
V2-Ovrvlt [%]	over-voltage on phase 2
V3-Ovrvlt [%]	over-voltage on phase 3
V1-Ovrvlt durtn	over-voltage duration on phase 1
V2-Ovrvlt durtn	over-voltage duration on phase 2
V3-Ovrvlt durtn	over-voltage duration on phase 3

Supply Voltage Unbalance

Each basic measurement is the true RMS value over a fixed 10-minute period (see the UNIPEDE *Measurement Guide for Voltage Characteristic* for more details).

- Observation period of one week with fixed steps of 10 minutes.
- **N** = number of 10-minute intervals in which the supply voltage is within ±15% of nominal.
- $\mathbf{N_1}$ = number of intervals in which the voltage unbalance exceeds 2% (3% in some areas) and the supply voltage is within ±15% of nominal.

Voltage unbalance complies with the standard if $N_1/N <= 5\%$ during the observation period (1 week by default).

Each measurement is the RMS unbalance voltage:

$$V_{UNBAL\%} = \frac{negative\ sequence\ voltage}{positive\ sequence\ voltage}$$

EN 50160 data (current observation period): The meter generates the N and N_1 counts as described above. These counters are reset at the beginning of the next observation period.

EN 50160 data (previous observation period): The meter stores the N and N_1 counter values at the end of each observation period before these counters are reset. These 2 registers are also stored in a data recorder for each observation period.

Events: A message is created in the Event log every time the N_1 counter increases.

Unbalance Default Measurements

Register Label	Module Type	Description
Vubal N*	Signal Limit Evaluation	Number of valid intervals (voltage on all phases within +/- 15% of nominal)
Vunbal N invld*		Number of invalid intervals
Vunbal N1*		Number of valid intervals in which the voltage unbalance exceeds 2%
PO Vunbal N	Store	Vunbal N of the previous Observation Period
PO Vunbal N1		Vunbal N1 of the previous Observation Period
Vunbal mean	Sliding Window Demand	Average voltage unbalance over 10 minutes (used for display purposes)
Vunbl mean mn	Minimum	Minimum average voltage unbalance over 1 week (used for display purposes)
Vunbl mean mx	Maximum	Maximum average voltage unbalance over 1 week (used for display purposes)
Vunbal N1/N	Arithmetic	N1/N ratio
PO Vunbal N1/N		N1/N ratio of the previous Observation Period

* This data is recorded once every week by Data Recorder 28.

Harmonic Voltage

All harmonic measurements are performed as defined by IEC 61000-4-7.

- Observation period of one week with fixed steps of 10 minutes.
- **N** = number of 10-minute intervals in which the supply voltage is within ±15% of nominal.
- $\mathbf{N_1}$ = number of intervals in which one or more of the individual harmonic levels defined in the table below are exceeded and the supply voltage is within ±15% of nominal. Levels for individual harmonics (for each phase) up to the 25th are defined in the table below.
- $\mathbf{N_2}$ = number of intervals in which the THD value for one or more of the voltage phases exceeds 8% and the supply voltage is within ±15% of nominal. The THD calculation will include all harmonics up to the 40thd).

Harmonic voltage complies with the standard if $N_1/N <= 5\%$ and $N_2/N <= 5\%$ during the observation period (1 week by default).

Odd Harmonics					
Not Multiples of 3				Multiples of 3	
Order	Threshold	Order	Threshold	Order	Threshold
5	6%	17	2%	3	5%
7	5%	19	1.5%	9	1.5%
11	3.5%	23	1.5%	15	0.5%
13	3%	25	1.5%	21	0.5%

Even Harmonics	
Order	Threshold
2	2%
4	1%
6…24	0.5%

EN 50160 data (current observation period): The meter generates the N, N_1 and N_2 counts described above for each phase. These counters are reset at the beginning of the next observation period.

EN 50160 data (previous observation period): The meter stores the N, N_1 and N_2 counter values at the end of each observation period before these counters are reset. These 9 registers are also stored in a data recorder for each observation period.

Events: The meter creates a message in the Event log every time the N_1 and N_2 counters increase.

Parameter data: The meter can be enabled to record the 10-minute mean, minimum and maximum values of THD, TO(odd)HD and TE(even)HD for each voltage phase into a data recorder every 10 minutes.

Harmonics Default Measurements

Register Label	Source Module	Description
V1-Hrm N*	Harmonics Evaluation	number of valid intervals (voltage on phase 1 within +/- 15% of nominal)
V1-Hrm N invld*		number of invalid intervals
V1-Hrm N1*		number of intervals in which one or more individual harmonics on phase 1 exceed their limits
V1-Hrm N2*		number of intervals in which the THD value on phase 1 exceeds the limit
V2-Hrm N*		number of valid intervals (voltage on phase 2 within +/- 15% of nominal)
V2-Hrm N invld*		number of invalid intervals
V2-Hrm N1*		number of intervals in which one or more individual harmonics on phase 2 exceed their limits
V2-Hrm N2*		number of intervals in which the THD value on phase 2 exceeds the limit
V3-Hrm N*		number of valid intervals (voltage on phase 3 within +/- 15% of nominal)
V3-Hrm N invld*		number of invalid intervals
V3-Hrm N1*		number of intervals in which one or more individual harmonics on phase 3 exceed their limits
V3-Hrm N2*		number of intervals in which the THD value on phase 3 exceeds the limit
PO V1-Hrm N	Store	V1-Hrm N of the previous Observation Period
PO V1-Hrm N1		V1-Hrm N1 of the previous Observation Period
PO V1-Hrm N2		V1-Hrm N2 of the previous Observation Period
PO V2-Hrm N		V2-Hrm N of the previous Observation Period
PO V2-Hrm N1		V2-Hrm N1 of the previous Observation Period
PO V2-Hrm N2		V2-Hrm N2 of the previous Observation Period
PO V3-Hrm N		V3-Hrm N of the previous Observation Period
PO V3-Hrm N1		V3-Hrm N1 of the previous Observation Period
PO V3-Hrm N2		V3-Hrm N2 of the previous Observation Period
V1 THD mean	Sliding Window Demand	average THD on phase 1 over 10 minutes (used for display purposes)
V2 THD mean		average THD on phase 2 over 10 minutes (used for display purposes)
V3 THD mean		average THD on phase 3 over 10 minutes (used for display purposes)
V1 THD mean mn	Minimum	minimum average THD on phase 1 over 1 week (used for display purposes)
V2 THD mean mn		minimum average THD on phase 2 over 1 week (used for display purposes)
V3 THD mean mn		minimum average THD on phase 3 over 1 week (used for display purposes)
V1 THD mean mx	Maximum	maximum average THD on phase 1 over 10 minutes (used for display purposes)
V2 THD mean mx		maximum average THD on phase 2 over 1 week (used for display purposes)
V3 THD mean mx		maximum average THD on phase 3 over 1 week (used for display purposes)

Register Label	Source Module	Description
V1-Hrm N1/N	Arithmetic	N1/N ratio
V1-Hrm N2/N		N2/N ratio
V2-Hrm N1/N		N1/N ratio
V2-Hrm N2/N		N2/N ratio
V3-Hrm N1/N		N1/N ratio
V3-Hrm N2/N		N2/N ratio
PO V1-Hrm N1/N		N1/N ratio of previous Observation Period
PO V1-Hrm N2/N		N2/N ratio of previous Observation Period
PO V2-Hrm N1/N		N1/N ratio of previous Observation Period
PO V2-Hrm N2/N		N2/N ratio of previous Observation Period
PO V3-Hrm N1/N		N1/N ratio of previous Observation Period
PO V3-Hrm N2/N		N2/N ratio of previous Observation Period

* This data is recorded by Data Recorder module 29 once a week.

Optionally, the following data is recorded once every 10 minutes by Data Recorder modules 37 and 38.

Register Label	Description		Register Label	Description
PQ V1 THD mean	average THD on phase 1 over 10 minutes		PQ V2 TOHD mx	maximum TOHD on phase 1 over 10 minutes
PQ V1 THD mn	minimum THD on phase 1 over 10 minutes		PQ V2 TEHD mean	average TEHD on phase 1 over 10 minutes
PQ V1 THD mx	maximum THD on phase 1 over 10 minutes		PQ V2 TEHD mn	minimum TEHD on phase 1 over 10 minutes
PQ V1 TOHD mean	average TOHD on phase 1 over 10 minutes		PQ V2 TEHD mx	maximum TEHD on phase 1 over 10 minutes
PQ V1 TOHD mn	minimum TOHD on phase 1 over 10 minutes		PQ V3 THD mean	average THD on phase 3 over 10 minutes
PQ V1 TOHD mx	maximum TOHD on phase 1 over 10 minutes		PQ V3 THD mn	minimum THD on phase 3 over 10 minutes
PQ V1 TEHD mean	average TEHD on phase 1 over 10 minutes		PQ V3 THD mx	maximum THD on phase 3 over 10 minutes
PQ V1 TEHD mn	minimum TEHD on phase 1 over 10 minutes		PQ V3 TOHD mean	average TOHD on phase 1 over 10 minutes
PQ V1 TEHD mx	maximum TEHD on phase 1 over 10 minutes		PQ V3 TOHD mn	minimum TOHD on phase 1 over 10 minutes
PQ V2 THD mean	average THD on phase 2 over 10 minutes		PQ V3 TOHD mx	maximum TOHD on phase 1 over 10 minutes
PQ V2 THD mn	minimum THD on phase 2 over 10 minutes		PQ V3 TEHD mean	average TEHD on phase 1 over 10 minutes
PQ V2 THD mx	maximum THD on phase 2 over 10 minutes		PQ V3 TEHD mn	minimum TEHD on phase 1 over 10 minutes
PQ V2 TOHD mean	average TOHD on phase 1 over 10 minutes		PQ V3 TEHD mx	maximum TEHD on phase 1 over 10 minutes
PQ V2 TOHD mn	minimum TOHD on phase 1 over 10 minutes			

Interharmonic Voltage

Interharmonics are the entire *band* of frequencies between two successive integer multiples of the fundamental. All harmonic measurements are performed as defined in IEC 61000-4-7.

- Observation period of one week with fixed steps of 10 minutes.
- **N** = number of 10-minute intervals in which the supply voltage is within ±15% of nominal.
- $\mathbf{N_1}$ = number of intervals in which one or more of the interharmonic levels defined in the table below are exceeded and the supply voltage is within ±15% of nominal. Levels for interharmonic bands up to the 25th harmonic are defined in the table below.

Apply your own compliance evaluation criteria to the interharmonic statistics provided by the meter.

In the table below, order 2 specifies all frequencies between the fundamental and the 2nd harmonic; order 3 specifies all frequencies between the 2nd harmonic and the 3rd; etc.

Odd Harmonics					
Not Multiples of 3				Multiples of 3	
Order	Threshold	Order	Threshold	Order	Threshold
5	6%	17	2%	3	5%
7	5%	19	1.5%	9	1.5%
11	3.5%	23	1.5%	15	0.5%
13	3%	25	1.5%	21	0.5%

Even Harmonics	
Order	Threshold
2	2%
4	1%
6…24	0.5%

EN 50160 data (current observation period): The meter generates the N and N1counts described above for each phase. These counters are reset at the beginning of the next observation period.

EN 50160 data (previous observation period): The meter stores the N and N_1 counter values at the end of each observation period before these counters are reset. These registers are also stored in a data recorder for each observation period.

Events: The meter creates a message in the Event log every time the N_1 counter increases.

Interharmonics Default Measurements

Register Label	Source Module	Description
V1-Inthrm N*	Harmonics Evaluation	number of valid intervals (voltage on phase 1 within +/- 15% of nominal)
V1-Inthrm N ivd*		number of invalid intervals
V1-Inthrm N1*		number of intervals in which one or more individual harmonics on phase 1 exceed their limits
V2-Inthrm N*		number of valid intervals (voltage on phase 2 within +/- 15% of nominal)
V2-Inthrm N ivd*		number of invalid intervals
V2-Inthrm N1*		number of intervals in which one or more individual harmonics on phase 2 exceed their limits
V3-Inthrm N*		number of valid intervals (voltage on phase 3 within +/- 15% of nominal)
V3-Inthrm N ivd*		number of invalid intervals
V3-Inthrm N1*		number of intervals in which one or more individual harmonics on phase 3 exceed their limits
PO V1-Inthrm N	Store	V1-Inthrm N of the previous Observation Period
PO V1-Inthrm N1		V1-Inthrm N1 of the previous Observation Period
PO V2-Inthrm N		V2-Inthrm N of the previous Observation Period
PO V2-Inthrm N1		V2-Inthrm N1 of the previous Observation Period
PO V3-Inthrm N		V3-Inthrm N of the previous Observation Period
PO V3-Inthrm N1		V3-Inthrm N1 of the previous Observation Period
V1-Inthrm N1/N	Arithmetic	N1/N ratio
V2-Inthrm N1/N		N1/N ratio
V3-Inthrm N1/N		N1/N ratio
PO V1-Ihrm N1/N		N1/N ratio of previous Observation Period
PO V2-Ihrm N1/N		N1/N ratio of previous Observation Period
PO V3-Ihrm N1/N		N1/N ratio of previous Observation Period

* This data is recorded weekly by Data Recorder 30.

Mains Signaling Voltage

In some countries, power transmission and distribution systems are also used to carry communication signals. If the magnitude of these signals becomes too large, they have the potential to interfere with the operation of electrical equipment in much the same way that excessive harmonic and interharmonic voltages do. The purpose of this measurement component is to ensure that these signals do not exceed defined levels. EN 50160 defines three types of mains signals:

1. **Ripple control**: frequencies between 110 to 3000 Hz
2. **Power line carrier**: frequencies between 3 to 148.5 kHz
3. **Marking signals**: short transients superimposed at select points on the voltage waveform

The meter can monitor ripple control signals between 110 Hz and 3000 Hz. The meter performs signaling voltage measurements using interharmonic voltages near the user-defined signaling frequencies. You can specify three frequencies to be monitored; the default is 1060Hz.

NOTE

Some common ripple control frequencies in Europe include 183 Hz, 191 Hz, 425 Hz and 1060 Hz.

The signaling voltage measurement is the mean voltage (not RMS) over a fixed interval of 3 seconds.

- Observation period of one day with fixed steps of 3 seconds.
- **N** = number of 3-second intervals in which the supply voltage is within ±15% of nominal.
- $\mathbf{N_1}$ = number of intervals in which the mean value of the signalling voltage exceeds the curve defined in the EN 50160 standard and the supply voltage is within ±15% of nominal.

Mains signaling voltage complies with the standard if $N_1/N <= 1\%$ during the observation period (1 day by default).

EN 50160 data (current observation period): the meter generates the N and N_1 counts for each phase as described above. These counters are reset at the beginning of the next observation period.

EN 50160 data (previous observation period): the meter stores the N and N_1 counter values at the end of each observation period before these counters are reset. These 6 registers are also stored in a data recorder for each observation period.

Events: the meter creates a message in the Event log every time the N_1 counter for each phase increases.

Mains Signaling Evaluation Module Settings

To enable EN50160 mains signal voltage monitoring, you must specify the signal frequency of interest and the allowable signal voltage threshold for each of the three voltage phases. These parameters are held in the *Frequency* and *Limit* setup registers of their respective Mains Signaling Evaluation modules.

The allowable *Frequency* range is 5 Hz to 2500 Hz (default is 1060 Hz). If this register is set to 0Hz, then no evaluation will be performed. The voltage threshold defined by the *Limit* setup register must be expressed as a percentage of the fundamental (default is 100%). Refer to the *ION Reference* for more details about this module.

Mains Signaling Default Measurements

Register Label	Source Module	Description
V1-MSignal N*	Mains Signalling Evaluation	number of valid intervals (voltage on phase 1 within +/- 15% of nominal)
V1-MSignl N ivd*		number of invalid intervals
V1-MSignal N1*		number of valid intervals in which the signaling voltage on phase 1 exceeds a user defined limit
V2-MSignal N*		number of valid intervals (voltage on phase 2 within +/- 15% of nominal)
V2-MSignl N ivd*		number of invalid intervals
V2-MSignal N1*		number of valid intervals in which the signaling voltage on phase 2 exceeds a user defined limit
V3-MSignal N*		number of valid intervals (voltage on phase 3 within +/- 15% of nominal)
V3-MSignl N ivd*		number of invalid intervals
V3-MSignal N1*		number of valid intervals in which the signaling voltage on phase 3 exceeds a user defined limit
PO V1-MSignal N	Store	PO V1-MSignal N of the previous Observation Period
PO V1-MSgnal N1		PO V1-MSgnal N1 of the previous Observation Period
PO V2-MSignal N		PO V2-MSignal N of the previous Observation Period
PO V2-MSgnal N1		PO V2 MSgnal N1 of the previous Observation Period
PO V3-MSignal N		PO V3-MSignal N of the previous Observation Period
PO V3-MSgnal N1		PO V3-MSgnal N1 of the previous Observation Period
V1-MSig N1/N	Arithmetic	N1/N ratio
V2-MSig N1/N		N1/N ratio
V3-MSig N1/N		N1/N ratio
PO V1-MSig N1/N		N1/N ratio of previous Observation Period
PO V2-MSig N1/N		N1/N ratio of previous Observation Period
PO V3-MSig N1/N		N1/N ratio of previous Observation Period

* This data is recorded weekly by Data Recorder 31.

EN50160 External Controls

To access these controls, double-click the Controls grouping object on the EN50160 tab in a default Power Quality Vista diagram.

Enabling the EN50160 Calculations

EN50160 statistics (counters N, N_1, etc.) monitoring and logging are enabled when:

- External Boolean module "EN50160 Enable" is ON (=1) (the default).
- Sag/Swell module's "Nominal Voltage" setup register has a value > 0. By default, this register is set to 0. You can set this value from the meter's front panel as well as in Designer.

In addition to the above, **EN50160 parameter logging** (logging of the EN50160 voltage measurements themselves) is enabled when:

- External Boolean module "PQ Prm Rc Enbl" is also ON (=1). To conserve memory, parameter data logging is disabled (OFF) by default.
- Double-click this control object to enable EN50160 parameters to be logged.

EN50160 Reset

EN50160 statistics (counters) and parameter data are cleared from the meter when the External Pulse module "EN50160 Reset" is triggered:

- Double-click this control object to clear the External Pulse module, or use the Setup Menu in the meter's front panel.

The logged EN50160 quantities (data logs) are preserved.

EN50160 Synchronization Mode & Synchronization Timing

These control objects allow you to choose a **Free** or **Scheduled** synchronization mode for the EN50160 data acquisition. If you select Scheduled, then you can opt for Synchronization Timing to start at midnight of the present day, or at midnight of the coming Saturday. If you select Free, then EN50160 statistics and data start accumulating after the first EN50160 Reset (see above).

By default, all cumulative EN50160 parameters are scheduled to synchronize every Saturday at midnight. You can alter these settings through links to two External Boolean modules:

- PQ Sync Mode (External Boolean 23)
- PQ Sync Tdy/Sat (External Boolean 24)