



*expert***meter**TM

High Performance Analyzer

PM180

Disturbance Direction Detection

Application Note

REVISION HISTORY

A1	May 2021	Initial release
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1 General

The disturbance direction detection function of the PM180 allows identifying and indicating the location of the voltage dip and swell source relative to the monitoring point where the device is installed. This function is available in devices with firmware V31.XX.43 and higher.

1.1 Measurement Techniques

Voltage dips and swells are commonly caused by short circuits, starting a large induction motor or energizing a power transformer.

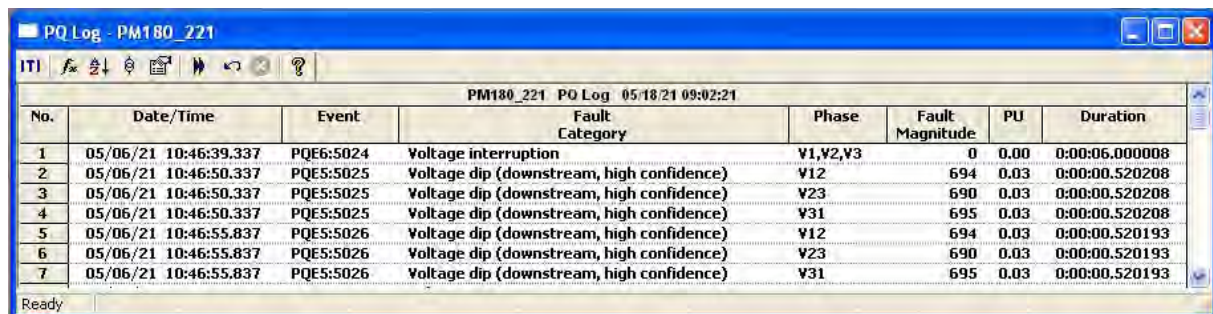
The PM180 uses synchronous voltage and current waveforms recorded before and during an event to determine the location of the disturbance source. Depending on the characteristics of the fault, the device can apply different methods of analyzing the collected data to give the most reliable indication of the direction of the fault.

Symmetrical (three-phase) dips and swells are analyzed using the relative level of the fault or inrush current and the fundamental power angle. Asymmetric (single-phase and two-phase) dips and swells can be analyzed using the negative sequence power angle or, in the case of insufficient information, using the fundamental power angle.

1.2 Disturbance Direction Indication

When disturbance direction detection is enabled in the device (see instructions below), the analysis results are stored along with the dip and swell characteristics in the PQ event log and can be reported using the supplied PAS software tool or via customer application software. See the PM180 Modbus Reference Guide for the information on organizing and accessing the PQ event log data from a client application.

The disturbance direction indication gives the direction of the fault source (downstream or upstream) in relation to the monitoring point and the confidence level of the direction information (high, medium, or low). The picture below shows how the direction of the disturbance is indicated in the PAS PQ event report.



The screenshot shows a software window titled "PQ Log - PM180_221". Inside, there is a table with the following columns: No., Date/Time, Event, Fault Category, Phase, Fault Magnitude, PU, and Duration. The table contains seven rows of data, all dated 05/06/21 at 10:46:50.337. The events include a voltage interruption and several voltage dips with high confidence, all categorized as downstream.

No.	Date/Time	Event	Fault Category	Phase	Fault Magnitude	PU	Duration
1	05/06/21 10:46:39.337	PQE6:5024	Voltage interruption	V1,V2,V3	0	0.00	0:00:06.000008
2	05/06/21 10:46:50.337	PQE5:5025	Voltage dip (downstream, high confidence)	V12	694	0.03	0:00:00.520208
3	05/06/21 10:46:50.337	PQE5:5025	Voltage dip (downstream, high confidence)	V23	690	0.03	0:00:00.520208
4	05/06/21 10:46:50.337	PQE5:5025	Voltage dip (downstream, high confidence)	V31	695	0.03	0:00:00.520208
5	05/06/21 10:46:55.837	PQE5:5026	Voltage dip (downstream, high confidence)	V12	694	0.03	0:00:00.520193
6	05/06/21 10:46:55.837	PQE5:5026	Voltage dip (downstream, high confidence)	V23	690	0.03	0:00:00.520193
7	05/06/21 10:46:55.837	PQE5:5026	Voltage dip (downstream, high confidence)	V31	695	0.03	0:00:00.520193

2 Configuring Disturbance Direction Detection

The use of the disturbance direction function does not require special configuration of the device, except for the activation of the disturbance direction indication. Use the supplied PAS software tool to enable or disable this function in your device.

2.1 Enabling Direction Indication in PQ Event Reports

The disturbance direction setting is displayed under the Recording Options section on the Advanced PQ Setup tab for all power quality standards except IEEE 1159 (see the following section).

To configure the disturbance direction option, select Memory/Log in the Meter Setup menu and then click on the corresponding Advanced PQ Setup tab. The picture below shows an example of the disturbance direction detection setting in the EN 50160 advanced setup tab.

Set the Disturbance Direction Detection option to “Enabled” to allow disturbance direction indication and send your settings to the device.

The screenshot shows the 'PM180_221 - Log Setup' dialog box with the 'EN 50160:2010 PQ Recorder' tab selected. The 'Disturbance Direction Detection' option is set to 'Enabled'. Other settings include 'Evaluation' set to 'Enabled', 'Evaluation Period' set to 'Weekly', 'First Day of the Week' set to 'Monday', and 'Start Time' set to '00:00'. The 'Recording Options' section shows 'Record Flagged Data', 'Record Coincident Currents', and 'Disturbance Direction Detection' all set to 'Enabled'. The 'Rapid Voltage Changes' section shows 'Minimum Steady State Time' set to '100/120 1/2-cyc.', 'Max. Repetition Rate [1-10, 0=any]' set to '0', and 'Evaluation Interval [1-60 min]' set to '60'. The 'Flicker' section shows 'Pst Period [1-10 min]' set to '10'. The 'Harmonic Voltage' section shows 'THD, up to order [25-50]' and 'Harmonics, up to order [25-50]' both set to '50'. The 'Interharmonic Voltage' section shows 'Evaluation' set to 'Disabled', 'THD, up to order [25-50]' set to '50', and 'Interharmonics, up to order [25-50]' set to '50'. The 'Mains Signaling Voltage' section shows 'Evaluation' set to 'Disabled', '1st Signaling Frequency, Hz' set to '183.0', '2nd Signaling Frequency, Hz' set to '191.0', '3rd Signaling Frequency, Hz' set to '217.0', '4th Signaling Frequency, Hz' set to '317.0', and 'Aggregation Interval' set to '3 s (150/180 cyc.)'. The 'Voltage Events' section shows 'Time Aggregation Interval, s [0-180]' set to '0'. The 'Data Monitoring Options' section shows 'Harmonics Aggregation Interval' set to '0.2 s (10/12 cyc.)'. The dialog box has buttons for 'Open', 'Save as...', 'Default', 'Print', 'Send', 'Receive', 'OK', 'Cancel', 'Apply', and 'Help'.

Compliance Statistics	
Evaluation	Enabled
Evaluation Period	Weekly
First Day of the Week	Monday
Start Time	00:00

Recording Options	
Record Flagged Data	Disabled
Record Coincident Currents	Disabled
Disturbance Direction Detection	Enabled

Rapid Voltage Changes	
Minimum Steady State Time	100/120 1/2-cyc.
Max. Repetition Rate [1-10, 0=any]	0
Evaluation Interval [1-60 min]	60

Flicker	
Pst Period [1-10 min]	10

Harmonic Voltage	
THD, up to order [25-50]	50
Harmonics, up to order [25-50]	50

Interharmonic Voltage	
Evaluation	Disabled
THD, up to order [25-50]	50
Interharmonics, up to order [25-50]	50

Mains Signaling Voltage	
Evaluation	Disabled
1st Signaling Frequency, Hz	183.0
2nd Signaling Frequency, Hz	191.0
3rd Signaling Frequency, Hz	217.0
4th Signaling Frequency, Hz	317.0
Aggregation Interval	3 s (150/180 cyc.)

Voltage Events	
Time Aggregation Interval, s [0-180]	0

Data Monitoring Options	
Harmonics Aggregation Interval	0.2 s (10/12 cyc.)

2.2 Enabling Direction Indication in IEEE 1159 PQ Reports

To configure the disturbance direction option, select Memory/Log in the Meter Setup menu and then click on the IEEE 1159 Recorder tab. Check the Disturbance Direction checkbox to enable disturbance direction indication and send your settings to the device.

PM180_217 - Log Setup

Log Memory | Data Recorder | IEEE 1159 PQ Recorder | Fault Recorder | Waveform Recorder | Programmable Min/Max Log

PQ Events and Recording													
Event Category	PQ Log		Waveform Log			Data/RMS Trend - Time Envelopes and Maximum Durations							
	Thresh- old,%	Hyste- resis,%	On Start	On End	Log No.	Ena- bled	1/2-cyc, cycles	0.2-s, seconds	3-s, minutes	10-min, hours	Before, cycles	After, cycles	Log No.
Impulsive Transients	20.0	5.0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	8	<input type="checkbox"/>	----	----	----	----	----	----	----
Sag/Undervoltages	90.0	5.0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	7	<input type="checkbox"/>	30	3	3	0	2	2	14
Swell/Overvoltages	110.0	5.0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	7	<input type="checkbox"/>	30	3	3	0	2	2	14
Interruption	10.0	5.0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	7	<input type="checkbox"/>	30	3	3	0	2	2	14
Voltage Unbalance	5.0	5.0	<input type="checkbox"/>	<input type="checkbox"/>	7	<input type="checkbox"/>	----	----	3	0	----	----	14
Frequency Variations	1.0	5.0	<input type="checkbox"/>	<input type="checkbox"/>	7	<input type="checkbox"/>	----	----	3	0	----	----	14
Harmonics, THD	8.0	5.0	<input type="checkbox"/>	<input type="checkbox"/>	8	<input type="checkbox"/>	----	----	3	0	----	----	14
Interharmonics, THD	2.0	5.0	<input type="checkbox"/>	<input type="checkbox"/>	8	<input type="checkbox"/>	----	----	3	0	----	----	14
Voltage Fluctuations (Flicker)	1.0	5.0	<input type="checkbox"/>	<input type="checkbox"/>	7	<input type="checkbox"/>	----	----	0	3	----	----	14

☒ Disturbance Direction

☒ Recorder Enabled

Open

Save as...

Default

Print

Send

Receive

OK

Cancel

Apply

Help