

INSTRUCTION MANUAL

3196

POWER QUALITY ANALYZER **EN50160 MODE**

HIOKI E.E. CORPORATION

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Introduction

3196 EN50160 mode is available on Ver1.30 or later. Note that EN50160 mode is not available in versions prior to Ver1.30.



For operating environment, maintenance, and disposal at end of life, the same conditions apply as to the main 3196. Refer to the 3196 Instruction Manual for details regarding basic operation procedures.

Symbols

The following symbols in this manual indicate the relative importance of cautions and warnings.

A CAUTION	Indicates that incorrect operation presents a possibility of injury to the user or damage to the product.
NOTE	Advisory items related to performance or correct opera- tion of the product.
*	Indicates the reference.

Safety

Read the Instruction Manual supplied with the 3196 unit very carefully, and follow the indications given under "DANGER," "WARN-ING," "CAUTION," and "NOTE."

Outlook of Operating Procedures



1.1 Product Overview

The EN50160 version of the 3196 can measure and analyze the power supply voltage characteristics in accordance with the definitions stated in the European standard EN50160:1999 "Voltage characteristics of electricity supplied by public distribution systems".



EN50160 Overview Screen

Preparation for Measurement

2.1 EN50160 Mode and Normal Mode

Model 3196 (Ver1.30 or later) can be used to measure in EN50160 mode in addition to the normal measurement of Model 3196 (normal mode).

When EN50160 mode is selected, the measurement function for EN50160 is added to the normal mode, and some functions in normal mode will be limited.

Refer to Section 2.4, "Limitations in EN50160 mode" (page 8) for details of the limitations.

Be sure to check that you are in the correct measurement mode before using the 3196.



2.2 EN50160 Screen

In EN50160 mode, the screen for EN50160 is accessible from the "EVENT" screen.

In general, there are 3 screen types, and measurement in EN50160 mode is possible only in these screens.

In addition, screens for normal mode (e.g., Timeplot and DMM) can be displayed during EN50160 measurement.



						-
*		SYSTEM	V VIEW	TIME PLO	EVENT	STATUS
CH1,2,	З С⊦	4	50Hz	INTERN	IAL MEMORY	SETTING
3P4W 300V 56	00A AC 30	00V 500A	PLL: U1	PC CAF	D MEMORY	RECORDING
	Thursdald	Cood Y				ANALYZING
	Inresnoto	4000 <u>/</u>				
Freq.A(±)	1.000 %	99.50 %				
Freq.B +	4.000 %	100.00 %				EVENT
Freq.B -	- 6.000 %					LIST
V Vari.A(±)	10.000 %	95.00 %				
V Vari.B +	10.000 %	100.00 %				
V Vari.B -	-15.000 %					EN50160
Flicker	1.000	95.00 %				Uverview
Unbalance	2.00 %	95.00 %				
THD	8.00 %	95.00 %				EN50160
Signaling p1	0.5000kHz	99.00 %				Harmonic
Signaling p1	9.00 %					
Signaling p2	1.0000kHz	Î				
Signaling p2	5.00 %	1 1				EN50160
Signal spec1	OFF					Settings1
Signal spec2	OFF					Settings2
						beetings
• •			1			2003/01/23

2.3 PC Card

DF4

When EN50160 mode is selected, the detailed data for EN50160 is saved into the PC card in real time, and only data for the display is saved in the internal memory.

Using a PC card is recommended for further analysis after measurement by using the PC application software.

Section 4.5, "PC Card" (page 42)

2.4 Limitations in EN50160 mode

Items	Fixed value
Wiring (123ch)	3P3W3M or 3P4W
Frequency	50Hz
U Calc Type	PHASE-N (3P4W), LINE-LINE (3P3W3M)
Harm Calc	For EN *1
THD Calc	THD_F
Flicker	Pst, Plt
Filter	230V lamp
MemoryFull	LOOP
Interval	10 min
Auto Save	BINARY

The limitations are indicated below.

note *1: Harm Calc For EN

Harmonic Calculation of Voltage is % of Un (Nominal voltage). Harmonic Calculation of Current and Power are % of Fundamental.

Events	Fixed value
U Transient	123ch ON, 4ch OFF
Urms SWELL	ON
Urms DIP	ON
U Interrupt	ON
Frequency	ON (common to Freq.A of EN50160 settings)
U THD (123ch)	123ch ON, 4ch OFF
U unb	ON
U Harmonics	123ch ON, 4ch OFF

2.5 Default Values

When pressing the default key (F1 key) in the EN50160 setting screen [EVENT]-[DF4_Setting], the settings related to EN50160 mode is reset to the following default values that are set forth by the EN50160 standard. The settings for other parameters are not reset.

Default Values

Items	Default	Good% Default
Wiring	3P4W	
U Range	300V	
PT Ratio	1	
U Reference	230V	
Freq. A (±)	±1.0%	99.5%
Freq. B +	+4.0%	100.0%
Freq. B -	-6.0%	100.0 %
V Variation A (±)	±10.0%	95.0%
V Variation B +	+10.0%	100.0%
V Variation B -	-15.0%	100.0 %
Flicker	1.0	95.0%
Unbalance	2.0%	95.0%
THD	8.0%	95.0%
Harmonics(h2-h50)	refer to next table	95.0%
Signaling p1 Hz	500Hz	
Signaling p1 %	9.0%	
Signaling p2 Hz	1000Hz	00.0%
Signaling p2 %	5.0%	99.0%
Signaling spec1	off (110Hz)	
Signaling spec2	off (110Hz)	
Transient	180.0%	
Over voltage(swell)	110.0%	
Dips	90.0%	
Interruption	1.0%	
Short int time	180s	

0	rder	% of Un	Order	% of Un	Order	% of Un
-			11	3.5	21	0.5
	2	2.0	12	0.5	22	0.5
	3	5.0	13	3.0	23	1.5
	4	1.0	14	0.5	24	0.5
	5	6.0	15	0.5	25-50	OFF
	6	0.5	16	0.5		
	7	5.0	17	2.0		
	8	0.5	18	0.5		
	9	1.5	19	1.5		
	10	0.5	20	0.5		

Default value of each Harmonic order

Signaling



Signaling p1:

Threshold level and the End of frequency in the First area Signaling p2:

Threshold level and the Start of frequency in the Third area

The threshold level of the first area and the third area is the same value from the starting frequency to the ending frequency, and the second area is their transition area.

The threshold level of the second area is decided automatically by the first and the third areas.

Measurement

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3.1 Setting Default Values

To simplify the settings, Model 3196 is programmed with the settings as described in the EN50160 standard as default.

By initializing the settings before starting measurement, EN50160 measurement can be started without making further complicated settings.

In addition, changing each setting is possible. Please refer to 4. Detailed settings for details.



3.2 Starting Measurement



Start measurement by pressing the START key after wiring and settings have been completed.



Punctual time measurement start

EN50160 mode starts measurement at the punctual times as shown below immediately after the START key is pressed. xx:00:00, xx:10:00, xx:20:00, xx:30:00, xx:40:00, xx:50:00 Until the above times are reached, the 3196 is in waiting status.

(Example)

When the start key is pressed at 10:05, the 3196 waits to start measurement until 10:10.

10:05	Waiting	10:10
0	Waiting	►0
Start key is	pressed	Measurement starts

3.3 The EN50160 Screen during Measurement

The EN50160 screen is changeable after as well as during measurement. Also, the analysis start date and period to display can be switched arbitrarily.

The data is displayed on the main unit in one-day units except for the measurement start date and the last date (including the current date).

Select either "Excl. Flag" or "Incl. Flag" in each screen to choose whether or not to analyze the parameters when a dip, swell or interruption event occurs.

3.3.1 Common Display Areas

		Present time or end t	^{*2} Flagging (Including flagged data or Exclud-
	Measureme	nt start time	ing flagged data) 4
Display methods_ (All/ Previous/ Specific) ^{*5}	EN50160 0vo Start: 03/4 Specific 1 Start date of	erview 01/01 08:00 End: 03/0 From : 01/01 Period: 1 display	Excluding flagged data /21 17:24 Duration: 20d 11:24 Week 01/01 $\rightarrow 01/07$ Turned to 1 An actual display period ^{*8}
	(Only when is chosen) *	Specific Period of d	splay *7 Duration from start time
*1 Stort	Indicatos mo	asuromont start data	and time
*0 Fred	Indicates ne	to and time during me	
"2 End	date and tim	e.	easurement or measurement end
*3 Duration	Indicates du	ration from start time t	o end time (now)
*4 Flagging	This is offered and interrupt When the F switches bet data". The display of Including flag Excluding flag	ed to see the judgme ion events which affec 4 button is pushed, ween "Including flagg will also change. gged data: Include flag gged data: Do not inc	nt without the effect of dip, swell ct all parameters. the indication in the upper right led data" and "Excluding flagged gged data in the statistics lude flagged data in the statistics
*5 Display methods	There are th All Previous Specific	ree display methods. Display the data fu present (or end) time Display the data fo prior to the present (or Display the data for a fied date	rom measurement start to the r a designated period recorded or end) time a designated period from a speci-
*6 Start date of display	When "Spec input. When "Previ "Before:End"	ific" is chosen as the ous" is chosen as the ' is displayed.	display method, the date can be display method, "Before:Now" or
*7 Period of display	When "Previ period can b Note that or selected. (e.g.)Record	ous" or "Specific" is c e selected. nly periods shorter th ed period:10 days, ch	hosen as the display method, the nan the recorded period can be oose from 1 day or 1 week only.
*8 An actual dis- play period	Indicate an a play end dat The time is r to 23:59 of th When the ba display start	actual display date fror e. not displayed, but it m ne end date. ackground turns orang date or the display en	n the display start date to the dis- eans from 00:00 of the start date ge, this indicates that data on the d date did not reach a day.

	Method	Start date	Period
ex.1	All		
ex.2	Previous		1 day
ex.3	Previous		1 week
ex.4	Specific	01/02 (Jan./2nd)	1 day
ex.5	Specific	01/02 (Jan./2nd)	1 week
ex.6	Specific	01/02 (Jan./2nd)	2 weeks

Sample combinations of the display method and period



Note:



Indicates data does not reach a day. Background turns red for the item of an actual display period.

NOTE

The latest data is always displayed when "Previous" is chosen during the measurement.



The ratio of Good judgment in the designated period is displayed as a numeric value and bar graph.

The left end of the bar graph indicates 0% and the right end indicates 100%.

Also, the results of the comparison ratio and the Good% is expressed by the color.

Vvar i	± 10.0%	95.0%	R
CH1	93.2%		
CH2	95.5%		
CH3	100.0%		
-			

- Red: the ratio of Good judgment is less than Good%.
- Blue: the ratio is more than or equal to Good%.

When there are no recorded data, it is displayed as the following figure.

e.g.) Right after measurement start.

or When Excl. Flag is chosen under the conditions which flagging occurs in frequently.

Vvar i	± 10.0%	95.0%
CH1	%	
CH2	%	
CH3	%	

3.3.2 Overview Screen

Display all the measurement parameters for EN50160 measurement.

The details of each screen are explained as follows.



The following 4 parameters are simplified and displayed.



Changing the display met	hod		
EVENT OVerview All (example) ENTER Select from pull- down menu Confirm Cancel	BN50160 Overvi Cl. + C ²² /01/0 All From Freq. ± 1.0% 100.02 +4.0/ -6.0% 1 100.02 All Previous Specific	ew E 1 08:00 End: 03/01/21 17:24 :/ Period: 99.5% 00.0% Unbalance 95.0% 93.2% Display the data from n to the present (or end) to Display the data for a d recorded prior to the pre- Display the data for a d from a specified date	xcluding flagged data Duration: 20d 11:24 01/01 → 01/21 Transients 0 Ver voltages 0 Voltage dips 1 Interrupt long 0 Interrupt short 1 measurement start ime esignated period esignated period

Changing the start date of display



EN50160 Overview	cluding flagged data
Start: 03/01/01 08:00 End: 03/01/21 17:24 Specific From: 01/01 eriod: 1 Week	Duration: 20d 11:24 01/01 \rightarrow 01/07
Freq. ± 1.0% 99.5%	Transients 0 Over voltages 0
+4.0/-6.0% 100.0% Unbalance 95.0%	Interrupt long 0 Interrupt short 1

When "Specific" is chosen as the display method, input the date.

Changing the period of display



Changing the flagging



3.3.3 Harmonic Screen

Display each order of Harmonic.





Changing the start date of display





When "Specific" is chosen as the display method, the date can be input.

When "Previous" is chosen as the display method, "Before:Now" or "Before:End" is displayed.



Changing the flagging EVENT Excluding flagged data pecific From : 12/11 PERIOD: 1 Day 177111 100.00 CH1 2order Harmonic DF 3 100.00 95.00 90.00 [%] Incl. Flag F 4 CH2 2order 100.00 188.88 05 AG Excl. Flag 48 50 Include flagged data in the Including flagged data statistics Do not include flagged data in Excluding flagged data the statistics This is offered to see the judgment without the effect of dip, swell and interruption events which affect all parameters. When the F4 button is pushed, the indication in the upper right switches between "Including flagged data" and "Excluding flagged data". The display will also change.



3.3.4 Signaling Screen

Display the results of an analysis for all and specified frequency.

EVENT	CH1,2,3 3P4W 300V 500A DN50160 Signalin Start: 03/01/01 Specific From :	SYSTEM CH 4 AC 300V 500A ng Detail 08:00 End: 03/01/2 01/02 Period: 1 D	VIEW TIME I 50Hz INT PLL: UI Excluding 21 17:24 Duratio ay 01/02	PLOT/ EVENT TENAL MEMORY CARD MEMORY g flagged data on: 20d 11:24 → <u>01/02</u>	STATUS SETTING RECORDING ANALYZING EVENT
-	All 110H CH1 100.02 CH2 100.02 CH3 100.02 Specifie	tz – 3000Hz ed Frequency 315Hz			LIST MONITOR EN50160 Overview
	CH1 100.02 CH2 100.02 CH3 100.02 CH3 100.02 Specifie CH1 100.02 CH2 100.02 CH3 100.02	ed Frequency 1225Hz			EN50160 Harmonic Signaling Events EN50160 Settings1 Settings2 Settings3
	▶ □			Excl. Flag	2003/01/23 12:29:24



The data displayed in the Signaling screen is one-day data of the specified date, because EN50160 standards require that signaling be assessed terms of one-day periods. However, signaling in the Overview screen is the result of statistics from the same period as other parameters.

Changing the start date of	of display
EVENT Signaling O From (example) ENTER Select date O	EN50160 Signaling Detail Excluding flagged data Start: 03/01/01 03/01/21 17:24 Duration: 20d 11:24 Specific From: 01/02 Period: 1 Day 01/02 → 01/02 All 110Hz - 3000Hz -
▼	Input the date.
ENTER / ESC Confirm Cancel	

Changing the flagging



EN50160 Signaling Detail Excluding flagged data Start: 03/01/01 08:00 End: 03/01/21 17:24 Duration: 200 11:24 Specific From: 01/02 Period: 1 Day 01/02 → 01/02
All 110Hz - 3000Hz CH1 100.0X CH2 100.0X CH3 100.0X
Specified Frequency 315Hz CH1 100.0x CH2 100.0x CH3 100.0x
CH3 199.02 Excl. Flag
Including flagged data Include flagged data in the statistics
Excluding flagged data Do not include flagged data in the statistics
This is offered to see the judgment without the effect of dip, swell and interruption events which affect all parameters
When the F4 button is pushed, the indication in the upper right switches between "Including flagged data" and "Excluding flagged data". The display will also change

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Display a detailed table which indicates Dips, Swells, Interruptions and Transients.

The time and level cannot be changed.

	<u>*</u>		/ S1	STEM	VIEW 1	'IME PLOT/	EVENT	STATUS
EVENT	CH1,2	,3	CH 4		iØHz 🛛	INTERNAL	J MEMORY	SETTING
	3P4W 300V	500A A	C 300V	500A F	PLL: U1	PC CARD	MEMORY	RECORDING
	EN50160 Ev	ents Deta	il					ANALYZING
	Start: 03/	01/01 08:	00 End:	03/01/21	17:24 Du	ration:	20d 11:24	
(DF3) Events	<u>A11</u>	From :	/ Peric		- 🧕 🥖	/01 → 0	./21	EVENT
								LIST
	Transient	S						MONITOR
	<u>> 180%</u>	0						EVEO 4 CO
								FN20100
	[%]	100[ms]	500[ms]	1[s]	3[s]	180[s]	>180[s]	Uverview
	> 180	8	8	8	8	8	8	
	140 - 180	8	8	8	8	8	8	EN50160
	120 - 140	8	8	8	8	8	8	Harmonic
	110 - 120	0	0	0	0	0	0	Signaling
	70 - 90	8	3	8	8	8	8	Events
	40 - 70	8	3	8	8	8	8	EN50160
	1 - 40	8	2	8	8	8	8	Settings1
	0 - 1	1	0	0	8	1	8	Settings3
								2003/01/23
								12:29:24

In the normal mode, when an event occurs, an event is counted twice.

e.g.) "Event IN", "Event OUT"

However in the EN50160 events screen, one event is counted only once.

No. Date	Time	Event	Category	U Cycle Event		
1 01-22 2 01-22 3 01-22	09:33:35.645 09:33:35.435 09:30:00.084	Dip Dip Start	CH1 OUT CH1 IN	Transient Swell	Dip 2	Interrupt Wave

Normal event list

Normal event monitor

Transients	8								
Over voltages	8		[%]	100[ms]	500[ms]	1[s]	3[s]	180[s]	>180[s]
U 11 12	-		> 180	8	8	8	8	8	8
Voltage dips	1		140 - 180	8	8	8	8	8	8
Interrupt long	8		120 - 140	8	8	8	8	8	8
Interrupt short	8		110 - 120	8	8	8	8	8	8
			70 - 90	0	8	0	0	8	0
	VIEV	v	40 - 70	0	1	8	8	8	8
			1 - 40	8	8	0	8	0	8
			0 - 1	0	0	0	0	0	0



The above screens (normal mode and EN50160 screen) display the same event.

Changing the display method

EVENT DF3 Events O All (overmela)	EN50160 Ev Start: 037 1 Transient > 180%	ents Deta 01/01 08: From : s 0	il 00 End: / Perio	03/01/21 d:	<u>17:24</u>] <u>Du</u>	ration:] /01 → 01	20d <u>11:24</u> 721
(example)	[%]	100[ms]	500[ms]	1[s]	3[s]	180[s]	>180[s]
ENTER	> 180	8	8	8	8	8	8
	140 - 180	8	8	8	0	8	0
Select from pull-	120 - 140	8	8	8	8	0	8
🕤 down menu	110 - 120	8	8	8	0	0	0
Ť	70 - 90	8	3	8	8	8	0
	40 - 70	8	3	8	8	8	8
	1 - 40	8	2	8	8	8	θ
ENTER ESC	0 - 1	1	8	8	0	1	8
Confirm Cancel							
	All	Dis to t	play the he pres	e data fi ent (or e	rom me end) tim	asurem Ie	ent start
	Previous Display the data for a designated period recorded prior to the present (or end) time						
	Specific	Dis fror	play the n a spe	e data fo cified da	or a des ate	ignated	period

Changing the start date of	f display	1					
EVENT DF3 Events	EN50160 Ev Start: 03/ Specific Transient > 180%	ents Deta 01/01 08: From : 01 s	il 99 End: 701 Perio	03/01/21 nd: 1 Week	17:24 Du	ration: <mark>701</mark> → <u>01</u>	20d 11:24 /07
From	[%]	100[ms]	500[ms]	1[s]	3[s]	180[s]	>180[s]
	> 180	0	8	0	0	8	8
ENTER	140 - 180	8	8	8	0	0	8
	120 - 140	8	8	8	0	0	8
Select date	110 - 120	8	8	8	0	0	8
Õ	70 - 90	8	8	8	0	8	8
Ŷ	40 - 70	8	1	8	0	0	θ
V	1 - 40	8	1	8	0	0	0
	0 - 1	1	8	8	8	0	0
Confirm Cancel	When "S date can When "P "Before:N	pecific" be inpu revious low" or	is chos ut. s" is ch "Befor	sen as t nosen a re:End"	the disp the the is disp	olay me display layed.	ethod, the method,

Changing the period of display



NOTE

The displayed time in the table indicates event duration. The displayed time equals to the time range shown below.



*1: Setting value of Short interruption time (default 180 s)

Detailed Settings

4.1 Selecting EN50160 mode

Settings for EN50160 mode are made in the EN50160 setting screen.

Details for each setting are as follows:



3P4W 300V 50	DAL AC 30	INV 500A	PLL: U1	PC CARD	MEMORY	DEC
34 10 3001 30				110 01110		REL
	Threshold	Good %				ANA
Freq.A(\pm)	1.000 %	99.50 %				
Freq.B +	4.000 %	100.00 %				EVENT
Freq.B -	- 6.000 %	Î				LI
V Vari.A(±)	10.000 %	95.00 %				
V Vari.B +	10.000 %	100.00 %				ENEOA
V Vari.B -	-15.000 %					ENSOI
Flicker	1.000	95.00 %				
Unbalance	2.00 %	95.00 %				
THD	8.00 %	95.00 %				EN501
Signaling p1	0.5000kHz	99.00 %				Hari
Signaling p1	9.00 %					
Signaling p2	1.0000kHz					
Signaling p2	5.00 %	1				EN501
Signal spec1	OFF	1				Set
Signal spec2	OFF	1				Set
						bet
• •			1			2003
						10:

Settings3

Settings2

	***			SYST	rem	\ V]	EW	TIME P	LOT/	EVENT	STATUS
СН	1,2,	3	СН	4		50H	tz 📃	INTE	RNAL	MEMORY	SETTING
3P4₩	3001 5	20A	AC 300\	1	500A	PLI	: U1	PC C	ARD	MEMORY	RECORDING
EN50	160 Harm	onic	Settings								ANALYZING
										[% of Un]	
<u>h 1</u>	OFF	h11	3.50%	h21	0.	50%	h31	OFF	h41	OFF	EVENT
h 2	2.00%	h12	0.50%	h22	0.	50%	h32	OFF	h42	OFF	LIST
h 3	5.00%	h13	3.00%	h23	1.	50%	h33	OFF	h43	OFF	MONITOR
h 4	1.00%	h14	0.50%	h24	0.	50%	h34	OFF	h44	OFF	
h 5	6.00%	h15	0.50%	h25	OFF		h35	OFF	h45	OFF	EN50160
h 6	0.50%	h16	0.50%	h26	OFF		h36	OFF	h46	OFF	Overview
h 7	5.00%	h17	2.00%	h27	OFF		h37	OFF	h47	OFF	
h 8	0.50%	h18	0.50%	h28	OFF		h38	OFF	h48	OFF	
h 9	1.50%	h19	1.50%	h29	OFF		h39	OFF	h49	OFF	EN50160
h10	0.50%	h20	0.50%	h30	OFF		h40	OFF	h50	OFF	Harmonic
	C W		- 00 W								EVENUS ENEO140
Har	m Good%	9.	0.00 %								Cottingal
											Settings?
											Settings3
									_		2003/01/23
> <] OF		01	N							10:38:23

Settings for threshold of Harmonic (page 40)

4.2 Settings for the Measurement System

The following (Wiring setting, U range setting, VT(PT) Ratio, U Reference) are settings for installation. Please set the values according to your measurement system.

The setting contents are similar to those available in the normal 3196 mode but the settings conducted here will take priority when EN50160 mode is selected. As such, setting in the system screen of normal mode will not be possible.



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U range setting



PT(VT) ratio settings EVENT 3P4W Wiring U Range 300V Settings1 UReference 230 V PT Ratio U Transient 180.00 % ENTER Urms SWELL 110.00 % = 253.00 V VARIABLE,1, 60, 100, 200, 300, 600, 700, 1000, 2000, Select from pull-2500, 5000 down menu You can set the optional PT ratio within the 0.01 to ENTER ESC 9999.99 range. Confirm Cancel When setting Optional: O: Moves up through the values between val-S: Moves down through the values ues Increases the value Setting value \bigcirc : Lowers the value



Settings for threshold of Event_____

Transient	
EVENT DF4 Settings1 O O U Transient	U Transient 180.00 % Urms SWELL 110.00 % = 253.00 V Urms DIP 90.00 % = 207.00 V U Interrupt 1.000 % = 2.30 V
ENTER Setting value	Short int T 180.00 s Set transient value. Nominal voltage (UReference) is standard (100%).

Over volt	age(swell)	
EVENT		
	Settings1	U Transient, 180.00 %
	Urms SWELL	Urms DIP 90.00 % = 207.00 V U Interrupt 1.000 % = 2.30 V Short int T 180.00 s = -
	Setting value	Set swell value. Nominal voltage (UReference) is standard (100%).





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Short interruption time



4.3 Threshold Setting

The threshold values set here are compared to the measured power supply voltage characteristics for the High/Low judgment. The default values are set forth by the EN50160 standard, but they can be modified arbitrarily. Once set, these values cannot be changed during or after measurement because the calculated data during measurement will not be stored and therefore cannot be reanalyzed. The measured data will be judged "good" or "no good" against these thresholds.

Settings for threshold of parameter



Voltage variation A,B EVENT — Б. ИИИ % Settings2 DF4 10 000 % 95.00 % Vari.B + 10.000 % 100.00 % V Vari.A(±) V Vari.B --15.000 % 95.00 % r i i cker 1.000 V Vari.B+ 2.00 % Unbalance 95.00 % THN 8.00 % V Vari.B-95.00 % ENTER Signaling p1 0.5000kHz 99.00 % The decision range is narrow. Setting value V Vari.A(±) (Plus and minus values are the same) V Vari.B +/- The decision range is wide. (Plus and minus values are different) ENTER

Flicker EVENT $V Vari.A(\pm)$ 10.000 % 95.00 % Settings2 DF4 V Vari.B + 10.000 % 100.00 % 15 000 % 000 95.00 % Flicker 95.00 % Unbalance Z.00 % THD 8.00 % 95.00 % Signaling p1 0.5000kHz 99.00 % ENTER 0.00.00 Set Plt value of Flicker. Setting value ENTER



THD EVENT Flicker 1.000 95.00 % Settings2 Unhalan 200 % 95.00 % 8.00 % 95.00 % 99.00 % THD Signaling pl 0.5000kHz Ó Signaling p1 9.00 % Signaling p2 1.0000kHz ENTER Signaling p2 5.00 % Set THD value. Setting value ENTER



"Good percentage" Setting

Good%	
EVENT	
DF4	Settings2
	Setting value

	Inresnoia -	L0004 4
Freq. $A(\pm)$	1.000 %	99.50 %
Freq.B +	4.000 %	100.00 %
Freq.B -	- 6.000 %	1
V Vari.A(±)	10.000 %	95.00 %
V Vari.B +	10.000 %	100.00 %
V Vari.B -	-15.000 %	<u>1</u>
Flicker	1.000	95.00 %
Unbalance	2.00 %	95.00 %
THD	8.00 %	95.00 %
Signaling p1	0.5000kHz	99.00 %
Signaling p1	9.00 %	
Signaling p2	1.0000kHz	
Signaling p2	5.00 %	
Signal spec1	OFF	
Signal spec2	OFF	

Set the threshold for the ratio of "Good" judgments for the measurement period or the specified display period.

This setting does not affect the measurement calculations directly. The ratio is indicated in the statistics display against a blue background if the "Good" percentage is more than the set value and against a red background if the percentage is less than that set for the "Good" ratio.

The default values are set forth by the EN50160 standard, but they can be modified arbitrarily.

The set value cannot be changed during measurement, but can be modified after measurement.

Special Settings _____

Signaling specified frequ	ency
EVENT	
	THD 8.00 % 95.00 %
OF4 Settings2	Signaling p1 0.5000kHz 99.00 %
	Signaling p1 9.00 % ↑
Signal spec1	Signaling p2 1.0000kHz ↑
0	Signaling n2 5 00 %
Signal spec2	Signal spec1 0.3100kHz
	51gnal specZ UHH
ENTER	
	To monitor a specific frequency, two optional fre-
Setting value	quencies can be specified.
¥	The frequency range is from 110 Hz to 3000 Hz in 5
	Hz stone
ENTER	12 31643.

Settings for threshold of Harmonic _____

Harmonic (fro	om 2nd to 50th))							
									[% of Un]
EVENT	h	1 OFF	h11	3.50% h21	0.50%	h31	OFF	h41	OFF
	h	2 2.00%	h12	0.50% h22	0.50%	h32	OFF	h42	OFF
OFA Se	ettings3	3 5.00%	h13	3.00% h23	1.50%	h33	OFF	h43	OFF
	h h	4 1.00%	h14	0.50% h24	0.50%	h34	OFF	h44	OFF
	h	5 6.00%	h15	0.50% h25	OFF	h35	OFF	h45	OFF
Sele	ct item 🕒	6 0.50%	h16	0.50% h26	OFF	h36	OFF	h46	OFF
	h	7 5.00%	h17	2.00% h27	OFF	h37	OFF	h47	OFF
U U	h	8 0.50%	h18	0.50% h28	OFF	h38	OFF	h48	OFF
	h	9 1.50%	h19	1.50% h29	OFF	h39	OFF	h49	OFF
	<u>h1</u>	0.50%	h20	0.50% h30	OFF	h40	OFF	h50	OFF
O Setti	ng value	larm Good%	95.00	%					
ENTER		OF:	Ŧ	ON					
	Se No	et each h ominal vo	armoi oltage	nic orde (URefe	r. rence)	is s	tandar	d (1	00%).

4.4 Settings in 3196 Mode Screen

Normal measurement and various settings in normal mode are possible in addition to EN50160 measurement except for the limitations explained earlier.

Set the values in normal mode as required.

4.5 PC Card

In EN50160 mode, 3 files consisting of detailed data, event data and display data are created and saved as dedicated files in addition to normal measurement data. All of these data files are stored in the same directory as normal measurement data.

The file names are "EN50160.EN", "EVENT.EN" and "EN_DISP.EN".

These files are always stored in the PC card and it is not possible to turn off this function manually. "EN_DISP.EN" files are also stored in internal memory.

If a PC card is not inserted, there will be a warning message, but please note that the internal memory will store only "EN_DISP.EN" files.

"EN_DISP.EN" data can also be saved manually after measurement has been completed.



- Using a PC card during measurement is strongly recommended.
- Normal storage data: Data stored in normal mode
- In EN50160 mode, setting of "Autosave" is fixed at "BINARY."
- See Section 9.2.3 of the Instruction Manual (CD-R) for the main unit.

How Each File is Used

Detailed data and event data are the files used for further analysis and print out via the PC application software. However, these data cannot be loaded to the 3196 unit.

Display data "EN_DISP.EN" is data used for displaying information on the EN50160 screen of the 3196. This data can be loaded on the 3196 main unit only.

Specifications

The specifications not indicated in this document are stated in the standard specifications for Model 3196.

5.1 Basic Specifications

Applicable version	Ver1.30 or later
Mode	EN50160 mode (EN50160 ON), Normal mode (EN50160 OFF) The mode is selectable under the EN50160 item in the "SYSTEM-MAIN-MEASURE" screen.
Measurement system	Measurement frequency: 50Hz Amplitude of supply voltage: 230V Supply system: 3-phase 4-wire or 3-phase 3-wire

5.2 In EN50160 mode, items that differ from normal 3196 specifications

1. Setting function specifications

When EN50160 mode is selected, some functions in normal mode will be limited. The limitations are described in below.

System settings

Measured Line	3P3W3M/3P4W
Measured line frequency	50 Hz (fixed)
RMS voltage measurement	Automatically set depending on the measured line. Phase-to-neutral voltage (3P4W) Line-to-line voltage (3P3W3M)
Harmonic measurement	For EN (fixed) Harmonic voltage calculation: "% of Un" (nominal voltage) Harmonic current and power calculations: "% of funda- mental" (percentage content)
Harmonic distortion factor measurement	THD-F (fundamental standard)(fixed)
Flicker measurement	Pst, Plt (fixed)
Filter	230V lamp (fixed)

Measurement time control settings

ON/O	FF
OFF	After the start button is pressed, the start time will
	be automatically set to the next 10-minute unit on
	the internal clock, and the end time will be auto-
	matically set to 1 month after the start time.
ON	Manually set the start time in 10-minute units and end time in 1-minute units.
	ON/O OFF ON

Time series data settings

interval settings to thin (inter)	Interval settings 1	10 min (fixed)
-----------------------------------	---------------------	----------------

PC card settings

(b

Event settings

The following items are fixed values and cannot be changed.

Transient overvoltage	CH1,2,3: ON, CH4:OFF
Voltage swell	CH1,2,3: ON
Voltage dip	CH1,2,3: ON
Voltage interruption	CH1,2,3: ON
Voltage frequency	ON common with Freq.A
Voltage unbalance factor	ON (fixation)
Harmonic voltage	CH1,2,3: ON, CH4: OFF
Total voltage harmonic distortion factor	CH1,2,3: ON, CH4: OFF

2. Measurement function and analysis function specifications

The following screens are added to the "EVENT" screen.

- (1) EN50160 Overview (display)
- (2) EN50160 Harmonic (display)
- (3) EN50160 Signaling (display)
- (4) EN50160 Events (display)
- (5) EN50160 Settings1 (display)
- (6) EN50160 Settings2 (display)
- (7) EN50160 Settings3 (display)

5.3 EN50160 Measurement Parameters

Parameter name use in EN50160 standards	Parameter name used in Model 3196 normal mode	Equivalent name on 3196 EN50160 screen
Power frequency	Voltage frequency	Freq.A, Freq.B
Supply voltage variations	RMS voltage value	Vvari.A, Vvari.B
Flicker severity	Long interval IEC volt- age flicker	Flicker
Supply voltage dips	Voltage dip	Voltage dips
Short interruptions of the supply voltage	Voltage interruption	Interrupt short
Long interruptions of supply voltage	Voltage interruption	Interrupt long
Temporary power frequency overvoltages between live conductors and earth	Voltage swell	Over voltages
Transient overvoltages between live conductors and earth	Transient overvoltage	Transients
Supply voltage unbalance	Voltage unbalance fac- tor	Unbalance
Harmonic voltage	Harmonic voltage	THD, Harmonic
Mains signaling voltage on the supply voltage	None	Signaling

5.4 EN50160 Display Specifications

EN50160 Overview display

Contents of display	All measurement results of EN50160 measurement parameters are displayed in the bar graph as well as under the number of event occurrences.			
Bar graph display	The ratio of Good results in the display period is displayed as a value and a bar graph.			
Displayed parameters as bar-graph	Freq.A, Freq.B, Vvari.A, Vvari.B, Unbalance, THD, Har- monic, Flicker, Signaling			
Displayed parameters as the number of event occurrences	Transients, Over voltages, Voltage dips, Interrupt long, Interrupt short			
Display selection	 Display Methods: All/ Previous/ Specific All Display the data from measurement start to the present (or end) time. Previous Display the data for a designated period recorded prior to the present (or end) time. Specific Display the data for a designated period from a specified date. From: Display start date is input. Period: 1day/ 1week/ 2weeks/ 3weeks/ 4weeks Note that only periods shorter than the recorded period can be selected 			
Flagging selection	Incl. Flag/Excl. Flag			
Display renewal period	3 seconds signaling 10 secondsFreq.A, Freq.B 10 minutes Vvari.A, Vvari.B, Unbalance, THD, Harmonic, Flicker			

EN50160 Harmonic display

Contents of display	Measurement results of the voltage harmonic in each order are displayed as a bar graph for each channel.
Display form	Three division display CH1, CH2, CH3

EN50160 Harmonic display

Display selection	 Display M All Previous Specific From: Dis Period: 1c Note that can be se 	ethods: All/ Previous/ Specific Display the data from measurement start to the present (or end) time. Display the data for a designated period recorded prior to the present (or end) time. Display the data for a designated period from a specified date. play start date is input. lay/1week/ 2weeks/ 3weeks/ 4weeks only periods shorter than the recorded period lected
Cursor measurement	Cursor read	-out value of order (from 2nd to 50th)
Flagging selection	Incl. Flag/Ex	cl. Flag
Display renewal period	10 minutes	

EN50160 Signaling display

Contents of display	Measurement results of signaling are displayed as a bar graph for each channel.
Display form	Three division display (All and specific frequency1,2)
Display selection	Display Method: Specific (fixed) From: Display start date
Display period	Display the data for 1 day from a specified date
Flagging selection	Incl. Flag/Excl. Flag
Display renewal period	3 seconds

EN50160 Events display

Contents of display	Display the number of transient occurrences.
	Display a table which indicates the relation with the period
	and the depth of the event.
	Used events: Over voltages, Voltage dips, Interrupt long,
	Interrupt short
Display form	Three division display

EN50160 Events display

Sorting	Depth: 0 to 1% ^{*1} , 1 to 40%, 40 to 70%, 70 to 90% ^{*2} 110 ^{*3} to 120%, 120 to 140%, 140 to 180% ^{*4} , 180% ^{*4} or more Period: 20ms to 100ms, 100ms to 500ms, 500ms to 1s, 1s to 3s, 3s to 180s ^{*5} , 180s ^{*5} or more *1: Setting value of Interruption(default 1%) *2: Setting value of Dip(default 90%) *3: Setting value of Swell(default 110%) *4: Setting value of Transient(default 180%) *5: Setting value of Short Interruption time(default 180s) Depth is given as a percentage of the nominal voltage (Un).
Display selection	 Display Methods: All/ Previous/ Specific All Display the data from measurement start to the present (or end) time. Previous Display the data for a designated period recorded prior to the present (or end) time. Specific Display the data for a designated period from a specified date. From: Display start date is input. Period: 1day/1week/2weeks/3weeks/4weeks Note that only periods shorter than the recorded period can be selected

Flagging display

Including Flagged data Including flagged data in the statistics Excluding Flagged data Excluding flagged data in the statistics

5.5 EN50160 Setting Specifications

Settings1

Measurement system settings and parameter settings

Setting items	Setting range	Default
Measured line	3P3W3M, 3P4W	3P4W
Voltage range	150V/300V/600V	300V
VT(PT) ratio	1/60/100/200/300/600/700/1000/2000/2500/5000/ variable(0.01 to 9999.99)	1
Nominal voltage	100/101/110/120/200/202/208/220/230/240/277/ 346/380/400/415/480/600/ variable (50 to 600V in 1V steps)	230V
Transient overvoltage	$\begin{array}{l} 40.0 \text{ to } 800.0\% \ (\ 50V \leq nominal \ voltage \leq 200V) \\ 40.0 \text{ to } 500.0\% \ (200V \leq nominal \ voltage \leq 400V) \\ 40.0 \text{ to } 300.0\% \ (400V < nominal \ voltage \leq 600V) \end{array}$	180.0%
Voltage swell	100.0 to 120.0%	110.0%
Voltage dip	70.0 to 100.0%	90.0%
Voltage interruption	0.0 to 40.0%	1.0%
Short interruption time	3 to 300s	180s

Setting items	Threshold		Good%	
	Setting range	Default	Setting range	Default
Freq.A(±)	0.0 to 10.0%	1.0%	80.0 to 100.0%	99.5%
Freq.B +	0.0 to 10.0%	4.0%	80.0 to 100.0%	100.0%
Freq.B -	-10.0 to 0.0%	-6.0%	00.0 10 100.070	100.070
Vvari.A(±)	0.0 to 20.0%	10.0%	80.0 to 100.0%	95.0%
Vvari.B +	0.0 to 20.0%	10.0%	80.0 to 100.0%	100.0%
Vvari.B -	-20.0 to 0.0%	-15.0%	00.0 10 100.0 %	100.078
Flicker	0.0 to 20.0	1.0	80.0 to 100.0%	95.0%
Unbalance	0.0 to 100.0%	2.0%	80.0 to 100.0%	95.0%
THD	0.0 to 100.0%	8.0%	80.0 to 100.0%	95.0%

Setting items	Threshold		Good%		
	Setting range	Default	Setting range	Default	
Signaling p1	110Hz to (p2 freq-5Hz)	500Hz	80.0 to 100.0%	99.0%	
(frequency)					
Signaling p1	0.0 to 100.0%	9.0%			
(ievei)					
Signaling p2	(p1 freq+5Hz) to	1000Hz			
(frequency)	3000Hz				
Signaling p2	0.0 to 100.0%	5.0%			
(level)					
Signaling	110 to 3000Hz/OFF	OFF			
spec1					
Signaling	110 to 3000Hz/OFF	OFF	1		
spec2					

Settings3

Settings of voltage harmonic

Setting order	2nd to 50th
Threshold default value	Refer to the following table
Good% setting range	80.0 to 100.0%
Good% default value	95.0%

Threshold default values of individual voltage harmonic for orders up to 50th

Order	%ofUn								
		6	0.5	11	3.5	16	0.5	21	0.5
2	2.0	7	5.0	12	0.5	17	2.0	22	0.5
3	5.0	8	0.5	13	3.0	18	0.5	23	1.5
4	1.0	9	1.5	14	0.5	19	1.5	24	0.5
5	6.0	10	0.5	15	0.5	20	0.5	25-50	OFF

5.6 Data Storage

Stored data	EN50160.EN, EVENT.EN, EN_DISP.EN						
Auto save	ON (fixed)						
Stored directory	The same dire	ctory as normal measu	urement da	ita			
File form	Binary only						
File load	•: Possible / ×: Not possible						
	File name	Contents	Unit load	9624-10*1			
	EN50160.EN	All parameter data	×	•			
	EVENT.EN	Events detailed data	×	•			
		for EN50160					
	EN_DISP.EN	Display data	•	×			
		for EN50160					
	*1: Future relea	ase					
	By specifying a directory to load the data, the 3196 will load						
	the display data for EN50160 along with the time plot data						
and event data, which are normal measurement data.							

5.7 EN50160 Measurement Specifications

The results of calculations are compared to the threshold at every interval. When a result is less than the threshold, it is recorded as a "Good" judgment.

(Refer to the appendix for details regarding the "ten-minute mean rms value" as well as the "three-second mean value" and " $U_{rms(1/2)}$ " calculation methods.)

1. Flagged data

During a voltage dip, voltage swell or voltage interruption, the other parameters are recorded as Flagged data.

2. Measurement parameters

Power frequency (Voltage frequency)

Interval	10 seconds
Calculation method	The mean value for 10 seconds Calculated from the number of cycles within 10 seconds of the internal clock (absolute time).
Threshold default value	Freq.A ±1.0%, Freq.B +4.0%/-6.0% (Given as a percentage of 50Hz)
Good% default value	Freq.A: 99.5%, Freq.B: 100.0%

Supply voltage variations (RMS voltage value)

Interval	10 minutes
The basic measurement time interval	10 cycles (about 200ms)
Calculation method	Ten-minute mean rms value
Threshold default value	Vvari.A ±10.0%, Vvari.B +10.0%/-15.0% (Given as a percentage of the nominal voltage(Un))
Good% default value	Vvari.A 95.0%, Vvari.B 100.0%

Flicker severity (Long interval IEC voltage flicker)

Interval	10 minutes

Flicker severity (Long interval IEC voltage flicker)

Calculation Plt (Plt is calculated from Pst available every 10 minutes) Plt is calculated using the following formula if "Flagging" occurs.

$$\mathsf{Plt}(\mathsf{flg}) = \sqrt[3]{\frac{1}{N}\sum_{i=1}^{N} (\mathsf{Pst}i)^3}$$

[N = 12 - (number of Pst*i* not flagged)] However, Plt(flg)=0 (if all Pst*i* are flagged)

Threshold default value 1.0 Good% default value 95.0%

Supply voltage unbalance (Voltage unbalance factor)

10 minutes
10 cycles (about 200ms)
Ten-minute mean rms value
2.0%
95.0%

Harmonic voltage

Interval	10 minutes
The basic measurement time interval	10 cycles (about 200ms)
Calculation method	Ten-minute mean rms value
Used order for THD	2nd to 50th
Threshold default value	THD 8.0%, Refer to the following table for each order.
Good% default value	95.0%

Threshold default values of individual voltage harmonic for orders up to 50th

Order	%ofUn								
		6	0.5	11	3.5	16	0.5	21	0.5
2	2.0	7	5.0	12	0.5	17	2.0	22	0.5
3	5.0	8	0.5	13	3.0	18	0.5	23	1.5
4	1.0	9	1.5	14	0.5	19	1.5	24	0.5
5	6.0	10	0.5	15	0.5	20	0.5	25-50	OFF



Mains signaling voltage on the supply voltage

Supply voltage dips (Voltage dip)

Detection method	A dip begins when the $U_{rms(1/2)}$ voltage of one or more channels is below the dip threshold and ends when the $U_{rms(1/2)}$ voltage on all measured channels is equal to or above the dip threshold plus the hysteresis voltage. When an interruption occurs during a voltage dip, this event is not detected as a "Voltage dip" but as a "Voltage interruption".
Threshold default	90.0% (Given as a percentage of the nominal voltage(Un))
Voltage dip duration	The time difference between the beginning and the end of the voltage dip.
Voltage dip depth	The lowest $U_{\text{rms}(1/2)}$ value measured on any channel during the dip.

Temporary power frequency overvoltages between live conductors and earth (Voltage swell)

Detection method	A swell begins when the Urms $(1/2)$ voltage of one or more channels is above the swell threshold and ends when the Urms $(1/2)$ voltage on all measured channels is equal to or below the swell threshold minus the hysteresis voltage.
Threshold default	110.0% (Given as a percentage of the nominal voltage(Un)) $% \left(\left({{{\rm{Un}}} \right)_{{\rm{N}}} \right)$
Voltage swell duration	The time difference between the beginning and the end of the voltage swell.
Maximum swell voltage	The largest $U_{\text{rms}(1/2)}$ value measured on any channel during the swell.

Short interruptions of the supply voltage (Voltage interruption) Long interruptions of the supply voltage (Voltage interruption)

Detection method	A voltage interruption begins when the $U_{rms(1/2)}$ voltage of one or more channels is below the voltage interruption threshold and ends when the $U_{rms(1/2)}$ voltage on all mea- sured channels is equal to or greater than the voltage interruption threshold plus the hysteresis voltage. An interruption up to the short interruption time is identified as a "short interruption." An interruption longer than the short interruption time is identified as a "long interruption."
Threshold default	1.0% (Given as a percentage of the nominal voltage(Un))
Short interruption time default	180 seconds
Voltage interruption duration	The time difference between the beginning and the end of the voltage swell.
Voltage interruption depth	The lowest $U_{\mbox{rms}(1/2)}$ value measured on any channel during the interruption.
Frequency during the interruption	50 Hz

Transient overvoltages between live conductors and earth (Transient overvoltage)

Detection Method	Data sampled at 2MHz and those sampled in one wave- form/256 points are compared and the threshold is set above those values.
Default threshold	Given as a percentage of nominal voltage (Un)
Size of Transient	Maximum value within 2MHz sampling (absolute value)
Transient Period	Transient Detection Period (4 ms max)

5.8 Calculation Formulas

Ten-minute mean rms value

Ten-minutes mean rms value =
$$\sqrt{\frac{1}{N_{10}}\sum_{i=1}^{N_{10}}(V_{r200}i)^2}$$

- N₁₀: Number of the basic measurement time intervals during 10min of absolute time.
- V_{r200}: Calculated value in a basic measurement time interval of 10 cycles (200ms)

The basic measurement time interval of all parameters using the ten minutes mean rms value calculation formula is 10 cycles (200ms), so that N_{10} = 3000.

There is a possibility that 10 cycles may not equal 200ms due to frequency fluctuations, and because 10min of absolute time and the basic measurement time interval is not exactly the same.

Three-second mean value

Three-second mean value =
$$\sqrt{\frac{1}{N_3}\sum_{i=1}^{N_3} (V_{r200}i)^2}$$

- N₃ Number of basic measurement time intervals during 3s of absolute time.
- V_{r200} Calculated value in a basic measurement time interval of 10 cycles (200ms)

 $N_3 \cong 15$ for this calculation.

U_{rms(1/2)}

 $U_{rms(1/2)}RMS$ voltage refreshed each half cycle Value of the rms voltage measured over one cycle, commencing at a zero-crossing of PLL CH, and refreshed each half cycle.

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