BHP BILLITON IRON ORE
NEWMAN TOWNSHIP ELECTRICITY SUPPLY

ANNUAL COMPLIANCE REPORT
2014/2015

REVISION A

4/12/2015

APD Job Number: W_APD04094

APD POWER ENGINEERING

REVISION HISTORY

Document Revision History					
Revision	**Description**	**Prepared By**	**Checked By**	**Approved By**	**Date**
A	Original Issue	Dave Reilly	Irfan Midjaja	M. Mohseni NPER #3861990	4/12/2015

PREPARED FOR

Ben Brydson

Superintendent Electrical

HV Inland Utilities, NPI

BHP Billiton Iron Ore

T (08) 9175 3445 | **M** +61 428 669 982

E Ben.Brydson@bhpbilliton.com

RESPOND TO

Mansour Mohseni (PhD, NPER)

Manager

Earthing & Power System Engineering

APD Power

T 1300 273 797 | **M** 0459 996 022

E mansour.mohseni@apdpower.com.au

EXECUTIVE SUMMARY

BHP Billiton Iron Ore (BHPBIO) own and operate numerous iron ore mines located at the Pilbara region of WA, including Mt Whaleback, Mining Area C and several smaller satellite mines. The township of Newman is located approximately 1,200km to the north of Perth; and the town's electricity network is owned, governed and operated by BHPBIO Supply Authority (BHPBIOSA).

In accordance with Western Australia Electricity Industry Code 2005 (the Code), the electrical supply authority must publish a report setting out the information described in Schedule 1 of the Code, in respect to each year ending on 30th of June. This document, known as the annual compliance report, is to provide the full suite of information outlined in Schedule 1 of the Code, relating to the Network Quality and Reliability of Supply.

The methodology adopted to examine compliance/non-compliance with the Code utilises 2 notable sources of information as follows:

1. Power quality data measured from the Newman 0.415kV network over a period of 7 calendar days or more; and
2. Outage data and other relevant information provided by BHPBIOSA.

The Code is effectively written in four Parts plus a reporting-requirements Schedule; namely,

1. Part 1: Preliminary information associated with term of reference.
2. Part 2: Quality and reliability standards, which is further partitioned into 4 *divisions:*
3. Part 3: Payment to customers for lack of regulatory adherence.
4. Part 4: Incidental duties as a Supply Authority.
5. Schedule 1: Information to be published in this report.

This report addresses the relevant parts listed above; in particular the power quality criteria pertaining to each of Newman's seven 11kV feeders (A total of 7 feeders) and the reportable requirements as outlined in Part 2 and Schedule 1 of the Code, for the 2014/15 Financial Year (FY).

With regards to the PQ criteria, the ***average*** values of all electrical parameters logged over the monitoring period (~1 week) were found well within the limits stipulated by the Code. That is, the ***average*** of the following parameters are in full compliance with the Code's requirements:

- Flicker, as per Part 3.7, Clause 3 of AS 61000:2001
- RMS Voltage
- Power System Frequency
- Voltage
- Voltage Total Harmonic Distortion (U-THD)

Note that there are a very limited number of instances (i.e., under 0.5% of the measurement period) where the maximum magnitude of certain electrical parameters were found to exceed the limits prescribed by the Code. However, this is not deemed as a major compliance issue due to the temporary and extremely isolated nature of the instances.

Reportable parameters for Newman Township Electricity Supply over the 2014/15 FY (as outlined in the 'Schedule 1' of the Code) are presented below:

- >12 hour interruptions: no interruption of over 12 hours duration is recorded for *small use customers*.
- No *small use customer* was disconnected from the network more frequent than the Code's requirements (i.e., limit of 16 times).
- A total of 3 complaints were received, which were all related to the billing issues; hence no complaints made by customer on the quality or reliability of supply.
- Within the 2014/15 FY, a total of $16.9M (AUD) was invested by the network operator (BHPBIOSA) towards Newman network operations, maintenance and reinforcement works; to not only address the issues identified by the operator but also to significantly improve the quality and reliability of supply.
- The key reliability indices are calculated as listed below:
    - *Customer Average Interruption Duration Index* (CAIDI) of 80 minutes – CAIDI is the average outage duration that any given customer experience (i.e., the average restoration time).
    - *System Average Interruption Frequency Index* (SAIFI) of 4.23 interruptions – SAIFI is the number of interruptions that the customers experienced.
    - *Average Service Availability Index* (ASAI) of 99.94% – ASAI is the perceived availability of the network to the customers.
    - *System Average Interruption Duration Index* (SAIDI) of 339 minutes – SAIDI is the average outage duration for each customer served.

In summary, the metering data collected from 14 locations throughout the Newman network indicates that the Power Quality, *as so far as is reasonably practical*, is compliant with the Code. With regards to the Reliability of the Supply, the overall network performance is deemed satisfactory however there has been a number of outages recorded over the course of 2014/15 FY (mainly due to genuine backbone feeder faults, human error or mal-operation of protection devices).

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

The township of Newman is located approximately 1,200km to the north of Perth; the town's electricity network is owned, governed and operated by BHP Billiton Iron Ore Supply Authority (BHPBIOSA). The network encompasses the township of Newman, Newman Airport, Capricorn Roadhouse, town water supply bore field, Mt Whaleback iron ore mine, and several smaller satellite mines in the adjacent areas.

At present, the township of Newman includes 2,546 registered premises comprised of a mixture of residential and commercial customers.

According to Western Australia Electricity Industry (Network Quality and Reliability of Supply) Code 2005 (the Code) an electricity distributor must prepare a report setting out the information described in Schedule 1 of the Code, in respect to each year ending on 30 June.

This annual compliance report presents all information required by "Schedule 1 – Information to be published", relating to supply of electricity, for the period of 1st July 2014 to 30th of June 2015. Measurement information is based on sampled data outlined in Section 6, whereas outage information is based on data provided by BHPBIOSA.

The compliance statistical analysis has focused solely on Newman Township and the key infrastructure adjacent to the township. The electrical network supplying the BHPBIO mining operation and the surrounding mine leases have not been assessed.

2. ASSUMPTIONS

The terminologies used throughout this compliance report are as defined in the Western Australia Electricity Industry (Network Quality and Reliability of Supply) Code 2005 (The Code).

The logging information gathered over the limited period is indicative of the performance of the network over the complete financial year (2014/2015 FY).

3. METHODOLOGY

The electricity supply compliance review entailed the following processes:

1. The temporary Installation of power quality (PQ) loggers at the beginning and end of each of 7 feeders emanating from the Town and Southtown Substations (a total of 14 loggers, 2 for each feeder). Each power quality logger was installed on the low voltage (LV) side of pad-mounted transformers. The measuring period lasted for between 7 to 10 days in the months between January 2015 and May 2015. The power quality measurements were undertaken in accordance with AS 61000.4.30:2007 Annex A (Power Quality Measurements).
2. Interpretation and analysis of the logged PQ data using HIOKI 3196 Power Quality Analyser.
3. The receipt of the following information from BHPBIOSA:
    - Network outage information for planned and forced outages for the Newman Township during the 2014/2015 FY as well as information on customer complaints.
    - Expenditure information as a consequence of network complaints or programs directed to improve reliability or power quality of the network.
4. Identification of any breaches of The Code's provisions and Electricity Act 1945.
5. Statistical analyses and review of network performance.
6. Preparation of a compliance report that fulfils the requirements outlined in The Code.

4. NEWMAN TOWNSHIP PQ MONITORING

4.1. PQ Device Specification

The equipment used to undertake the PQ logging were a mixture of HIOKI 3198 and HIOKI 3196 Power Quality Analysers. HIOKI 3198 is the updated iteration of HIOKI 3196 but both types of loggers are practically identical in terms of their features, functionality, and user interface.

The HIOKI devices can measure multiple waveforms and transient events simultaneously using 3 voltage channels and 4 current channels per device. The device is compliant with AS61000-4-30 Ed 2 Class A, which specifies compatibility with industry standard power quality parameters (further information pertaining to the HIOKI 3198 is provided in Appendix A).

The measurements obtained for the loggers are then extracted and analysed with the accompanying analysis software (HIOKI 9624).

4.2. PQ Devices

4.2.1. Locations

A total of 14 PQ HIOKI loggers were deployed at 14 pre-determined locations on TC1, TC2, TC3, TC4, STS1, STS2, and STS6 feeders, as listed in Table 1.

Figure 1 presents a colour-coded single line diagram of the 7 Newman township feeders. Hatched circles indicate the locations at which the PQ loggers were temporary located.

The loggers were installed on the LV secondary side of the transformers. Due to the difficulty to install the loggers on the LV side of pole-top transformer, all of locations were associated with pad-mounted substations.

Table 1 | PQ Logger Locations

Zone Sub	Feeder	Location at the Start	Location at the End
Township	TC1	PS86 Red Sands	T68 Capricorn Oval
Township	TC2	T81 North Newman Rec Area	PS14 Bondini Drive
Township	TC3	PS108 Kurra Subdivision	PS69 Giles Avenue
Township	TC4	PS21 Nimingarra Drive	PS83 Airport
South Town	STS1	PS94 Pardoo Street	PS96 Pardoo Street
South Town	STS2	PS60 Forrest Avenue	T70 Jabbarup Crescent
South Town	STS6	T80 Old LIA	T41 Newman Drive

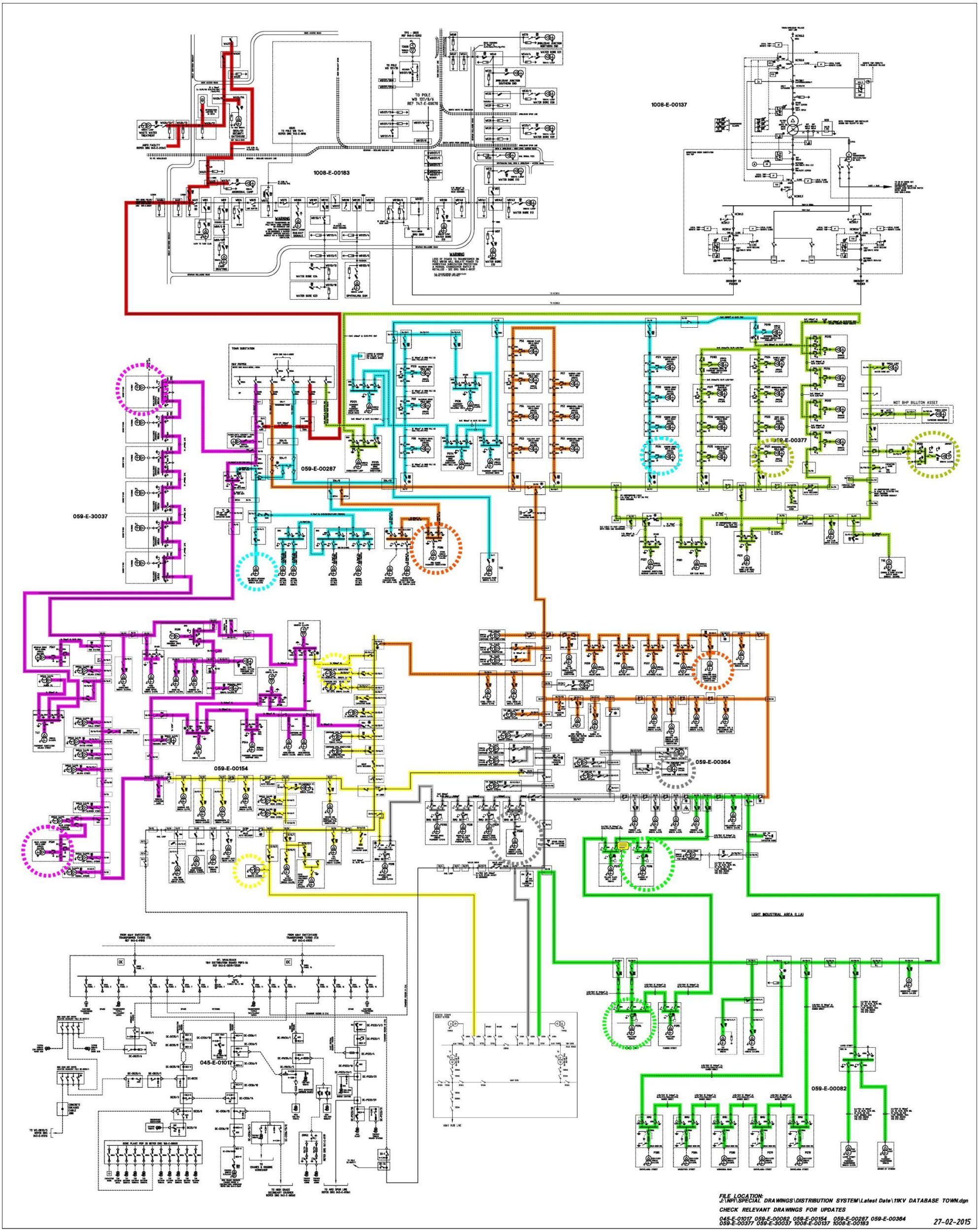


Figure 1 | Single line diagram of the Newman township (coloured circles indicate the location of PQ loggers

4.2.1. In-services Period

present the times and dates of when the PQ loggers were installed and removed from the Newman LV network.

Table 2 | Installation and removal dates of the PQ logger used throughout the Newman network

Zone Subs	Feeder	Start or End of Feeder	Date Installed	Date Removed
Township	TC1	Start	28/03/2015 11:17:08	5/04/2015 7:48:56
		End	24/03/2015 16:45:00	4/04/2015 11:22:25
	TC2	Start	28/03/2015 11:53:40	5/04/2015 10:19:29
		End	24/03/2015 14:10:00	4/04/2015 10:47:57
	TC3	Start	23/03/2015 13:50:00	30/03/2015 11:00:11
		End	23/03/2015 11:55:00	30/03/2015 11:27:32
	TC4	Start	4/04/2015 10:15:00	6/04/2015 15:57:43
		End	28/03/2015 12:40:00	5/04/2015 13:42:28
South Town	STS1	Start	24/03/2015 8:10:00	31/03/2015 9:26:00
		End	23/03/2015 14:50:00	31/03/2015 9:11:34
	STS2	Start	24/03/2015 13:35:00	1/04/2015 11:32:51
		End	25/03/2015 8:25:00	1/04/2015 11:56:54
	STS6	Start	28/03/2015 10:29:38	5/04/2015 10:56:43
		End	24/03/2015 17:15:00	4/04/2015 12:59:21

4.3. PQ Device Setup

The setup of the PQ loggers was as per the relative HIOKI instruction manual.

As shown in the frequency and voltage time-based PQ plots in Appendix B , three values have been logged and plotted: the maximum RMS, the average RMS and the minimum RMS value over the recording interval. The recording interval setup in the PQ loggers was 5 minutes, with the exception of flicker which uses 10 minute intervals. That is, over the course of the in-service days the PQ loggers sampled various time-based parameters (e.g., Hz, U and I) at 5 Hz; and at the end of every 5 minute sampling interval the 3 abovementioned RMS values where recorded.

Figure 2 is an extract from the HOIKI instruction manual depicting the sampling and interval-recording of maximum, average and minimum RMS values.

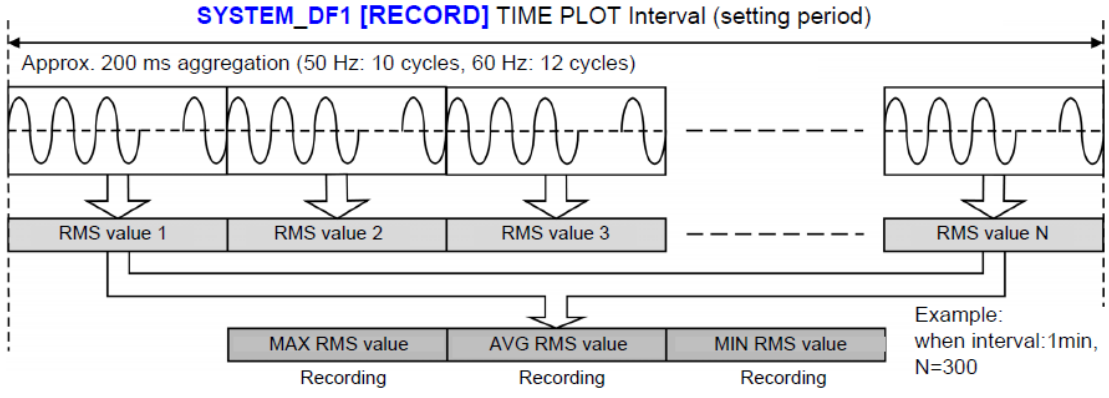


Figure 2 | Sampling and interval recording philosophy used in the Hioki PW loggers (from Hioki Manual)

4.4. PQ Device Installation Checklist

For each of the 14 PQ loggers which were installed by BHPBIOSA personnel, a PQ Logger Installation Checklist was supplied by APD. Upon completing individual logger's setup, the check sheets were to be completed and signed by the installation supervisor (partly received by APD).

Refer to Appendix A for copied of the completed checklists.

5. COMPLIANCE REQUIREMENTS

This section summarises the *Compatibility Levels* by which a 'Distributor's' electrical network is to comply with, as outlined by the Code.

5.1. Voltage Fluctuations

5.1.1. Flicker

The Code specifies that flicker shall comply with long- and short-term flicker 'compatibility levels' as per AS61000:2001. The compatibility levels are shown in Table 3, and are a measure of the voltage quality limits over a 10 minute and 2 hour interval for short- (*Pst*) and long-term (*Plt*) flicker.

Table 3 | Long & short-term flicker limits (extract from The Code)

	Compatibility levels
P_{st}	1.0
P_{lt}	0.8

5.1.2. Voltage Levels

According to AS60038-2000 Standard Voltages Section 2, the voltage levels of the electrical network must be maintained at +10% and -6% of the supply voltage of 230V single-phase.

5.2. Frequency

The Code specifies the frequency fluctuation shall adhere to the Electricity Act 1945 with the level to be maintained at +/-2.5% of 50Hz.

5.3. Voltage Total Harmonic Distortion

The Code specifies the voltage total harmonic distortion (U-THD) is to be kept under 8%.

Individual odd and even harmonic components are not to exceed the figures shown in Table 4 below.

Table 4 | Harmonic Compatibility Level (extract from The Code)

Compatibility levels for harmonic voltages (in percent of the nominal voltage)					
Odd harmonics non multiple of 3		Odd harmonics multiple of 3		Even harmonics	
Order h	Harmonic voltage %	Order h	Harmonic voltage %	Order h	Harmonic voltage %
5	6	3	5	2	2
7	5	9	1.5	4	1
11	3.5	15	0.3	6	0.5
13	3	21	0.2	8	0.5
17	2	>21	0.2	10	0.5
19	1.5			12	0.2
23	1.5			>12	0.2
25	1.5				
>25	0.2+1.3 (25/h)				
Note — Total harmonic distortion (THD): 8%					

5.4. Power Industry Reliability Indicators

As per Schedule 1, Clause 11 (a) to (d) of The Code, a number of reliability indicators (eg interruption durations and quantity of interruptions) are required to be reported. To achieve The Code's requirement, the following standard utility reliability indices have been used.

5.4.1. Customer Average Interruption Duration Index (CAIDI)

Customer Average Interruption Duration Index is defined as the sum of the duration of each customer interruption (in minutes) divided by the number of distribution customers served.

$$CAIDI_{Minutes} = \frac{\sum \text{Customer Interruption Durations}}{\sum \text{Customer Interruptions}} = \frac{\text{SAIDI}}{\text{SAIFI}}$$

5.4.2. System Average Interruption Frequency Index (SAIFI)

System Average Interruption Frequency Index is defined as the sum of the frequency of each sustained distribution customer interruption (in interruption events) attributable to the distribution system divided by the number of distribution customers served.

$$SAIFI_{Interruptions} = \frac{\sum \text{Number of Sustained Distribution Customer Interruptions}}{\text{Number of Distribution Customers Served}}$$

5.4.3. Average Service Availability Index (ASAI)

Average Service Availability Index is the percentage of time that the service is available to the networks' customers in a reportable year.

$$ASAI_{Percent} = 1 - \frac{SAIDI_{Hours}}{8760}$$

5.4.4. System Average Interruption Duration Index (SAIDI)

System Average Interruption Duration Index is defined as the sum of the duration of each sustained distribution customer interruption (in minutes) attributable to the distribution system divided by the number of distribution customers served.

$$SAIDI_{Minutes} = \frac{\sum \text{Sustained Distribution Customer Interruption Durations}}{\text{Number of Distribution Customers Served}}$$

6. Site Measurements (PQ Loggers Data)

The following sections describe the results and notable PQ events which have been recorded by the loggers for each of the 7 feeders.

6.1. Feeder TC1

The PQ logger at the start of the TC1 feeder was installed in the PS86 Red Sands pad-mounted substation between 28/3/2015 and 5/4/2015, thus satisfying the 7 days minimum logging duration requirement.

The PQ logger at the end of the TC1 feeder was installed in the T68 Capricorn Oval substation between 24/3/2015 and 4/04/2015, thus satisfying the 7 days minimum logging duration requirement. As shown in Figure 1 (orange feeder), TC1 originates from the Township Substation. It is a feeder that supplies a number of old distribution substations.

6.1.1. Flicker

The logged flicker data for the start and end of feeder-TC1 are shown in Figure 21 and Figure 24 of Appendix B (page 49) respectively.

The non-compliant flicker events and their respective magnitudes and effected-phases constitute a very small fraction (i.e., under 0.2% of the measurements periods), as listed in Table 5.

Table 5 | TC1 - Summary of non-compliant flicker measurements

Date	Non-compliant Short Term Flicker Events	
	Feeder - TC1	
	Start of Feeder	End of Feeder
	Pst	*Pst*
24/03/2015 – 17:45:00		1.06 (W Phase)
25/03/2015 – 17:45:00		1.65 (R Phase)
27/03/2015 – 18:35:00		1.38 (B Phase)
2/04/2015 – 11:15:00		1.02 (R Phase)
2/04/2015 - 11:17:08	1.06 (B Phase)	

6.1.2. Voltage Levels

The logged voltage level data for the start and end of feeder-TC1 are shown in Figure 22 and Figure 25 in Appendix B (page 49) respectively. There were no voltage limit events causing the voltage level to breach The Code's limits (i.e., full compliance with the Code requirements).

6.1.3. Frequency

The logged frequency data for the start and end of feeder-TC1 are shown in Figure 23 and Figure 26 in Appendix B (page 51) respectively. There were no notable voltage limit events which caused the voltage level to breach The Code's limits (i.e., full compliance with the Code requirements).

6.1.4. Harmonics

The logged harmonic data for the start and end of feeder TC1 are shown in Figure 27 through Figure 34 in Appendix B . Of particular interest is the non-compliant harmonics measured by the PQ

loggers, which is again a very small fraction of the measurement period. A summary of non-compliant harmonics and the scale of non-compliance are shown in Figure 3 and Figure 4.

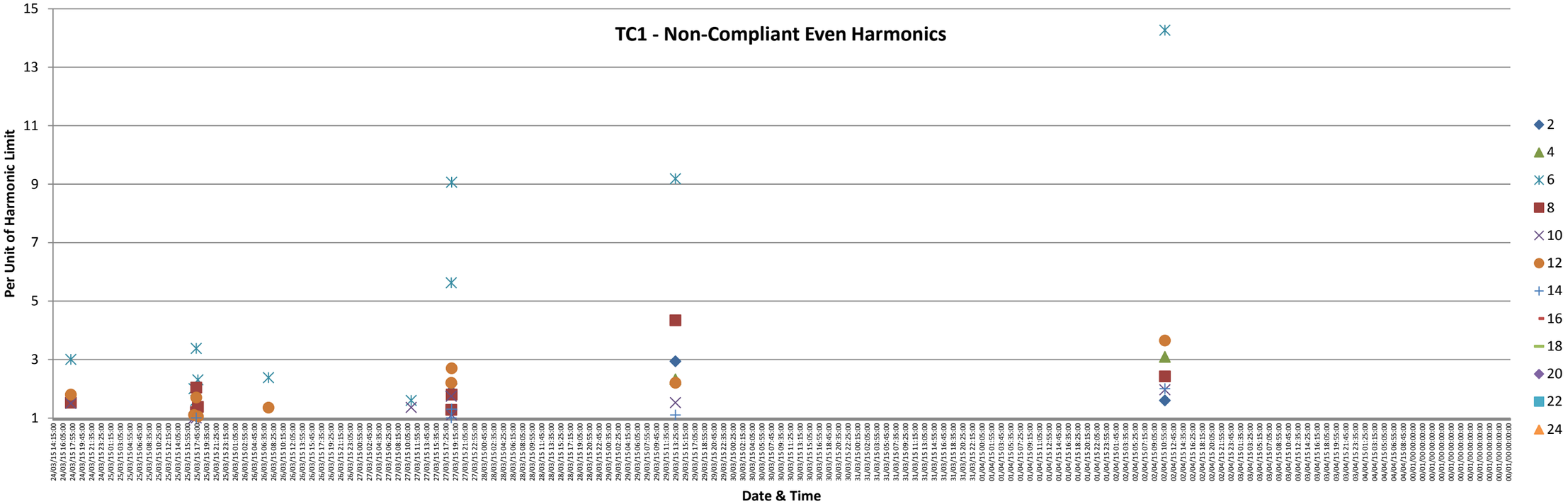


Figure 3 | TC1- Non-compliant even harmonics

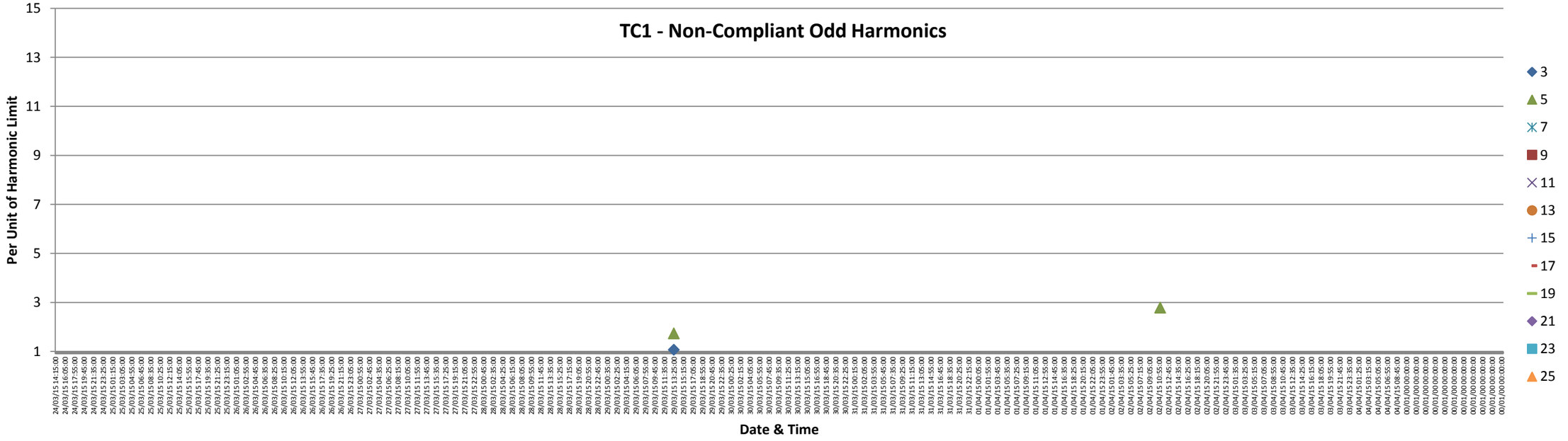


Figure 4 |TC1- Non-compliant odd harmonics

6.2. Feeder TC2

The PQ logger at the start of the TC2 feeder was installed in the T81 North Newman Recreation Area pad-mounted substation between 28/03/2015 and 5/04/2015, thus satisfying the 7 days minimum logging duration requirement.

The PQ logger at the end of the TC2 feeder was installed in the PS14 Bondini Drive substation between 24/03/2015 and 4/04/2015, thus satisfying the 7 days minimum logging duration requirement.

As shown in Figure 1 (cyan-coloured feeder), TC2 originates from the Township Substation.

6.2.1. Flicker

The logged flicker data for the start and end of feeder-TC2 are shown in Figure 35 and Figure 38 of Appendix B (page 51), respectively.

The non-compliant flicker events and their respective magnitudes and effected-phases are shown in Table 6, which is a very small fraction (under 0.1%) of the measurement period.

Table 6 | TC2 - Summary of non-compliant flicker measurements

Date	Non-compliant Short Term Flicker Events	
	Feeder – TC2	
	Start of Feeder	End of Feeder
	Pst	*Pst*
24/03/2015 – 17:40:00		1.06 (W Phase)
25/03/2015 – 17:40:00		1.64 (R Phase) & 1.29 (B Phase)
27/03/2015 – 18:35:00		1.38 (B Phase)
02/04/2015 - 11:13:40	1.13 (B Phase)	

6.2.1. Voltage Levels

The logged voltage level data for the start and end of feeder-TC2 are shown in Figure 36 and Figure 39 in Appendix B (page 51), respectively. There were no voltage limit events which caused the voltage level to breach The Code's limits, hence full compliance with the Code requirements.

6.2.1. Frequency

The logged frequency data for the start and end of feeder-TC2 are shown in Figure 37 and Figure 40 in Appendix B (page 51) respectively. There were no notable voltage limit events which caused the voltage level to breach The Code's limits, hence full compliance with the Code requirements.

6.2.1. Harmonics

The logged harmonic data for the start and end of feeder TC2 are shown in Figure 41 through Figure 48 in Appendix B , (page 52). Of particular interest is the non-compliant harmonics that were measured by the PQ loggers, which is a very small fraction of the measurements. A summary of non-compliant harmonics and the scale of their non-compliance are shown in Figure 5 and Figure 6.

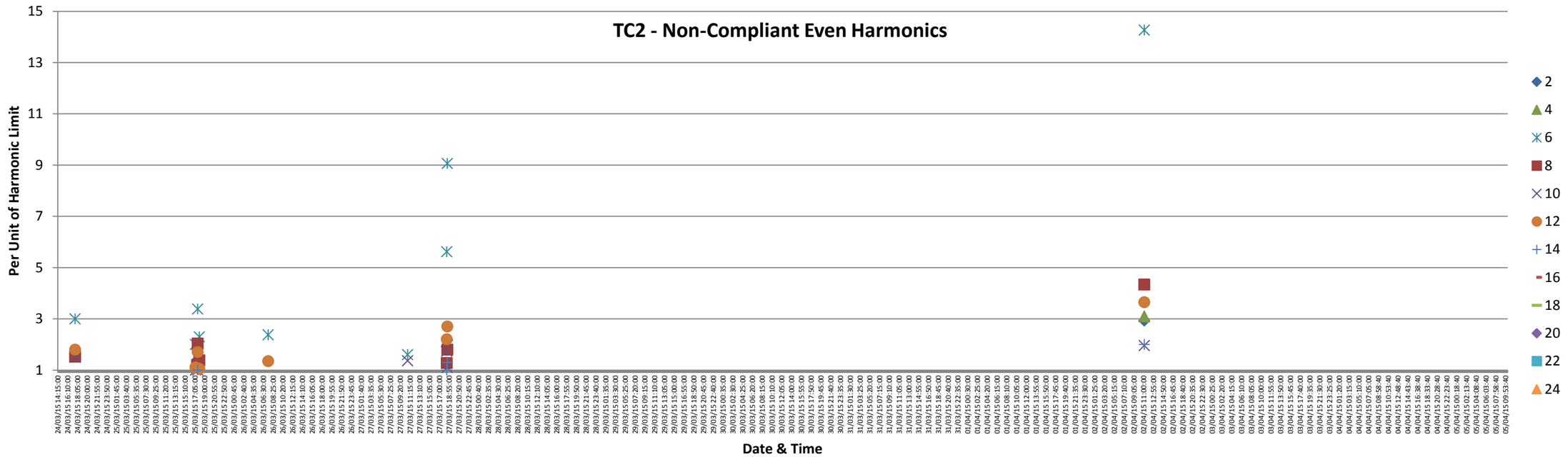


Figure 5 | TC2- Non-compliant even harmonics

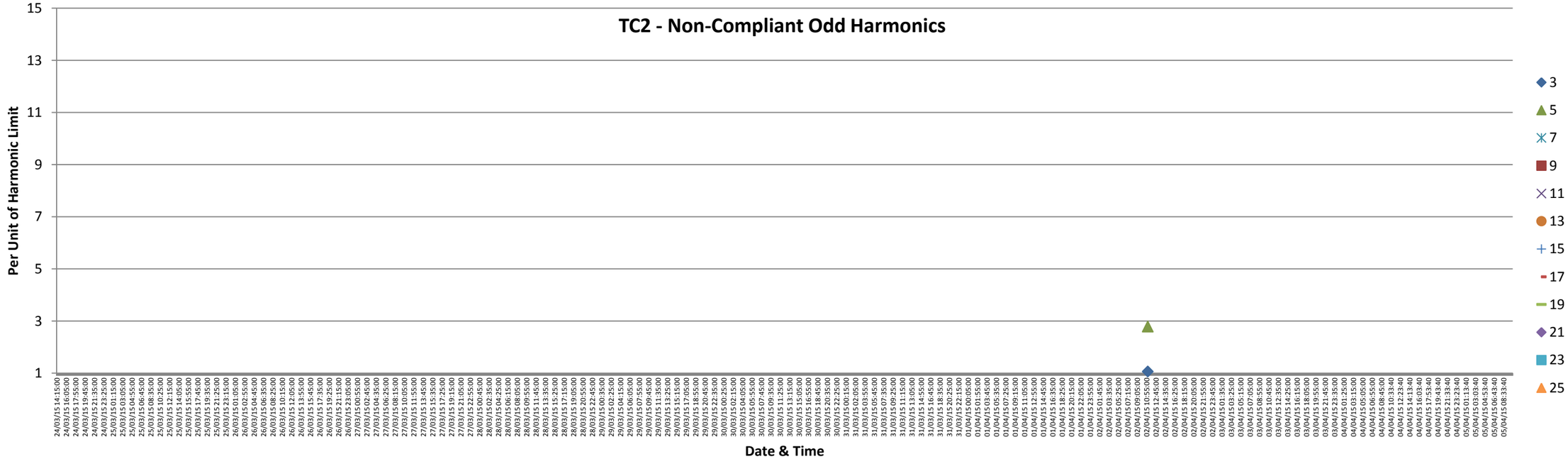


Figure 6 | TC2- Non-compliant odd harmonics

6.3. Feeder TC3

The PQ logger at the start of the TC3 feeder was installed in the PS108 Kurra Subdivision Area pad-mounted substation between 23/03/2015 and 30/03/2015, thus satisfying the 7 days minimum logging duration requirement.

The PQ logger at the end of the TC3 feeder was installed in the PS69 Giles Avenue substation between 23/03/2015 and 30/03/2015, thus satisfying the 7 days minimum logging duration requirement.

As shown in Figure 1 (purple-coloured feeder), TC3 originates from the Township Substation.

6.3.1. Flicker

The logged flicker data for the start and end of feeder-TC3 are shown in Figure 49 and Figure 52 of Appendix B (page 53), respectively.

Notable non-compliant flicker events and their respective magnitudes and effected-phases are shown in Table 7, which is under 0.2% on the measurement period.

Table 7 | TC3 - Summary of non-compliant flicker measurements

Date	Non-compliant Short Term Flicker Events	
	Feeder – TC3	
	Start of Feeder	End of Feeder
	Pst	*Pst*
24/3/2015 – 17:40:00	1.07 (B Phase)	1.03 (W Phase)
25/03/2015 – 17:40:00	1.64 (R Phase) & 1.28 (B Phase)	1.61 (R Phase) & 1.29 (B Phase)
27/03/2015 – 18:35:00		1.36 (R Phase)

6.3.1. Voltage Levels

The logged voltage level data for the start and end of feeder-TC3 are shown in Figure 50 and Figure 53 in Appendix B (page 53) respectively. There were no notable voltage limit events which caused the voltage level to breach The Code's limits, hence full compliance with the Code.

6.3.2. Frequency

The logged frequency data for the start and end of feeder-TC3 are shown in Figure 51 and Figure 54 in Appendix B (page 53) respectively. There were no notable voltage limit events which caused the voltage level to breach The Code's limits, hence full compliance with the Code.

6.3.1. Harmonics

The logged harmonic data for the start and end of feeder TC3 are shown in Figure 55 through Figure 62 in Appendix B (page 54). Of particular interest is the non-compliant harmonics that were measured by the PQ loggers (a very small fraction of the measurements). A summary of non-compliant even harmonics and the scale of their non-compliance are shown in Figure 7.

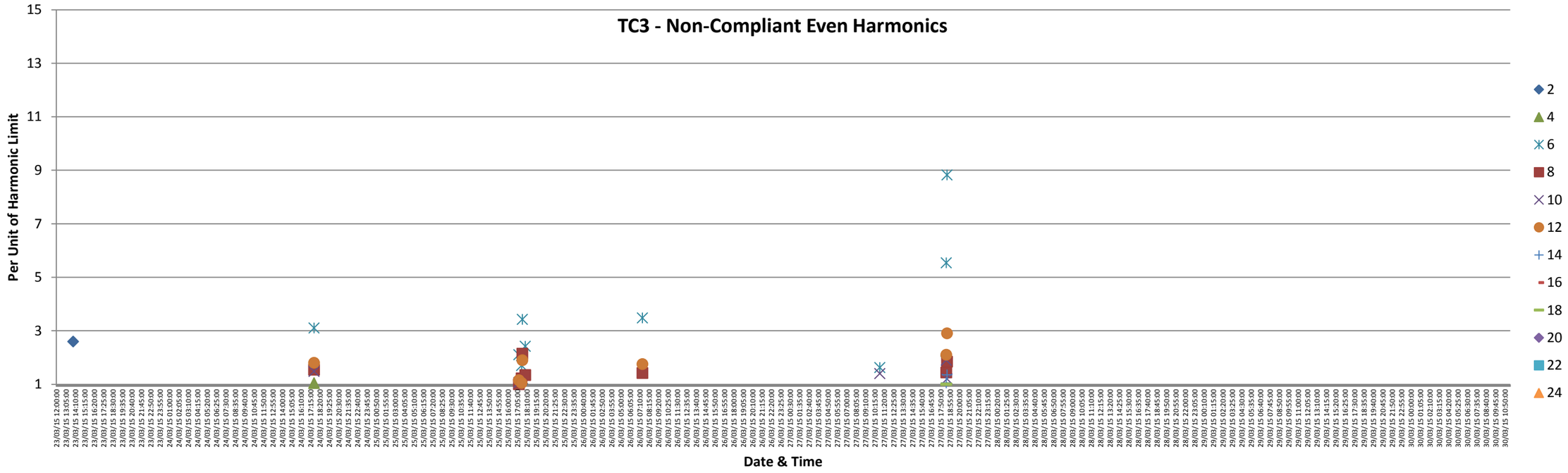


Figure 7 | TC3- Non-compliant even harmonics

6.4. Feeder TC4

The PQ logger at the start of the TC4 feeder was installed in the PS21 Nimingarra Drive pad-mounted substation between 4/04/2015 and 6/04/2015.

The PQ logger at the end of the TC4 feeder was installed in PS83 Airport substation between 28/03/2015 and 5/04/2015, thus satisfying the 7 days minimum logging duration requirement.

As shown in Figure 1 (light-green coloured feeder), TC4 originates from the Township Substation.

6.4.1. Flicker

The logged flicker data for the start and end of feeder-TC4 are shown in Figure 63 and Figure 66 of Appendix B (page 55) respectively.

The non-compliant flicker events and their respective magnitudes and effected-phases are shown in Table 8, which constitutes under 0.2% of the measurement period.

Table 8 | TC4 - Summary of non-compliant flicker measurements

Date	Non-compliant Short Term Flicker Events	
	Feeder – TC4	
	Start of Feeder	End of Feeder
	Pst	*Pst*
2/4/2015 – 11:10:00		1.01 (R Phase)
5/4/2015 – 14:25:00	1.91 (R Phase) 1.93 (W Phase) 2.91 (B Phase)	
5/4/2015 – 20:25:00	1.06 (R Phase)	

6.4.2. Voltage Levels

The logged voltage level data for the start and end of feeder-TC4 are shown in Figure 64 and Figure 67 in Appendix B (page 55) respectively. There was only one 5 minute interval where the upper and lower voltage limits were exceeded, as shown in Figure 8. The event occurred at 5/4/2015 14:22:47. The over- and under-voltage event(s) coincides with over-frequency data presented below in Section 6.4.3. Note that these are extremely rare and temporary incidents that cannot be of any l practical concern, hence no compliance issues is envisaged.

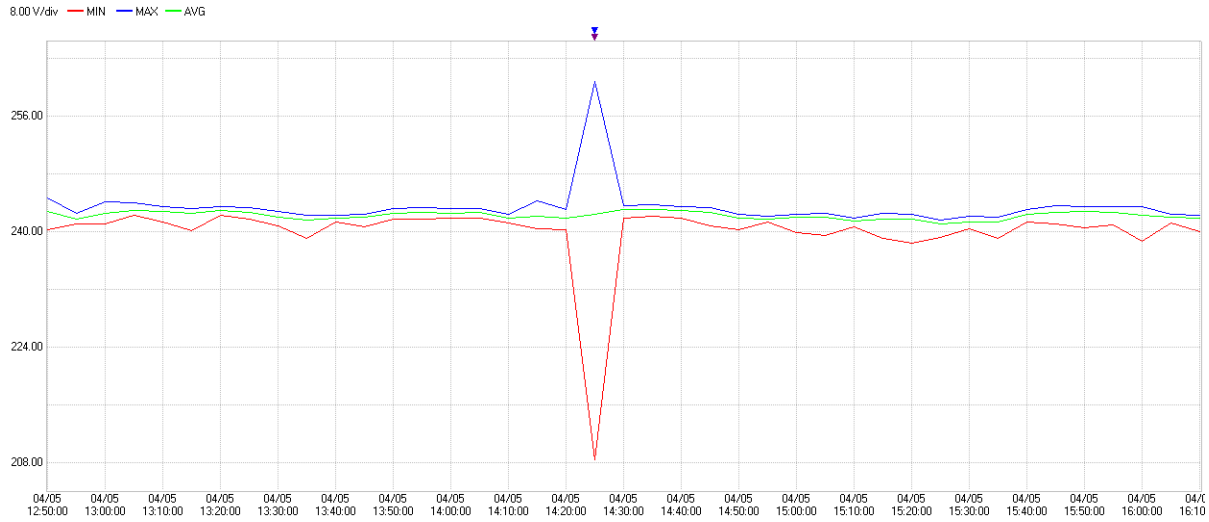


Figure 8 | TC4 – Over- and under-voltage event occurring at 5/4/2015 14:22:47

6.4.3. Frequency

The logged frequency data for the start and end of feeder-TC4 are shown in Figure 65 and Figure 68 in Appendix B (page 55) respectively. There was only one event where the *maximum* frequency elevated to 51.6 Hz; as shown in Figure 9. Again, the incident is of extremely low probability and unlikely to raise any practical concern due to its temporary and isolated nature.

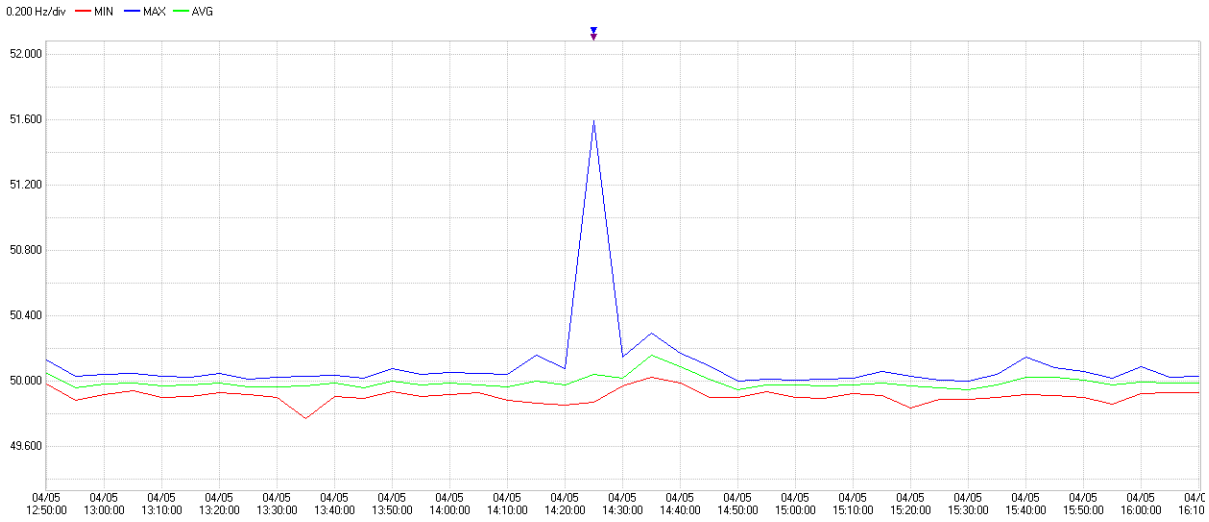


Figure 9 | TC4 – Over frequency event logged at the start of the feeder (5/4/2015 14:22:47)

6.4.1. Harmonics

The logged harmonic data for the start and end of feeder TC4 are shown in Figure 69 through Figure 76 in Appendix B (page 56). Of particular interest is the non-compliant harmonics that were measured by the PQ loggers (a very small fraction of the measurements). A summary of non-compliant harmonics and the scale of their non-compliance are shown in Figure 10 and Figure 11.

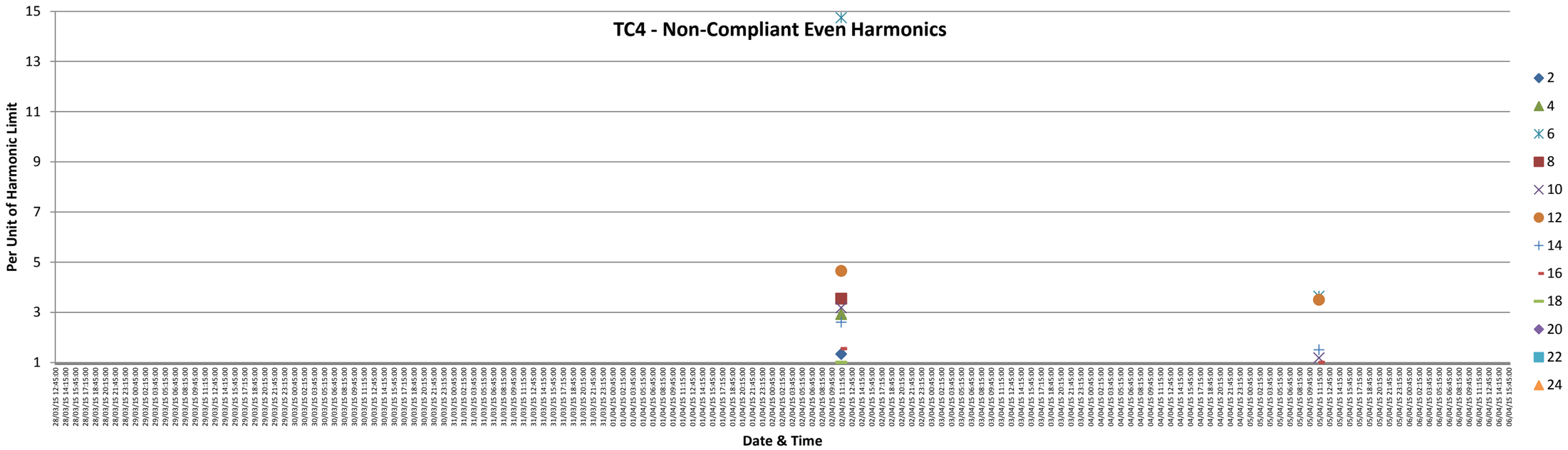


Figure 10 | TC4- Non-compliant even harmonics

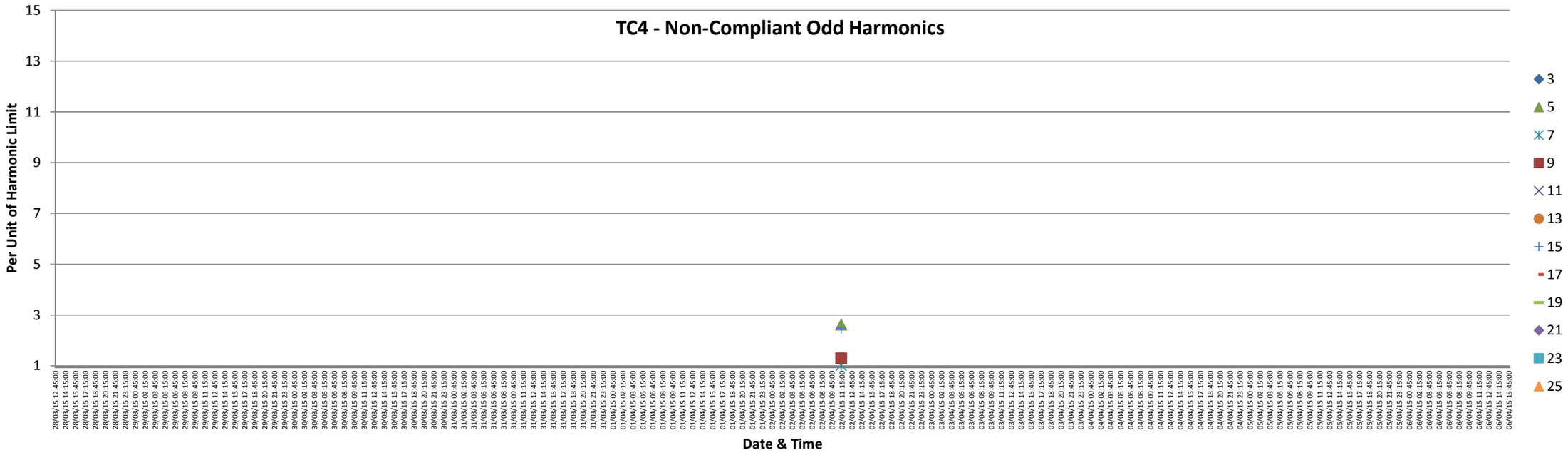


Figure 11 | TC4- Non-compliant odd harmonics

6.5. Feeder STS1

The PQ logger at the start of the STS1 feeder was installed in the PS94 Pardoo Street pad-mounted substation between 24/03/2015 and 31/03/2015, thus satisfying the 7 days minimum logging duration requirement.

The PQ logger at the end of the STS1 feeder was installed in PS96 Pardoo Street substation between 23/03/2015 and 31/03/2015, thus satisfying the 7 days minimum logging duration requirement.

As shown in Figure 1 (green-coloured feeder), STS2 originates from the Southtown Substation.

6.5.1. Flicker

The logged flicker data for the start and end of feeder-STS1 are shown in Figure 77 and Figure 80 of Appendix B (page 57), respectively.

Non-compliant flicker events and their respective magnitudes and effected-phases are shown in Table 9, constituting under 0.5% of the measurement samples.

Table 9 | STS1 - Summary of non-compliant flicker measurements

Date	Non-compliant Short Term Flicker Events	
	Feeder – STS1	
	Start of Feeder	End of Feeder
	Pst	*Pst*
24/3/2015 – 17:40:00	1.12 (W Phase)	1.13 (W Phase)
25/3/2015 – 17:40:00	1.78 (R Phase) 1.01 (W Phase) 1.32 (B Phase)	1.78 (R Phase) 1.01 (W Phase) 1.29 (B Phase)
27/3/2015 – 18:40:00	1.01 (R Phase)	1.02 (R Phase)

6.5.2. Voltage Levels

The logged voltage level data for the start and end of feeder-STS1 are shown in Figure 78 and Figure 81 respectively. There were no notable voltage limit events which caused the voltage level to breach The Code's limits, hence full compliance with the Code.

6.5.1. Frequency

The logged frequency data for the start and end of feeder-STS1 are shown in Figure 79 and Figure 81 in Appendix B (page 57) respectively. There were no notable voltage limit events which caused the voltage level to breach The Code's limits, hence full compliance with the Code.

6.5.1. Harmonics

The logged harmonic data for the start and end of feeder STS1 are shown in Figure 83 through Figure 90 in Appendix B (page 58). Of particular interest is the non-compliant harmonics that were measured by the PQ loggers (an extremely small fraction of the measurement). A summary of non-compliant harmonics and the scale of their non-compliance are shown in Figure 12 and Figure 13.

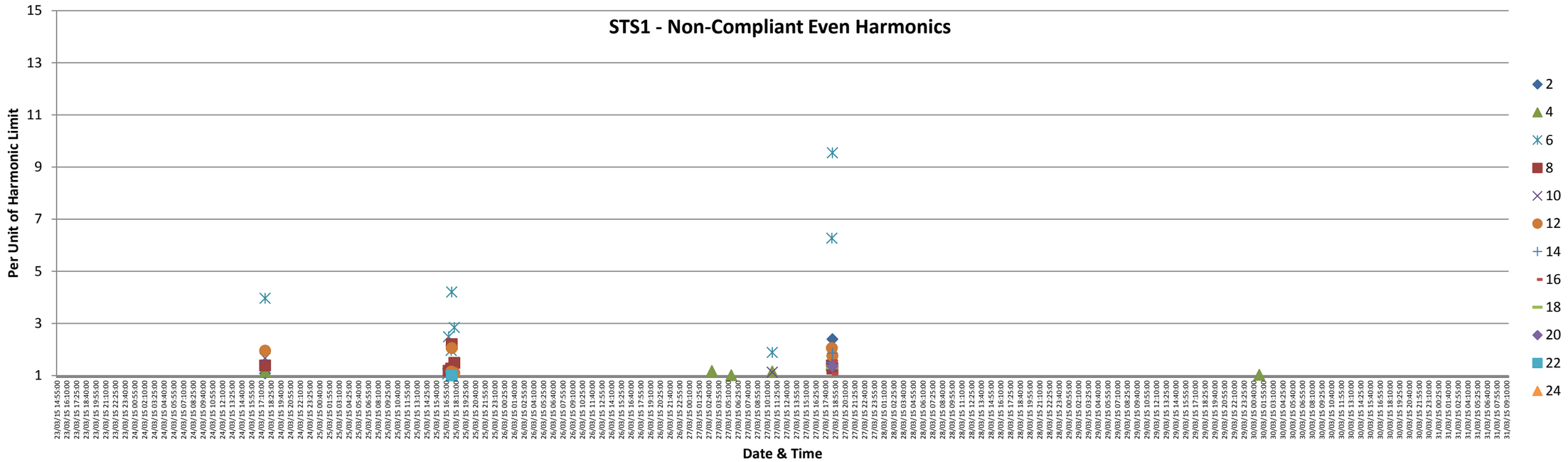


Figure 12 | STS1- Non-compliant even harmonics

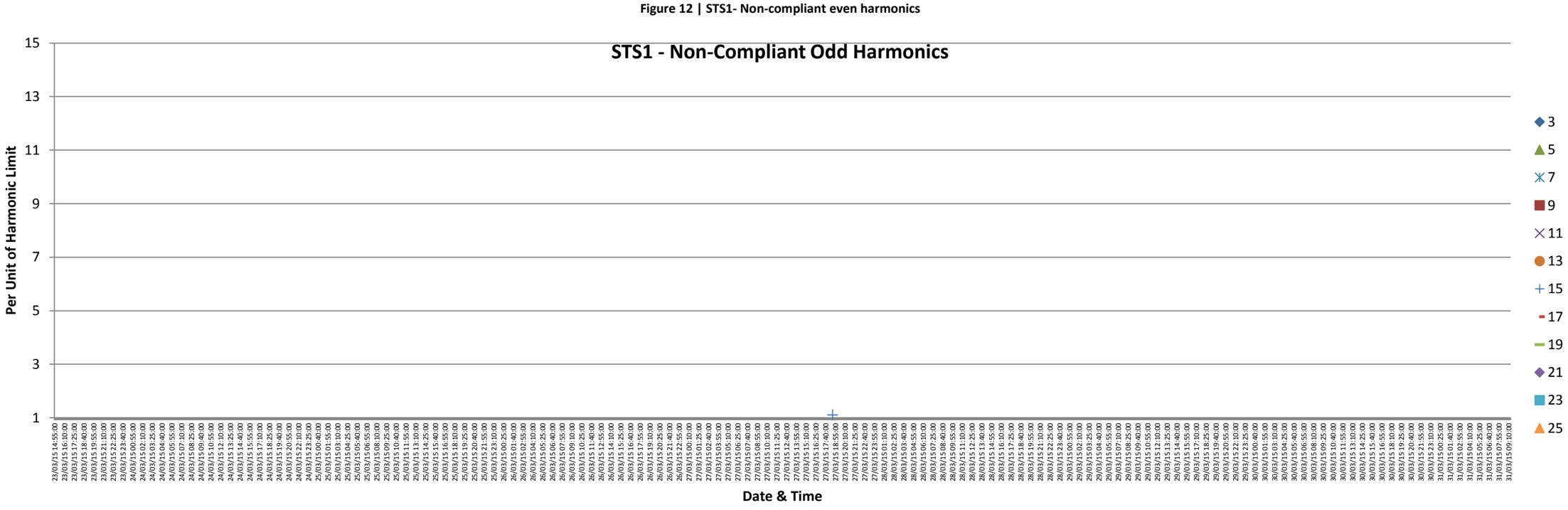


Figure 13 | STS1- Non-compliant odd harmonics

6.6. Feeder STS2

The PQ logger at the start of the STS2 feeder was installed in the PS60 Forrest Avenue pad-mounted substation between 24/03/2015 and 1/04/2015, thus satisfying the 7 days minimum logging duration requirement.

The PQ logger at the end of the STS2 feeder was installed in the T70 Jabbarup Crescent substation between 25/03/2015 and 1/04/2015, thus satisfying the 7 days minimum logging duration requirement.

As shown in Figure 1 (grey-coloured feeder), STS2 originates from the Southtown Substation.

6.6.1. Flicker

The logged flicker data for the start and end of feeder-STS2 are shown in Figure 91 and Figure 94 of Appendix B (page 59) respectively.

Non-compliant flicker events and their respective magnitudes and effected-phases are shown in Table 10, constituting a very small fraction (i.e., <0.2%) of the measurements.

Table 10 | STS2 - Summary of non-compliant flicker measurements

Date	Non-compliant Short Term Flicker Events	
	Feeder – STS2	
	Start of Feeder	End of Feeder
	Pst	*Pst*
24/3/2015 – 17:45:00	1.10 (W Phase)	
25/3/2015 – 17:45:00	1.74 (R Phase) 1.30 (B Phase)	1.71 (R Phase) 1.29 (B Phase)
27/3/2015 – 18:35:00	1.44 (R Phase)	1.44 (R Phase)

6.6.2. Voltage Levels

The logged voltage level data for the start and end of feeder-STS2 are shown in Figure 92 and Figure 95 in Appendix B (page 59) respectively. There were no notable voltage limit events which caused the voltage level to breach The Code's limits, hence full compliance with the Code.

6.6.1. Frequency

The logged frequency data for the start and end of feeder-STS2 are shown in Figure 93 and Figure 95 in Appendix B (page 59) respectively. There were no notable voltage limit events which caused the voltage level to breach The Code's limits, hence full compliance with the Code.

6.6.1. Harmonics

The logged harmonic data for the start and end of feeder STS2 are shown in Figure 97 through Figure 104 in Appendix B (page 60). Of particular interest is the non-compliant harmonics that were measured by the PQ loggers, which again constitute a very small fraction of the measurement period with limits not being met. A summary of non-compliant harmonics and the scale of their non-compliance are shown in Figure 14 and Figure 15.

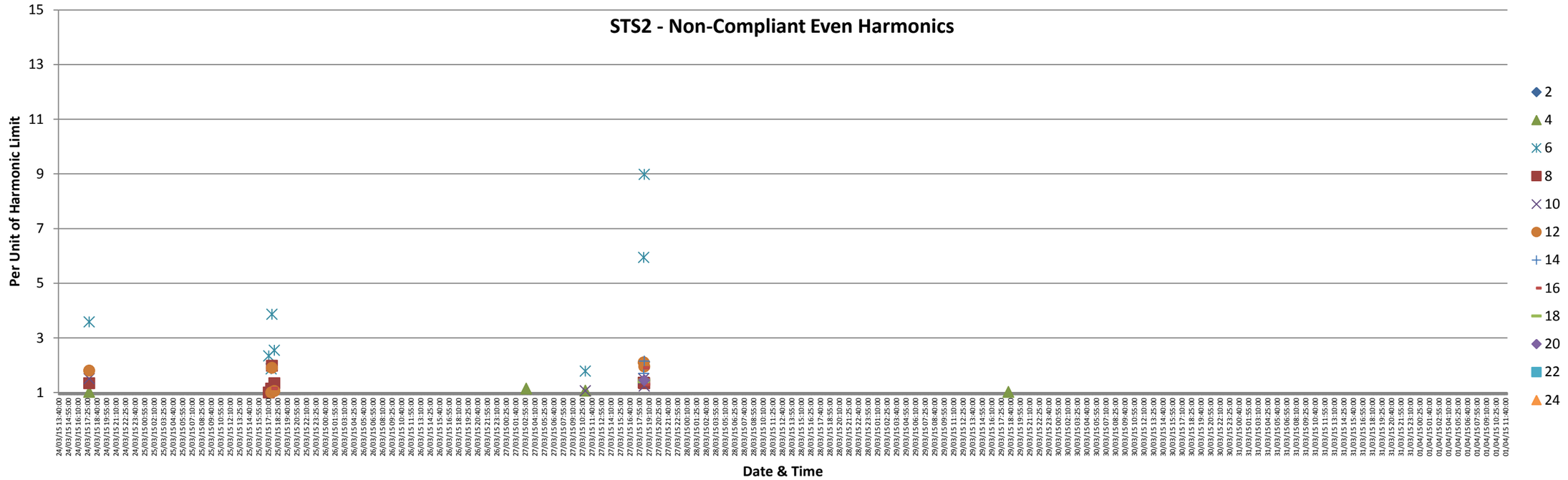


Figure 14 | STS2- Non-compliant even harmonics

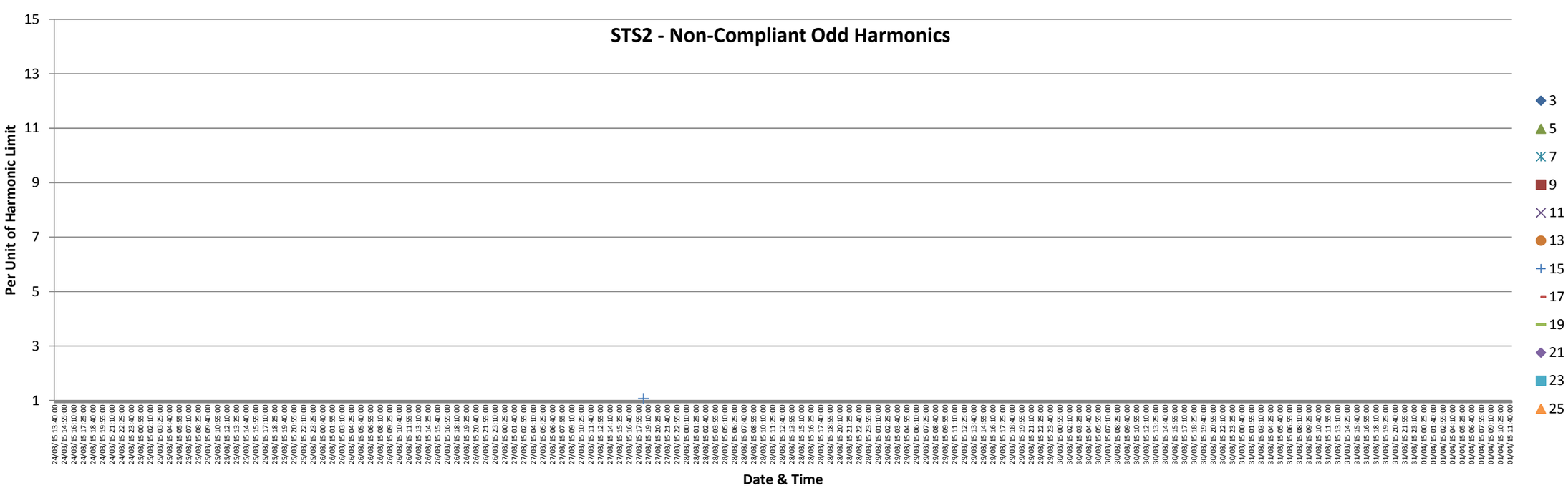


Figure 15 | STS2- Non-compliant odd harmonics

6.7. Feeder STS6

The PQ logger at the start of the STS6 feeder was installed in the T80 Old LIA pad-mounted substation between 28/03/2015 and 5/04/2015, thus satisfying the 7 days minimum logging duration requirement.

The PQ logger at the end of the STS6 feeder was installed in the T41 Newman Drive substation between 24/03/2015 and 4/04/2015, thus satisfying the 7 days minimum logging duration rule.

As shown in Figure 1 (yellow-coloured feeder), STS2 originates from the Southtown Substation.

6.7.1. Flicker

The logged flicker data for the start and end of feeder- STS6 are shown in Figure 105 and Figure 108, respectively.

Non-compliant flicker events and their respective magnitudes and effected-phases constitute an extremely small fraction (<0.2%) of the measurements, as shown in Table 11.

Table 11 | STS6 - Summary of non-compliant flicker measurements

Date	Non-compliant Short Term Flicker Events	
	Feeder – STS6	
	Start of Feeder	End of Feeder
	Pst	*Pst*
24/3/2015 – 17:45:00		1.05 (W Phase)
25/3/2015 – 17:45:00		1.64 (R Phase) 1.27 (B Phase)
27/3/2015 – 18:35:00		1.37 (R Phase)
2/4/2015 – 11:09:38	1.10 (B Phase)	
2/4/2015 – 11:15:00		1.02 (R Phase)

6.7.2. Voltage Levels

The logged voltage level data for the start and end of feeder-STS6 are in Figure 106 and Figure 108 in Appendix B (page 61) respectively. There were no notable voltage limit events which caused the voltage level to breach The Code's limits, hence full compliance with the Code.

6.7.1. Frequency

The logged frequency data for the start and end of feeder-STS6 are shown in Figure 107 and Figure 109 in Appendix B (page 61) respectively. There were no notable voltage limit events which caused the voltage level to breach The Code's limits, hence full compliance with the Code.

6.7.1. Harmonics

The logged harmonic data for the start and end of feeder STS6 are shown in Figure 111 through Figure 118 in Appendix B (page 62). Of particular interest is the non-compliant harmonics measured by the PQ loggers, which is a very small fraction of the measurement data. A summary of non-compliant harmonics and the scale of their non-compliance are shown in Figure 16 and Figure 17.

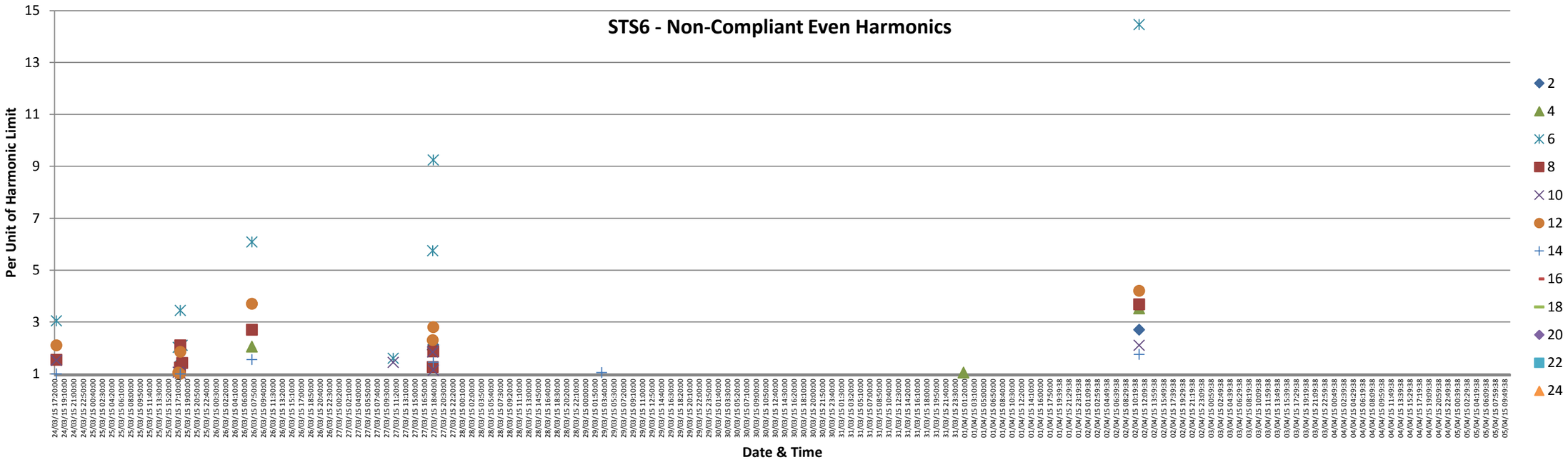


Figure 16 | STS6- Non-compliant even harmonics

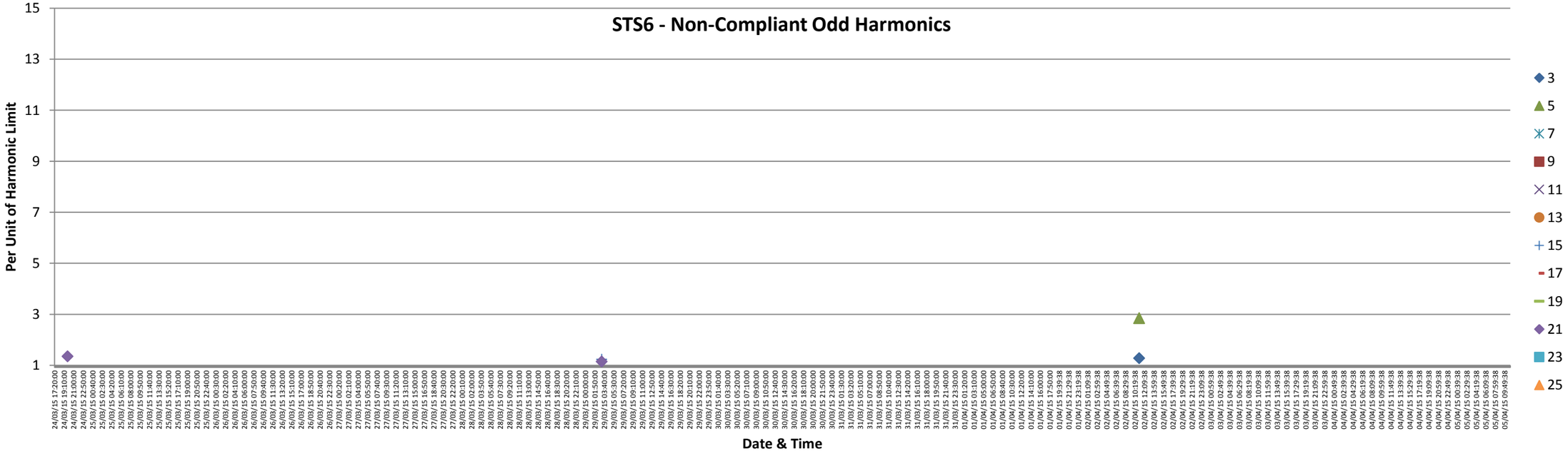


Figure 17 | STS6- Non-compliant odd harmonics

7. RESPONSE TO THE CODE REQUIREMENTS

This section contains all of the information required for compliance reporting as detailed in The Code "Schedule 1 - Information to be published" and "Part 2 – Quality and reliability standards".

7.1. Quality and Reliability Standards (Part 2)

7.1.1. Voltage Fluctuations (Part 2 Division 1 Quality Standards Section 6(2))

The voltage fluctuations (flicker) of electricity supplied must not exceed the compatibility levels for long- and short-term flicker as described in Section 5.1.1.

The PQ logging results indicate a small number of voltage fluctuation breaches on all feeders supplying the township network during the logged periods. Table 12 presents the results for the previous three reporting periods together with the 2014/2015 result. The dates and times of their occurrence are shown in Table 13.

Given the results presented in Table 12, a significant improvement is observed over the 2014/15 FY compared to the measurements of the years before.

Table 12 | Total number of breaches of voltage fluctuation compatibility levels

Description	Reportable Period			
	2011/2012	2012/2013	2013/2014	2014/2015
Total number of breaches of *Pst*	16	5	79	5
Total number of breaches of *Plt*	6	1	72	1

Table 13 | Dates and times of non-compliant short-term flicker events

Date	Time
24/03/2015	17:45:00
25/03/2015	17:45:00
27/03/2015	18:35:00
2/04/2015	11:09:38
5/04/2015	14:25:00

7.1.2. Harmonics (Part 2 Division 1 Quality Standards Section 7)

Within the Code, there are two measures for assessing the power quality of the Newman network. The two measures are:

1 Assessment of individual harmonics and a comparison of their magnitudes against the table in Part 2, Division 1, Section 7 of The Code; and

2 Assessment of the calculated Voltage Total Harmonic Distortion (U-THD) and a comparison of its magnitude with The Code's compliant value of 8%.

7.1.2.1. Individual Voltage Harmonics

Individual, non-compliant harmonics for each respective feeder are already presented in Section 6.

7.1.2.2. Voltage Total Harmonic Distortions

The voltage harmonic distortion levels of electricity supplied must not exceed the Voltage Total Harmonic Distortion (U-THD) of 8% stated in Part 2, Division 1, Section 7 of the Code. Table 14 presents the results for the previous three reporting periods together with the 2014/2015 result. In the 2014/2015, a single event occurred where the *maximum* U-THD was greater than the 8% limit. The *average* of the U-THD was consistently well within the 8% limit.

Table 14 | Total number of breaches of total harmonic distortion limit

Description	Reportable Period			
	2011/2012	2012/2013	2013/2014	2014/2015
Total number of breaches of Voltage Total Harmonic Distortion	2	0	0	1

7.1.3. Voltage Level Compliance (Part 2 Division 2 Quality Standards Section 8 Note (a))

This information is not required as part of the reporting requirements of The Code. It has been included here to provide a more complete indication of supply PQ.

According to AS60038-2000 Standard Voltages Section 2, the voltage levels of the electrical network must be maintained at +10% and -6% of the supply voltage of 230V single-phase.

As the voltage measurements were taken at the secondary (LV) side of the pad-mounted transformers located at the beginning and the end of each feeder supplying the township, the voltage level at the customer's connection point would be lower than the logged results. The voltage drop due to customers' loads must be limited to 5%, in accordance to AS 3000. The lowest averaged minimum voltage levels recorded during the PQ logging period was 236V (end of TC4). Therefore, it is expected that the voltage level at the customer's connection would be within the required range.

Table 15 presents the results for the previous three reporting periods together with the 2014/2015 result. In 2014/2015, there were two instances where the voltage level breached the voltage limits. Incidentally the two breaches probably occurred in the same event as the two results occurred in the same 5 minute interval.

Table 15 | Total number of breaches of voltage level limits

Description	Reportable Period			
	2011/2012	2012/2013	2013/2014	2014/2015
Total number of breaches of voltage limits	15	8	0	2

7.1.4. Frequency Compliance (Part 2 Division 2 Quality Standards Section 8 Note (b))

According to Electricity Act 1945 Section 25(1)(d), the frequency of electricity supplied must be maintained at +/-2.5% of the frequency of 50 cycles per second. This information is not required as part of the reporting requirements of The Code. It has been included here to provide a more complete indication of supply PQ.

Table 16 presents the results for the previous three reporting periods together with the 2014/2015 result. For the 2014/2015 PQ logging period, there was only one instance where the frequency reached 51.6 Hz (greater than the 51.25 Hz upper limit).

Table 16 | Total number of breaches of frequency limits

Description	Reportable Period			
	2011/2012	2012/2013	2013/2014	2014/2015
Total number of breaches of frequency limits	0	0	0	1

7.2. Remedial actions taken for breaches of provisions (Schedule 1 Item 4 (b))

Newman BHPBIOSA is found very pro-active in establishing and executing asset replacement programs in order to sustain and improve power quality and reliability.

To ensure compliance to Australian Standards, BHPBIOSA proactively undertake annual power quality (PQ) logging on the 11kV supply feeders from both Whaleback and Township Substations during the summer period. Improvements are continuously implemented based on the PQ logging data results, and complaints received from customers related to power quality issues.

Asset replacements including:

- Re-conductoring of Homestead Creek and TC3 feeder.
- Replacement of distribution transformers and associated assets in the Yalara ring; within Newman centre; including 16 pad-mounted substations.

Additionally, a 'Raiser Bracket' replacement program has been successfully completed which has significantly reduced the number of customer call-outs and complaints.

The standardisation of assets, particularly strategic spares, has been considered by BHPBIOSA. The manufacturer and size of pole-top transformers has been reduces to two standard transformers; hence standardising design, procurement, construction and maintenance.

7.3. Supply interrupted (Schedule 1 Item 5)

The provisions of The Code have the following requirements:

> *"The number of premises of small use customers the supply of electricity to which has been interrupted —*
>
> > *(a) for more than 12 hours continuously; or*
> >
> > *(b) more than the permitted number of times, as that expression is defined in section 12(1),*
>
> *and in the case of interruptions referred to in paragraph (a), the number of interruptions and the length of each interruption."*

7.3.1. Interruptions Exceeding 12 Hours

Table 17 presents the interruptions over 12 Hours for small use customer, with no such interruptions recorded for 2014/15 FY.

Table 17 | Total number of premises of small customers interrupted continuously for more than 12 hours

Description	Reportable Periods			
	2011/2012	2012/2013	2013/2014	2014/2015
Total number of premises that experienced interruptions more than 12 hours	0	1	5	0

7.3.2. Frequent Interruptions (over 16 Instances)

The permitted number of times a customer can be disconnected in the Newman Township is 16 interruptions as per Section 12. (1) (b) of The Code. Analysis of BHPBIOSA's outage logs indicate that the no customers were disconnected move than 15 times.

Table 18 | Total number of premises that experienced more than 16 interruptions

Description	Reportable Periods			
	2011/2012	2012/2013	2013/2014	2014/2015
Total number of premises that experienced interruptions more than 16 times	0	0	0	0

7.4. Number of complaints received (Schedule 1 Item 6 and Item 10)

According to Schedule 1, "complaint" means that a provision of Electricity Code 2005 Part 2; or an instrument made under Electricity Code 2005 Section 14(3), has not been, or is not being, complied with. For the reporting period, a total of 3 complaints were made, each associated with billing issues, hence no complaints received on the reilabity or quality of the supply.

Table 19 | Total number of formal complaints lodged to BHPBIOSA

Description	Reportable Periods			
	2011/2012	2012/2013	2013/2014	2014/2015
Total number of formal complaints received	0	0	0	0

7.5. Complaints received in each discrete area (Schedule 1 Items 7 & 10)

The township of Newman is supplied from an integrated network and there are no discrete areas.

7.6. Total amount spent addressing complaints (Schedule 1 Items 8 & 10)

There has been no technical complaint over the 2014/15 FY that required BHPBIO's action. However, the complaints related to bill issues which were resolved by the retailing and billing contractor (MBC Global).

7.7. Investments over 2014/2015 FY to improve the Reliability of Supply & Power Quality

Table 20 shows the total AUD amount spent in improving the supply quality and reliability and to cater for network expansion. It is evident that the investment over 2014/15 FY is larger than those of previous years.

Table 20 | Total amount spent by BHPBIOSA in network improvements

Description	Reportable Periods			
	2011/2012	2012/2013	2013/2014	2014/2015
Total amount spend in dollars (AUD)	$8.18 million	$13.68 million	$14.90 million	$16.90 million

7.8. Number and Total amount of payments made (Schedule 1 Items 9 & 10)

This section outlines the total number of payments and the amount of those payments made by BHPBIOSA under Sections 18 and 19 of the Code. That is payment for failure to give the require notice of planned interruptions and payments for supply interruptions exceeding 12 hours. The was no supply interruptions exceeding 12 hours or small customer being disconnected for over 16 times, hence no payment needed to be made.

Table 21 | Total number and amount of payments made under Sections 18 and 19

Description	Reportable Periods			
	2011/2012	2012/2013	2013/2014	2014/2015
Total number of payments	0	0	0	0
Total amount of payments (AUD)	0	0	0	0

7.9. Reliability of Supply (Schedule 1 Item 11)

This section covers the requirements of Item 11 of Schedule 1 of The Code, as reproduced below:

1. *"For each discrete area —*
    - *(a) the average length of interruption of supply to customer premises expressed in minutes;*
    - *(b) the average number of interruptions of supply to customer premises;*
    - *(c) the average percentage of time that electricity has been supplied to customer premises; and*
    - *(d) the average total length of all interruptions of supply to customer premises expressed in minutes."*

In this report, the township of Newman is considered the *discrete area*.

7.9.1. Average interruption (Schedule 1 Items 11 (a), 12 and 13)

The average length of interruption of supply to customer premises for the Newman township electrical network is measured in minutes over the course of the 2014/2015 FY.

Table 22 | The average length of interruption of supply to customer premises expressed in minutes (CAIDI)

Description	Reportable Period				
	2011/2012	2012/2013	2013/2014	2014/2015	Average
Average length of interruptions - CAIDI (minutes)	167	95	132	80	118

7.9.2. Average number of interruptions (Schedule 1 Items 11 (b), 12 and 13)

The average number of interruptions of supply to customer premises for the township of Newman is shown in Table 23 .

Table 23 | The average number of interruptions of supply to customer premises (SAIFI)

Description	Reportable Period				
	2011/2012	2012/2013	2013/2014	2014/2015	Average
Average supply interruptions – SAIDI (No. of Interruptions)	1.18	2.59	2.40	4.23	2.6

7.9.3. Average percentage of time electricity supplied (Schedule 1 Items 11 (c), 12 and 13)

The average percentage of time that electricity has been supplied to customer premises is shown in Table 24.

Table 24 | The average percentage of time that electricity has been supplied to customer premises (ASAI)

Description	Reportable Period				
	2011/2012	2012/2013	2013/2014	2014/2015	Average
Average number of supply interruptions ASAI (Percentage of time connected)	99.96%	99.95%	99.94%	99.94%	99.95

7.9.4. Average total length of all interruptions (Schedule 1 Items 11 (d), 12 and 13)

The average total length of all interruptions of supply to customer premises, expressed in minutes, is shown in Table 25 .

Table 25 | The average total length of all interruptions of supply to customer premises in minutes (SAIDI)

Description	Reportable Period				
	2011/2012	2012/2013	2013/2014	2014/2015	Average
SAIDI (minutes)	198	245	318	339	275

7.10. Percentile Values (Schedule 1 Items 14 and 15)

This section outlines the response to schedule 1 items 14 and 15 of the Code. An extract from the code requirements is shown below:

Item 14: *"For customer premises in each discrete area, an estimate of the 25th, 50th, 75th, 90th, 95th, 98th and 100th percentile values of —*

(a) the average length of interruption referred to in item 11(a);

(b) the number of interruptions; and

(c) the total length of interruptions."

Item 15: *"For each category of information in item 14(a), (b) and (c), a graph showing the distribution of customer premises across the range of that category."*

7.10.1. Percentile – Average Length of Interruption

As required by 'Schedule 1' of The Code, Table 26 presents the CAIDI results on a percentile basis.

Table 26 | Percentile of the average length of interruption of supply to customer premises in 2014/2015

Description	25th	50th	75th	90th	95th	98th	100th
Average Length of Interruption (CAIDI)	106	90	80	80	80	80	80

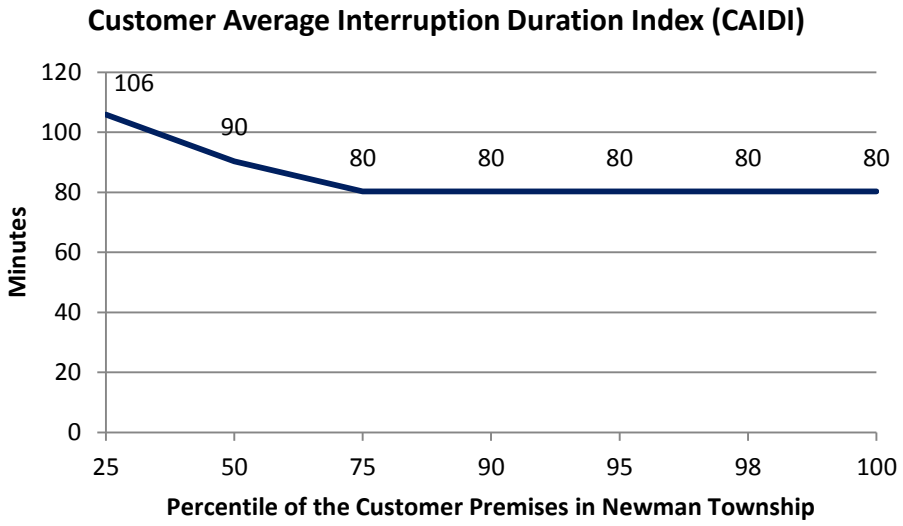


Figure 18 **| The average length of interruption (minutes) of supply to customers over 2014/2015 FY**

7.10.2. Percentile - Number of interruptions

As required by 'Schedule 1' of The Code, Table 27 presents the SAIFI results on a percentile basis.

Table 27 | Percentile values of the number of interruptions in 2014/2015

Description	25th	50th	75th	90th	95th	98th	100th
Number of interruptions (SAIFI)	2.09	3.6	4.2	4.2	4.2	4.2	4.2

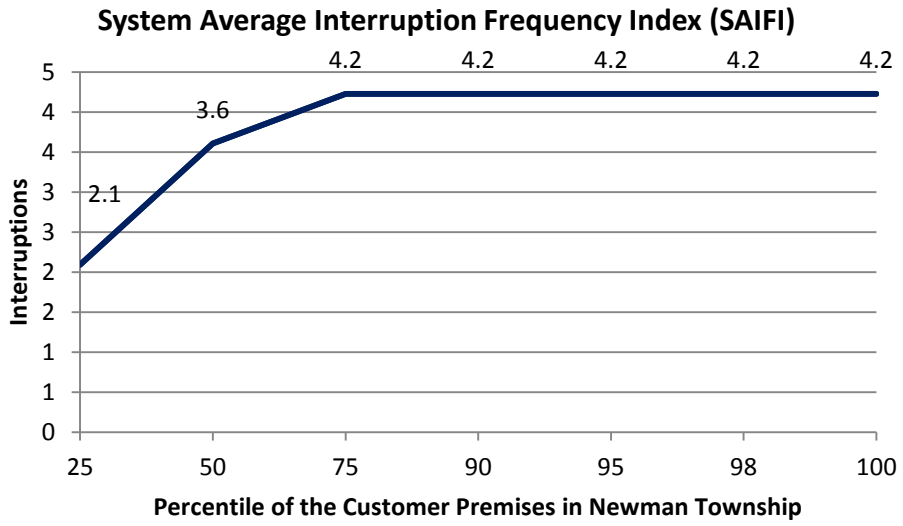


Figure 19 | Percentile graph showing the number of interruptions in 2014/2015

7.10.3. Percentile - Total Length of Interruptions

As required by 'Schedule 1' of The Code, Table 28Table 27 presents the SAIDI results on a percentile basis.

Table 28 | Percentile values of the total length of interruptions in 2014/2015

Description	25th	50th	75th	90th	95th	98th	100th
Total lengths of interruptions (SAIDI)	222	326	339	339	339	339	339

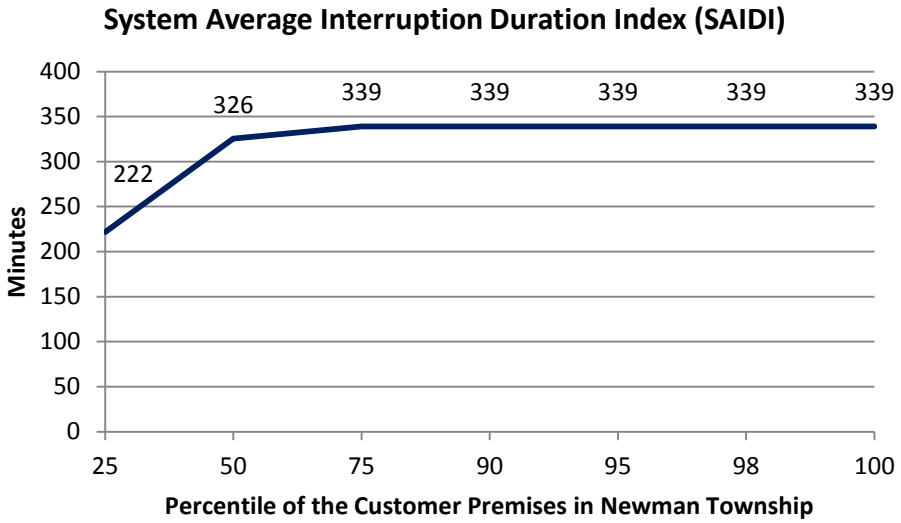


Figure 20 | Percentile graph showing the total length of interruptions (SAIDI) in 2014/2015

8. CONCLUSION

This report addresses all relevant parts; in particular the power quality standards pertaining to each of Newman's 11kV supply network and the reportable requirements as per Part 2 and Schedule 1 of the Code.

With regards to the PQ standards, the *average* values of all electrical parameters logged over the monitoring period of around a week were found well within the limit stipulated by the Code. That is, the *average* of the following parameter easily complied with the Code:

- Flicker, as per Part 3.7, Clause 3 of AS 61000:2001
- RMS Voltage
- Power System Frequency
- Voltage
- Voltage Total Harmonic Distortion (U-THD)

Note that there are a very limited number of instances (i.e., under 0.5% of the measurement period) where the maximum magnitude of certain electrical parameters were found to exceed the limits prescribed by the Code. However, this is not deemed as a major compliance issue due to the temporary and extremely isolated nature of the instances.

Reportable parameters for Newman Township Electricity Supply over the 2014/15 FY (as outlined in the 'Schedule 1' of the Code) are presented below:

- >12 hour interruptions: no interruption of over 12 hours duration is recorded for *small use customers*.
- No *small use customer* was disconnected from the network more frequent than the Code's requirements (i.e., limit of 16 times).
- A total of 3 complaints were received, which were all related to the billing issues; hence no complaints made by customer on the quality or reliability of supply.
- Within the 2014/15 FY, a total of $16.9M (AUD) was invested by the network operator (BHPBIOSA) towards Newman network operations, maintenance and reinforcement works; to not only address the issues identified by the operator but also to significantly improve the quality and reliability of supply.
- The key reliability indices are calculated as listed below:
    - *Customer Average Interruption Duration Index* (CAIDI) of 80 minutes – CAIDI is the average outage duration that any given customer experience (i.e., the average restoration time).
    - *System Average Interruption Frequency Index* (SAIFI) of 4.23 interruptions – SAIFI is the number of interruptions that the customers experienced.
    - *Average Service Availability Index* (ASAI) of 99.94% – ASAI is the perceived availability of the network to the customers.
    - *System Average Interruption Duration Index* (SAIDI) of 339 minutes – SAIDI is the average outage duration for each customer served.

The metering data collected from 14 locations throughout the Newman network indicate that the power quality, *as so far as is reasonably practical*, is compliant with The Code. However there were a number of instances where certain power quality variables did not meet the Code's requirements.

With regards to reliability, the Supply Authority's outage data indicate that there were a number of feeder trips (including the loss of complete zone substations) which have affected the reliability indices. In some cases the substation outages were a result of human error or mal-operation of protection. In other cases, genuine backbone feeder faults have resulted in large-scale loss of customers due to the correct operation of protection.

In summary, this report finds the reliability and quality of the supply for Newman Township network in compliance with the Code's requirements; however, there are areas that require the BHPBIOSA's attention and investment to ensure improved quality of electricity supply in the upcoming years.

APPENDIX A PQ Logging Device

HIOKI

POWER QUALITY ANALYZER PW3198

Power Measuring Instruments

Record and Analyze Power Supply Problems Simultaneously with a Single Unit

The New World Standard for Power Quality Analysis

Never Miss the Moment

- Detect power supply problems and perform onsite troubleshooting
- Do preventive maintenance to avert accidents by managing the power quality

CAT IV-600V Safety Standard

- Meets the CAT IV safety rating required to check an incoming power line
- Safe enough to measure up to 6,000Vpeak of transient overvoltage

Easy Setup Function with PRESETS

- Just select the measurement course, wiring, and clamps
- Automatic one-step setup based on measurement conditions

Compliant with New International Standards

- International power quality measurement standard IEC 61000-4-30 Edition 2 Class A
- High precision with a basic voltage measurement accuracy of 0.1%

CE

ISO 9001 JMI-0216

ISO14001 JQA-E-90091

www.hioki.com

HIOKI company overview, new products, environmental considerations and other information are available on our website.

One Single Unit Can Solve All Your Power Supply Problems

The number of power supply problems is increasing as power systems are becoming more and more complicated - all due to the rising use of power electronics devices plus a growing installed base of large systems and distributed power supplies. The quickest way to approach these problems is to understand the situation quickly and accurately. The PW3198 Power Quality Analyzer is ready to effectively solve your power supply problems.

Troubleshooting

- ✔ Understand the actual power situation at the site where the problem is occurring (e.g., the equipment malfunction, failure, reset, overheating, or burning damage).
- ✔ Ideal for troubleshooting solar and wind power generation systems, EV charge stations, smart grids, tooling machines, OA equipment (e.g., computers, printers, and UPS), medical equipment, server rooms, and electrical equipment (e.g., transformers and phase-advancing capacitors).

Field Survey and Preventive Maintenance

- ✔ Perform long-term measurements of the power quality and study problems that are difficult to detect or that occur intermittently.
- ✔ Maintain electrical equipment and check the operation of solar and wind power generation systems.
- ✔ Manage the parameters with a control set point, such as a voltage fluctuation, flicker, and harmonic voltage.

Power (Load) Survey

- ✔ Study the power consumption and confirm system capacity before adding load.

Advanced Features for Safe, Simple, and Accurate Measurements

1 International Standard IEC61000-4-30 Edition 2 Class A

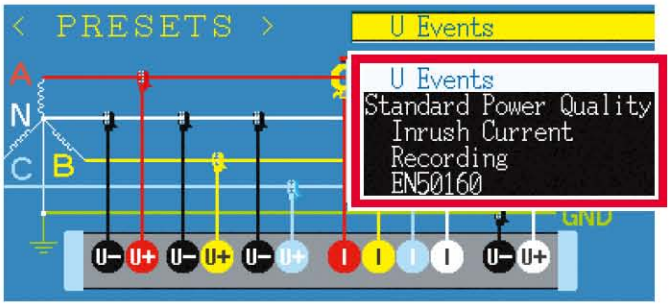
Class A is defined in the international standard IEC61000-4-30, which specifies compatibility with power quality parameters, accuracy, and standards to enable comparison and discussion of the measurement results of different measuring instruments.

The PW3198 is compliant with the latest IEC61000-4-30 Edition 2 Class A standard. The instrument can perform measurements in accordance with the standard, including continuous gapless calculation, methods to detect events such as dip, swell, and instantaneous power failure, and time synchronization using the optional GPS box.

2 CAT IV-600V Safety

The PW3198 is compliant with the measurement category CAT IV - 600V and can also safely test the incoming lines for both single-phase and three-phase power supplies.

3 Easy to set up - Just select the measurement course and the PW3198 will do the rest

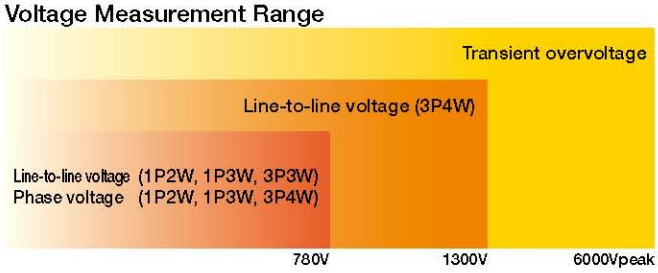


Simply choose the course based on the measurement objective and the necessary configurations will be set automatically.

U Events	Record voltage and frequency and detect errors simultaneously.
Standard Power Quality	Record voltage, current, frequency, and harmonic, and detect errors simultaneously.
Inrush current	Measure the inrush current.
Recording	Record only the TIME PLOT Data but do not detect errors.
EN50160	Perform measurements in accordance with EN50160.

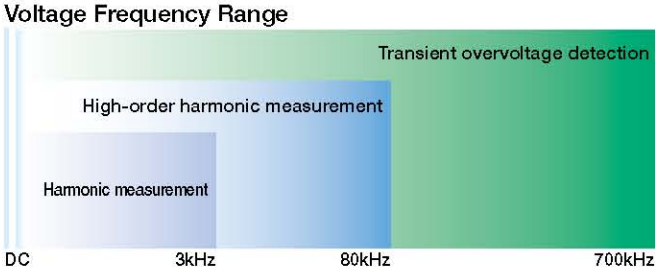
4 Highly Accurate, Broadband, Wide Dynamic Range Makes for Reliable Measurements

Voltage Measurement Range



Both low and high voltages can be measured in a single range.

Voltage Frequency Range



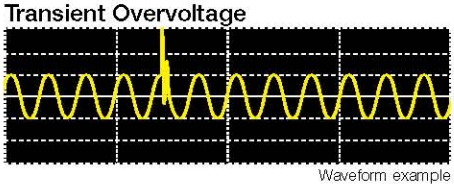
Wide range from DC voltage to 700 kHz

Basic Measurement Accuracy (50/60 Hz)

Voltage	±0.1% of nominal voltage
Current	±0.2% rdg. ±0.1% f.s. + Clamp-on sensor accuracy
Power	±0.2% rdg. ±0.1% f.s. + Clamp-on sensor accuracy

World's highest level of basic measurement accuracy. Extremely accurate voltage measurement without the need to switch ranges.

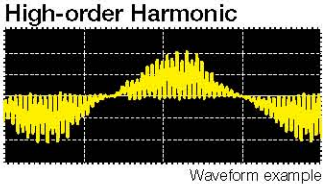
Transient Overvoltage



Waveform example

Transient overvoltage can also be measured in a range between the maximum 6,000 V and minimum 1 µs (2 MS/s).

High-order Harmonic



Waveform example

The PW3198 is the first power quality analyzer that can measure the high-order harmonic component of up to 80 kHz.

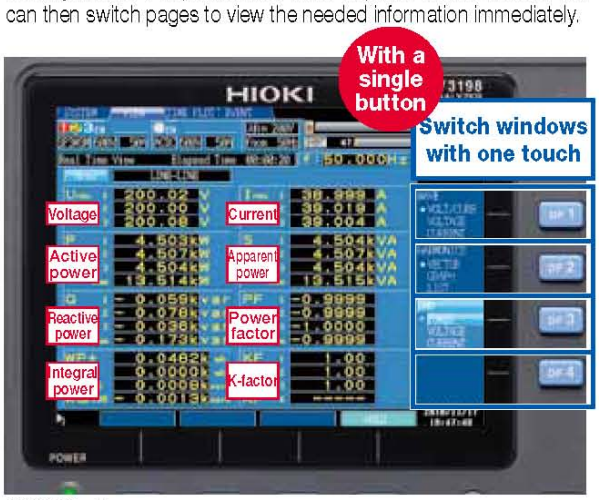
PW3198 Never Misses the Moment a Power Supply Failure Occurs

The PW3198 can measure all waveforms of power, harmonic, and error events simultaneously. When a problem occurs with the equipment or system on your site, the PW3198 will help you detect the cause of the problem early and solve it quickly. You can depend on the PW3198 to monitor all aspects of your power supplies.

Measure All Parameters at the **Same Time**

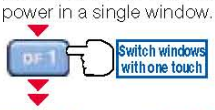
Acquire the Information You Need Quickly by Switching Pages (RMS Value)

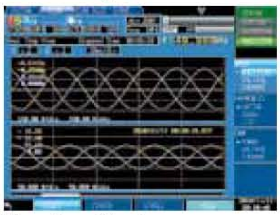
Just connect to the measurement line, and the PW3198 will simultaneously measure all parameters, such as power and harmonic. You can then switch pages to view the needed information immediately.



DMM Display

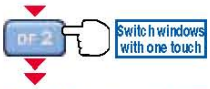
Display parameters such as voltage, current, power, power factor, and integral power in a single window.





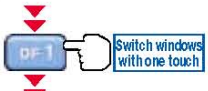
Waveform Display

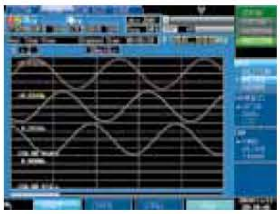
Display the voltage and current waveforms on channels 1 to 4 one above the other in a single window.



Vector Display

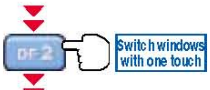
Display the measured value and vector of the voltage and current of each order harmonic.

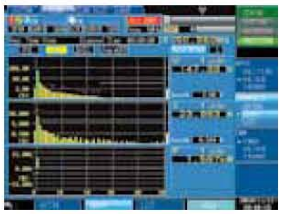




4-channel Waveform Display

Display the voltage and current waveforms on channels 1 to 4 individually.



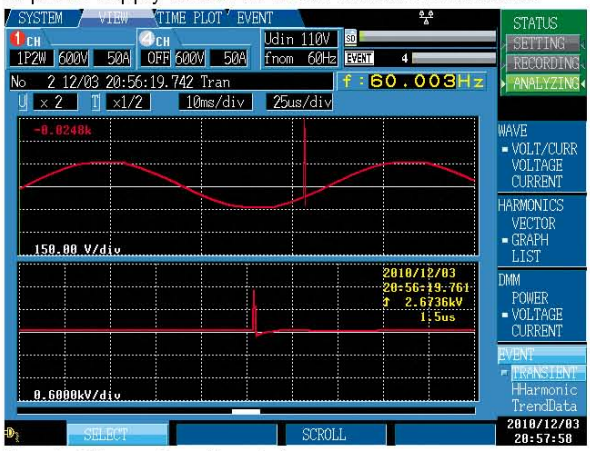


Harmonic Bar Graph Display

Display the RMS value and phase angle of harmonics from the 0th order to the 50th either in a graph or as numerical values.

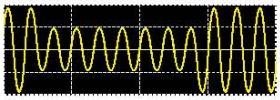
Reliably Detect Power Supply Failures (Event)

To detect power supply failures, measurement does not need to be performed multiple times under different conditions. The PW3198 can always monitor and reliably detect all power supply failures for which detection is enabled.



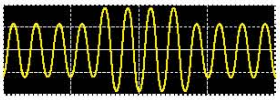
Transient Overvoltage (Impulse)

A transient overvoltage is generated by a lightning strike or a contact fault or closed contact of a circuit breaker and relay, and often causes a steep voltage change and a high voltage peak.



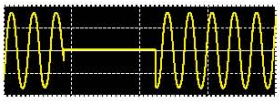
Voltage Dip (Voltage Drop)

Voltage drops for a short time as a result of large inrush current generated in the load by, for example, a starting motor.



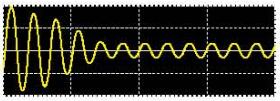
Voltage Swell (Voltage Rise)

A voltage swell is generated by a lightning strike or a heavily loaded power line being opened or closed, causing the voltage to rise instantaneously.



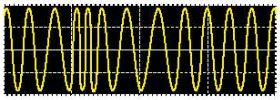
Interruption

The power supply stops instantaneously or for a short or long time because electrical power transmission is stopped as a result of a lightning strike, or because the circuit breaker is tripped by a power supply short circuit.



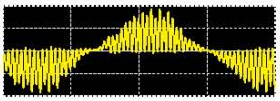
Inrush Current

A large current flows instantaneously at the moment electrical equipment, a motor, or similar devices are powered on.



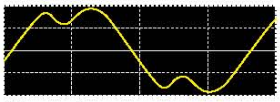
Frequency Fluctuations

An excessive increase or decrease of the load causes the operation of a generator to become unstable, resulting in frequency fluctuations.



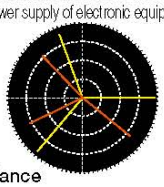
High-order Harmonic

Voltage and current waveforms are distorted by noise components generated by a semiconductor control device or the like installed in the power supply of electronic equipment.



Harmonic

Harmonic is generated by a semiconductor control device installed in the power supply of equipment, causing distortion of voltage and current waveforms.



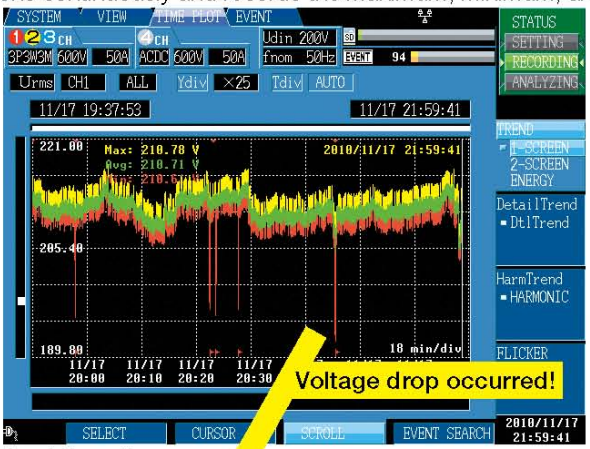
Unbalance

An increase or decrease in the load connected to each phase of the three-phase power supply or an unbalanced operation of equipment and devices causes the load of a particular phase to become heavy so that voltage and current waveforms are distorted, voltage drops, or negative phase sequence voltage is generated.

Simultaneous Recording of TIME PLOT Data and Event Waveforms

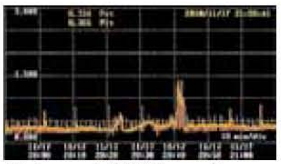
TIME PLOT Data — TIME PLOT Recording of All Parameters

The PW3198 can simultaneously record 8,000 or more parameters, such as voltage, current, power, power factor, frequency, integral power, harmonic, and flicker, at the specified recording interval. The PW3198 never fails to capture the peak because it performs calculations continuously and records the maximum, minimum, and average values within the recording interval.

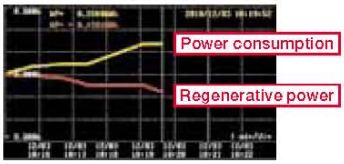


Trend Recording
(TIME PLOT Recording)

Harmonic Recording



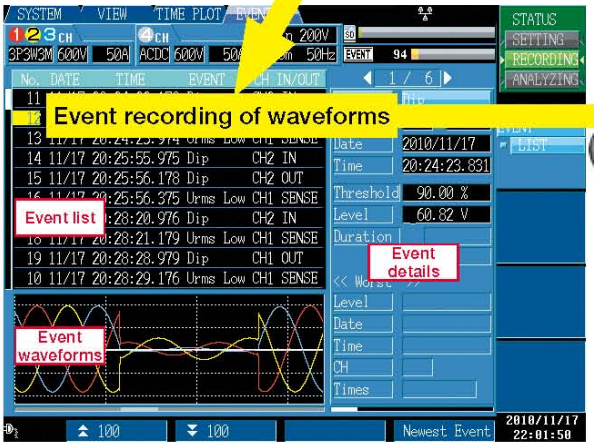
Flicker and ΔV10 Recording

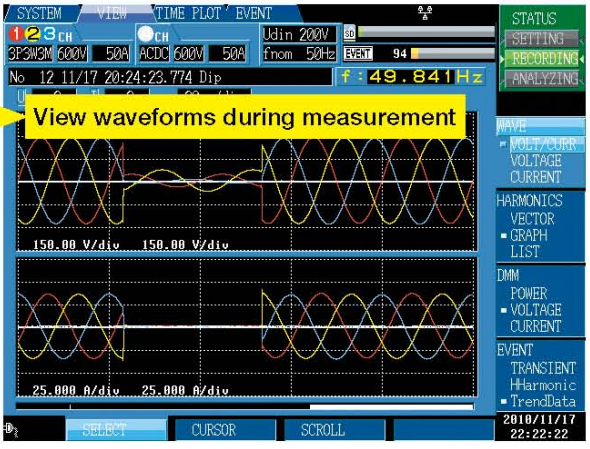


Integral Power Recording

Event Waveforms — Capture up to 55,000 Instantaneous Waveforms of Power Supply Failures

The PW3198 can record up to 1,000 instantaneous waveforms of power supply failures (up to 55,000 when repeat recording is set to ON) while performing TIME PLOT recording.



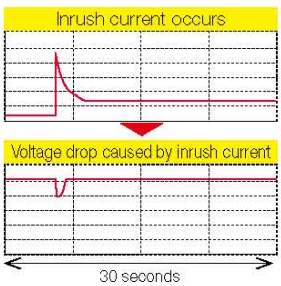


Event List

This list records instantaneous waveforms of power supply failures (events), such as a voltage drop or inrush current, along with the time or other information. Events are always monitored, regardless of the recording interval of the TIME PLOT recording.

Event Waveform

The PW3198 lets you view the instantaneous waveform (200 ms) of a power supply failure in the window.



RMS value changes over 30 seconds

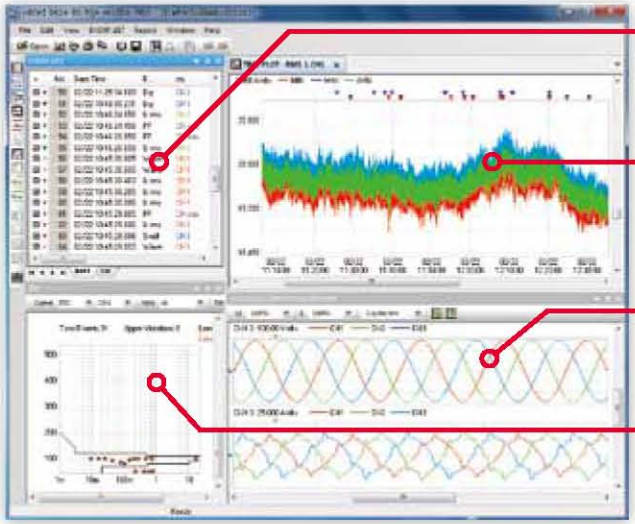
When a voltage drop or inrush current occurs, RMS value changes are recorded over 30 seconds simultaneously. This function can also be used to check the voltage drop caused by inrush current generated by the start of the motor.

Analyze Recorded Data with a PC Using Application Software 9624-50 PQA-HiVIEW PRO

Use Model 9624-50 PQA-HiVIEW PRO (version 2.00 or later) with a PC to analyze the data collected by the PW3198.

Viewer Function

Display and analyze the data recorded by the **PW3198 POWER QUALITY ANALYZER**.



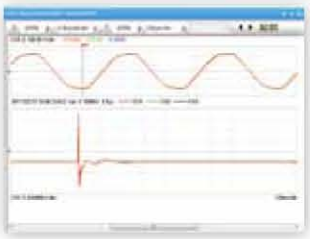
Event List Window
Display a list of power supply failures (events) that occurred.

TIME PLOT Window
Display the TIME PLOT (recorded trend) data as well as changes in the voltage/current RMS values, harmonic, and many other parameters.

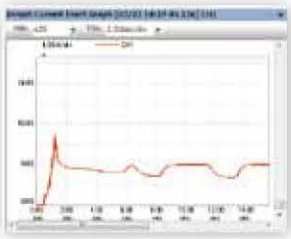
Event Waveform Window
Display the waveform of an event that occurred, plus the vector, harmonic, DMM, and instantaneous harmonic values.

ITIC Curve Display Window
Analyze the ITIC (CBEMA) curve (tolerance curve) used in the power quality standards in the United States.

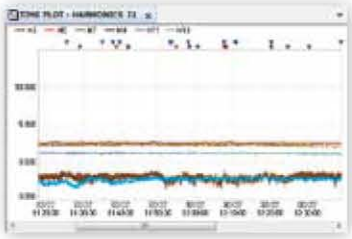
Status Window



Transient Waveform Window



Inrush Current Event Graph Window



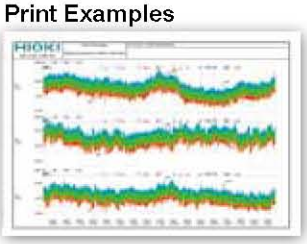
Harmonics TIME PLOT Window

Report Creation Function

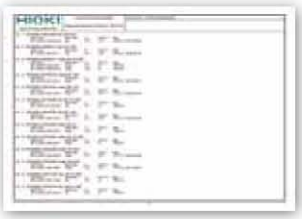
Automatically and effortlessly create rich reports for compliance and record management.

Report output items: Voltage/current RMS value fluctuation graph, harmonic fluctuation graph, inter-harmonics fluctuation graph, flicker graph, integral power graph, demand graph, total harmonic voltage/current distortion rate list, EN50160 window (Overview, Harmonic, Measurement Results Category), worst case, transient waveform, maximum/minimum value list, all event waveforms/detailed list, and setup list

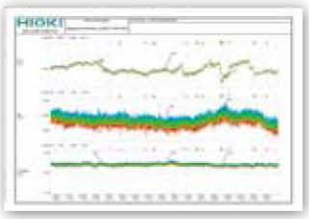
Print Examples



RMS Value Voltage Fluctuations



All Event Detailed List



TIME PLOT Recording of Parameters

EN50160

Other Functions

CSV Conversion of Measurement Data
Convert data in the range specified in the TIME PLOT window into CSV format and then save for further processing. The 9624-50 can also convert event waveforms into CSV format. Open CSV data using any commercially available spreadsheet software for advanced data management and analysis.

Even Analyze Data Recorded with Models 3196 and 3197 PQAs
Data recorded with the HIOKI 3196 and 3197 Power Quality Analyzers can also be analyzed.

Download Measurement Data via USB/LAN
Data in the SD card inserted in the PW3198 can be downloaded to a PC via USB or LAN.

EN50160 Display Function
EN50160 is a power quality standard for the EU. In this mode, evaluate and analyze power quality in accordance with the standard. You can display the Overview, Harmonic, and Measurement Results Category windows.

9624-50 Specifications

Delivery media	CD-R
Operating environment	AT-compatible PC
OS	Windows XP, Windows Vista (32-bit), Windows 7 (32/64-bit)
Memory	512 MB or more

Useful Functions for a Wide Variety of Applications

Large Capacity Recording with SD Card

Data is recorded to a large capacity SD card. The data can be transferred to a PC and analyzed using dedicated application software. If your PC is not equipped with an SD card slot, simply connect a USB cable between the PW3198 and the PC. The PC will then recognize the SD card as removable media.

Repeat record	Recording period
OFF	Max. 35 days Reference value: ALL DATA (all items recorded), repeat recording OFF, and TIME PLOT interval 1 minute or longer)
ON	Max. 55 weeks (about 1 year) Reference value: ALL DATA (all items recorded), repeat recording ON (1 week x 55 times), and TIME PLOT interval 10 minutes or longer)

Simultaneously Measure Three-phase Lines and Grounding Wire

Apart from the main measurement line, you can also measure the AC/DC voltage on another line using Channel 4.

Yes! Simultaneously!

- Measure the primary and secondary sides of UPS
- Two-line voltage analysis
- Measure three-phase lines and grounding wire
- Measure neutral lines to detect short circuits
- Measure the input and output of a DC-AC converter for solar power generation

Remote Measurement Using HTTP Server Function

You can use any Internet browser to remotely operate the PW3198, plus download the data stored in the SD card using dedicated software (LAN access required).

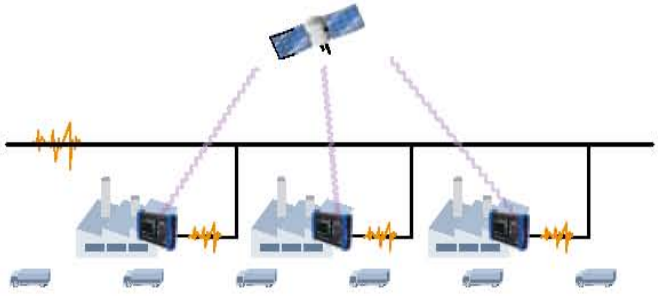
Conduct off-site remote control with a tablet PC using a wireless LAN router

An Assortment of Clamp-on Sensors Covers a Broad Range of Measurements

In addition to current sensors for measuring 100A AC, 500A AC, 1000A AC and 5000A AC rated currents, a 5A AC sensor is also available. In addition, HIOKI's CLAMP ON LEAK SENSORS enable you to accurately measure for leakage current down to the mA level, while the new CT969X-90 AC/DC Clamp On Sensors further widen applications by supporting DC current testing.

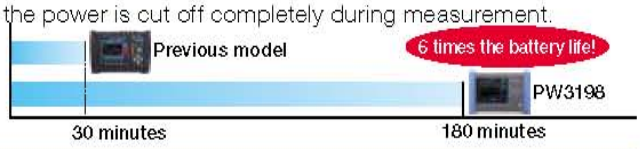
GPS Time Synchronization

The PW9005 GPS BOX lets you synchronize the clock on the PW3198 to the UTC standard time. Eliminate time differences between multiple PQAs and correctly analyze measurement data taken by several instruments.



Backup and Recovery from Power Failure

The PW3198 uses the new large capacity BATTERY PACK Z1003, enabling continuous measurement for three hours even if a power failure occurs. In addition, a power failure processing function restarts measurement automatically even if the power is cut off completely during measurement.



Other Measurement Applications

Flicker measurement
Measure flicker in conformance with IEC 61000-4-15 Ed2.

Phase voltage check for Δ connection
Use the Δ-Y and Y-Δ conversion function to measure phase voltage using a virtual neutral point.

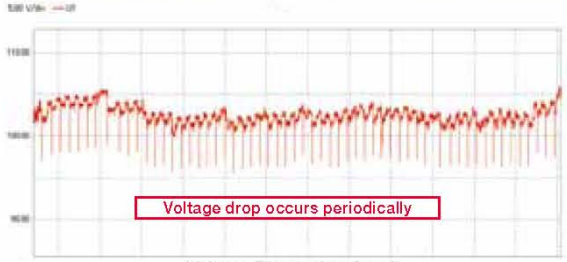
400 Hz line measurement
Measure at a power line frequency of 50/60 Hz as well as 400 Hz.

Power Quality Survey Applications

The power supply of the office equipment sometimes shuts down

Survey Objective
The power supply of a printer at the office shuts down even though it is not operated. Equipment other than the printer can also sometimes perform a reset unexpectedly.

Measurement Method
Setup is very easy. Just install the PW3198 on the site, and measure the voltage, current, and power. To troubleshoot, just select the clamp-on sensor and wiring, and then select the "U Events" course.



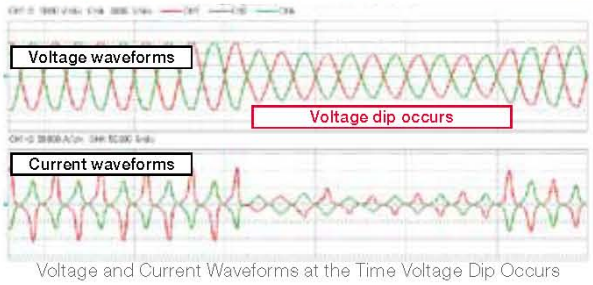
Voltage Fluctuation Graph

Analysis Report
No failure occurred during the measurement period, but a periodic voltage drop was confirmed. The voltage drop may have been caused by the periodic start and operation of the electrical equipment connected to the power supply line. **Equipment, such as a laser printer, copier, and electrical heater, may start themselves periodically due to residual heat. An instantaneous voltage drop is likely to have been caused by inrush current from equipment that consumes a large amount of power.**

Medical equipment malfunctions

Survey Objective
Replacing the equipment with a new one by the service provider did not improve the malfunction. A survey of the power supply was required to clarify the cause.

Measurement Method
Select the "U Events" course in the PW3198 in the same way as with the office equipment example.



Voltage and Current Waveforms at the Time Voltage Dip Occurs

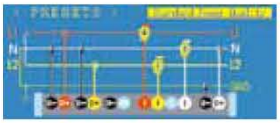
Analysis Report
It was determined that a voltage dip (voltage drop) occurred and impacted the operation of the equipment. **If a voltage dip occurs every day on a regular basis, the probable cause is the start of a large air-conditioning unit, pump, heater, or similar equipment.**

Surveying a Solar Power Generation System

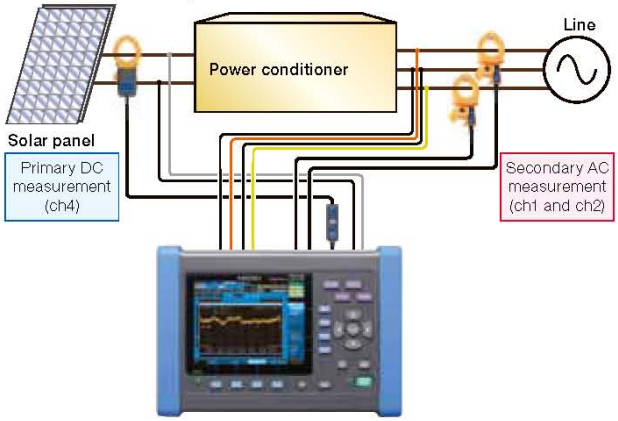
Survey Objective

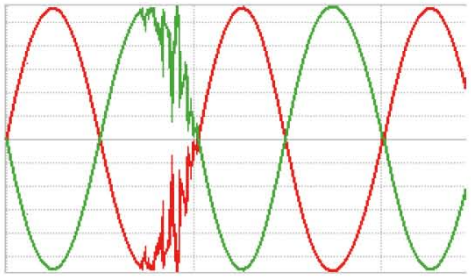
- Maintain a solar power generation system and check its operation (verify the power quality)
- Troubleshoot (impact on the peripheral equipment, operation shutdown, etc.)

Measurement Method
Set up the PW3198 on the site and measure the voltage, current, and power. To survey the power quality, select the "Standard power quality measurement" course in the PRESETS menu. To measure the DC voltage, connect channel 4 to the primary side of the solar panel.

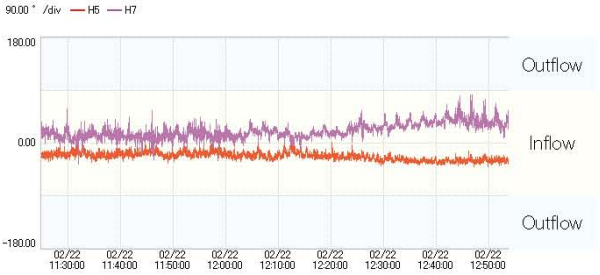


Connection Example





Example of Voltage Waveforms at the Time of Line Switching



Example of Determining Inflow or Outflow
(Inflow of 5th and 7th Order Harmonic)

Analysis Report
All parameters can be recorded simultaneously with a single measurement.

- Identify changes in the output voltage of the power conditioner
- Presence or absence of the occurrence of a transient overvoltage
- Frequency fluctuation important for system interconnection
- Identify changes in the harmonic voltage and current included in the output
- Power (AC), integral power (AC), etc.

PW3198 Specifications (Accuracy guaranteed for one year)

Measurement items

Voltage measurement items (TIME PLOT Recording)	RMS voltage Frequency DC voltage Harmonic voltage (0 to 50th order) Inter-harmonic voltage (0.5 to 49.5th) Total harmonic voltage distortion factor	Waveform voltage peak Frequency (1 cycle, 10-sec) IEC Flicker (Pst, Plt) Harmonic voltage phase angle (0 to 50th) High order harmonic voltage component Voltage Unbalance factor (Zero-phase /Negative-phase)
Current measurement items (TIME PLOT Recording)	RMS current Waveform current peak Harmonic current phase angle (0 to 50th) Harmonic current (0 to 50th) Inter-harmonic current (0.5 to 49.5th)	High order harmonic current component Total harmonic current distortion factor Current Unbalance factor (Zero-phase /Negative-phase) K factor DC current (when using compatible sensor)
Power measurement items (TIME PLOT Recording)	Active power Reactive power Apparent power Power factor	Harmonic power (0 to 50th) Harmonic voltage-current phase angle (0 to 50th) Active energy Reactive energy
EVENT measurement items (EVENT Recording)	Transient overvoltage Voltage swell Voltage dip Interruption Inrush current	Frequency fluctuations Voltage waveform comparison Timer External events
	Event detection using upper and lower thresholds available with other voltage, current and power measurement parameters (excluding Integrated power, Unbalance, Inter-harmonic, Harmonic phase angle, IEC Flicker)	

Input specifications

Measurement circuits	Single-phase 2-wire (1P2W), single-phase 3-wire (1P3W), three-phase 3-wire (3P3W2M, 3P4W2.5E) or three-phase 4-wire (3P4W) plus one extra input channel (must be synchronized to reference channel during AC/DC measurement)
Fundamental frequency of measurement circuit	50Hz, 60Hz, 400Hz
Input channels	Voltage : 4 channels (U1 to U4), Current : 4 channels (I1 to I4)
Input methods	Voltage : Isolated and differential inputs (channels not isolated between U1, U2 and U3; channels isolated between U1 to U3 and U4) Current : Insulated clamp-on sensors (voltage output)
Input resistance	Voltage : 4MΩ ±80kΩ (differential inputs) Current : 100kΩ ±10kΩ
Compatible clamp sensors	Units with f.s.=0.5V output at rated current input (f.s.=0.5V recommended) Units with rate of 0.1mV/A, 1mV/A, 10mV/A, or 100mV/A
Measurement ranges (Ch1 to Ch4 can be configured the same way; only CH4 can be configured separately)	Voltage measurement ranges

Voltage measurement items	Ranges
Voltage measurement	600.00V
Transient measurement	6.0000kV peak

PW3198 current ranges

Current sensor	Current range setting (A)
9660	100.00 / 50.000
9661	500.00 / 50.000
9667 (500A) *Discontinued	500.00 / 50.000
9667 (5kA) *Discontinued	5.0000k / 500.00
CT9667 (500A)	500.00 / 50.000
CT9667 (5kA)	5.0000k / 500.00
9669	1.0000k / 100.00
9694	50.000 / 5.0000
9695-02	50.000 / 5.0000
9695-03	100.00 / 10.000

Current sensor	Current range setting(A)
CT9691 (10A)	10.000 / 5.0000
CT9691 (100A)	100.00 / 10.000
CT9692 (20A)	50.000* / 5.0000
CT9692 (200A)	500.00* / 50.000
CT9693 (200A)	500.00* / 50.000
CT9693 (2kA)	5.0000k* / 500.00
9657-10	5.0000 / 500.00m
9675	5.0000 / 500.00m

*The full scale for each sensor is based on the specifications of the sensor in use, not the range setting on the PW3198.

PW3198 Power ranges
(automatically configured based on current range)

Current range	Power range (W / VA / var)
5.0000 kA	3.0000M
1.0000 kA	600.00k
500.00 A	300.00k
100.00 A	60.000k

Current range	Power range (W / VA / var)
50.000 A	30.000k
10.000 A	6.0000k
5.0000 A	3.0000k

Basic specifications

Maximum recording period	55 weeks (with repeated recording set to [1 Week], 55 iterations) 55 days (with repeated recording set to [1 Day], 55 iterations) 35 days (with repeated recording set to [OFF])
Maximum recordable events	55,000 events (with repeated recording on) 1000 events (with repeated recording off)
TIME PLOT data settings	TIME PLOT interval (MAX/MIN/AVG within each interval recorded) 1s, 3s, 15s, 30s, 1m, 5m, 10m, 15m, 30m, 1h, 2h, 150 cycle (at 50Hz), 180 cycle (at 60Hz), 1200 cycle (at 400Hz) Screen copy interval (screen shot at each interval saved to SD card) OFF, 5m, 10m, 30m, 1h, 2h Timer EVENT interval (200ms instantaneous waveform saved at each interval) OFF, 1m, 5m, 10m, 30m, 1h, 2h Time start and End OFF: Start recording manually ON: Start time and End time can be configured Repeated recording settings (maximum 55 iterations) OFF: Recording is not repeated 1Week: 55 weeks maximum in 1week segmentations 1Day: 55 days maximum in 1day segmentations Repeat time Daily Start time and End time can be configured when Repeated recording set to 1Day.
Recording items settings	Power (Small): Recording basic parameters P&Harm (Normal): Recording basic parameters and harmonics All Data (Full): Recording P&Harm items and inter-harmonics
Memory data capacity	Max. 32 GB with SD Card; only use of the HIOKI 2GB SD Memory Card Model Z4001 is guaranteed by HIOKI. *Contact your HIOKI representative for special order larger capacity cards that offer the HIOKI guarantee.*

PRESETS function	**U Events** : Record and monitor voltage elements and frequency, plus detect events **Standard Power Quality** : Record and monitor voltage and current elements, frequency, and harmonics, plus detect events **Inrush Current** : Measure inrush current (basic voltage measurement required) **Recording** : Record only trend data, no event detection **EN50160** : Measure according to EN50160 standards
Real-Time Clock function	Auto-calendar, leap-year correcting 24-hour clock
Real-time clock accuracy	±0.3 s per day (with instrument on, 23°C±5°C (73°F±9°F)
Power supply	**AC ADAPTER Z1002** (12 VDC, Rated power supply 100VAC to 240VAC, 1.7Amax, 50/60Hz) **BATTERY PACK Z1003** (Ni-MH 7.2VDC 4500 mAh)
Maximum rated power	15VA (when not charging), 35VA (when charging)
Continuous battery operation time	Approx. 180 min. [@23°C (@73.4°F), when using **BATTERY PACK Z1003**]
Recharge function	**BATTERY PACK Z1003** charges regardless of whether the instrument is on or off; charge time: max. 5 hr. 30 min. @23°C (@73.4°F)
Power outage processing	In the event of a power outage during recording, instrument resumes recording once the power is back on (integral power starts from 0).
Power supply quality measurement method	IEC61000-4-30 Ed.2 :2008 IEEE1159 EN50160 (using Model **PQA-HiVIEW PRO 9624-50**)
Dimensions	Approx. 300 W× 211 H × 68 D mm (11.81" W × 8.31" H × 2.68" D) (excluding protrusions)
Mass	Approx. 2.6 kg (91.7 oz.) (including battery pack)
Accessories	Instruction manual, Measurement guide, **VOLTAGE CORD L1000** (8 cords, approx. 3 m each: 1 each red, yellow, blue, and gray plus 4 black; 8 alligator clips: 1 each red, yellow, blue, and gray plus 4 black), Spiral Tube, Input Cable Labels (for identifying channel of voltage cords and clamp-on sensors), **AC ADAPTER Z1002**, Strap, USB cable (1 m length), **BATTERY PACK Z1003**, **SD MEMORY CARD (2GB) Z4001**

Display specifications

Display	6.5-inch TFT color LCD (640 × 480 dots)

External Interface Specifications

SD card Interface	Saving of binary data, Saving and Loading setting files, Saving and Loading screen copies Slot : SD standard compliant Compatible card : SD memory card/ SDHC memory card Supported memory capacity : Max. 32 GB with SD Card; only use of the HIOKI 2GB SD Memory Card Model Z4001 is guaranteed by HIOKI. *Contact your HIOKI representative for special order larger capacity cards that offer the HIOKI guarantee.* Media full processing : Saving of data to SD memory card is stopped
RS-232C Interface	Measurement and control using GPS-synchronized time (connecting GPS BOX) Connector : D-sub9pin Connection destination : GPS box (cannot be connected to computer)
LAN Interface	1. HTTP server function (compatible software: Internet Explorer Ver.6 or later, Remote operation application function, measurement start and stop control functions, system configuration function, event list function (capable of displaying event waveforms, event vectors, and event harmonic bar graphs) 2. Downloading of data from the SD memory card using the 9624-50 PQA-HiView Pro Connector : RJ-45 Transmission method : 10BASE-T,100BASE-TX
USB2.0 Interface	1. Recognizes the SD memory card as a removable disk when connected to a computer. *The instrument cannot be connected during recording (including standby operation) or analysis.* 2. Download data from the SD memory card using the 9624-50 PQA-HiView Pro *The instrument cannot be connected during recording (including standby operation) or analysis.* Connector : Series B receptacle Connection destination : Computer [WindowsXP, WindowsVista(32bit), Windows7 (32/64bit)]
External control interface	Connector : 4-pin screwless terminal block External event input : External event input at TTL low level (at falling edge of 1.0 V or less and when shorted) between GND terminal and EVENT IN terminal Min. pulse width: 30 ms; rated voltage: -0.5 V to +6.0 V External event output :

External event output item setting	Operation	Pulse width
Short pulse output	TTL low output at event generation between [GND] terminal and [EVENT OUT] terminal	Low level for 10 ms or more
Long pulse output	TTL low output at event generation between [GND] terminal and [EVENT OUT] terminal (No external event output at START event)	Low level for approx. 2.5 s
ΔV10 alarm	TTL low output at ΔV10 alarm between [GND] terminal and [EVENT OUT] terminal	Low level while alarm occurring ; reverts to high at data reset

Environment and safety specifications

Operating environment	Indoors, altitude up to 3000 m (measurement category is lowered to 600 V CAT III when above 2000m), Pollution degree 2
Storage temperature and humidity	-20 to 50°C (-4 to 122°F) 80% RH or less (non-condensating) (If the instrument will not be used for an extended period of time, remove the battery pack and store in a cool location [from -20 to 30°C (-4 to 86°F)].)
Operating temperature and humidity	0 to 50°C (32 to 122°F) 80% RH or less (non-condensating)
Dust and water resistance	IP30 (EN60529)
Maximum input voltage	Voltage input section 1000 VAC, DC±600 V, max. peak voltage ±6000 Vpeak Current input section 3VAC, DC±4.24V
Maximum rated voltage to earth	Voltage input terminal 600 V (Measurement Categories IV, anticipated transient overvoltage 8000 V)
Dielectric strength	6.88 kVrms (@50/60 Hz, 1 mA sense current): Between voltage measurement terminals (U1 to U3) and voltage measurement terminals (U4) 4.30 kVrms (1 mA@50/60 Hz, 1 mA sense current): Between voltage input terminal (U1 to U3) and current input terminals/interfaces Between voltage (U4) and current measurement terminals, and interfaces
Applicable standards	Safety EN61010 EMC EN61326 Class A, EN61000-3-2, EN61000-3-3

Measurement Specifications (For specifications when measuring 400Hz circuits, please inquire with your HIOKI distributor.)

TIME PLOT : The MAX/MIN/AVG of each recording interval for each parameter are recorded.
EVENT : When a power anomaly occurs, approx. 200ms instantaneous waveform is recorded.
TRANSIENT : When a transient overvoltage is detected, the 2ms instantaneous waveforms before and after the occurrence (total 4ms) are recorded.
FLUCTUATION : The RMS fluctuation 0.5s before and 29.5s after an event has occurred are recorded.
HIGH-ORDER HARM : When a high order harmonic event occurs, the 40ms instantaneous waveform is recorded.

Transient overvoltage	TRANSIENT EVENT
Display items	For single transient incidents and continuous transient incidents Transient voltage value, Transient width For continuous transient incidents Transient period (Period from transient IN to transient OUT) Max. transient voltage value (Max. peak value during the period) Transient count during period
Measurement method	Detected from waveform obtained by eliminating the fundamental component (50/60/400 Hz) from the sampled waveform
Sampling frequency	2MHz
Measurement range, resolution	±6.0000kVpeak, 0.0001kV
Measurement bandwidth	5 kHz (-3dB) to 700 kHz (-3dB)
Min. detection width	0.5 µs
Measurement accuracy	±5.0% rdg.±1.0%f.s.

RMS voltage/ RMS current refreshed each half-cycle	TIME PLOT EVENT
Measurement method	RMS voltage refreshed each half-cycle : True RMS type, RMS voltage values are calculated using sample data for 1 waveform derived by overlapping the voltage waveform every half-cycle RMS current refreshed each half-cycle : RMS current is calculated using current waveform data sampled every half-cycle
Sampling frequency	200kHz
Measurement range, resolution	RMS voltage refreshed each half-cycle : 600.00V, 0.01V RMS current refreshed each half-cycle : Based on clamp-on sensor in use; see Input specifications
Measurement accuracy	RMS voltage refreshed each half-cycle : ±0.2% of nominal voltage (With 1.666% f.s. to 110% f.s. input and a nominal input voltage of at least 100 V) ±0.2%rdg.±0.08%f.s. (With input outside the range of 1.666% f.s. to 110% f.s. or a nominal input voltage of less than 100 V) RMS current refreshed each half-cycle : ±0.3% rdg.±0.5%f.s. + clamp-on sensor accuracy

Swell/ Dip/ Interruption	FLUCTUATION EVENT
Display item	Swell : Swell height, Swell duration Dip : Dip depth, Dip duration Interruption : Interruption depth, Interruption duration
Measurement method	Swell : A swell is detected when the RMS voltage refreshed each half-cycle exceeds the threshold in the positive direction Dip : A dip is detected when the RMS voltage refreshed each half-cycle exceeds the threshold in the negative direction Interruption : An interruption is detected when the RMS voltage refreshed each half-cycle exceeds the threshold in the negative direction
Range and accuracy	See RMS voltage refreshed each half-cycle

Inrush current	FLUCTUATION EVENT
Display item	Maximum current of RMS current refreshed each 1/2 cycle
Measurement method	Detected when the RMS current refreshed each 1/2 cycle exceeds the threshold in a positive direction
Range and accuracy	See RMS current refreshed each half-cycle

RMS voltage, RMS current	TIME PLOT EVENT
Display items	RMS voltage : RMS voltage for each channel and AVG (average) RMS voltage for multiple channels RMS current : RMS current for each channel and AVG (average) RMS current for multiple channels
Measurement method	AC+DC True RMS type (Current DC value: with release of new clamp-on sensor) RMS value calculated from 10 cycles (50 Hz) or 12 cycles (60 Hz)
Sampling frequency	200kHz
Measurement range, resolution	RMS voltage : 600.00V, 0.01V RMS current : Based on clamp-on sensor in use; see Input specifications
Measurement accuracy	RMS voltage : ±0.1% of nominal voltage (With 1.666% f.s. to 110% f.s. input and a nominal input voltage of at least 100 V) ±0.2%rdg.±0.08%f.s. (With input outside the range of 1.666% f.s. to 110% f.s. or a nominal input voltage of less than 100 V) RMS current : ±0.2% rdg.±0.1%f.s. + clamp-on sensor accuracy

Voltage waveform peak/ Current waveform peak	TIME PLOT EVENT
Display item	Positive peak value and negative peak value
Measurement method	Measured every 10 cycles (50 Hz) or 12 cycles (60 Hz) maximum and minimum points sampled during approx. 200 ms aggregation
Sampling frequency	200kHz
Measurement range, resolution	Voltage waveform peak : ±1200.0 Vpeak, 0.1V Current waveform peak : The quadruple of RMS current measurement range (Based on clamp-on sensor in use; See Input specifications)

Voltage waveform comparison	EVENT
Display item	Event detection only
Measurement method	A judgment area is automatically generated from the previous 200 ms aggregation waveform, and events are generated based on a comparison with the judgment waveform. Waveform judgments are performed once for each 200 ms aggregation.
Comparison window width	10 cycles (50 Hz), 12 cycles (60 Hz)
No. of window points	4096 points synchronized with harmonic calculations

Frequency cycle	TIME PLOT EVENT
Measurement method	Calculated as the reciprocal of the accumulated whole-cycle time during one U1 (reference channel) cycle
Measurement range, resolution	70.000Hz, 0.001Hz
Measurement bandwidth	40.000 to 70.000Hz
Measurement accuracy	±0.200 Hz or less (for input from 10% f.s. to 110% f.s.)

Frequency	TIME PLOT EVENT
Measurement method	Calculated as the reciprocal of the accumulated whole-cycle time during approx. 200ms period of 10 or 12 U1 (reference channel) cycles
Measurement range, resolution	70.000Hz, 0.001Hz
Measurement bandwidth	40.000 to 70.000Hz
Measurement accuracy	±0.020 Hz or less

10-sec frequency	TIME PLOT
Measurement method	Calculated as the reciprocal of the accumulated whole-cycle time during the specified 10s period for U1 (reference channel) as per IEC61000-4-30
Measurement range, resolution	70.000Hz, 0.001Hz
Measurement bandwidth	40.000 to 70.000Hz
Measurement accuracy	±0.010 Hz or less

Voltage DC value (ch4 only)

TIME PLOT EVENT

Measurement method	Average value during approx. 20ms aggregation synchronized with the reference channel (CH4 only)
Sampling frequency	200kHz
Measurement range, resolution	600.00V, 0.01V
Measurement accuracy	±0.3%rdg. ±0.08%f.s.

Current DC value (ch4 only; when using compatible sensor)

TIME PLOT EVENT

Measurement method	Average value during approx. 200ms aggregation synchronized to reference channel (CH4 only)
Sampling frequency	200kHz
Measurement range, resolution	Based on clamp-on sensor in use (with release of new clamp-on sensor)
Measurement accuracy	±0.5% rdg.±0.5%f.s. + clamp-on sensor accuracy

Active power/ Apparent power/ Reactive power

TIME PLOT EVENT

Display items	Active power : Active power for each channel and sum value for multiple channels. Sink (consumption) and Source (regeneration) Apparent power : Apparent power of each channel and its sum for multiple channels No polarity Reactive power : Reactive power of each channel and its sum for multiple channels Lag phase (LAG: current lags voltage) and Lead phase (LEAD: current leads voltage)
Measurement method	Active power : Measured every 10 cycles (50 Hz) or 12 cycles (60 Hz) Apparent power : Calculated from RMS voltage U and RMS current I Reactive power : Calculated using apparent power S and active power P
Sampling frequency	200kHz
Measurement range, resolution	Depends on the voltage × current range combination; see Input specifications
Measurement accuracy	Active power : ±0.2% rdg.±0.1%f.s. + clamp-on sensor accuracy Apparent power : ±1 dgt. for calculations derived from the various measurement values Reactive power : ±1 dgt. for calculations derived from the various measurement values

Active energy /Reactive energy

TIME PLOT

Display items	Active energy : WP+ (consumption), WP- (regeneration); Sum of multiple channels Reactive energy : WQLAG (lag), WQLEAD (lead); Sum for multiple channels Elapsed time
Measurement method	Measured every 10 cycles (50 Hz) or 12 cycles (60 Hz) Integrated separately by consumption and regeneration from active power Integrated separately by lag and lead from reactive power Integration starts at the same time as recording Recorded at the specified TIMEPLOT interval
Sampling frequency	200kHz
Measurement range, resolution	Depends on the voltage × current range combination; see Input specifications
Measurement accuracy	Active energy : Active power measurement accuracy ±10 dgt. Reactive energy : Reactive power measurement accuracy ±10 dgt.

Power factor /Displacement power factor

TIME PLOT EVENT

Display items	Displacement power factor of each channel and its sum value for multiple channels
Measurement method	Power factor : Calculated from RMS voltage U, RMS current I, and active power P Displacement power factor : Calculated from the phase difference between the fundamental voltage wave and the fundamental current wave Lag phase (LAG: current lags voltage) and Lead phase (LEAD: current leads voltage
Sampling frequency	200kHz
Measurement range, resolution	-1.0000 (lead) to 0.0000 to 1.0000 (lag)

Voltage unbalance factor/ Current unbalance factor (negative-phase, zero-phase)

TIME PLOT

Display items	Voltage unbalance factor : Negative-phase unbalance factor, zero-phase unbalance factor Current unbalance factor : Negative-phase unbalance factor, zero-phase unbalance factor
Measurement method	Calculated using various components of the three-phase fundamental wave (line-to-line voltage) for three-phase 3-wire (3P3W2M, 3P3W3M) and three-phase 4-wire connections
Sampling frequency	200kHz
Measurement range	Voltage unbalance factor : Component is V and unbalance factor is 0.00% to 100.00% Current unbalance factor : Component is V and unbalance factor is 0.00% to 100.00%
Measurement accuracy	Voltage unbalance factor : ±0.15% Current unbalance factor : —

High-order harmonic voltage component/ High-order harmonic current component

HIGH-ORDER HARM TIME PLOT EVENT

Display items	For single incidents and continuous transient incidents High-order harmonic voltage component value High-order harmonic current component value For continuous incidents High-order harmonic voltage component maximum value High-order harmonic current component maximum value High-order harmonic voltage component period High-order harmonic current component period
Measurement method	The waveform obtained by eliminating the fundamental component is calculated using the true RMS method during 10 cycles (50 Hz) or 12 cycles (60 Hz) of the fundamental wave
Sampling frequency	200kHz
Measurement range, resolution	High-order harmonic voltage component : 600.00V, 0.01V High-order harmonic current component : Based on clamp-on sensor in use; See Input specifications
Measurement bandwidth	2kHz (-3dB) to 80kHz (-3dB)
Measurement accuracy	High-order harmonic voltage component : ±10%rdg. ±0.1%f.s. High-order harmonic current component : ±10% rdg.±0.2%f.s. + clamp-on sensor accuracy

Harmonic voltage/ Harmonic current (including fundamental component)

TIME PLOT EVENT

Display items	Select either RMS or content percentage; From 0 to 50th order
Measurement method	Uses IEC61000-4-7:2002.
Comparison window width	10 cycles (50 Hz), 12 cycles (60 Hz)
No. of window points	4096 points synchronized with harmonic calculations
Measurement range, resolution	Harmonic voltage : 600.00V, 0.01V Harmonic current : Based on clamp-on sensor in use; see Input specifications
Measurement accuracy	See measurement accuracy with a fundamental wave of 50/60 Hz When using an AC-only clamp sensor, 0th order is not specified for current and power

Total harmonic voltage/ Total harmonic current distortion factor

TIME PLOT EVENT

Display items	THD-F (total harmonic distortion factor for the fundamental wave) THD-R (total harmonic distortion factor for the total harmonic including the fundamental wave)
Measurement method	Based on IEC61000-4-7:2002; Max. order: 50th
Comparison window width	10 cycles (50 Hz), 12 cycles (60 Hz)
No. of window points	4096 points synchronized with harmonic calculations
Measurement range, resolution	0.00 to 100.00%(Voltage), 0.00 to 500.00%(Current)
Measurement accuracy	—

Harmonic power (including fundamental component)

TIME PLOT EVENT

Display item	Select either RMS or content percentage; From 0 to 50th order
Measurement method	Uses IEC61000-4-7:2002.
Comparison window width	10 cycles (50 Hz), 12 cycles (60 Hz)
No. of window points	4096 points synchronized with harmonic calculations
Measurement range, resolution	Depends on the voltage × current range combination; See Input specifications
Measurement accuracy	See measurement accuracy with a fundamental wave of 50/60 Hz (When using an AC-only clamp sensor, order 0 is not specified for current and power)

Measurement accuracy with a fundamental wave of 50/60 Hz

Harmonic input	Measurement accuracy
Voltage (At least 1% of nominal voltage)	Specified with a nominal voltage of at least 100 V Order 0: ±0.3%rdg.±0.08%f.s. Order 1+: ±5.00%rdg
Voltage (<1% of nominal voltage)	Specified with a nominal voltage of at least 100 V Order 0: ±0.3%rdg.±0.08%f.s. Order 1+: ±0.05% of nominal voltage
Current	Order 0: ±0.5%rdg.±0.5%f.s. +clamp-on sensor accuracy Order 1 to 20th: ±0.5%rdg.±0.2%f.s. +clamp-on sensor accuracy Order 21 to 50th: ±1.0%rdg.±0.3%f.s. +clamp-on sensor accuracy
Power	Order 0: ±0.5%rdg.±0.5%f.s. +clamp-on sensor accuracy Order 1 to 20th: ±0.5%rdg.±0.2%f.s. +clamp-on sensor accuracy Order 21 to 30th: ±1.0%rdg.±0.3%f.s. +clamp-on sensor accuracy Order 31 to 40th: ±2.0%rdg.±0.3%f.s. +clamp-on sensor accuracy Order 41 to 50th: ±3.0%rdg.±0.3%f.s. +clamp-on sensor accuracy

Harmonic voltage phase angle/ Harmonic current phase angle (including fundamental component)

TIME PLOT

Display item	Harmonic phase angle components for whole orders
Measurement method	Uses IEC61000-4-7:2002.
Comparison window width	10 cycles (50 Hz), 12 cycles (60 Hz)
No. of window points	4096 points synchronized with harmonic calculations
Measurement range, resolution	-180.00° to 0.00° to 180.00°
Measurement accuracy	—

Harmonic voltage-current phase angle (including fundamental component)

TIME PLOT EVENT

Display item	Indicates the difference between the harmonic voltage phase angle and the harmonic current phase angle. Harmonic voltage-current phase difference for each channel and sum (total) value for multiple channels
Measurement method	Uses IEC61000-4-7:2002.
Comparison window width	10 cycles (50 Hz), 12 cycles (60 Hz)
No. of window points	4096 points synchronized with harmonic calculations
Measurement range, resolution	-180.00° to 0.00° to 180.00°
Measurement accuracy	1st to 3rd orders : ± 2° +clamp-on sensor accuracy 4th to 50th orders: ±(0.05° × k+2°) +clamp-on sensor accuracy; (k: harmonic orders) Specified with a harmonic voltage of 1 V for each order and a current level of at 1% f.s. or greater.

Inter-harmonic voltage and inter-harmonic current

TIME PLOT

Display item	Select either RMS or content percentage; 0.5 to 49.5th orders
Measurement method	Uses IEC61000-4-7:2002.
Comparison window width	10 cycles (50 Hz), 12 cycles (60 Hz)
No. of window points	4096 points synchronized with harmonic calculations
Measurement range, resolution	Inter-harmonic voltage : 600.00V, 0.01V Inter-harmonic current : Due to using clamp-on sensor; See Input specifications
Measurement accuracy	Inter-harmonic voltage (Specified with a nominal voltage of at least 100 V) : At least 1% of harmonic input nominal voltage : ±5.00% rdg. <1% of harmonic input nominal voltage : ±0.05% of nominal voltage Inter-harmonic current : Unspecified

K Factor (multiplication factor)

TIME PLOT EVENT

Measurement method	Calculated using the harmonic RMS current of the 2nd to 50th orders
Comparison window width	10 cycles (50 Hz), 12 cycles (60 Hz)
No. of window points	4096 points synchronized with harmonic calculations
Measurement range, resolution	0.00 to 500.00
Measurement accuracy	—

Instantaneous flicker value

TIME PLOT

Measurement method	As per IEC61000-4-15 User-selectable from 230 Vlamp/120 Vlamp (when Pst and Plt are selected for flicker measurement)/4 types of Ed2 filter (230 Vlamp 50/60 Hz, 120 Vlamp 60/50 Hz)
Measurement range, resolution	99.999, 0.001

Δ V10 Flicker

TIME PLOT

Display items	ΔV10 measured at one minute intervals, average value for one hour, maximum value for one hour, fourth largest value for one hour, total (within the measurement interval) maximum value
Measurement method	Calculated values are subject to 100 V conversion following gap-less measurement once each minute
Measurement range, resolution	0.000 to 99.999V
Measurement accuracy	±2% rdg.±0.01 V (with a fundamental wave of 100 Vrms [50/60 Hz], a fluctuation voltage of 1 Vrms, and a fluctuation frequency of 10 Hz)
Threshold	0.00 to 9.99V alarm output is generated when the reading for each minute is compared to the threshold and found to be greater

IEC Flicker

TIME PLOT

Display items	Short interval flicker Pst, long interval flicker Plt
Measurement method	Based on IEC61000-4-15:1997 +A1:2003 Ed1/Ed2. Pst is calculated after 10 minutes of continuous measurement and Plt after 2 hours of continuous measurement
Measurement range	0.0001 to 10000 P.U. broken into 1,024 segments with a logarithm
Measurement accuracy	Pst ±5% rdg. (Specified within range 0.1000 to 20.000 using IEC61000-4-15 Ed1.1 and IEC61000-4-15 Ed2 Class F1 performance test.)
Flicker filter	Select 230 V lamp Ed1, 120 V lamp Ed1, 230 V lamp Ed2, or 120 V lamp Ed2.

Clamp-on sensors specifications (Options)

Clamp-on sensor	CLAMP ON SENSOR 9694	CLAMP ON SENSOR 9660	CLAMP ON SENSOR 9661
Appearance			
Primary current rating	5A AC	100A AC	500A AC
Output voltage	10mV/A AC	AC 1mV/A AC	AC 1mV/A AC
Measurement range	See input specifications		
Amplitude accuracy *	±0.3%rdg.±0.02%f.s. *	±0.3%rdg.±0.02%f.s. *	±0.3%rdg.±0.01%f.s.*
Phase accuracy *	±2° or less *	±1° or less *	±0.5° or less *
Maximum allowable input *	50 A continuous *	130 A continuous *	550 A continuous *
Maximum rated voltage to earth	CAT III 300Vrms		CAT III 600 Vrms
Frequency characteristics	±1.0% or less for 65Hz to 5kHz (deviation from specified accuracy)		
Cord length	3m (9.84ft)		
Measurable conductor diameter	Max.φ15mm (0.59")		Max.φ46mm (1.81")
Dimensions, Mass	46W(1.81")x135H(5.31")x21D(0.83")mm, 230g(8.1oz.)		78W(3.07")x152H(5.98")x42D(1.65")mm, 380g(13.4oz.)

*: 45 to 65Hz

Clamp-on sensor	CLAMP ON SENSOR 9669	FLEXIBLE CLAMP ON SENSOR CT9667
Appearance		
Primary current rating	1000 A AC	500A AC, 5000A AC
Output voltage	0.5mV/A AC	500 mV AC f.s.
Measurement range	See input specifications	
Amplitude accuracy *	±1.0%rdg.±0.01%f.s. *	±2.0%rdg.±0.3%f.s. *
Phase accuracy *	±1° or less *	±1° or less *
Maximum allowable input *	1000 A continuous *	10000 A continuous *
Maximum rated voltage to earth	CAT III 600Vrms	CATIII 1000 Vrms CATIV 600 Vrms
Frequency characteristics	Within ±2% at 40Hz to 5kHz (deviation from accuracy)	±3dB or less for 10 Hz to 20kHz (within ±3dB)
Cord length	3m (9.84ft)	Sensor to circuit: 2m (5.56ft) Circuit to connector: 1m (3.28ft)
Measurable conductor diameter	Max. φ55 mm(2.17"), 80 (3.15")x20(0.79") mm busbar	Max. φ254mm(10")
Dimensions, Mass	99.5W (3.92") x 188H (7.40") x 42D (1.65") mm, 590g (20.8 oz.)	Circuit box: 35W (1.38") x 120.5H (4.74") x 34D (1.34") mm, 140 g (4.9 oz.)
Power supply	—	LR6 alkaline battery x2, AC Adapter (option) or external 5 to 15 V DC power supply
Options (sold separately)		AC ADAPTER 9445-02 (universal 100 to 240VAC , 9W1A output/for USA) AC ADAPTER 9445-03 (universal 100 to 240VAC , 9W1A output/for Europe)

*: 45 to 65Hz

Clamp-on sensor	CLAMP ON SENSOR 9695-02	CLAMP ON SENSOR 9695-03
Appearance		
Primary current rating	50A AC	100A AC
Output voltage	10mV/A AC	1mV/A AC
Measurement range	See input specifications	
Amplitude accuracy *	±0.3%rdg.±0.02%f.s. *	±0.3%rdg.±0.02%f.s. *
Phase accuracy *	Within ±2° *	Within ±1° *
Maximum allowable input *	130 A continuous *	130 A continuous *
Maximum rated voltage to earth	CAT III 300Vrms (insulated conductor)	
Frequency characteristic	Within ±2% at 40Hz to 5kHz (deviation from accuracy)	
Cord length	CONNECTION CORD 9219 (sold separately) is required.	
Measurable conductor diameter	Max. φ15mm(0.59")	
Dimensions, Mass	51W(2.01")x58H(2.28")x19D(0.75")mm , 50g(1.8oz.)	
Options (sold separately)	CONNECTION CORD 9219 (Cord length:3m (9.84ft)	

Note: CONNECTION CORD 9219 (sold separately) is required.
*: 45 to 65Hz


CONNECTION CORD 9219

Clamp-on AC/DC sensor	AC/DC CLAMP ON SENSOR CT9691-90 (CT9691 bundled with the CT6590)	AC/DC CLAMP ON SENSOR CT9692-90 (CT9692 bundled with the CT6590)	AC/DC CLAMP ON SENSOR CT9693-90 (CT9693 bundled with the CT6590)
Appearance			
Includes	CT9691 ×1, CT6590 ×1	CT9692 ×1, CT6590 ×1	CT9693 ×1, CT6590 ×1
CT9691,CT9692,CT9693 (Clamp sensor) specifications			
	CT9691	CT9692	CT9693
Primary current rating	100A AC/DC	200A AC/DC	2000A AC/DC
Maximum input range (RMS value)	100Arms continuous*	200Arms continuous*	2000Arms continuous*
Maximum rated voltage to earth	CAT III AC/DC 600V		
Frequency band	DC to 10 kHz (-3dB)	DC to 20 kHz (-3dB)	DC to 15 kHz (-3dB)
Cord length	2m (6.5 ft)		
Measurable conductor diameter	35 mm (1.38") or less	33 mm (1.30") or less	55 mm (2.17") or less
Dimensions, Mass	53W(2.09") × 129H(5.08") × 18D(0.71") mm, 230g (8.1 oz.)	62W(2.44") × 167H(6.57") × 35D(1.38") mm, 410g (14.5 oz.)	62W(2.44") × 196H(7.72") × 35D(1.38") mm, 500g (17.6 oz.)
CT6590 (SENSOR UNIT) specifications			
	CT6590		
Range when combined with sensor (H/L selectable)	H range : 100A AC/DC f.s. L range : 10A AC/DC f.s.	H range : 200A AC/DC f.s. L range : 20A AC/DC f.s.	H range : 2000A AC/DC f.s. L range : 200A AC/DC f.s.
Sensor combination Output rate	H range : 1mV/A L range : 10mV/A	H range : 1mV/A L range : 10mV/A	H range : 0.1mV/A L range : 1mV/A
Sensor combination measurement range	See input specifications		
Sensor combination accuracy (Continuous input)	±1.5%rdg.±1.0%f.s. (DC ≤ f ≤ 66 Hz)	±1.5%rdg.±0.5%f.s. (DC ≤ f ≤ 66 Hz)	±2.0%rdg.±0.5%f.s. (DC) ±1.5%rdg.±0.5%f.s. (45 ≤ f ≤ 66Hz, I ≤ 1800A) ±2.5%rdg.±0.5%f.s. (45 ≤ f ≤ 66Hz, 1800A<I ≤ 2000A)
Sensor combination accuracy (Phase)	±2deg. (DC < f ≤ 66 Hz)	±2deg. (DC < f ≤ 66 Hz)	±2deg. (45Hz ≤ f ≤ 66 Hz)
Cord length	1m (3.3ft)		
Dimensions, Mass	36W(1.42") × 120H(4.72") × 34D(1.34") mm (excluding protruding parts), 165g(5.8 oz.) (including batteries)		
Power supply	LR6 alkaline battery x2, optional AC adapter, or 5 V to 15 VDC external power		
Options (sold separately)	AC ADAPTER 9445-02 (universal 100 to 240VAC , 9V/1A output/for USA) AC ADAPTER 9445-03 (universal 100 to 240VAC , 9V/1A output/for Europe)		

* : Derating according to frequency

Clamp-on leak sensor	CLAMP ON LEAK SENSOR 9657-10	CLAMP ON LEAK SENSOR 9675
Appearance		
Primary current rating	10A AC (Up to 5A on Model PW3198)	
Output voltage	100 mV/A AC	
Measurement range	See input specifications (Cannot be used to measure power)	
Amplitude accuracy *	±1.0%rdg.±0.05%f.s. *	±1.0%rdg.±0.005%f.s. *
Residual current characteristics	Max. 5mA (in 100A go and return electric wire)	Max. 1mA (in 10A go and return electric wire)
Effect of external magnetic fields	400A AC/m corresponds to 5mA, Max. 7.5mA	
Maximum rated voltage to earth	CATIII 300Vrms (insulated conductor)	
Cord length	3m (9.84ft)	
Measurable conductor diameter	Max. φ40 mm (1.57")	Max. φ30 mm (1.18oz")
Dimensions, Mass	74W(2.91")×145H(5.71")× 42D(1.65)mm, 380g(13.4oz.)	60W(2.36")×112.5H(4.43")× 23.5D(23.6")mm, 160g(5.6oz.)

* : 45 to 66Hz

Options

Current measurement (see P.14 -15 Clamp-on sensors specifications for details)

CLAMP ON SENSOR (Load current, AC)

9694
5A AC, φ15mm(0.59")

9661
500A AC, φ46mm(1.81")

CT9667
500A AC/ 5000A AC (selectable), φ254mm (10"),
Power supply: LR06 alkaline battery or AC ADAPTER 9445-02/03 (sold separately)

9660
100A AC, φ15mm(0.59")

9669
1000A AC, φ55mm(2.17"),
80(3.15")×20(0.79")mm busbar

9695-02 (50A AC)
9695-03 (100A AC)
φ15mm(0.59"), CONNECTION CORD 9219 is required (sold separately)

CONNECTION CORD 9219
For connecting 9695-02,9695-03
Cord length : 3m (9.84ft)

CLAMP ON AC/DC SENSOR (Load current, AC/DC)

CT9691-90
100A AC/DC / 10A AC/DC (selectable),
φ55mm(1.38")
Power supply:
LR6 alkaline battery or AC ADAPTER 9445-02/03 (sold separately)

CT9692-90
200A AC/DC / 20A AC/DC (selectable),
φ33mm(1.30")
Power supply:
LR6 alkaline battery or AC ADAPTER 9445-02/03 (sold separately)

CT9693-90
2000A AC/DC / 200A AC/DC (selectable),
φ55mm(2.17")
Power supply:
LR6 alkaline battery or AC ADAPTER 9445-02/03 (sold separately)

The CT9691-90, CT9692-90, and CT9693-90 represent the respective clamp sensor bundled with the CT6280 Sensor Unit.

CLAMP ON ADAPTER

9290-10
CT ratio 10:1, AC1000A,
φ55mm(2.17"),
80(3.15")×20(0.79")mm busbar,
Cord length : 3m(9.84ft)

CLAMP ON LEAK SENSOR (Leak Current)

Cannot be used to measure power

9657-10
10A AC (Up to 5A on Model PW3198),
φ40mm(1.57"),

9675
10A AC (Up to 5A on Model PW3198),
φ30mm(1.18"),

Voltage measurement

WIRING ADAPTER
PW9000
For 3P3W WIRING

WIRING ADAPTER
PW9001
For 3P4W WIRING

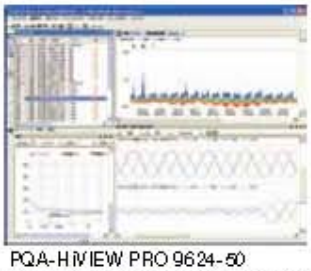
Reduce voltage cords for easy wiring

MAGNETIC ADAPTER 9804-01 (red)
MAGNETIC ADAPTER 9804-02 (black)
Magnetic tip for use with the standard Voltage Cord L1000
(generally compatible with M6 pan screws)

Red and black adapters sold separately.
Purchase the quantity and color appropriate for your application.
(Example: 3P3W - 3 adapters; 3P4W - 4 adapters)

GRABBER CLIP
9243
For use with the standard Voltage Cord L1000

Application software



PQA-HiVIEW PRO 9624-50
Use Model 9624-50 PQA-HiVIEW PRO (version 2.00 or later) with a PC to analyze the data collected by the PW3198.

Case

CARRYING CASE
C1001
Soft case
450(W)×345(H)×210(D)mm
(17.7"W×13.6"H×8.3"D)
3.4kg (120oz.)

CARRYING CASE
C1002
Hard case
413(W)×595(H)×255(D)mm
(16.3"W×23.4"H×10.4"D)
5.7kg (201oz.)

Clock synchronization

GPS BOX PW9005
To synchronize the PW3198 clock.
Accessory: Connection cable set

POWER QUALITY ANALYZER PW3198
(Bundled accessories)
SD MEMORY CARD 2GB Z4001,
VOLTAGE CORD L1000, AC ADAPTER Z1002,
BATTERY PACK Z1003, Instruction manual,
Measurement guide, Strap, USB cable (Approx. 1m in length)

POWER QUALITY ANALYZER PW3198-90

(Set with PQA HiVIEW PRO 9624-50 and bundled accessories)

IMPORTANT

Use Model PQA-HiVIEW PRO 9624-50 (version 2.00 or later) with a PC to analyze the data collected by the PW3198.

Bundled accessories

Voltage Cord L1000
8 cords, approx. 3m each:
1 each red, yellow, blue, and gray plus 4 black;
8 alligator clips: 1 each red, yellow, blue, and gray plus 4 black

AC ADAPTER Z1002
Power supply for the PW3198
100V AC to 240V AC

SD MEMORY CARD 2GB
Z4001

IMPORTANT

Use only the SD Card Z4001 sold by HIOKI.

BATTERY PACK Z1003
(Ni-MH, 7.2 V/4500 mAh)

Combination example: For three-phase 4-wire circuits containing leak current

PW3198-90	+	9661 × 3	+	9675	+	PW9001	+	C1001
POWER QUALITY ANALYZER PW3198 set with PQA HiVIEW PRO 9624-50		CLAMP ON SENSOR (500A)		CLAMP ON LEAK SENSOR		WIRING ADAPTER		CARRYING CASE

HIOKI

HIOKI E. E. CORPORATION

Headquarters :
81 Koizumi, Ueda, Nagano, 386-1192, Japan
TEL +81-268-28-0562 FAX +81-268-28-0568
http://www.hioki.co.jp / E-mail: os-ccm@hioki.co.jp

HIOKI USA CORPORATION :
TEL +1-609-409-9109 FAX +1-609-409-9108
http://www.hiokiusa.com / E-mail: hioki@hiokiusa.com

HIOKI (Shanghai) Sales & Trading Co., Ltd. :
TEL +86-21-63910090 FAX +86-21-63910360
http://www.hioki.cn / E-mail: info@hioki.com.cn
Beijing Office : TEL +86-10-84418761
FAX +86-10-84418763 / E-mail: info-bj@hioki.com.cn
Guangzhou Office : TEL +86-20-38392673
FAX +86-20-38392679 / E-mail: info-gz@hioki.com.cn
Shenzhen Office : TEL +86-755-83036357
FAX +86-755-83036360 / E-mail: info-sz@hioki.com.cn
HIOKI INDIA PRIVATE LIMITED :
TEL +91-731-6548081 FAX +91-731-4020083
E-mail: info@hioki.in
HIOKI SINGAPORE PTE. LTD. :
TEL +65-6634-7677 FAX +65-6634-7477
E-mail: info@hioki.com.sg

DISTRIBUTED BY

All information correct as of Sep. 5, 2012. All specifications are subject to change without notice.

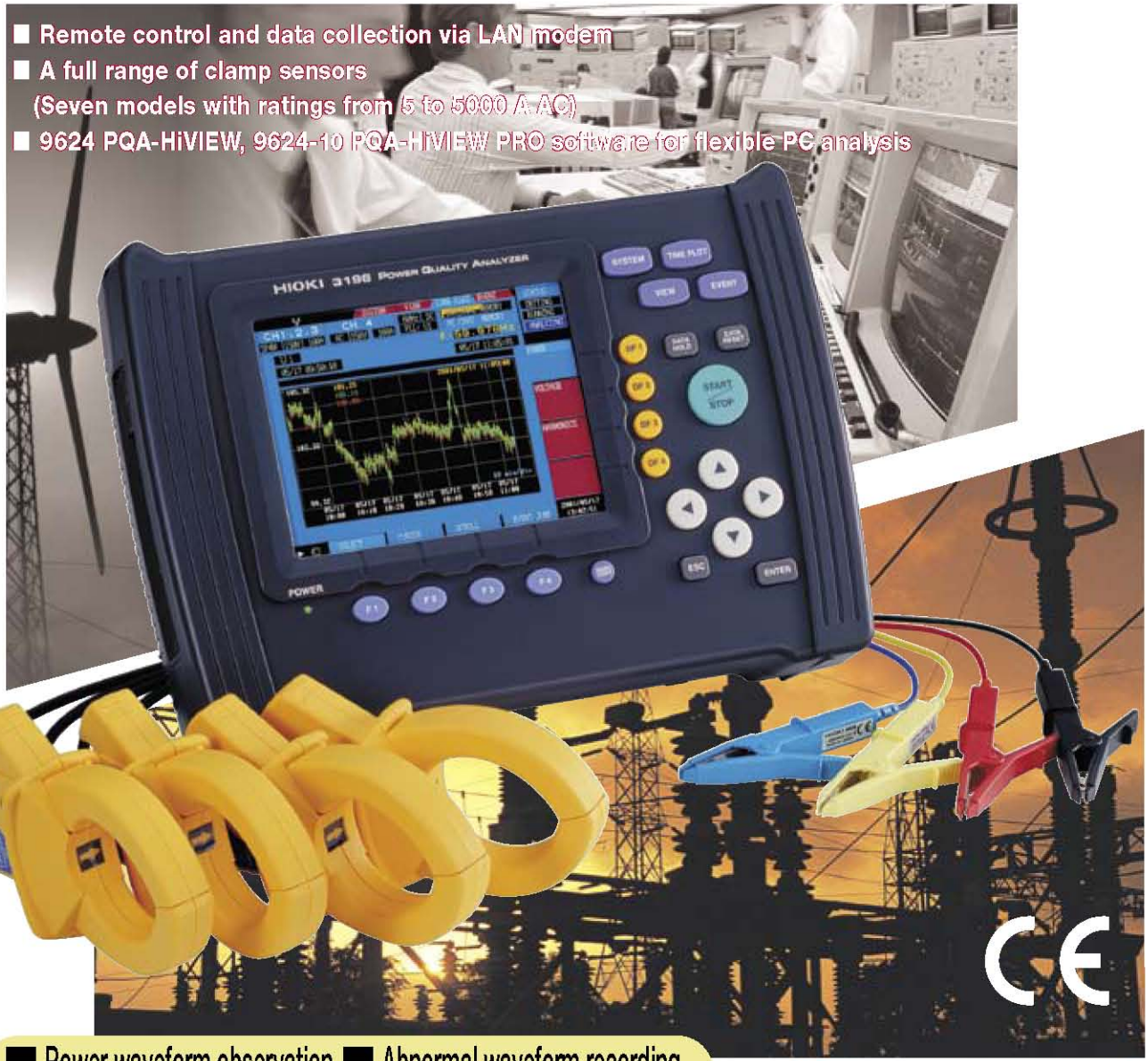
PW3198E4-29B Printed in Japan

HIOKI

3196 POWER QUALITY ANALYZER

Power Measuring Instruments

Investigate All Your Power Quality Problems



- Remote control and data collection via LAN modem
- A full range of clamp sensors
  (Seven models with ratings from 5 to 5000 A AC)
- 9624 PQA-HiVIEW, 9624-10 PQA-HiVIEW PRO software for flexible PC analysis

- Power waveform observation
- Abnormal waveform recording
- Harmonic measurement
- Flicker measurement
- Power measurement

All in a single unit!

EN50160
IEC61000-4-30

9624-10 PQA-HiVIEW PRO

New
Compatible to 400Hz Circuits!

ISO 9001
JMI-0216

ISO14001
JQA-E-90091

http://www.hioki.co.jp/

HIOKI company overview, new products, environmental considerations and other information are available on our website.

Capture all power anomalies without fail!

Problems with power quality are all around us

Have you ever experienced any of the following?

- Flickering lights
- Light bulbs burn out quickly
- Electronic office equipment does not function properly
- Sometimes devices operate abnormally
- Overheating in facilities using condensers fitted with reactors
- 3E (electrical overload, reverse phase, or phase loss) relays sometimes trip

These types of problems and others are often due to degraded power quality.

Discovering the cause can be difficult

The quickest way to solve power problems is to have a clear understanding of the cause, and be able to determine where the phenomenon occurred. However, it is not always possible to accurately grasp all of the various types of anomalies that may occur on power lines, even when using recording or harmonic analysis devices to investigate them.

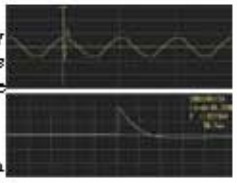
▼

Dedicated measuring instruments are required in order to accurately grasp these kinds of anomalies.

Fully identify the many phenomena hiding in your power lines

Overlooking the smallest of power anomalies can lead to enormous financial loss. Checking the quality of your power lines is the best way to prevent problems before they occur.

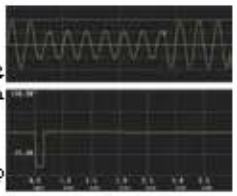
● Transient Overvoltage (Impulse)



Phenomenon :
Occurs due to lightning or circuit breaker/relay contact damage or closure. Often involves radical changes in voltage with high voltage peaks.

Damage :
In the vicinity of the event, high voltage often damages equipment power supplies or causes devices to reset.

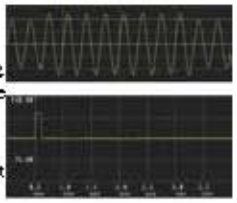
● Voltage Dip



Phenomenon :
Caused by momentary voltage drops resulting from large rush current in loads, such as when starting up a motor.

Damage :
The drop in voltage may cause devices to stop operating or reset.

● Voltage Swell



Phenomenon :
Caused by lightning strikes or opening/closing power lines with heavy loads, causing the voltage to swell momentarily.

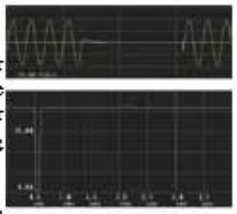
Damage :
The surge in voltage may damage equipment power supplies or cause devices to reset.

● Flicker (IEC, ΔV10)

Phenomenon :
Caused by blast furnaces, arc welding, and thyristor-controlled loads, and involving regularly repeated voltage impulses spanning one or more cycles.

Damage :
Because this phenomenon is cyclically repeated, it may cause lights to flicker or devices to malfunction.

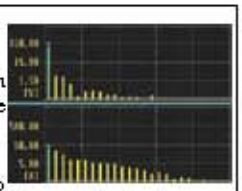
● Instantaneous interruptions



Phenomenon :
An instantaneous or short/long term power supply interruption caused by accidents at the power company (such as interruption of power transmission due to lightning strike) or tripping of breakers due a power supply short.

Damage :
Thanks to the increasingly widespread adoption of uninterruptible power supplies, equipment such as computers is increasingly protected against this problem. However, it may still cause other devices to stop operating or reset.

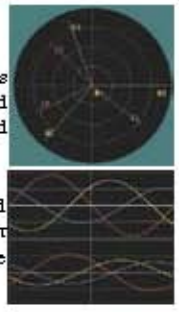
● Harmonics



Phenomenon :
Often occurs due to voltage/current waveform distortion when a semiconductor control device is used in a device's power supply.

Damage :
When harmonic components become too large, they can cause serious malfunctions, such as overheating in motor transformers, or burn-out of reactors connected to phase advance capacitors.

● Unbalance factor



Phenomenon :
Voltage/current waveform distortion and voltage drops or voltage phase reversals can occur when the load on a particular power line phase increases due to load fluctuations or imbalances.

Damage :
Voltage imbalance, reverse phase voltage, and harmonics can result in events such as uneven motor rotation, tripping of 3E breakers, and overheating due to transformer overloading.

The 3196 can **simultaneously measure, record, and analyze all of the above phenomena.**

Supports data analysis with a wide range of functions!

The 3196 measures, records and analyzes power line quality

Features

■ Supports single-phase 2-wire, single-phase 3-wire, three-phase 3-wire and three-phase 4-wire systems. Further, the unit has an extra input channel providing enhanced analysis capabilities.

An isolated CH4 terminal is provided for AC and DC measurement.

- Neutral line measurement you can use for ground fault detection!
- Analyze DC power supplies
- Performs simultaneous analysis of two isolated systems, such as single phase and three phase lines

■ Comes equipped with Δ-Y and Y-Δ conversion functions

Supports Δ-Y voltage conversion for three-phase, 3-wire systems, and Y-Δ voltage conversion for three-phase, 4-wire systems. Selectable display of inter-line voltage and phase voltage.

■ Wide selection of clamp on current sensors

In addition to clamp-on current sensors Models 9660 (100 A), 9661(500 A), 9669 (1000 A), and 9667 (5000 A, flexible), HIOKI also provides the 9694 (5 A) sensor, which is ideal for CT terminal measurement, as well as two other clamps for 5A leak measurement, Models 9657-10 and 9675, to suit every application need.

■ Three-phase voltage wiring adapter (optional)

Use the wiring adapter to simplify voltage wiring procedures.

- 9264-01 for three-phase, 3-wire systems
- 9264-02 for three-phase, 4-wire systems

* The 9264-01/02 Wiring Adapters are designed to reduce voltage cord wiring to a bare minimum for use with specific power lines. Do not use with installations other than those specified.

■ External event input/output terminals

Event output :

Outputs a signal when events occur-either as an alarm or device control signal.

Event input :

Accepts a trigger signal to initiate measurement.

■ Small and Lightweight

Compact A4 size, and weighing only 2.25 kg (79.4 oz).

New Full compatibility to 400Hz circuits

(Please specify inspection data sheet requirements for 400 Hz test points at time of order.)

■ Simultaneous measurement and continuous processing

All data are measured simultaneously and processing is performed continuously, so important fault data is not missed.
Further, transient overvoltages up to 2000 V with durations as low as 0.5 μs are captured without fail.

■ Seven different display languages

Select a display language from Japanese, English, German, French, Spanish, Italian or Chinese .You can switch between the different display languages to suit your location.

■ 6.4-inch color LCD

The unit uses a TFT color LCD screen, providing bright display with a wide viewing angle.The color display provides easy viewing of waveforms, both indoors and out.

■ Extended measurement of up to one month with internal memory

The unit's internal memory (13 MB) supports up to one month of continuous recording.

*The amount of time available for continuous measurement can be checked when setting the measurement interval.

*Use a PC card to record at shorter measurement intervals over longer periods in conjunction with the internal memory.

Storage Media	Storage of Events (Usage capacity)	Interval time	Power Saving RMS only	P&Harm Saving RMS + harmonics	ALL DATA Save all data
Internal Memory Time Series: 5MB Fixed Events: 8MB Fixed	Max. 100 (approx. 8MB)	1 s	2 h 01 m	8 m	5 m
		1 m	5 days 1 hour	8 h 29 m	5 h 45 m
		1 h	31 days	21 days 5 h	14 days 9 h
PC Card (128MB)	When storing 100 (approx. 8MB)	1 m	31 days [119 days]	8 days 8 h	5 days 16 h
	Max. 1000 (approx. 81MB)	1 m	31 days [36 days]	2 days 13 h	1 days 17 h
	Max. 1000 (approx. 81MB)	1 s	14 h 40 m	1 h 1 m	41 m

*When recoriding Time Series data, select MAX/MIN/AVE
*Refer to the specifications for details regarding the recordable items.
*Max. continuous save: 31 days
*During the measurement period, all dips, swells and interruptions are calculated.

■ PC card slot

Flash ATA cards up to 528 MB can be used to allow more detailed data collection.
Compact flash cards can also be used with an adapter.

■ LAN and RS-232C interfaces

The 3196 features an HTTP server to enable easy configuration and data analysis through a Web browser from a remote location.

■ Synchronize the 3196 clock New

Connect the optional XD112 GPS Box to make sure the time recorded for measured events is based on the global standard time.

Set includes antenna and RS-232C cable

■ Optional printer for easy hard copy output

Connect the optional 9670 printer to the RS-232C terminal for easy hard copy output of screens.

Printing method : Thermal line dot
Printing width : 72 mm (2.83")
Printing speed : 47.5 mm/sec (1.87"/sec)
Power supply : 9671 AC ADAPTER or the BATTERY PACK
Dimensions and mass : 119 (4.69") × 77 (3.03") × 174 (6.85") mm, approx. 500 g (17.6 oz.)

■ Two types of carrying case available (optional)

Choose from the soft (9339) or hard (9340) carrying case and measure while the 3196 is safely stored.

The top side of the case holds the 3196.

Model 9339 soft case

The bottom side of the case holds accessories.

Real-time data display for power supplies

Display waveform, vector, DMM, and harmonic data in real-time

The VIEW screen displays voltage/current waveforms, vector diagrams, DMM values (voltage, current, and power), and harmonic data. All data can be measured and processed simultaneously, and power conditions such as distortion factor, K factor, and the unbalance factor for three-phase lines can be monitored using the various data displays.

Connect the 3196 to a power source to display power line data in real-time

All power line conditions can be monitored from the VIEW screen!

Display data in real-time

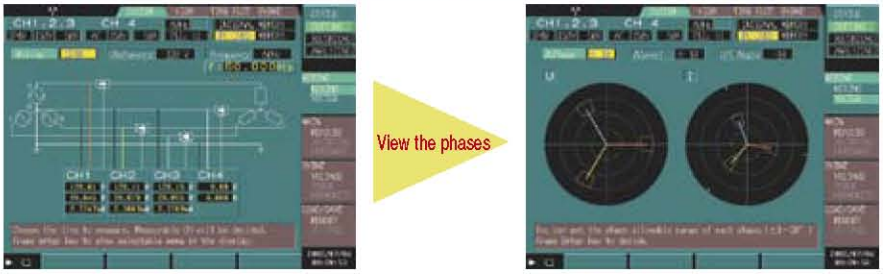
-1. Waveform display (voltage/current display, 4-channel voltage display, 4-channel current display)
-2. Vector display
-3. DMM display (power, voltage, and current displays)
-4. Harmonics (graph and list displays)

Power management through a rich array of information

-1. Check the distortion of power waveforms using electronic devices and electrical overloads.
-2. Manage the phase of power lines. Check the phase and wiring of the VT (PT) and CT terminals.
-3. Manage, maintain and check the unbalance factor, peak values, and distortion factor of power lines.
-4. Assess and develop countermeasures to prevent the occurrence of harmonic power flow.

Check for proper instrument connection using the numerical value or vector display

Connect the 3196 to the power line to be monitored while viewing the connection diagram.Upon connection, you can confirm voltage, current, and power values. Further, through the vector display, you can verify proper connection of clamp-on current sensors to the VT (PT) and CT terminals.

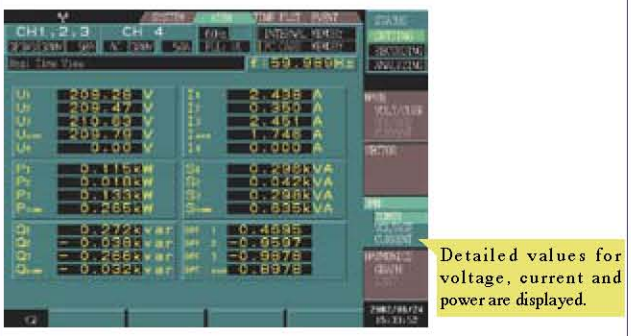


Waveform display

This displays the voltage and current waveforms for each phase.
Waveform display makes it easy to understand distortion conditions that (as with harmonics) are difficult to grasp from numerical values alone.

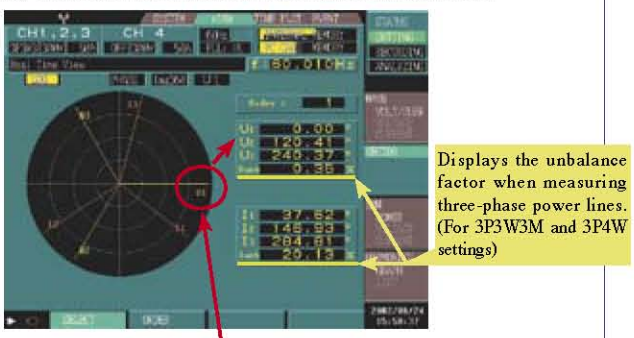
DMM display

This displays detailed data for voltage, current, and power.
View the data necessary for power management or maintenance and inspection of power lines at a single glance.



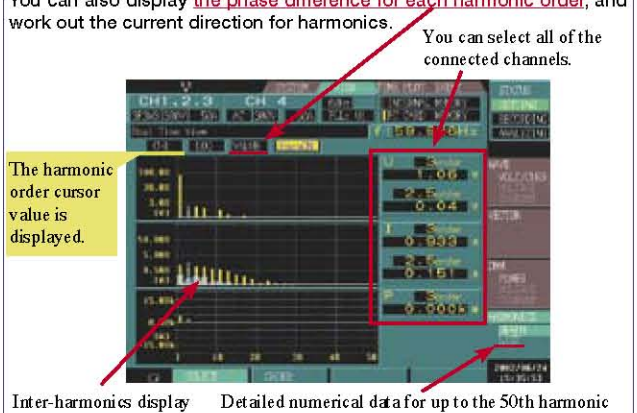
Vector display

This displays the voltage and current vectors for each phase, as well as RMS values and phase angles as numerical values.
Easily check the phase of three-phase lines and harmonics.



Harmonics display

This displays harmonics and inter-harmonics data in a graph or list.
You can also display the phase difference for each harmonic order, and work out the current direction for harmonics.



Capture anomalies while using time series measurement to monitor power lines

Simultaneous time series monitoring for RMS fluctuations, voltage fluctuations, harmonics fluctuations, and flickering

RMS fluctuation, voltage fluctuation, harmonic fluctuation, and flicker (IEC and ΔV10) time series data is displayed on the TIME PLOT screen. In addition to cursor measurement, you can enlarge events that occur in the voltage fluctuation event screen if a voltage dip, swell, or instantaneous interruption event occurs during the measurement period.

Simply set the interval and start time series measurement to display events in the fluctuation graph

Time series fluctuation results are displayed in the TIME PLOT screen ▶ **Continuous data calculation processing of all data without fail!**

■ All measurement results are automatically recorded

-1. RMS fluctuation (dual screen display selection)
-2. Voltage fluctuation (interval and event displays)
-3. Harmonic fluctuation (harmonics and inter-harmonics displays)
-4. Flicker (graph and list displays)
   - Pst and Plt measurement conditions according to IEC standards
   - ΔV10 measurement (according to Japanese domestic guidelines)

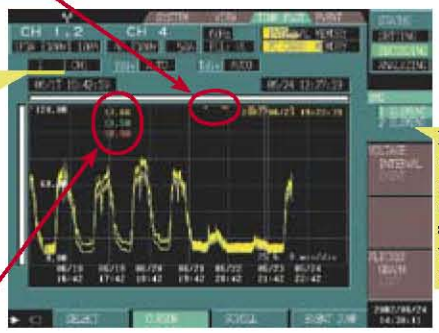
■ Calculation method for measured data

-1. RMS fluctuations/Harmonic fluctuations : Values are calculated continuously every 200 ms. The maximum, minimum, and average values are those applicable within the specified interval.
-2. Voltage fluctuations : Values are calculated for a single waveform shifted by a half wave. The maximum and minimum values are those applicable within the specified interval. Detailed measurement of voltage fluctuations is possible because values are calculated every half wave.
-3. Flicker : Values are calculated in accordance using calculation methods defined in the IEC and ΔV10 standards.

In addition to displaying the various measurements in fluctuation graphs, the 3196 also displays the maximum, minimum, and average values for each specified interval.
Further, when the 3196 captures a power anomaly, an event marker appears in the upper part of the graph.

RMS fluctuation display

When a power anomaly occurs during measurement, the event is indicated using the ▼ marker.



All RMS measurement items can be selected for display.

Dual screen display is possible for combinations such as voltage and current.

Cursor values (maximum, minimum, and average values for the specified interval) are displayed.

Harmonic fluctuation display

You can specify display of up to six harmonic orders.

Cursor values are displayed for the specified orders.

Voltage fluctuation display

Cursor values (maximum and minimum values for the specified interval) are displayed.

Even when a long interval is set, momentary voltage fluctuations are accurately captured.

Markers are displayed in blue. (▼ marker)

Event display
When an event such as a dip, swell, or instantaneous interruption occurs, the time axis is enlarged on the event screen.

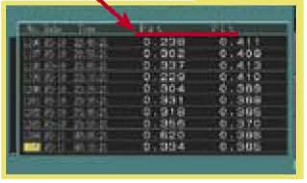
Flicker display

IEC flicker display

Displays the Pst and Plt values as a graph once every ten minutes.

The Pst and Plt cursor values are displayed.

Displays a list of detailed data for Pst and Plt values once every ten minutes.



Use event data to analyze the cause of power anomalies!

Display the details for power anomalies captured using event triggers

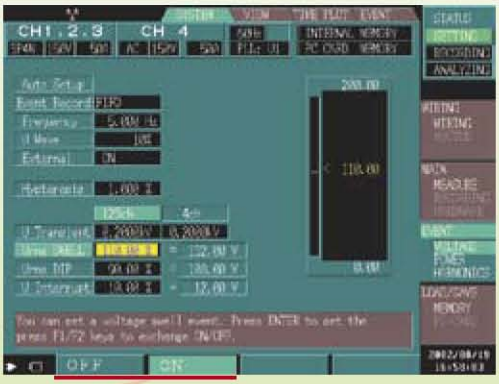
You can capture a variety of power anomalies by setting the individual trigger levels on the event setting screen. Captured data is displayed in the event list. This enables you to quickly confirm detailed data for phenomena (such as date/time, waveforms, RMS values, and harmonics), that are the source of problems, and effectively assess the cause of the problem.

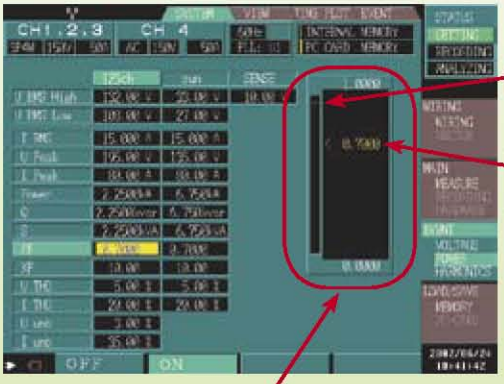
Set event triggers, start measurement → Capture power anomalies → Search list → Display details

Make event trigger settings and start measurement!

1. Select a trigger threshold value that is suitable for the parameter being measured.

Set thresholds along with other settings. You can make threshold settings while monitoring the actual input level, input waveform, and harmonics graph.





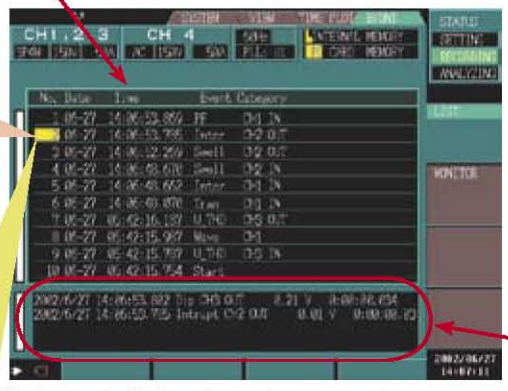
All trigger settings can be made at once, enabling accurate capture of complex power anomalies.

When using the unit's internal memory to save events, up to 100 events are automatically saved, or up to 1000 events when using a PC card.

Once measurement is finished, search the event list to confirm detailed data for events-even during measurement

2. Confirm the details for events in the list screen.

The capture date and event category are displayed.



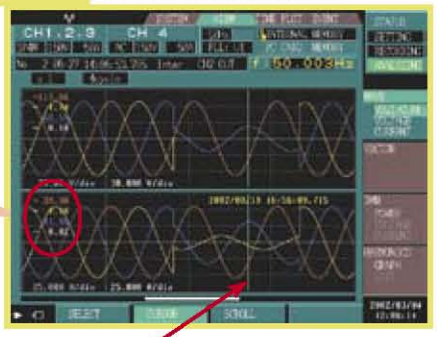
Waveform display range:
14 waveforms at 50 Hz
16 waveforms at 60 Hz

Simultaneously display voltage and current waveforms for instantaneous interruptions.

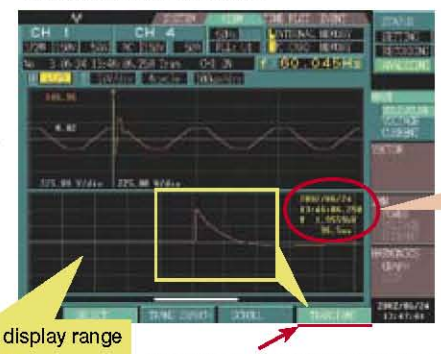
3. Confirm the number of captured events in the monitor screen.

The number of times each event occurred is visible at a glance.
You can also check the events while they are being measured.

Transient overvoltages up to 2000 Vpk with durations as low as 0.5 μs are captured without fail.



For transient capture



Remote measurement is simplified using the HTTP server function

Real-time measurement/control and download measurement data over the Worldwide Web

■ The HTTP server function as a standard feature makes remote measurement even more convenient

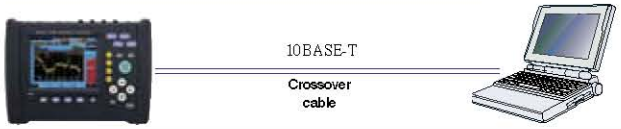
You can perform remote observation and control using an ordinary Web browser, such as Internet Explorer, without the need for special software. Further, you can download measurement data that has been saved onto a PC card.

Using the 3196 and your PC, you can observe power anomalies at remote locations and analyze measurement data

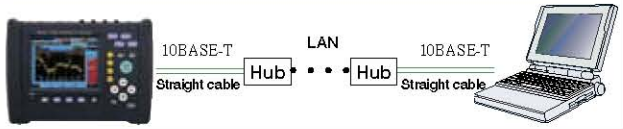
■ Choose from a variety of network measurement plans

By connecting a PC to the 3196, you can set up various types of network measurement systems through a LAN or RS-232C interface.

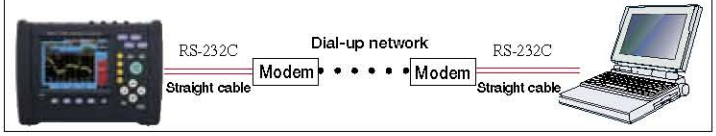
Ex. 1. Direct connection with a LAN cable



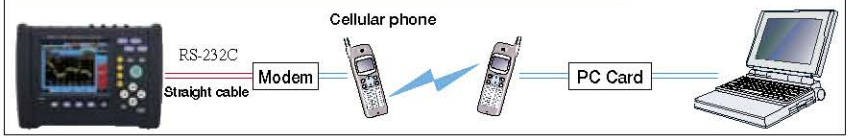
Ex. 2. Remote connection with a LAN through a hub



Ex. 3. Remote RS-232C connection through a modem



Ex. 4. Remote RS-232C connection through a modem



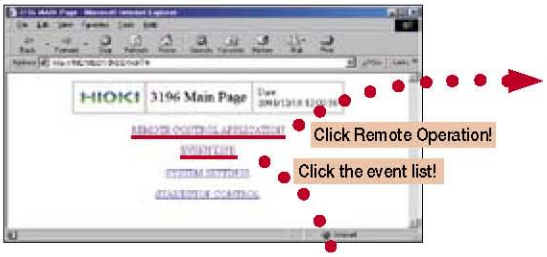
Transfer Measurement Data to Your PC

Data saved in Binary/Text/BMP formats in the PC Card or internal memory of the 3196 can easily be transferred to your PC using the freeware Down96, supplied with your purchase or downloadable from the HIOKI website. (Compatible with 3196 version 1.21 or later)

Note: To further analyze binary data, use the optional 9624 PQA HiVIEW or 9624-10 PQA HiVIEW Pro application software.

View the 3196 screen on your PC as soon as you open the remote application from your Web browser!

1. Enter the IP address for the 3196 on the browser to display the main screen.

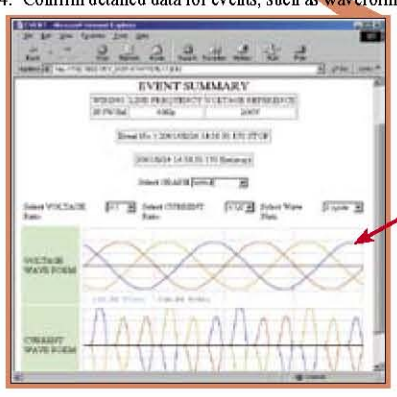


2. A display screen and operation keys identical to those for the 3196 appear, allowing full control of remote operation.

Because the various key operations are identical to those for the 3196, the keys are easy to use.

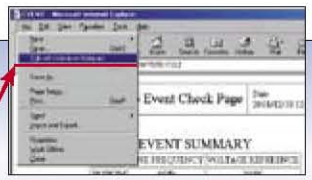
3. Confirm the events that occurred in the list.

4. Confirm detailed data for events, such as waveforms.



Convenient Feature

5. You can also convert waveform data into text.
Click the waveform data. Microsoft Excel starts, and you can save the text data for the waveforms.



6. Using the report creation function, you can paste the event screen displayed into Microsoft Word*.

*When Microsoft Word is selected as the Internet Explorer HTML editor; Compatible with Microsoft Word 97 or later.

Choose from 2 Easy-to-Use Application Software Packages for Further Data Analysis

9624 PQA-HiVIEW & 9624-10 PQA-HiVIEW PRO

Features

■ Viewer function

Use this function to display screens similar to those used for the 3196.
Select from the **TIME PLOT screen** (voltage fluctuation, RMS fluctuation, harmonic fluctuation, inter-harmonic fluctuation), **event list screen**, **event data screen** (waveforms, vectors, DMM, harmonics, event details), **ΔV10 screen**(Japanese standard), or **settings screen**. In the TIME PLOT screen, and use the two cursors (A and B) to calculate waveforms within a specified interval.

■ Demand/integral power consumption function

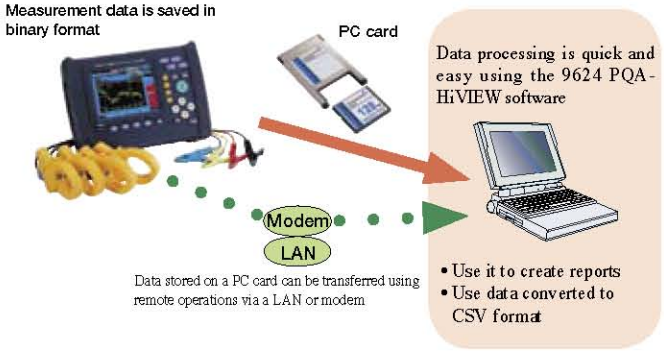
Calculate demand and integral power consumption from TIME PLOT data for effective power.

■ Binary CSV format conversion function

Convert binary data into CSV format for event waveforms within the specified range in the TIME PLOT screen or event waveforms selected in the event waveform screen. Files saved in CSV format can be used with spreadsheet software on your PC.

■ Print function

Use this function in each screen to output reports to a printer connected to your PC.



1.Load measurement data and then select the desired display from the toolbar

1. After loading the data, the possible displays are shown on the toolbar

1. Open a file
2. Copy (a screen)
3. Print
4. Event list screen
5. Event data screen
6. TIME PLOT screen
7. ΔV10 screen
8. Integral power consumption screen
9. Demand screen
10. Settings screen
11. Arrange windows
12. A and B cursors

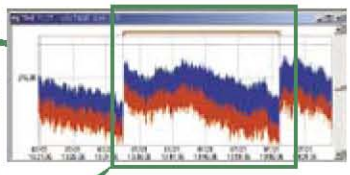
2.Display multiple 3196 screens simultaneously on your PC, and make calculations and analyses using cursors

■ TIME PLOT screen

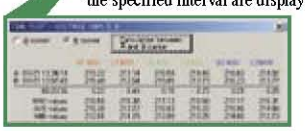
This screen enables you to select four different types of data, including RMS fluctuation, voltage fluctuation, harmonic fluctuation, and inter-harmonic fluctuation data, and display the data in graphs corresponding to the TIME PLOT screen of the 3196.

■ Spot analysis using the cursor

Conduct spot analysis of time series data using the A and B cursors.



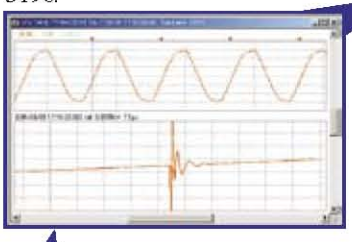
Calculations for the details within the specified interval are displayed.



View power, voltage, and current data at a single glance in the DMM screen!

■ Event list screen

This screen displays an event list corresponding to the event list on the 3196.



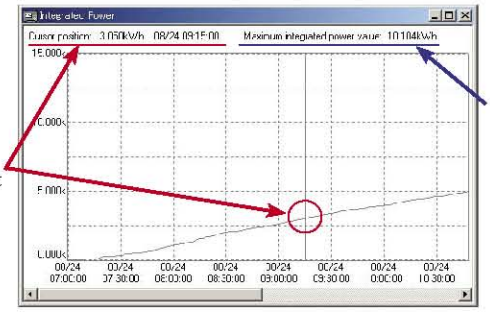
■ Event data screen

1. Displays detailed data for the event that you selected in the event list.
2. Displays nine different screens that correspond to the VIEW screen on the 3196, such as the waveform, vector, harmonics, and DMM screens.

Analyze power consumption and demand using acquired data

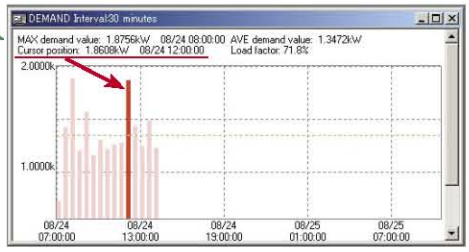
■ Integral power consumption analysis and demand analysis screens

These screens allow you to calculate measurement data and display it in the integral power consumption graph or demand graph. (Use them to display the maximum demand, average demand, and load ratio values.) Further, you can confirm the power data for a specific interval using the cursor function.



Cursor measurement

General power consumption is displayed.



Quickly print reports and apply data

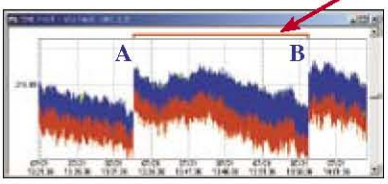
■ CSV format conversion function

Convert data displayed in the TIME PLOT or event waveform screen into CSV format. Converted data can be used with spreadsheet software on your PC.

Convenient Feature

Specify a range using the A and B cursors, and convert the data within that range into CSV format.

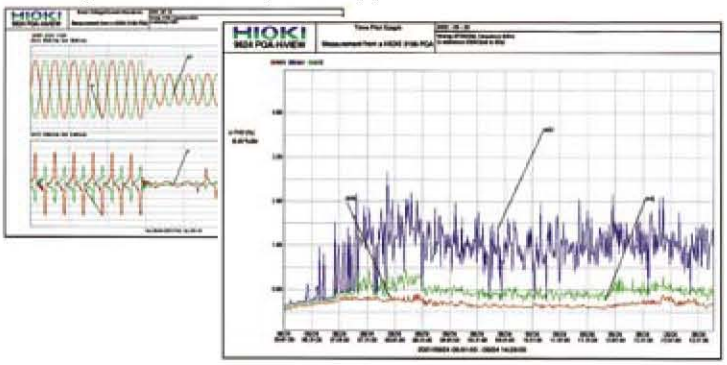
The interval between the A and B cursors is displayed in red.



■ Print function

Print a hard copy of the event list screen, event data screen, ΔV10 screen, integral power consumption screen, or demand screen, one at a time. In the TIME PLOT screen, you can collect all of the screens that are currently open and print them on a single sheet.

Print example: Event waveform screen printed on A4 paper



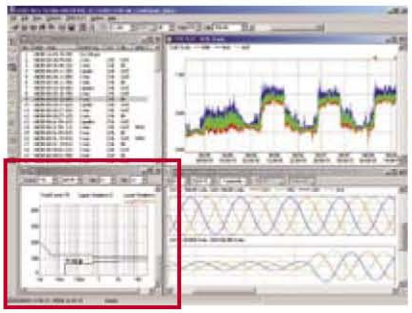
Print example: TIME PLOT screen (U-THD RMS fluctuation) printed on A4 paper

9624-10 PQA-HiVIEW PRO (Advanced functions added to the standard Model 9624)

■ ITIC curve display function

Make ITIC (CBEMA) curve analyses (limit curve) based on the power quality control standards of the U.S.A.

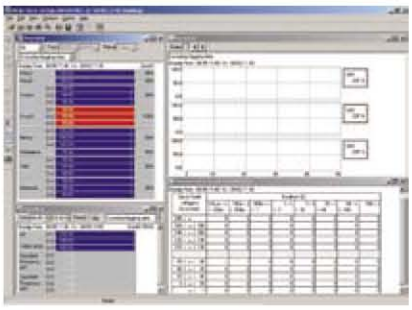
✻ Change the upper or lower limit of the curve as desired.



■ EN50160 display functions

(applicable standard is EN50160:1999)

Effectively evaluate and analyze the quality of power according to EU standards.



■ Downloading from LAN

Data (BINARY/TEXT/BMP) recorded on a PC card or the internal memory of the 3196 can be downloaded via LAN to a personal computer. (*This can be done without use of the freeware Down96. Measurement on the 3196 must be halted during download.)

■ Report generation function

Choose from 3 types of report generation settings to take care of all the troublesome reporting operations, and either send the data to a printer or save as a Rich Text file. (Automatic: Output basic items. Individual setting: Select any item for output. Detailed setting: Specify a time-series graph in details for output.)

■ Positive phase, negative phase, and zero phase function

Recalculate event data captured by 3P4W circuits, and display each component of the voltage/current of the positive phase, negative phase, and zero phase.

■ Model 9624-10 can be used only in conjunction with a hardware license key.

Please select either USB or Parallel license key when ordering.

9624 /-10 Specifications

(Items in blue ■ symbolize specifications unique to Model 9624-10, and are not available in the standard Model 9624.)

-1. Function specifications

Data loading functions

Data that can be loaded : Binary data recorded using the 3196
SET files (Settings data), ITV files (TIME PLOT data), EVT files (Event data (lists, voltage and current waveforms, transient waveforms, numerical values), FLC files (Flicker data (ΔV10, IEC)), TRN files (Transient waveforms), EN50160. files (EN50160 dasta), EVENT.EN files (EN50160 Event data)

Maximum data capacity : Up to 528 MB

Data display functions

SYSTEM display function
Screen display : SYSTEM (settings) content screen

TIME PLOT display function
Screen display : RMS fluctuation, voltage fluctuation, harmonic fluctuation, inter-harmonic fluctuation
Number of display screens : Up to 4 screens
Cursor function : A and B cursors (interval calculation function provided)

EVENT list display function
Screen display : EVENT list content display
Display method selection : Order events occurred in, or order of priority

EVENT data display function
Display function : Display the event data selected in the EVENT list display screen
Screen display : Display one of the following screens ((1) to (4))
(1)Waveform display : Select from the voltage/current waveform, 4-channel voltage waveform, 4-channel current waveform, and voltage/transient overvoltage waveform displays.
(2)Vector display : Select from the harmonic RMS value and phase angle displays.
(3)DMM display : Displays power, voltage, and current values.
(4)Harmonics display : Select from the harmonics bar graph and list displays.
Cursor function : A and B cursors (interval calculation function provided) for the waveform display screen

Positive/ Negative/ Zero phase calculation function
: Display voltage and current of the positive phase, negative phase, and zero phase. (In vector display screen, this is conducted during the 3P4W wiring analysis.)

Flicker graph Display function
Screen display : ΔV10 Flicker graph or IEC Flicker graph
Cursor function : A and B cursors (interval calculation function provided)

EVENT voltage fluctuation graph Display function
Cursor function : A and B cursors (interval calculation function provided)

Integral power consumption calculation function

Settings : Analysis start time/period : Set the year, month, day, hours, minutes, and seconds. /1 to 31 days
Display method and calculation items :
Integral power consumption graph, Integral power consumption (consumption + regeneration, and cursor measurement functions provided), Maximum integral power consumption (final integral power consumption for the specified analysis period)

Demand calculation function

Settings : Analysis start time/period : Set the year, month, day, hours, minutes, and seconds. /1 to 31 days
Demand interval settings : 5, 10, or 30 minutes, 1, 2, 3, 6, or 12 hours
Display method and calculation items :
Demand graph (for consumption only), Average demand (average demand value for the specified analysis period), Maximum demand (maximum demand value for the specified analysis period), Load ratio (average demand/maximum demand × 100 [%])

ITIC curve display function

Display function : Plot event points on limited value curve (points indicating swell/dip/interruption occurrence period and voltage)
Percent of nominal voltage : Maximum swell voltage or residual voltage ratio against official voltage
Violation count display : Number of upper-limit violations, number of lower- limit violations, and total number of events
Limit curve selection : ITIC curve or user-defined curve (any setting)

EN50160 display function

Screen display : Overview/Harmonic/Signaling/Measurement result sorting

Copy function

Copy content : Saves the various screens in BMP format

Print function

Print format: Prints screen images, Paper size: A4 and Letter, Print preview: Yes

CSV format conversion function

Screens that can be converted : TIME PLOT and event waveform screens
Conversion settings : Specified interval conversion (TIME PLOT screen only)
Conversion setting selection (TIME PLOT screen only)

Report creation function

Output format : Output setting contents can be printed, or saved as a rich text file.
(1) Automatic output : RMS voltage fluctuation graph, worst case, maximum/minimum list, total harmonic voltage distortion graph, Overview and Signaling data of EN50160, and all event detail list.
(2) Arbitrary output : Includes, in addition to automatic output, RMS current fluctuation graph, transient waveform, total harmonic current distortion graph, Harmonic and result classification data of the EN50160, and settings list.
(3) Detailed output : Voltage fluctuation, RMS fluctuation, harmonics fluctuation, and interharmonics fluctuation.

Settings save function

Save user-defined curves, setting for sorting measurement result, report setting, etc.

Download function

Download data from the 3196 via LAN.

-2. Basic specifications

Supplied accessories : CD-R × 1
Operating environment : PC/AT-compatible devices
OS : English or Japanese versions of the following
- Microsoft Windows 95 (9624 only, OSR2 or later versions only supported, Internet Explorer 3 or later required)
- Microsoft Windows 98, Me, NT 4.0, 2000 or XP

Memory : At least 128 MB

3196 Specifications

-1. Measurement and recording items

Recording item	Power	P&Harm	ALL_D	Recording item	Power	P&Harm	ALL_D
Transient overvoltage	○	○	○	Voltage unbalance factor	○	○	○
Voltage swell	○	○	○	Current unbalance factor	○	○	○
Voltage dip	○	○	○	Harmonic voltage	×	○	○
Instantaneous interruption	○	○	○	Harmonic current	×	○	○
Frequency	○	○	○	Harmonic power	×	○	○
RMS voltage	○	○	○	Harmonic voltage-current phase difference	×	○	○
RMS current	○	○	○	Inter-harmonic voltage	×	×	○
Voltage peak	○	○	○	Inter-harmonic current	×	×	○
Current peak	○	○	○	Total harmonic voltage distortion factor	○	○	○
Effective power	○	○	○	Total harmonic current distortion factor	○	○	○
Apparent power	○	○	○	Total inter-harmonic voltage distortion factor	×	×	○
Reactive power	○	○	○	Total inter-harmonic current distortion factor	×	×	○
Power factor/Displacement power factor	○	○	○	K factor	○	○	○
				Flicker (ΔV10/Pst, Plt)	○	○	○

* Select from a total of six different patterns when recording data. These consist of three available data patterns (Power, P&Harm, or ALL DATA), combined with two patterns, AVE and ALL (maximum, minimum, and average), of detailed data for each measurement item.

-2. Basic specifications

Power quality measurement standards conformance : IEC61000-4-30:2002, IEEE1159, EN50160:1999
Clock functions : Auto calendar, auto leap year, 24-hour clock
Real-time clock accuracy : Within ±0.3 s/day (when the 3196 is turned on)
Internal memory capacity for data : 13 MB (time series and event data)
Maximum recording interval : 1 month (internal memory)
Measurement time control : Manual/Specified time
Time series data settings
Recording item setting patterns : Power, P&Harm, and ALL DATA
MAX/MIN/AVE values : AVE values, ALL values (maximum, minimum, and average values)
Interval selections : 1, 3, 15, or 30 seconds, 1, 5, 10, 15, or 30 minutes, 1 or 2 hours
Event settings
Event settings : All measurement settings except flicker and inter-harmonics
Event threshold value setting : OFF or desired numerical value
Maximum number of recording events : 100 (internal memory)
(Simultaneous events count as 1 event.)
Power supply : 12 V DC from the 9458 AC ADAPTER or 9459 BATTERY PACK
Maximum rated power : 40 VA
Continuous operating time with battery : Approximately 30 minutes (9459 battery pack)
External dimensions : Approximately 298W (11.73") × 215H (8.46") × 67D (2.64") mm (not including projections)
Mass : Approximately 2.25 kg (79.4 oz.) (including 9459 battery pack)

3196 Specifications

(Guaranteed accuracy period : 6 months / Certain specifications vary when measuring 400Hz circuits. Please inquire with your HIOKI distributor for details.)

-3. Input specifications

Measurement line types: Single-phase 2-wire, Single-phase 3-wire, Three-phase 3-wire (3P3W2M, 3P3W3M) or Three-phase 4-wire, plus one extra input channel

Input channels : Voltage : 4 channels (U1 to U4) (channel U4 can be switched between AC and DC)
Current : 4 channels (I1 to I4)

Input methods : Voltage between U1, U2, and U3 without inter-channel isolation
Voltage between U1 to U3 and U4 with inter-channel isolation
Current input by clamp-on sensor

Input resistance : Voltage : 4 MΩ ±10% (differential input)
Current : 200 kΩ ±10%

Measurement method : Simultaneous digital sampling of voltage and current
PLL synchronization (automatically switches to fixed clock during dropouts, so sampling is never interrupted)

PLL synchronization channel source : Voltage at either U1, U2, or U3

PLL synchronization frequency range : 42.5 to 69 Hz

Sampling frequency :
- For calculations (including DC measurement) : 256 points/cycle
  : 256 points/8 cycles (for 400 Hz)
- For harmonic and inter-harmonic analysis : 2048 points/10 cycles (for 50 Hz)
  2048 points/12 cycles (for 60 Hz)
  2048 points/80cycles (for 400 Hz)
- For transient overvoltage (impulse) : 2 MHz

A/D converter resolution :
- For calculations (including DC measurement) : 16 bits
- For transient overvoltage (impulse) : 12 bits

Voltage measurement range :
- Channels 1 to 3 : 150.00, 300.00, 600.00 Vrms
- Channel 4 : 60.000, 150.00, 300.00, 600.00 Vrms
  ±60.000, 600.00 V pk (DC measurement)

Voltage crest factor : 3 or less

Current measurement range :
- With Model 9694 sensor : 5.0000, 50.000 Arms
- With Model 9660 sensor : 50.000, 100.00 Arms
- With Model 9661 sensor : 50.000, 500.00 Arms
- With Model 9667 sensor : 50.000, 500.00 A or 500.00 A, 5.0000 kArms
- With Model 9669 sensor : 100.00 A, 1.0000 kArms

Current crest factor : 4 or less

-4. Measurement specifications

(For specifications when measuring 400Hz circuits, please inquire with your HIOKI distributor.)

RMS voltage

- Measurement method : True RMS (calculated continuously every 10 or 12 cycles at 50 or 60 Hz respectively)
- Range selection : Manual (channels 1 to 3 are set in the same operation)
- Measurement accuracy : AC : ±0.2% rdg. ±0.1% f.s.
  DC : ±0.3% rdg. ±0.4% f.s.

RMS current

- Measurement method : True RMS (calculated continuously every 10 or 12 cycles at 50 or 60 Hz respectively)
- Range selection : Manual (channels 1 to 3 are set in the same operation)
- Measurement accuracy : ±0.2% rdg. ±0.1% f.s. + clamp-on sensor accuracy

Transient overvoltage (impulse)

- Measurement method : 2 MHz sampling
- Measurement range : 2000 Vpk
- Display items : 4 ms waveform (2 ms before and after center peak)
- Period : Period exceeding threshold (max. 4 ms)
- Minimum detectable duration : 0.5 μs
- Measurement accuracy : ±5.0% rdg. ±20 V (1000 V DC and 700 Vrms/100 kHz)

Voltage swell (rise in RMS voltage)

- Measurement method : True RMS (a single cycle is calculated by overlapping each half cycle)
  (The voltage between lines is measured for three phase 3-wire lines, and phase voltage is measured for three phase 4-wire lines.)
- Display items : Amplitude and duration of swell
- Measurement accuracy : Same as RMS voltage

Voltage dip (drop in RMS voltage)

- Measurement method : True RMS (a single cycle is calculated by overlapping each half cycle)
  (The voltage between lines is measured for three phase 3-wire lines, and phase voltage is measured for three phase 4-wire lines.)
- Display items : Amplitude and duration of dip
- Measurement accuracy : Same as RMS voltage

Instantaneous Interruption

- Measurement method : Same as voltage dip

Frequency

- Measurement range : 42.500 to 69.000 Hz
- Measurement source : Voltage (same as the PLL synchronization source)
- Measurement accuracy : ±10 mHz (10 to 110% of range, with sine wave)

Active power

- Measurement method : Calculated continuously every 10 or 12 cycles at 50 or 60 Hz respectively
- Measurement accuracy : ±0.2% rdg. ±0.1% f.s. + clamp-on sensor accuracy

Reactive power

- Measurement accuracy : ±1 dgt. from the calculation of each measurement value (±3 dgt. for the sum)

Power factor

- Measurement range : -1.000 (lead) to 0.000 to +1.000 (lag)
- Measurement accuracy : ±1 dgt. from the calculation of each measurement value (±3 dgt. for the sum)

Displacement power factor

- Measurement method : Calculated from the phase difference between the fundamental waveforms of voltage and current
- Measurement range : -1.000 (lead) to 0.000 to +1.000 (lag)
- Measurement accuracy : ±0.5% rdg. ±0.2% f.s. ±1 dgt. (±3 dgt. for the sum)

Voltage unbalance factor

- Measurement method : Calculation for three-phase 3-wire (3P3W3M) and three phase 4-wire fundamental waveforms of voltage

Current unbalance factor

- Measurement method : Calculation for three-phase 3-wire (3P3W3M) and three-phase 4-wire fundamental waveforms of current

ΔV10 flicker

- Display items : ΔV10, ΔV10 (average over one hour, fourth maximum over one hour, maximum over one hour, overall maximum (during the measurement period)), ΔU (deviation with respect to nominal voltage)
- Standard voltage: Auto : Same operation as AGC for IEC flicker
- Measurement accuracy : ±2% rdg.

IEC flicker (short period flicker Pst, long period flicker Plt)

- Measurement method : Per IEC61000-4-15
  Pst is measured for 10 minutes, and Plt is measured for 2 hours
- Measurement accuracy : ±5% rdg. or less of the limit value

Harmonic voltage, current and power (including fundamental waveform components)

- Analysis window : Rectangular
- Analysis orders : 1 to 50
- Measurement accuracy : Voltage/current : 1st to 20th orders : ±0.5% rdg. ±0.2% f.s.
  21st to 50th orders : ±1.0% rdg. ±0.3% f.s.
  Power : 1st to 20th orders : ±0.5% rdg. ±0.2% f.s.
  21st to 30th orders : ±1.0% rdg. ±0.3% f.s.
  31st to 40th orders : ±2.0% rdg. ±0.3% f.s.
  41st to 50th orders : ±3.0% rdg. ±0.3% f.s.
  (for 50/60 Hz, clamp-on sensor accuracy must be included for current and power)

Inter-harmonic voltage and current

- Analysis window : Rectangular
- Analysis orders : 0.5 to 49.5

Harmonic voltage/current phase difference (including fundamental waveform content)

- Measurement method : Difference between voltage and current phase angle components
- Display items : Sum of all or multiple channels
- Measurement accuracy : 1st to 3rd orders : ±2°
  4th to 50th orders : ±(0.02° × k+2°), k = harmonic order
  (for 50/60 Hz, clamp-on sensor accuracy must be included for current and power)

-5. Display specifications

Display device : 6.4" TFT color LCD (640 × 480 dots)

Text display : English, German, French, Italian, Spanish, Chinese or Japanese

-6. External interface specifications

(1) External control terminals : External event input and output

(2) PC card interface Slot : Compliant with PCMCIA/JEIDA PC Card Standard, Type II slot × 1
- Compatible cards : Flash ATA cards up to 528 MB

(3) RS-232C interface
- Standard : EIA RS-232C-compliant (with 9-pin D-sub connector)
- Destination device : Printer or modem or GPS
- Printer interval selections : OFF, 1, 5, 10, or 30 minutes, 1 or 2 hours

(4) LAN interface
- Communications protocol : Ethernet and TCP/IP (with 10BASE-T RJ-45 connector)

-7. Environment & safety specifications

Operating environment : Indoors, up to a height of 2000 m (6562.2 ft)

Storage temperature & humidity : -20 to 50°C, max. 80% rh (non-condensating)

Operating temperature and humidity : 0 to 40°C, max. 80% rh (non-condensating)

Maximum measurement terminal voltage : Voltage terminals : 780 Vrms AC, 1103 V peak
Current terminals : 1.7 Vrms AC, 2.4 V peak

Maximum in-phase voltage : 600 Vrms AC (50/60 Hz, voltage input terminals)

Withstand voltage : 5.55 kVrms AC/15 sec
(50/60 Hz, 1 mA current sensitivity)
Between voltage and clamp input terminals, between the voltage input terminal and 3196 casing, and between voltage input terminals (U1 to U3) and voltage input terminal (U4)

Enclosure protection : IP30 (per EN60529)

Standards conformance : EMC : EN61326:1997+A1:1998+A2:2001 CLASS A, EN61000-3-2:2000 and EN61000-3-3:1995+A1:2001
Safety : EN61010-1:2001
Voltage input unit : Contamination Level 2, Measurement Category III
(Anticipated transient overvoltage: 6000 V)

■ Option Specifications

Clamp On Sensors	9694	9660	9661	9669
Appearance	Cord length: 3 m (9.84 ft)  CE CAT III 300V	Cord length: 3 m (9.84 ft)  CE CAT III 300V	Cord length: 3 m (9.84 ft)  CE CAT III 600V	Cord length: 3 m (9.84 ft)  CE CAT III 600V
Primary current rating	5A AC	100 A AC	500 A AC	1000 A AC
Output voltage	10 mV/A AC	1 mV/A AC	1 mV/A AC	0.5 mV/A AC
Accuracy (45 to 66 Hz) Amplitude	±0.3% rdg. ±0.02% f.s.	±0.3% rdg. ±0.02% f.s.	±0.3% rdg. ±0.01% f.s.	±1.0% rdg. ±0.01% f.s.
Accuracy (45 to 66 Hz) Phase	±2° or less	±1° or less (±1.3° for 90 A or more)	±0.5° or less	±1° or less
Frequency characteristic	±1.0% or less for 66 Hz to 5 kHz (deviation from specified accuracy)			±2.0% or less for 66 Hz to 5 kHz (deviation from specified accuracy)
Effect of external magnetic field	Corresponding to 0.1 A or less (with magnetic field of 400 A/m AC)			Corresponding to 1 A or less (with magnetic field of 400 A/m AC)
Effect of conductor position	±0.5% or less			±1.5% or less
Maximum rated voltage to earth	300 Vrms (insulated conductor)	300 Vrms (insulated conductor)	600 Vrms (insulated conductor)	600 Vrms (insulated conductor)
Maximum allowable input (45 to 66 Hz)	50 A continuous	130 A continuous	550 A continuous	1000 A continuous
Measurable conductor diameter	ϕ15 mm (0.59") or less	ϕ15 mm (0.59") or less	ϕ46 mm (1.81") or less	ϕ55 mm (2.17") or less, 80 (3.15") x 20 (0.79") mm busbar
Dimensions and weight	46W (1.81") x 135H (5.31") x 21D (0.83") mm, 230 g (8.1 oz.)	46W (1.81") x 135H (5.31") x 21D (0.83") mm, 230 g (8.1 oz.)	77W (3.03") x 151H (5.94") x 42D (1.65") mm, 360g (12.7 oz.)	99.5W (3.92") x 188H (7.40") x 42D (1.65") mm, 590g (20.8 oz.)

Clamp On Sensor	9667
Appearance	Cord length Sensor to circuit: 2 m (6.56 ft) Circuit to connector: 1 m (3.28 ft) CE CAT III 1000V 
Primary current rating	500 A AC, 5000 A
Output voltage	500 mV AC f.s.
Accuracy (45 to 66 Hz) Amplitude	±2.0% rdg. ±1.5 mV (for input 10% or more of the range)
Accuracy (45 to 66 Hz) Phase	±1° or less
Frequency characteristic	±3 dB or less for 10 Hz to 20 kHz (deviation from specified accuracy)
Effect of external magnetic field	Corresponding to 5 A, 7.5 A max. (with magnetic field of 400 A/m AC)
Effect of conductor position	±3.0% or less
Maximum rated voltage to earth	1000 Vrms (insulated conductor)
Maximum allowable input (45 to 66 Hz)	10000 A continuous
Measurable conductor diameter	ϕ254 mm (10") or less
Dimensions and weight	Sensor length: 910 mm (2.99 ft), 240 g (8.5 oz.), Circuit: 57W (2.24") x 86H (3.39") x 30D (1.18") mm, 140 g (4.9 oz.)
Power supply	LR03 alkaline battery x 4 (continuous operation max. 168 hours) Or 9445 AC ADAPTER (optional)

9290-10 CLAMP-ON ADAPTER

Cord length: 3 m (9.84 ft)
Up to 1500 A AC, CT ratio: 10:1
Measurable conductor diameter:
ϕ65 mm (2.17"), width: 80 mm (2.17") bus bar

9339 CARRYING CASE

(soft case)

450W (17.72") x 350H (13.78") x 200D (7.87") mm, 3.0 kg (106.01 oz.)

9340 CARRYING CASE

(hard case)

380W (14.96") x 560H (22.05") x 260D (10.24") mm, 6.3 kg (222.2 oz.)

Standard accessories

9458 AC ADAPTER

100 to 240 VAC, 1.2 A
50/60 Hz

104W (4.09") x 51H (2.01") x 18D (0.71") mm, 250 g (8.85 oz.)

9459 BATTERY PACK

7.2 V DC, 2700 mAh

9670 PRINTER option components

The 9671 AC ADAPTER should be purchased along with the 9670 PRINTER. Also, the 9638 RS-232C CONNECTION CABLE or RS-232C cable (9- to 25-pin crossover) is required to connect to the 3196.
A battery pack and battery charger to power the 9670 Printer are also available in some countries. Please contact your HIOKI distributor for details.

9671 AC ADAPTER

100 to 240 VAC, 50/60 Hz
134W (5.28") x 70H (2.76") x 41D (1.61") mm
350 g (12.37 oz.)

■ Accessories

3196 POWER QUALITY ANALYZER
(9438-02 VOLTAGE MEASUREMENT CABLE (one each of red, yellow, blue and gray, plus four black lines, Cord length: 3 m (9.84 ft), 9459 BATTERY PACK, 9458 AC ADAPTER, Strap, LAN connector cover, Input Cord Label, Operating Manual (CD-R), Quick Start Manual)

By itself, the 3196 is only capable of voltage measurement. Purchase the optional 9660 or 9661 CLAMP-ON SENSOR for current and power measurement.

● Standard combination example

For three-phase 3-wire (3P3W3M) and three-phase 4-wire measurements
Models 3196 + 9661 (500 A) x 3 + 9339 + PC card (128 MB)

■ Options

9660	CLAMP ON SENSOR (100 A AC) Voltage output type
9661	CLAMP ON SENSOR (500 A AC) Voltage output type
9667	FLEXIBLE CLAMP ON SENSOR (5000 A AC) Voltage output type
9445-02	AC ADAPTER (for the 9667, for America, Japan)
9445-03	AC ADAPTER (for the 9667, for Europe)
9669	CLAMP ON SENSOR (1000 A AC) Voltage output type
9694	CLAMP ON SENSOR (5 A AC) Voltage output type
9657-10	CLAMP ON LEAK SENSOR (5A AC with Model 3196) Voltage Output Type
9675	CLAMP ON LEAK SENSOR (5A AC with Model 3196) Voltage Output Type
9290-10	CLAMP ON ADAPTER
9264-01	WIRING ADAPTER (3P3W)
9264-02	WIRING ADAPTER (3P4W)
9438-02	VOLTAGE MEASUREMENT CABLE (standard accessory)
9459	BATTERY PACK (standard accessory)
9670	PRINTER (with one roll recording paper)
9671	AC ADAPTER (for 9670)
9237	RECORDING PAPER (80 mm (3.15") x 25 m (82.03 ft), 4 rolls, for 9670)
9638	RS-232C CABLE (1.5 m (4.92 ft), for printer connection)
9642	LAN CABLE (5m (16.41 ft), with straight and crossover connectors)
9339	CARRYING CASE (soft)
9340	CARRYING CASE (hard)
9624	PQA-HiVIEW (PC application software)
9624-10	PQA-HiVIEW PRO (PC application software)
	*Please select either USB or Parallel license Key.
9726	PC CARD 128 M
9727	PC CARD 256 M
9728	PC CARD 512 M
Operating Manual	(bound version)
XD112	GPS Box (including antenna and RS-232C cable)

DISTRIBUTED BY

HIOKI
HIOKI E.E. CORPORATION

HEAD OFFICE :
81 Koizumi, Ueda, Nagano, 386-1192, Japan
TEL +81-268-28-0562 / FAX +81-268-28-0568
E-mail: os-com@hioki.co.jp

HIOKI USA CORPORATION :
6 Corporate Drive, Cranbury, NJ 08512 USA
TEL +1-609-409-9109 / FAX +1-609-409-9108
E-mail: hioki@hiokiusa.com

Shanghai Representative Office :
1704 Shanghai Times Square Office
93 Huaihai Zhong Road
Shanghai, 200021, P.R.China
TEL +86-21-6391-0090, 0092
FAX +86-21-6391-0360
E-mail: info@hioki.cn

3196E7-61B-05P Printed in Japan

APPENDIX B PQ Logging Data for 2014/2015 FY

Please refer to the following pages.

TC1 – Flicker, Voltage and Frequency

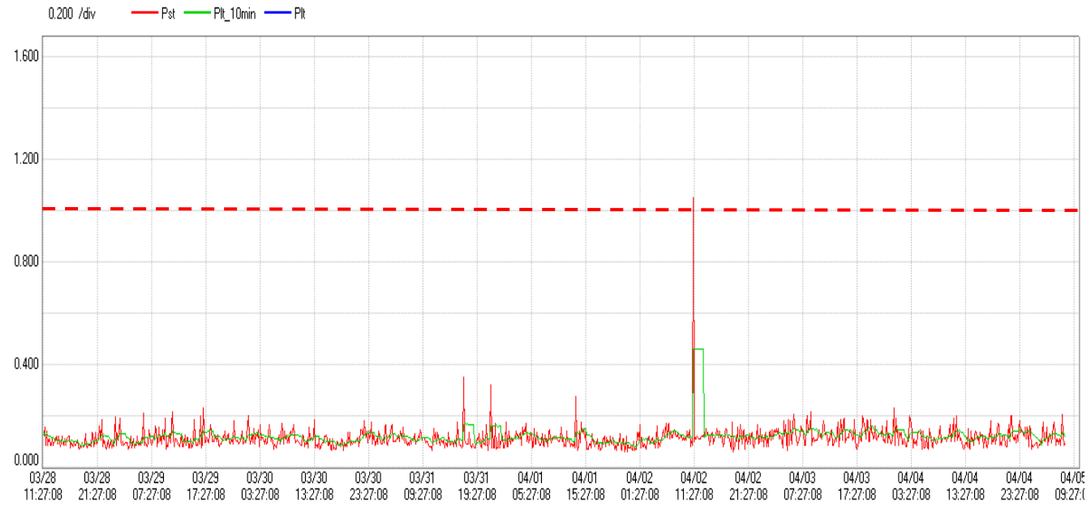


Figure 21 | TC1 - start of feeder – flicker measurements (Blue Phase)

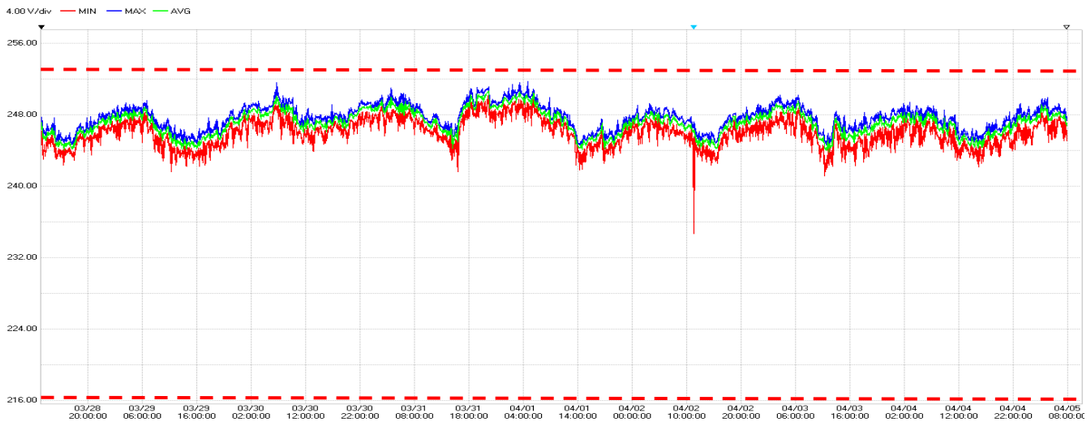


Figure 22 | TC1 - start of feeder – voltage measurements (Red Phase)

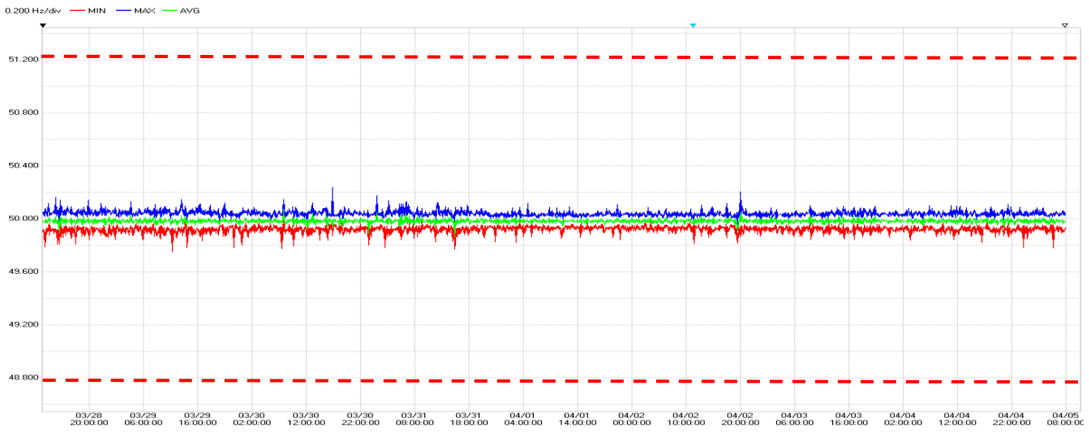


Figure 23 | TC1 - start of feeder – frequency measurements (Red Phase)

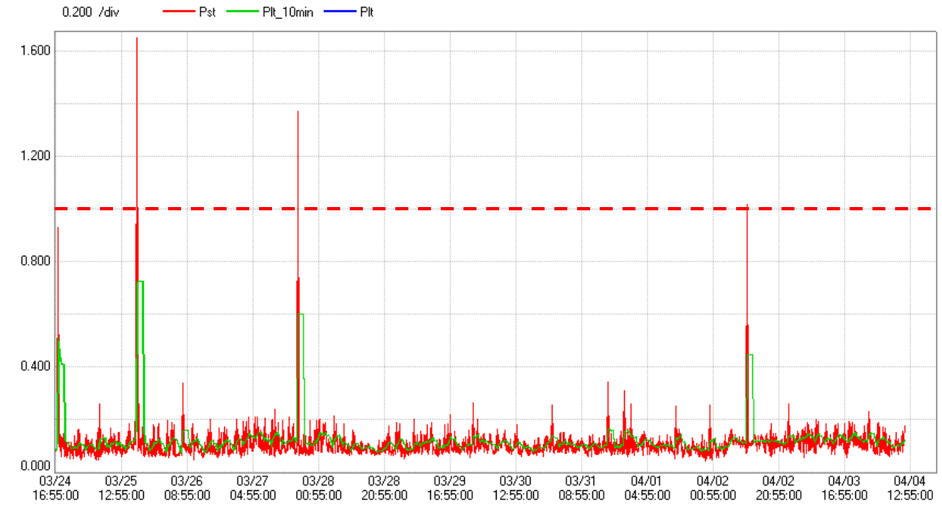


Figure 24 | TC1 - end of feeder – flicker measurements (Red Phase)

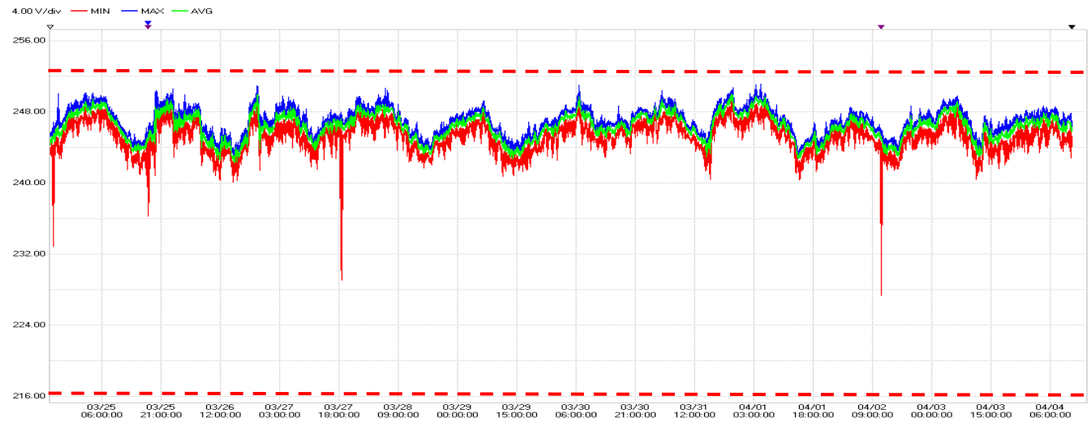


Figure 25 | TC1 - end of feeder – voltage measurements (Red Phase)

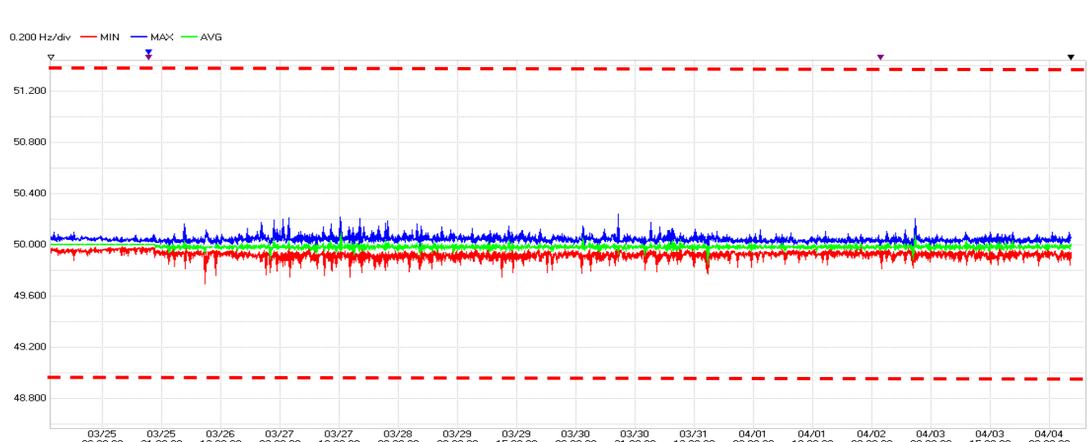


Figure 26 | TC1 - end of feeder – frequency measurements (Red Phase)

TC1 – Harmonics

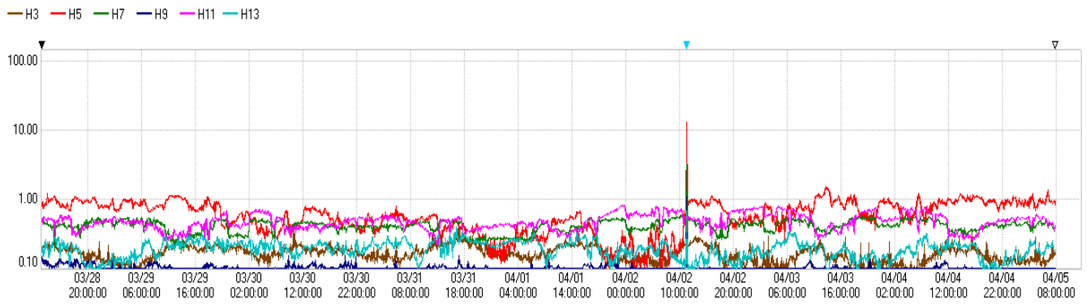


Figure 27 | TC1 – start of feeder – 3rd to 13th (odd) harmonics

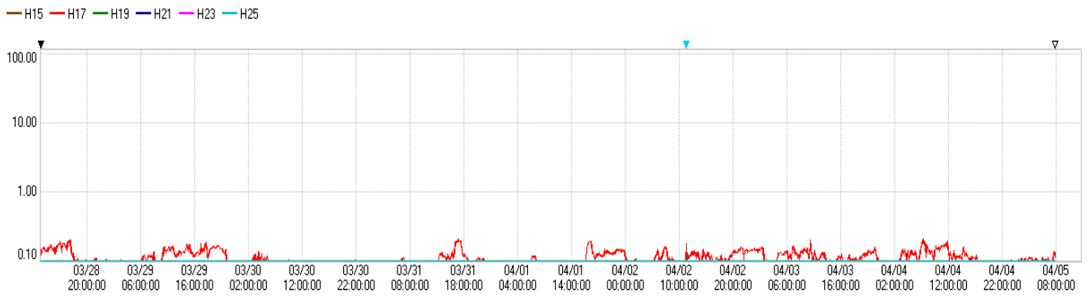


Figure 28 | TC1 – start of feeder – 15th to 25th (odd) harmonics

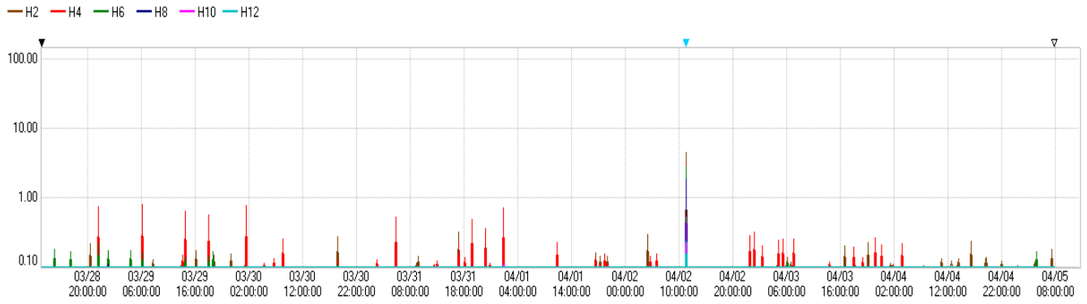


Figure 29 | TC1 – start of feeder – 2th to 12th (even) harmonics

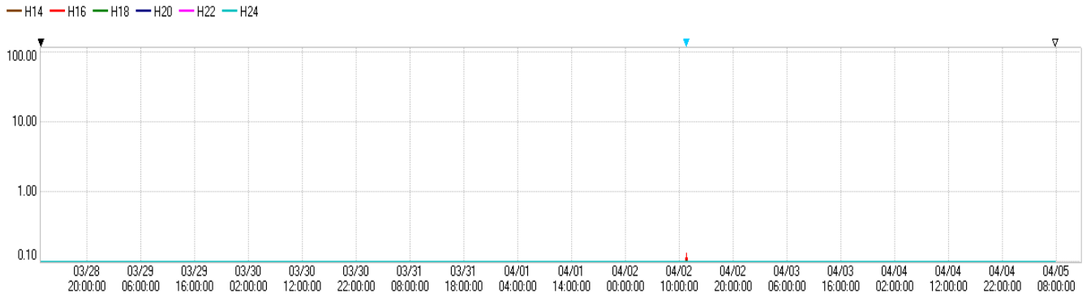


Figure 30 | TC1 – start of feeder – 14th to 24th (even) harmonics

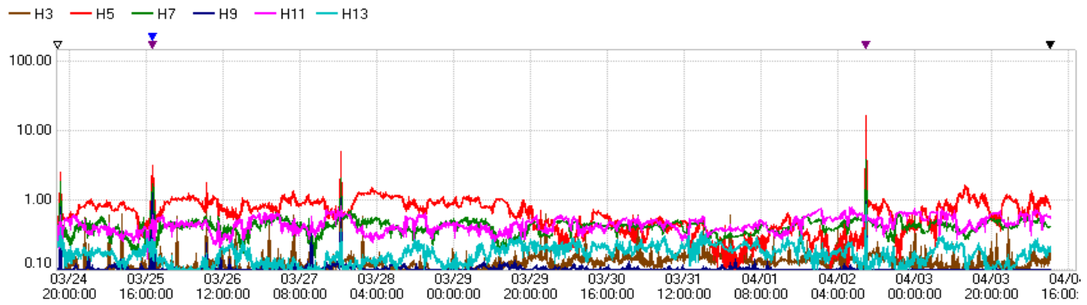


Figure 31 | TC1 – end of feeder – 3rd to 13th (odd) harmonics

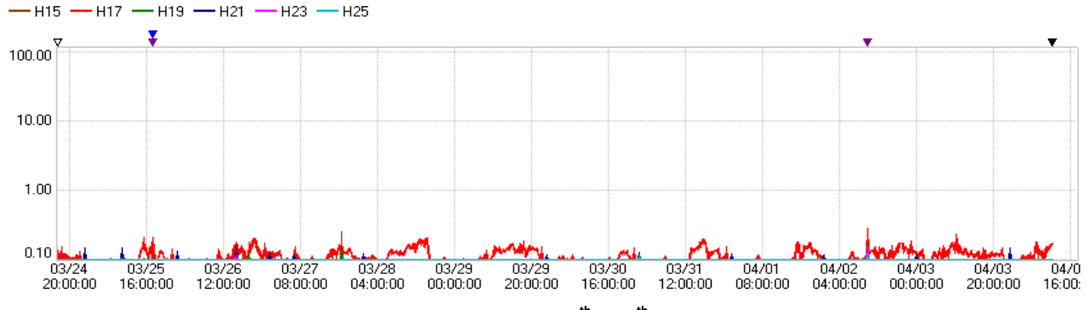


Figure 32 | TC1 – end of feeder – 15th to 25th (odd) harmonics

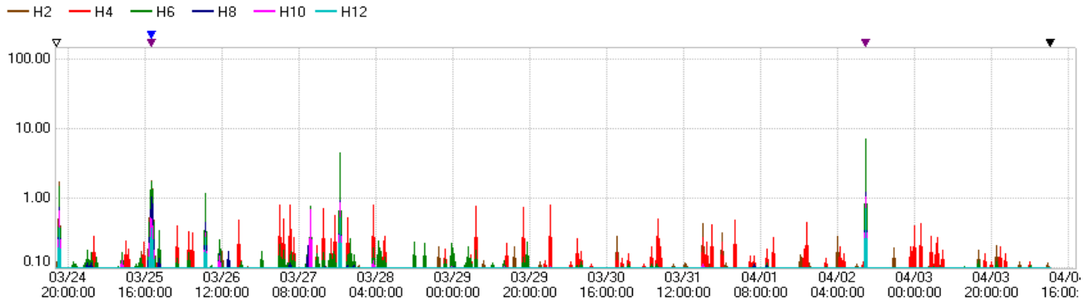


Figure 33 | TC1 – end of feeder – 2th to 12th (even) harmonics

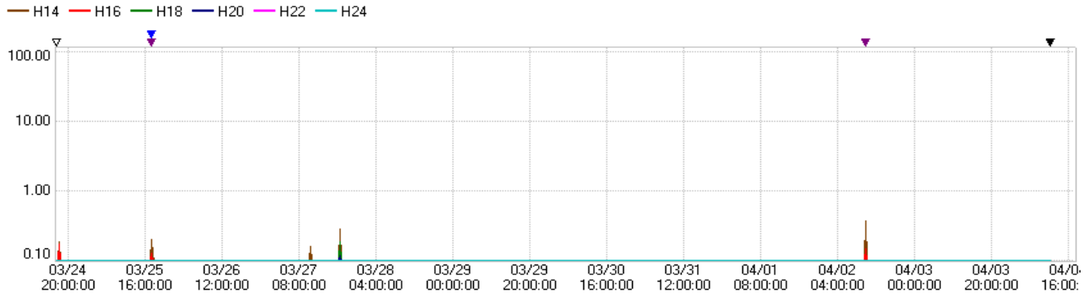


Figure 34 | TC1 – end of feeder – 14th to 24th (even) harmonics

TC2 – Flicker, Voltage and Frequency

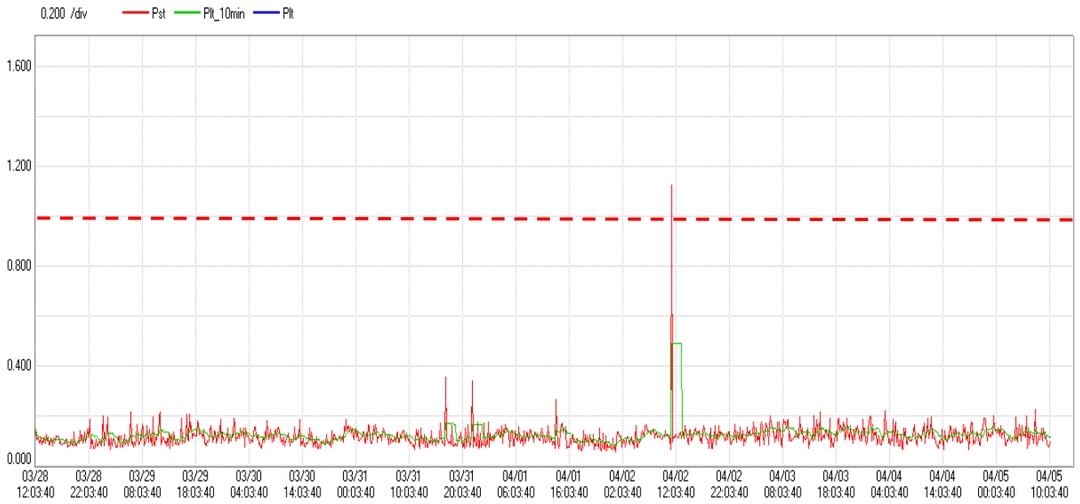


Figure 35 | TC2 - start of feeder – flicker measurements (Blue Phase)

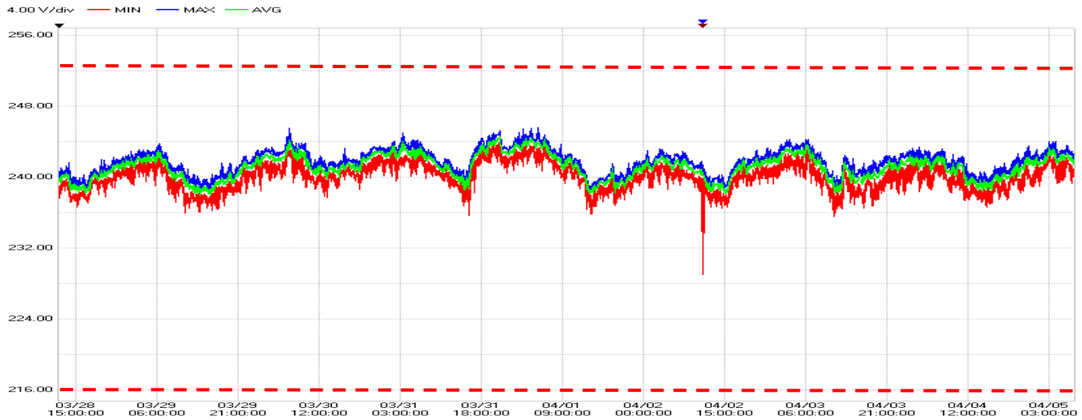


Figure 36 | TC2 - start of feeder – voltage measurements (Red Phase)

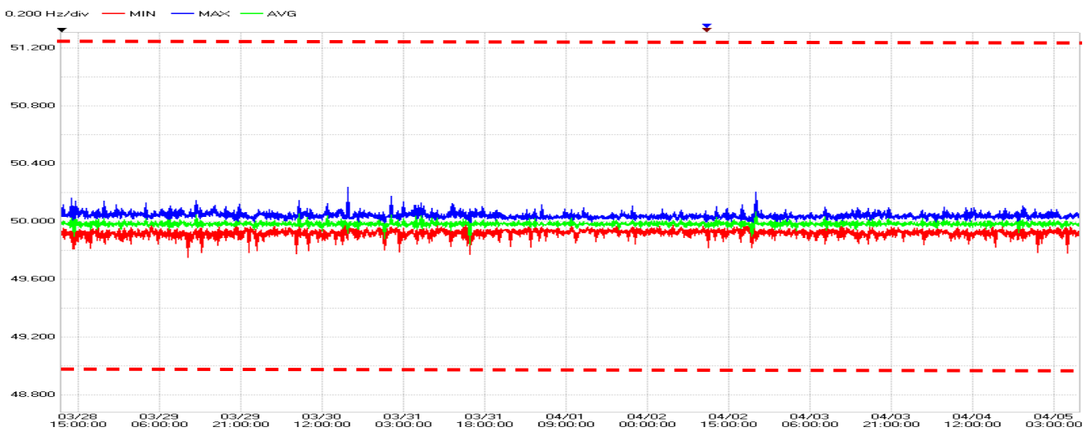


Figure 37 | TC2 - start of feeder – frequency measurements (Red Phase)

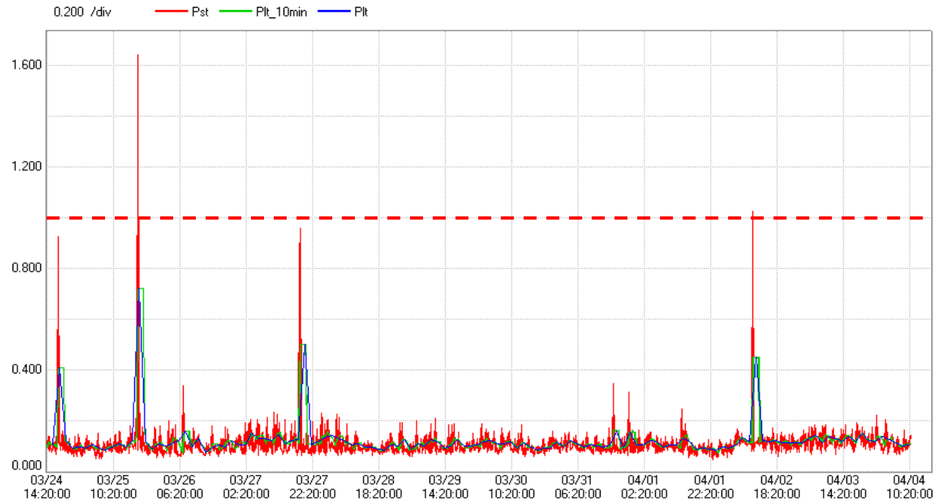


Figure 38 | TC2 - end of feeder – flicker measurements (Red Phase)

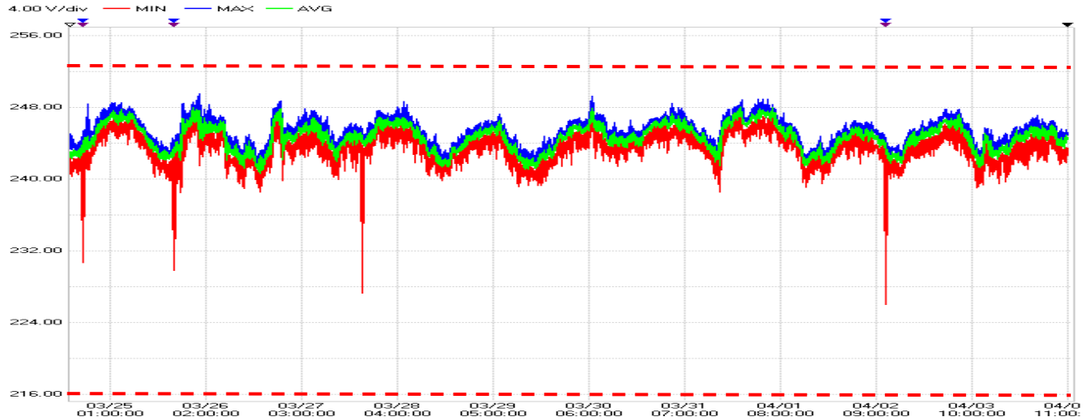


Figure 39 | TC2 - end of feeder – voltage measurements (Red Phase)

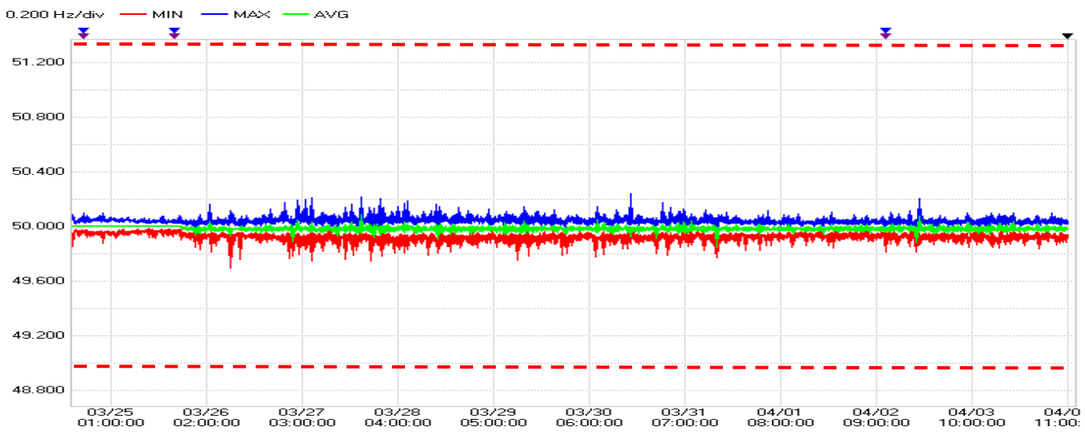


Figure 40 | TC2 - end of feeder – frequency measurements (Red Phase)

TC2 – Harmonics

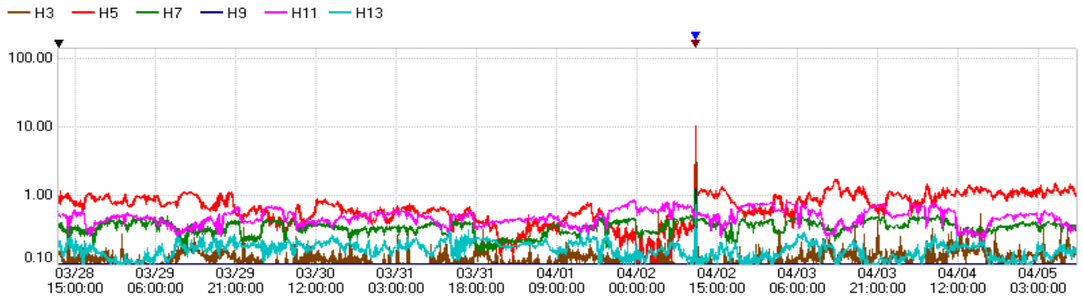


Figure 41 | TC2 – start of feeder – 3rd to 13th (odd) harmonics

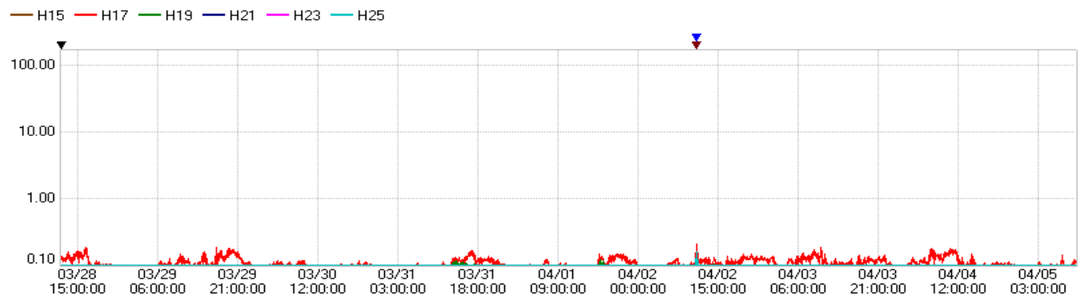


Figure 42 | TC2 – start of feeder – 15th to 25th (odd) harmonics

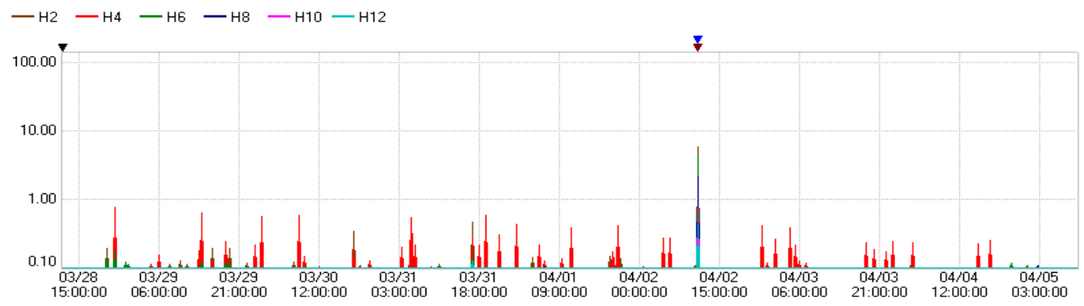


Figure 43 | TC2 – start of feeder – 2th to 12th (even) harmonics

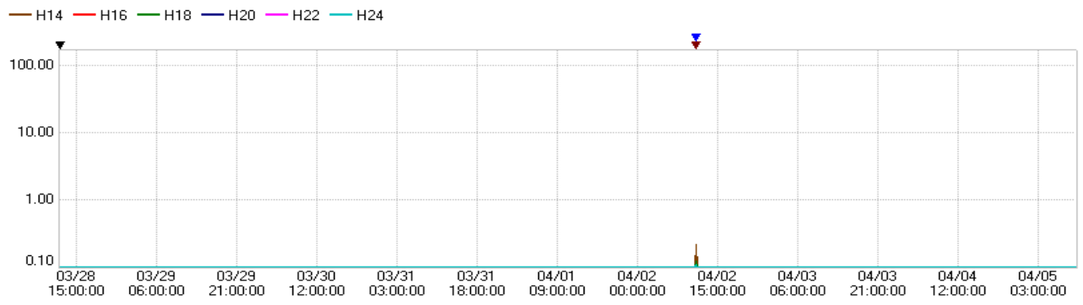


Figure 44 | TC2 – start of feeder – 14th to 24th (even) harmonics

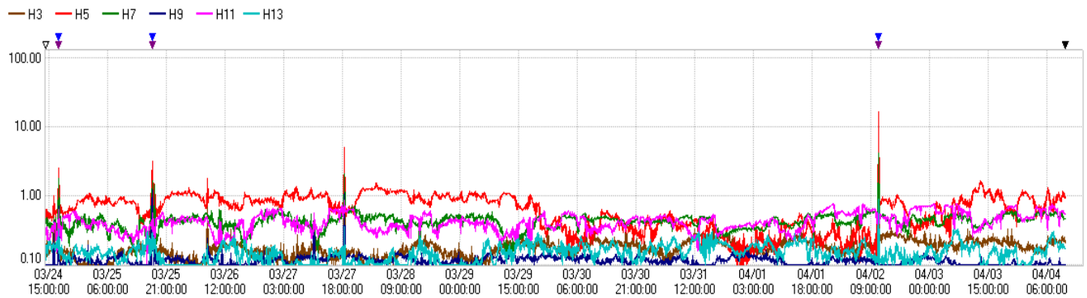


Figure 45 | TC2 – end of feeder – 3rd to 13th (odd) harmonics

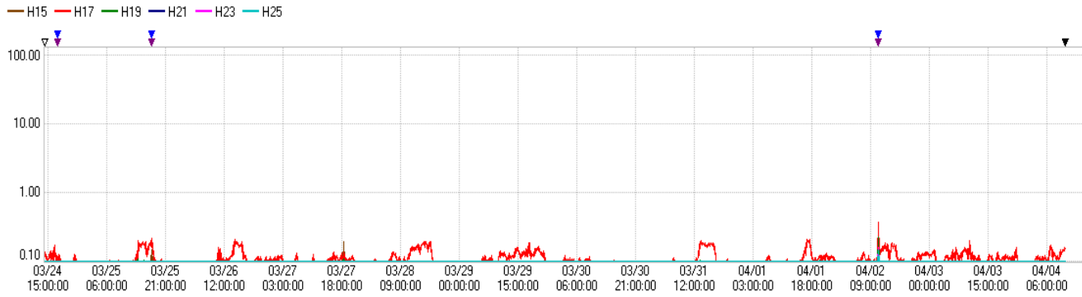


Figure 46 | TC2 – end of feeder – 15th to 25th (odd) harmonics

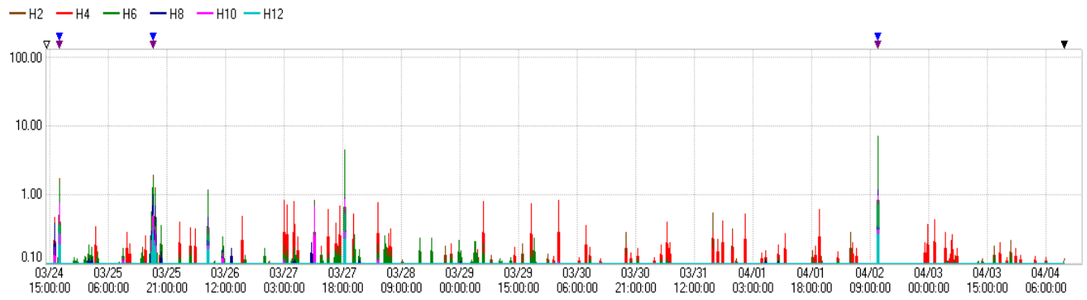


Figure 47 | TC2 – end of feeder – 2th to 12th (even) harmonics

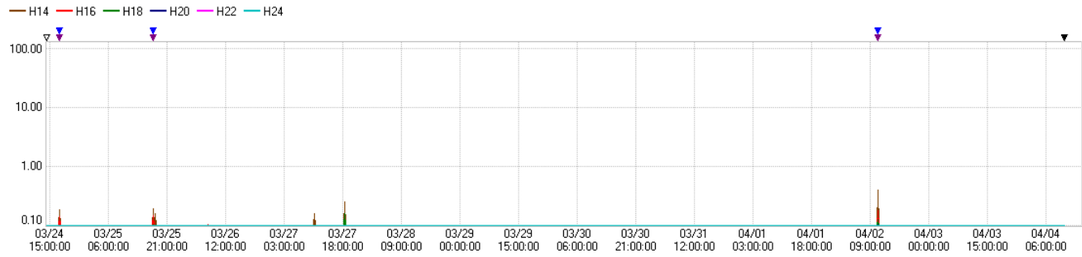


Figure 48 | TC2 – end of feeder – 14th to 24th (even) harmonics

TC3 – Flicker, Voltage and Frequency

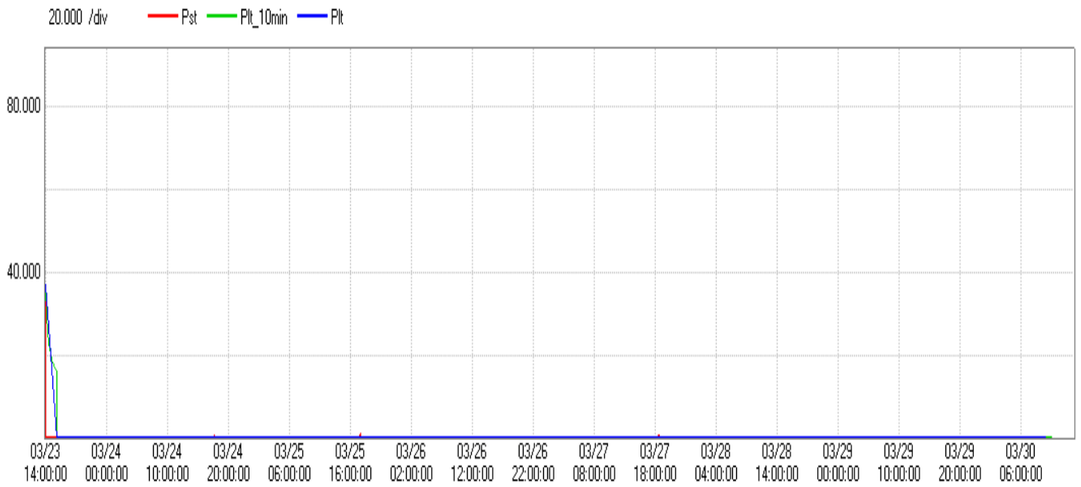


Figure 49 | TC3 - start of feeder – Disregards results – device turned on before installation

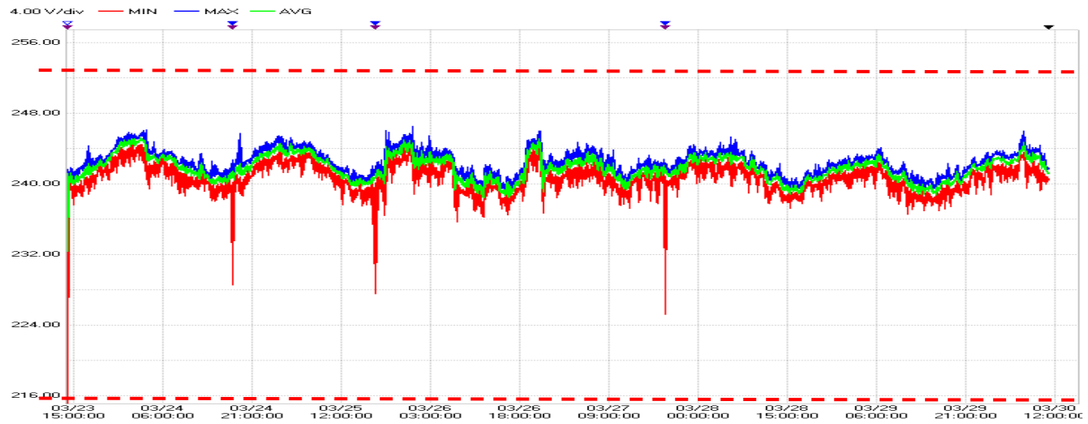


Figure 50 | TC3 - start of feeder – voltage measurements (Red Phase)

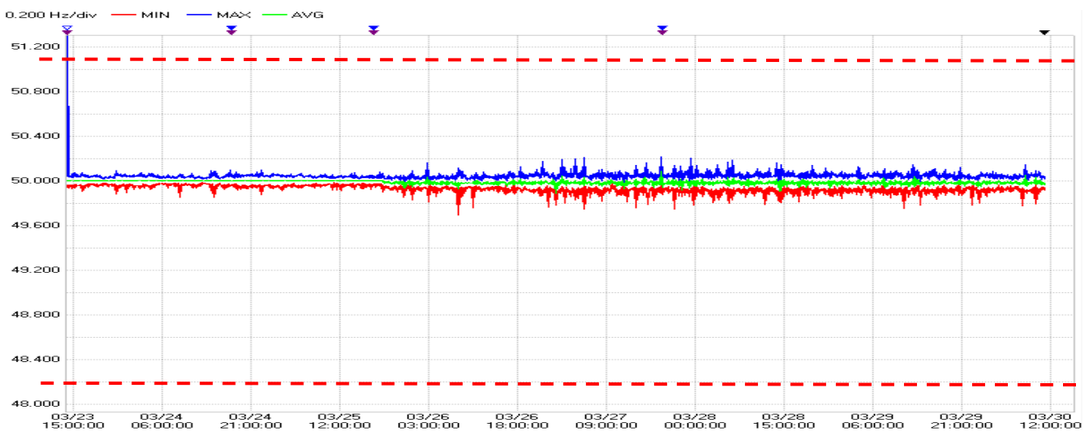


Figure 51 | TC3 - start of feeder – frequency measurements (Red Phase)

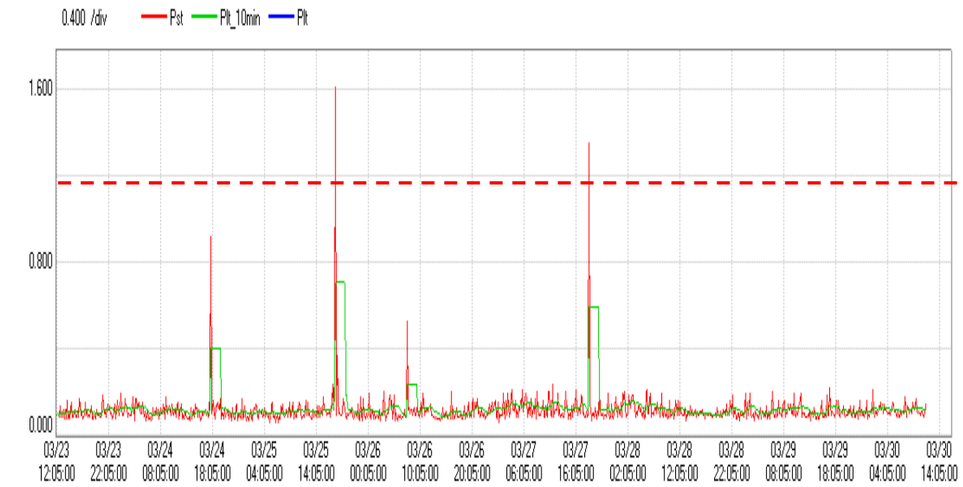


Figure 52 | TC3 - end of feeder – flicker measurements (Red Phase)

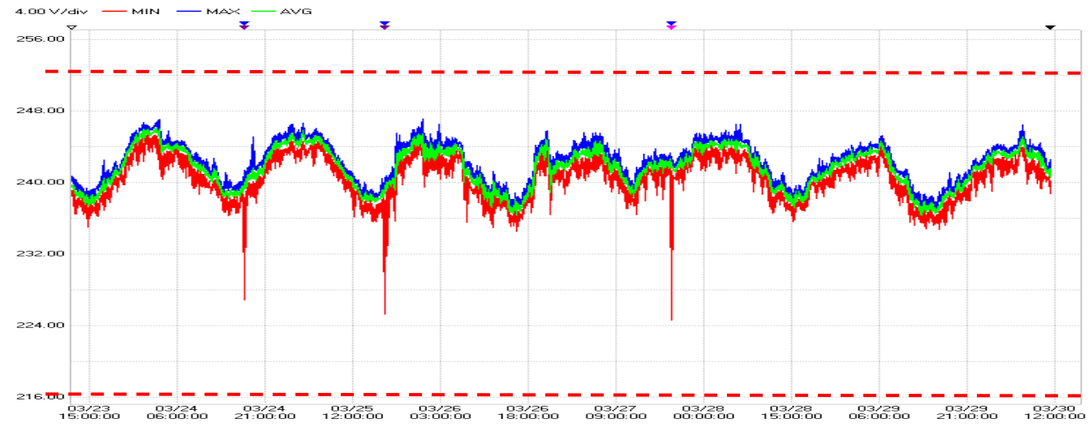


Figure 53 | TC3 - end of feeder – voltage measurements (Red Phase)

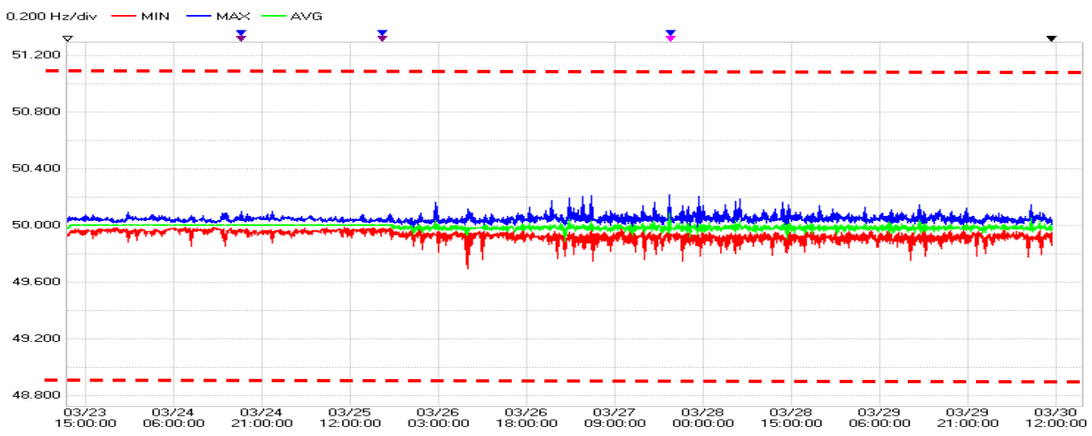


Figure 54 | TC3 - end of feeder – frequency measurements (Red Phase)

TC3 – Harmonics

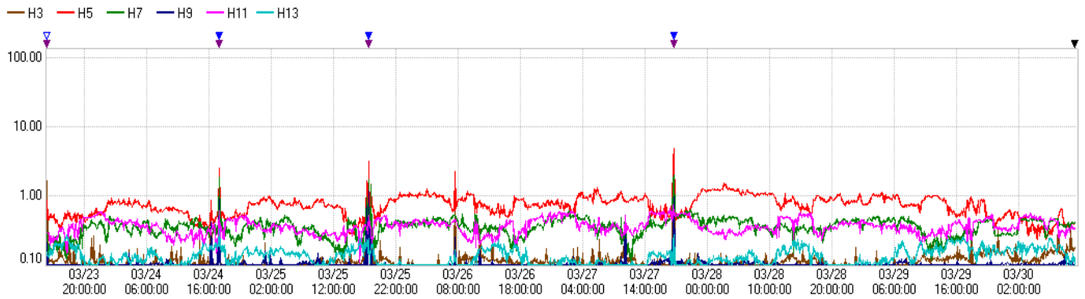


Figure 55 | TC3 – start of feeder – 3rd to 13th (odd) harmonics

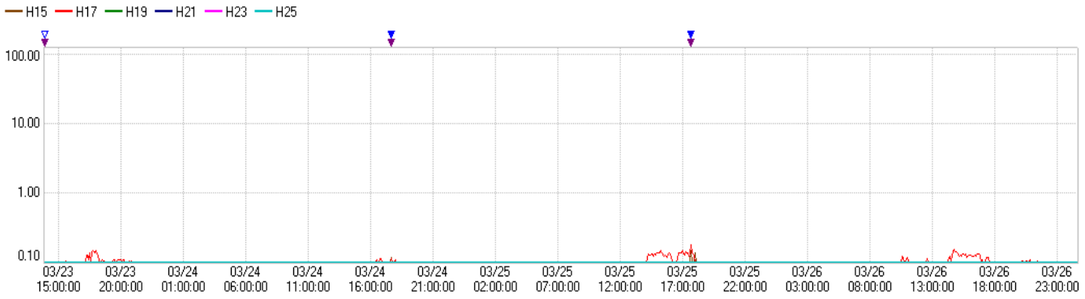


Figure 56 | TC3 – start of feeder – 15th to 25th (odd) harmonics

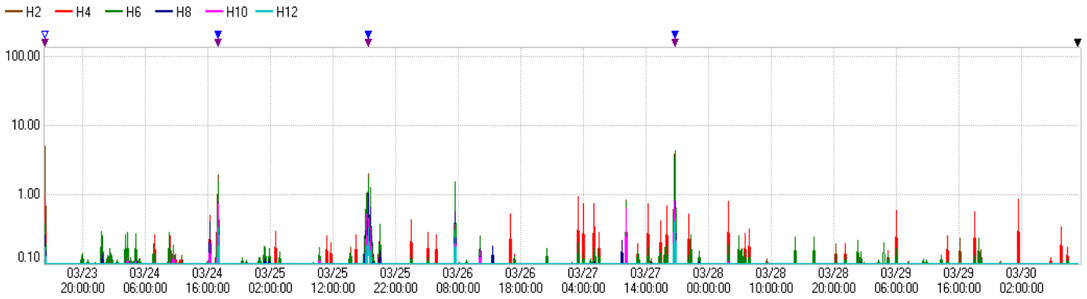


Figure 57 | TC3 – start of feeder – 2th to 12th (even) harmonics

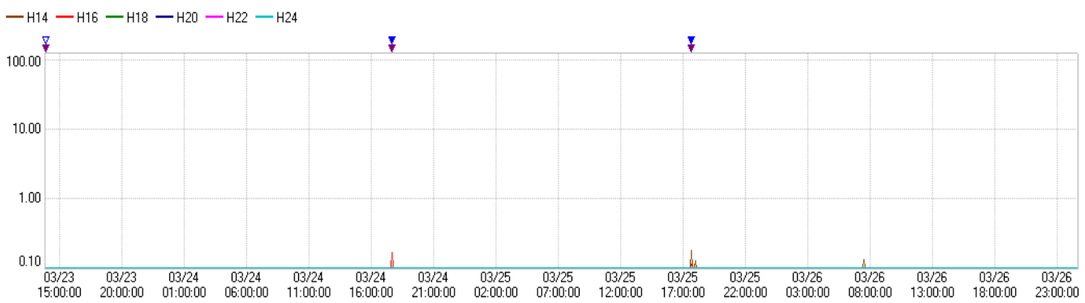


Figure 58 | TC3 – start of feeder – 14th to 24th (even) harmonics

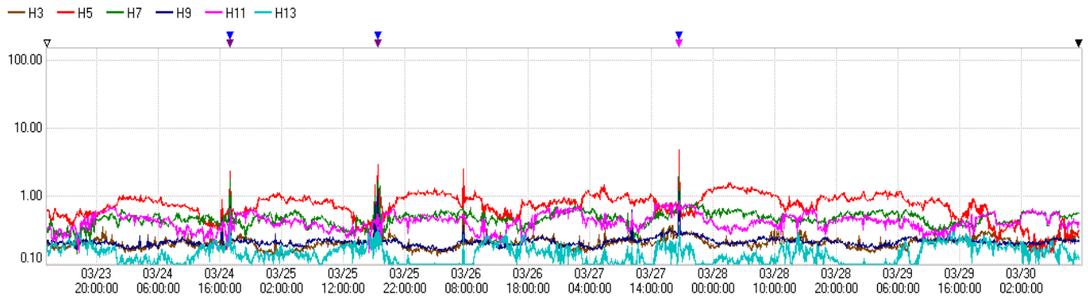


Figure 59 | TC3 – end of feeder – 3rd to 13th (odd) harmonics

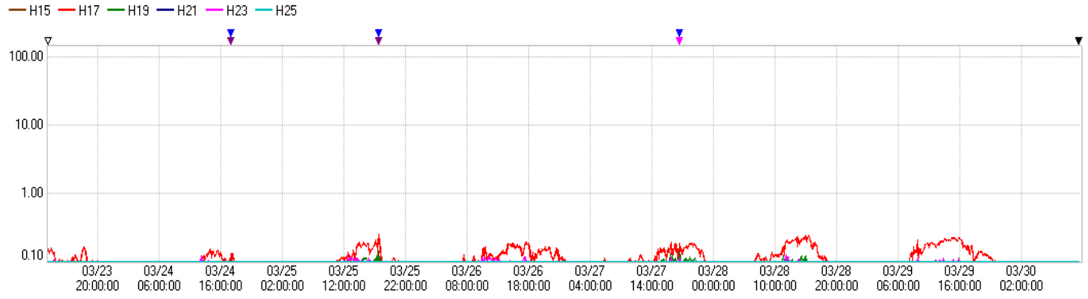


Figure 60 | TC3 – end of feeder – 15th to 25th (odd) harmonics

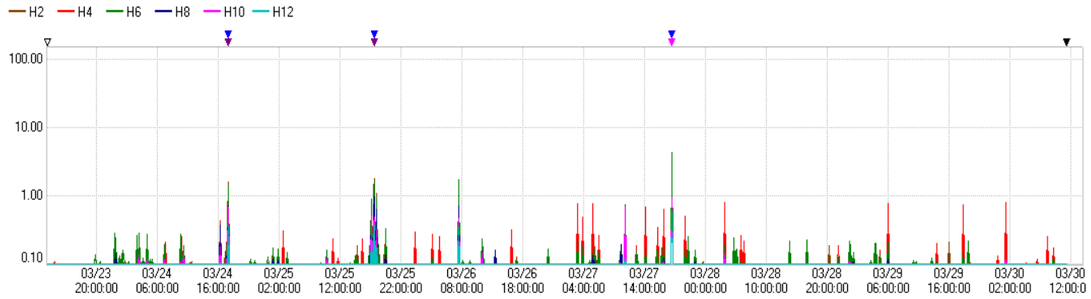


Figure 61 | TC3 – end of feeder – 2th to 12th (even) harmonics

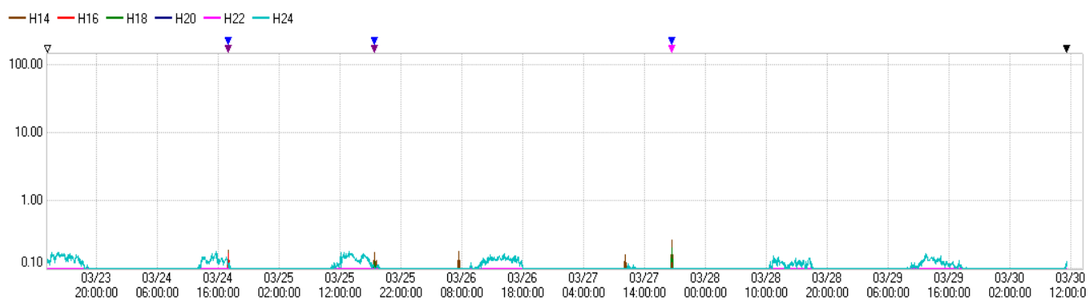


Figure 62 | TC3 – end of feeder – 14th to 24th (even) harmonics

TC4 – Flicker, Voltage and Frequency

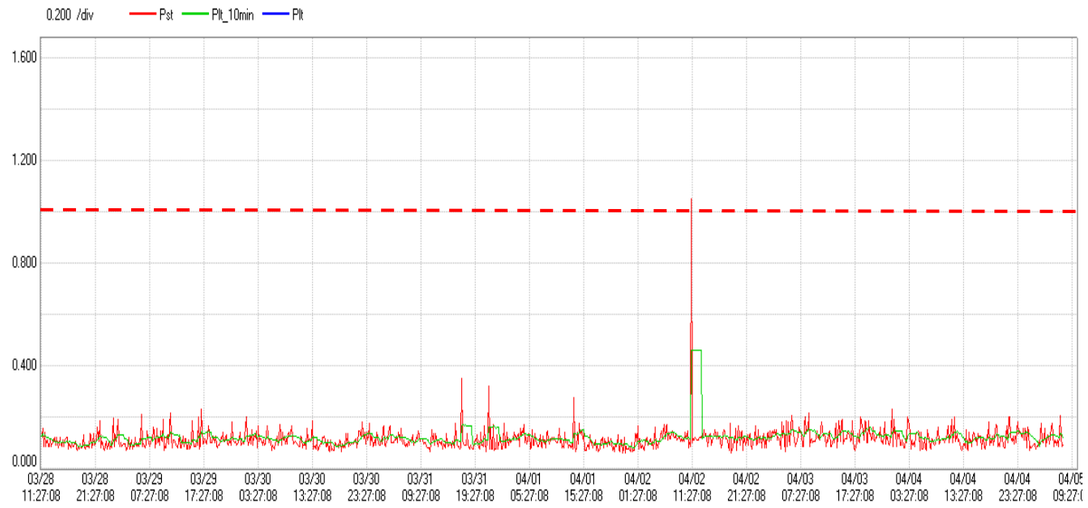


Figure 63 | TC4 - start of feeder – flicker measurements (Blue Phase)

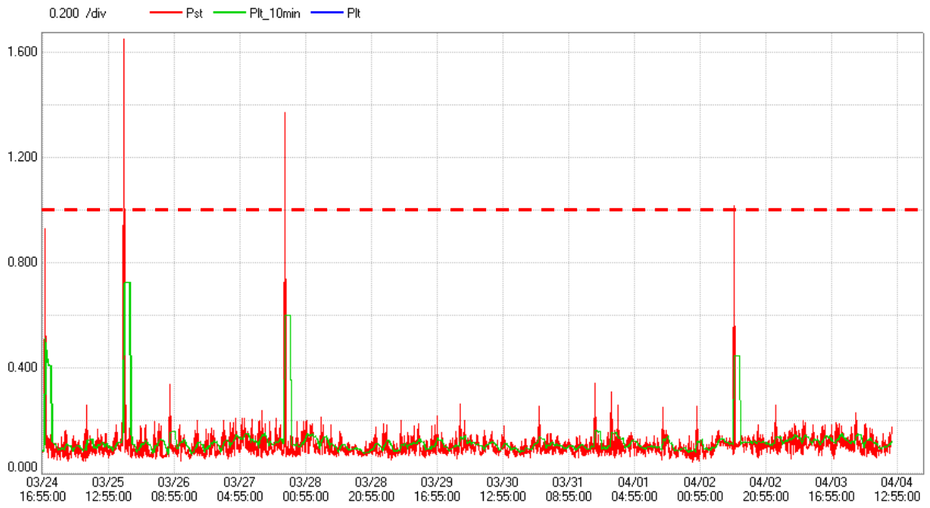


Figure 66 | TC4 - end of feeder – flicker measurements (Red Phase)

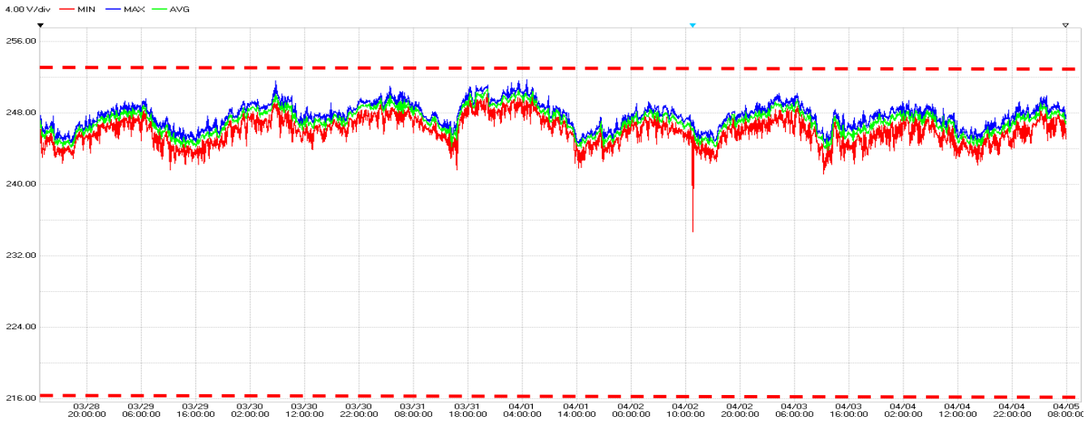


Figure 64 | TC4 - start of feeder – voltage measurements (Red Phase)

Figure 65 | TC4 - start of feeder – frequency measurements (Red Phase)

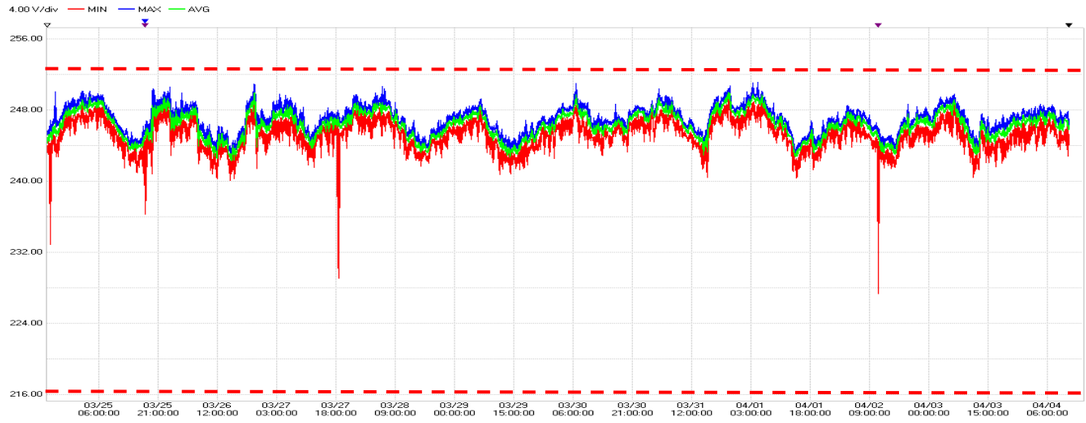


Figure 67 | TC4 - end of feeder – voltage measurements (Red Phase)

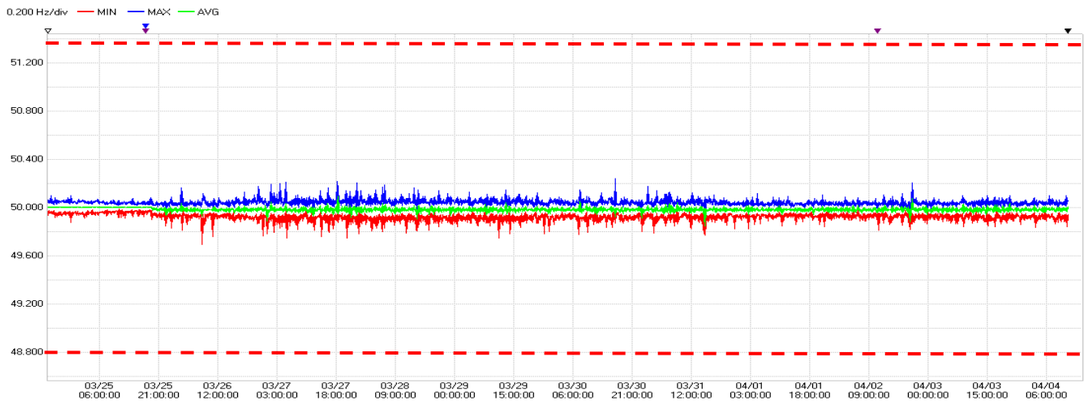


Figure 68 | TC4 - end of feeder – frequency measurements (Red Phase)

TC4 – Harmonics

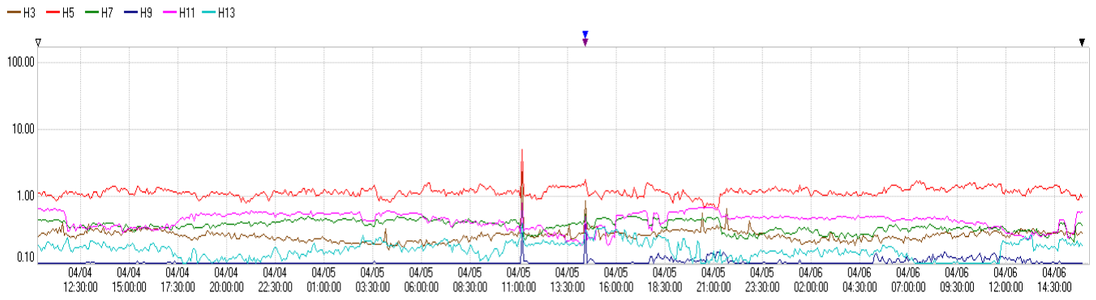


Figure 69 | TC4 – start of feeder – 3rd to 13th (odd) harmonics

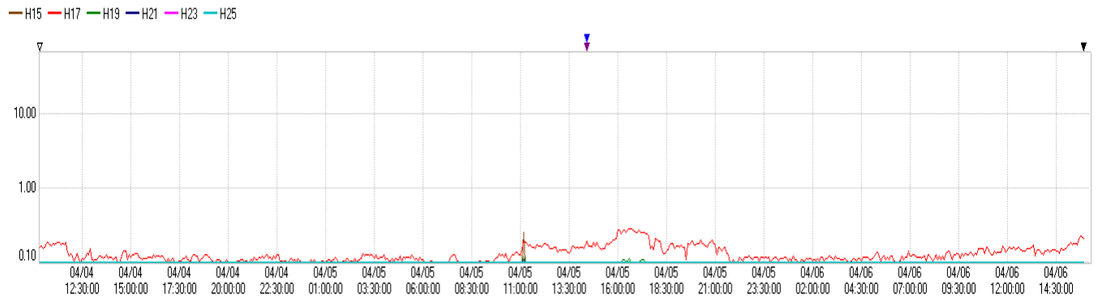


Figure 70 | TC4 – start of feeder – 15th to 25th (odd) harmonics

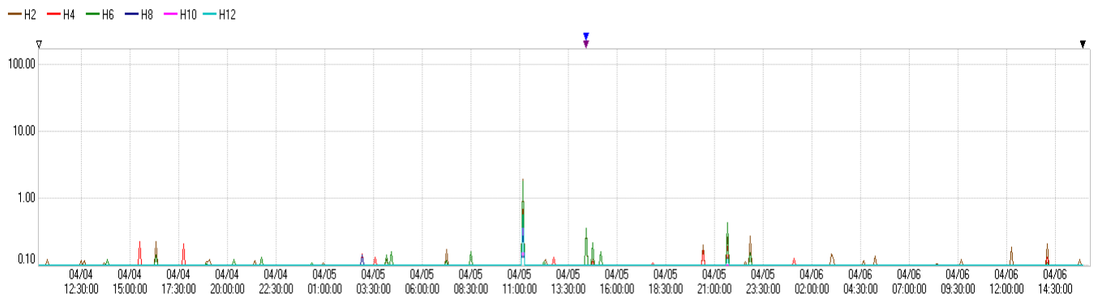


Figure 71 | TC4 – start of feeder – 2th to 12th (even) harmonics

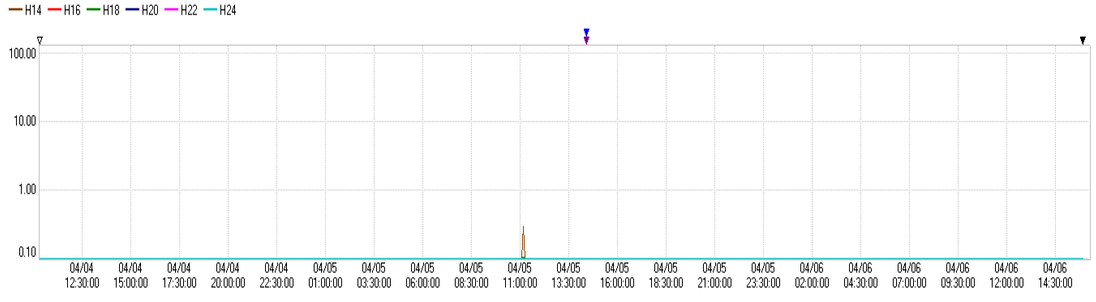


Figure 72 | TC4 – start of feeder – 14th to 24th (even) harmonics

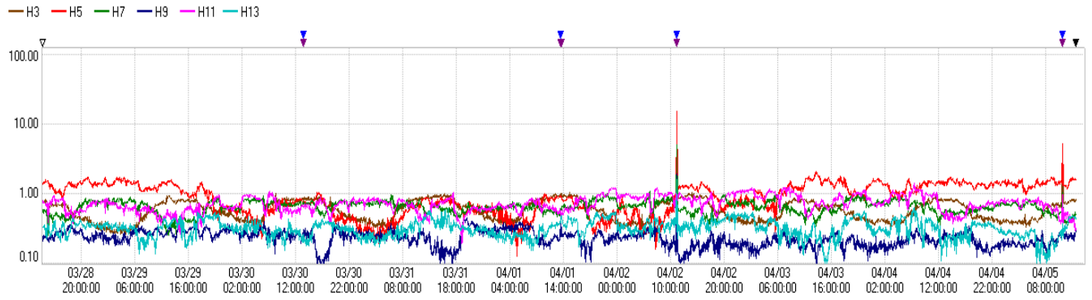


Figure 73 | TC4 – end of feeder – 3rd to 13th (odd) harmonics

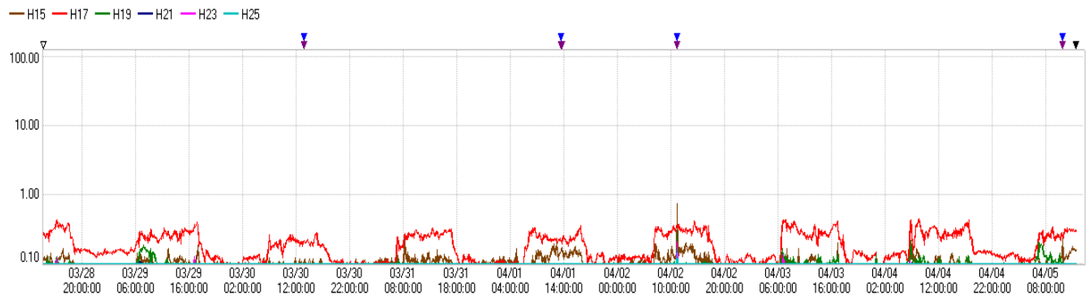


Figure 74 | TC4 – end of feeder – 15th to 25th (odd) harmonics

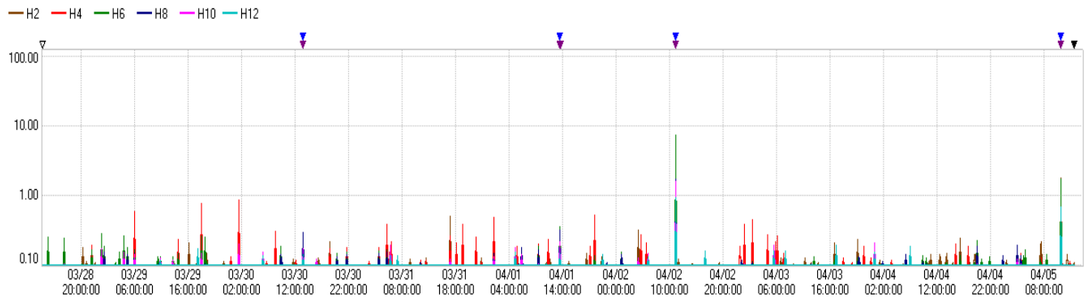


Figure 75 | TC4 – end of feeder – 2th to 12th (even) harmonics

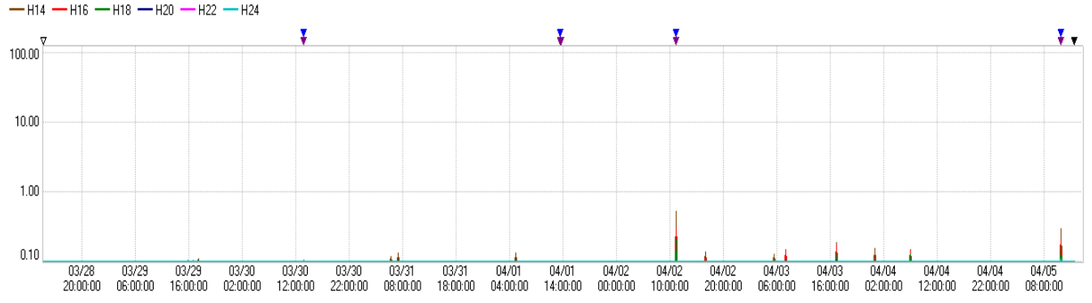


Figure 76 | TC4 – end of feeder – 14th to 24th (even) harmonics

STS1 – Flicker, Voltage and Frequency

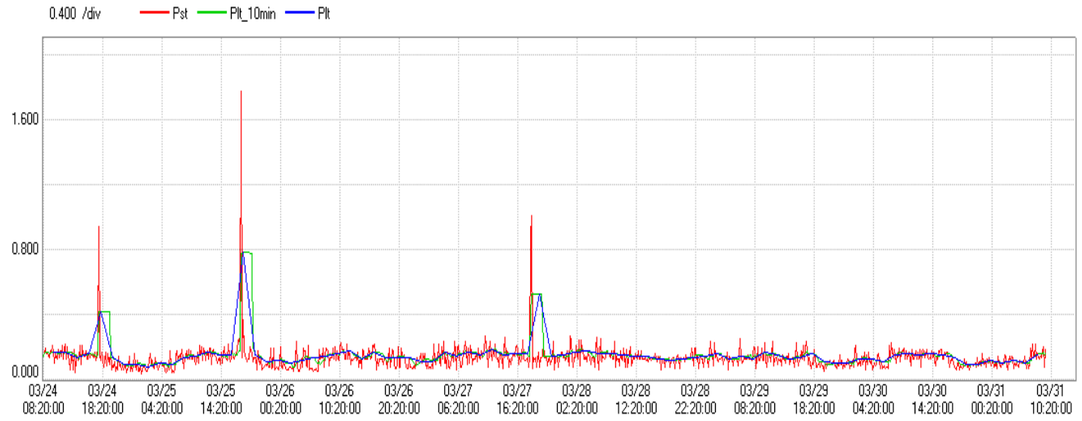


Figure 77 | STS1 - start of feeder – flicker measurements (Blue Phase)

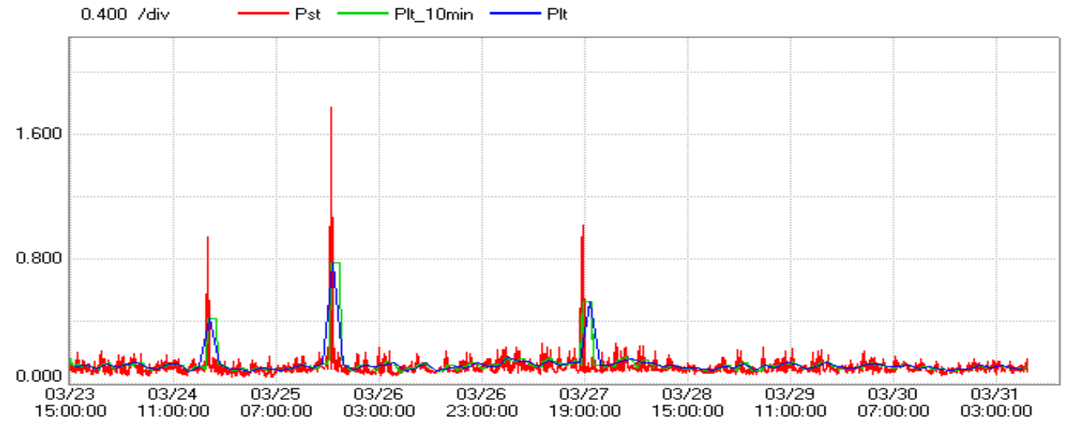


Figure 80 | STS1 - end of feeder – flicker measurements (Blue Phase)

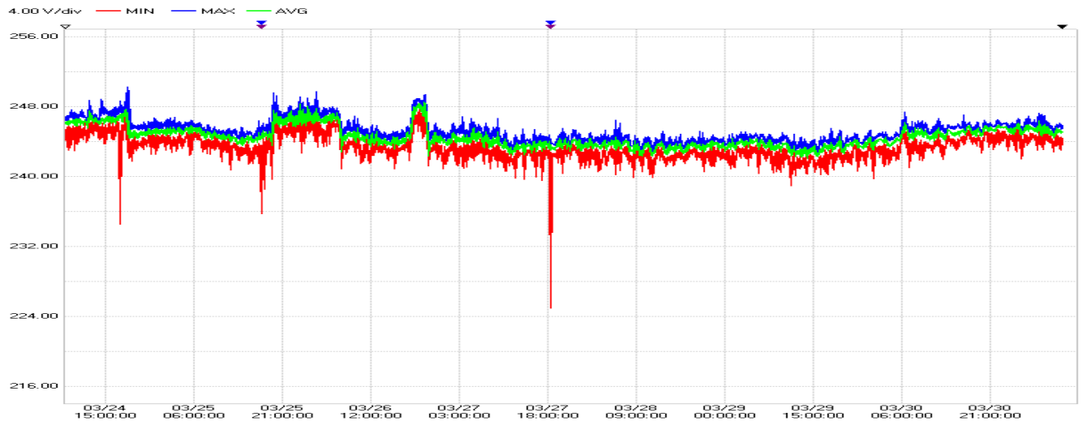


Figure 78 | STS1 - start of feeder – voltage measurements (Red Phase)

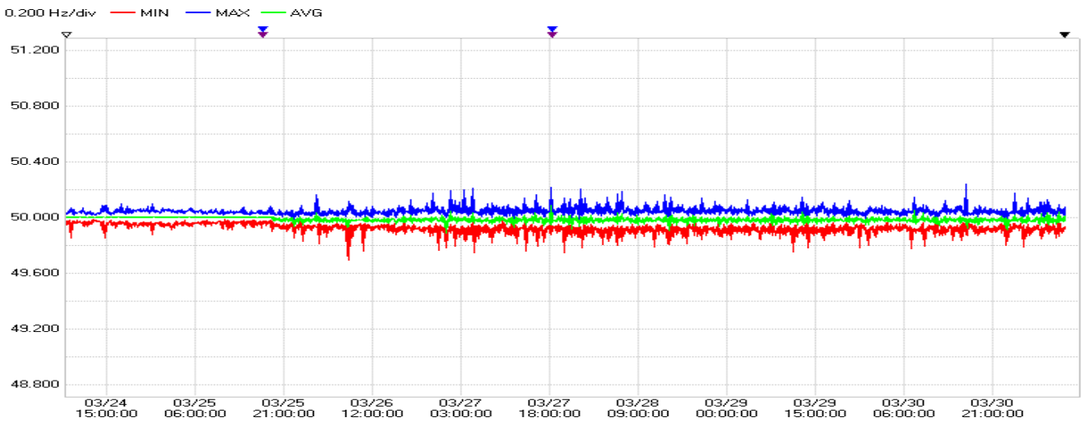


Figure 79 | STS1 - start of feeder – frequency measurements (Red Phase)

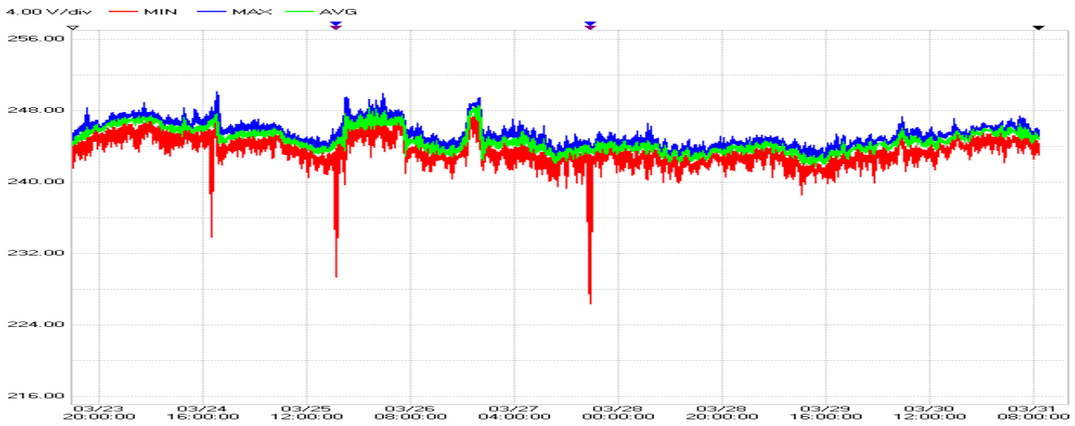


Figure 81 | STS1 - end of feeder – voltage measurements (Red Phase)

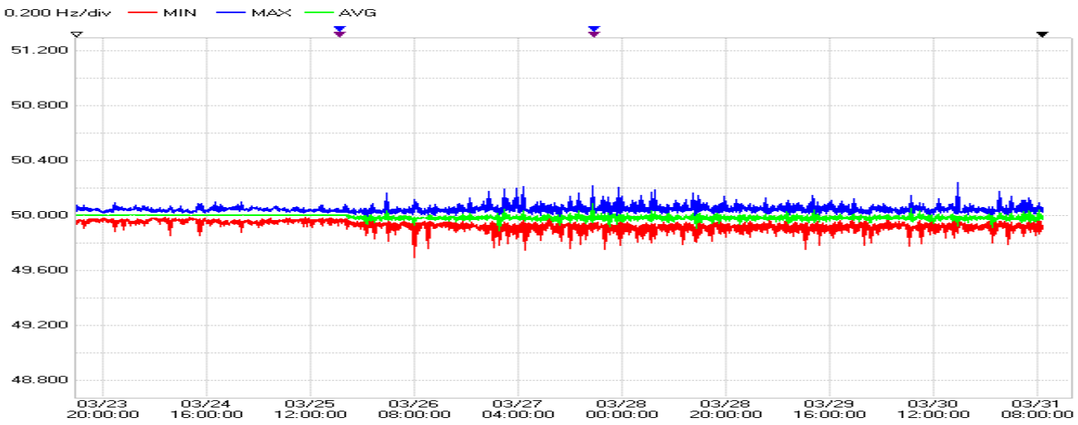


Figure 82 | STS1 - end of feeder – frequency measurements (Red Phase)

STS1 – Harmonics

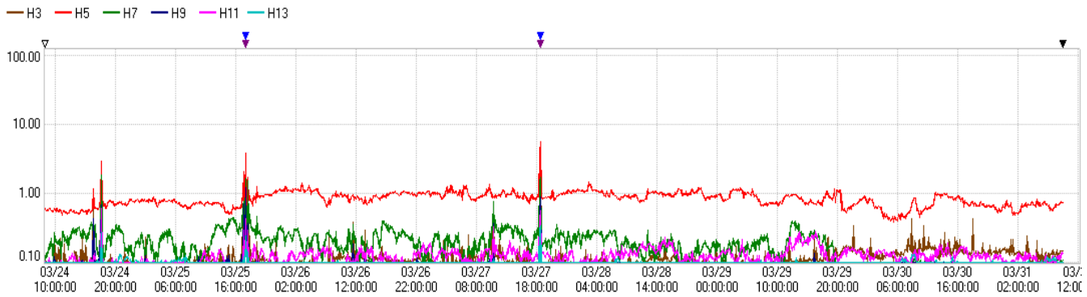


Figure 83 | STS1 - start of feeder – flicker measurements

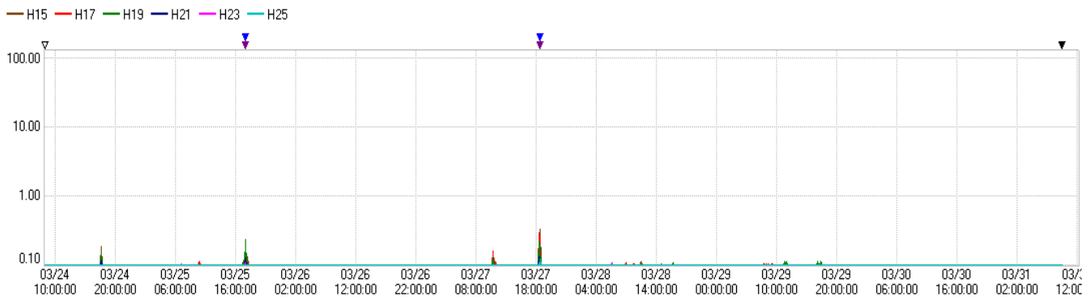


Figure 84 | STS1 – start of feeder – 15th to 25th (odd) harmonics

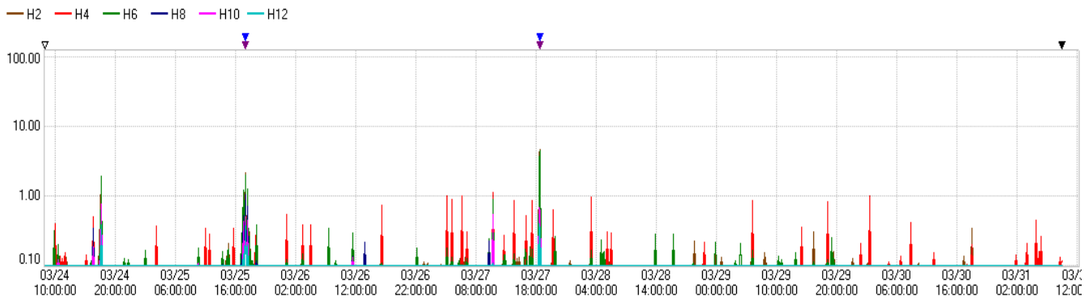


Figure 85 | STS1 – start of feeder – 2th to 12th (even) harmonics

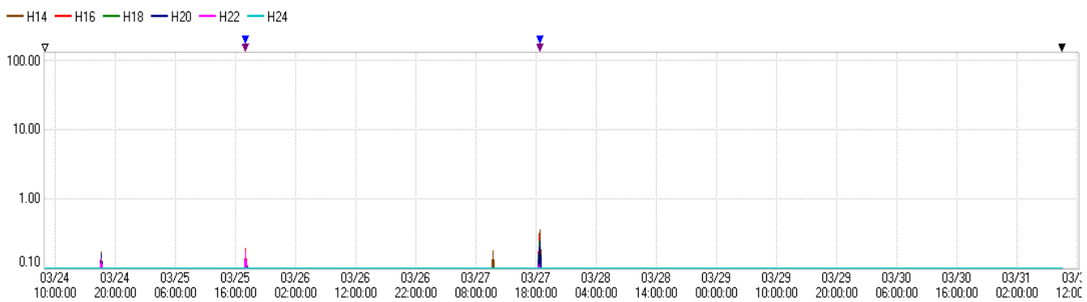


Figure 86 | STS1 – start of feeder – 14th to 24th (even) harmonics

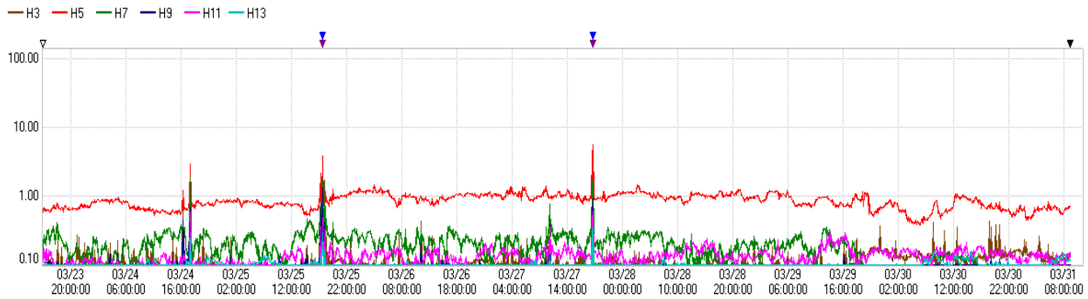


Figure 87 | STS1 - end of feeder – flicker measurements

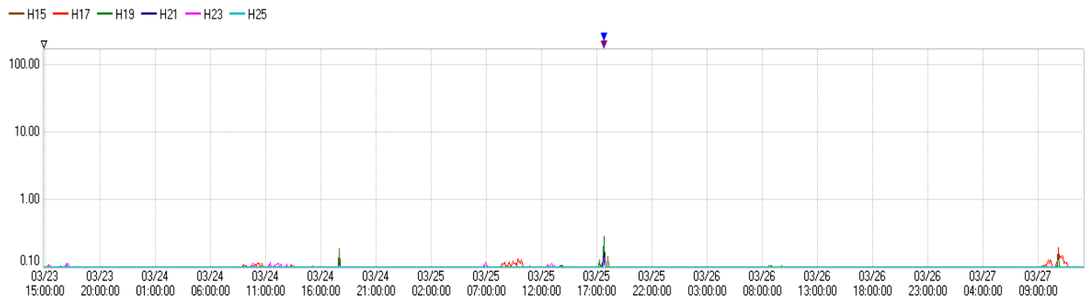


Figure 88 | STS1 – end of feeder – 15th to 25th (odd) harmonics

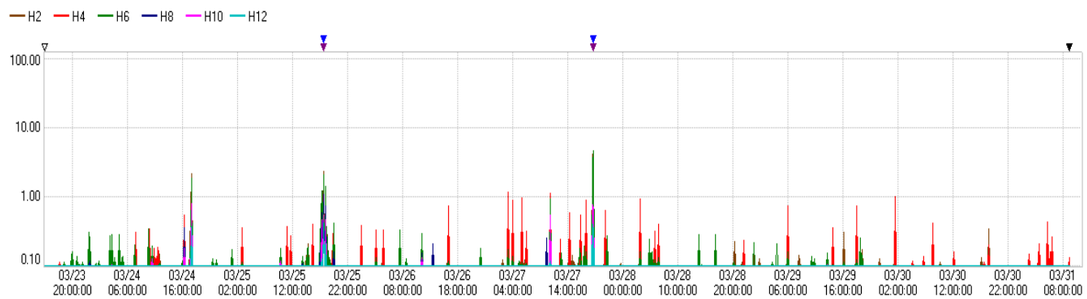


Figure 89 | STS1 – end of feeder – 2th to 12th (even) harmonics

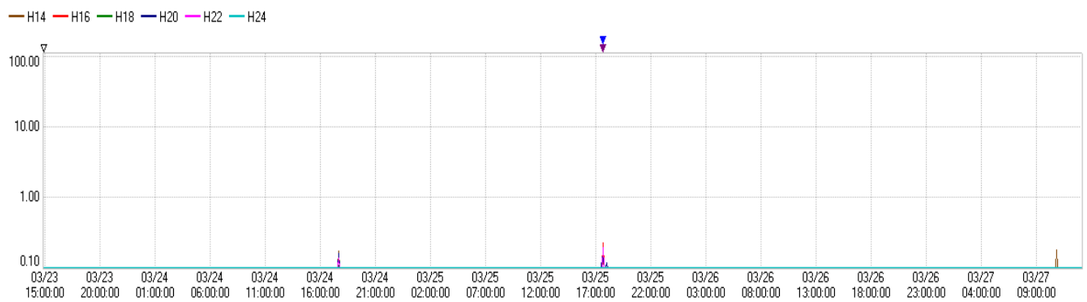


Figure 90 | STS1 – start of feeder – 14th to 24th (even) harmonics

STS2 – Flicker, Voltage and Frequency

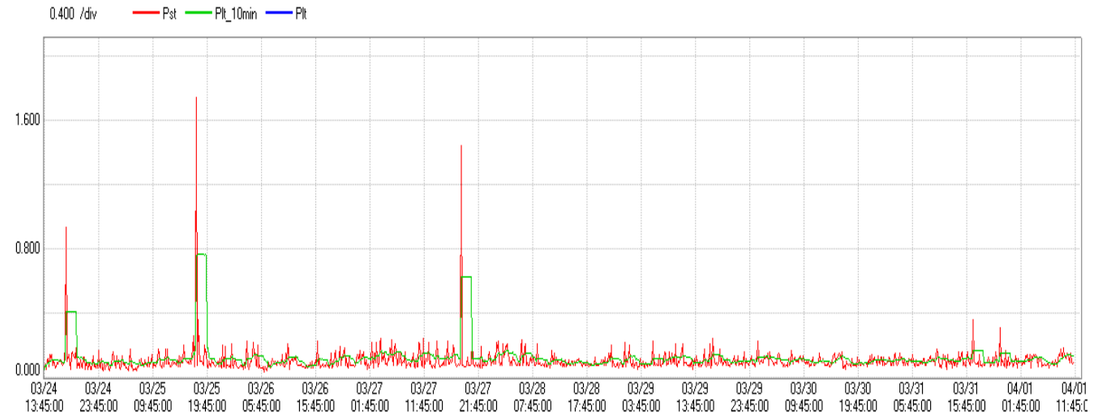


Figure 91 | STS2 - start of feeder – flicker measurements (Red Phase)

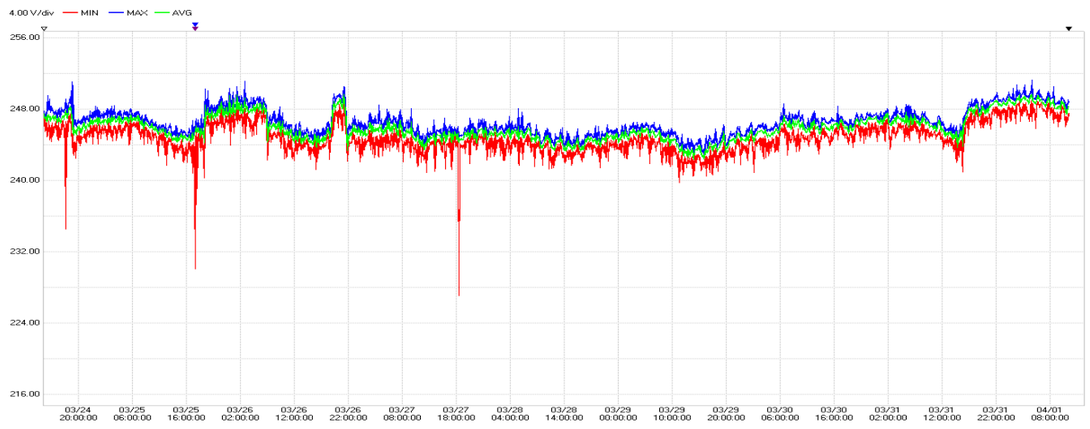


Figure 92 | STS2 - start of feeder – voltage measurements (Red Phase)

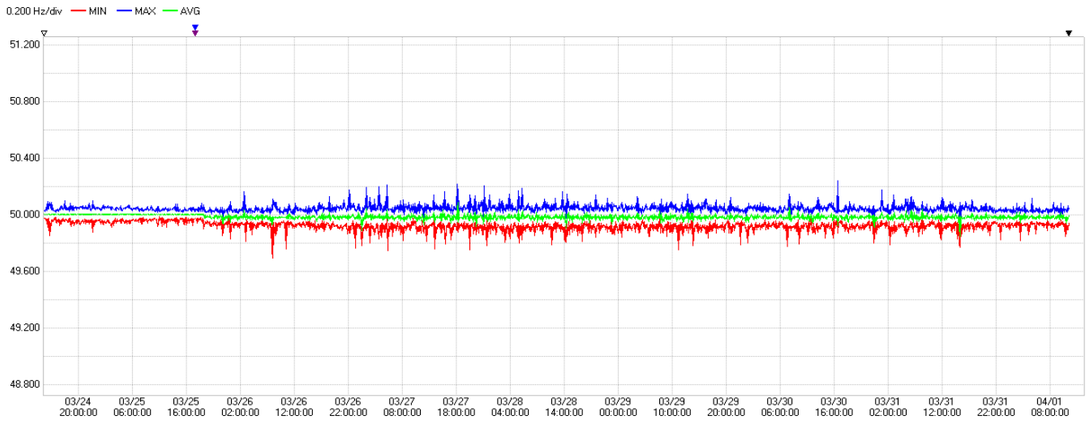


Figure 93 | STS2 - start of feeder – frequency measurements (Red Phase)

STS2 – Harmonics

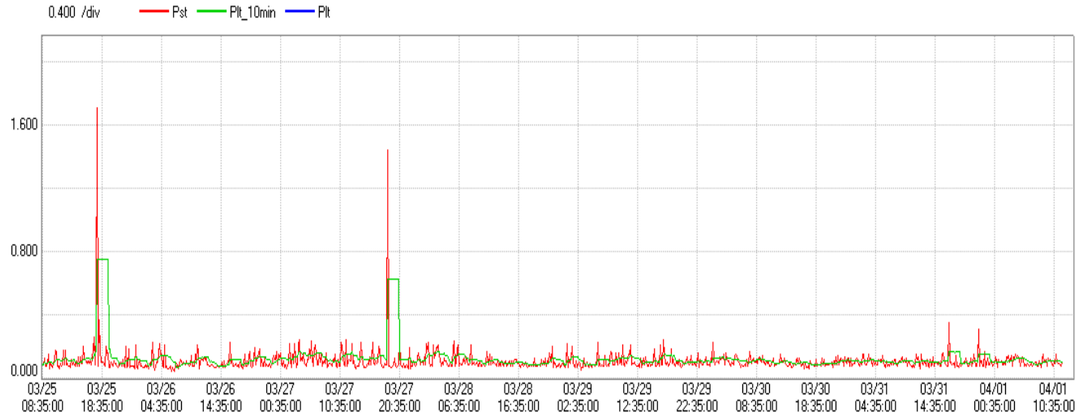


Figure 94 | STS2 - end of feeder – flicker measurements (Red Phase)

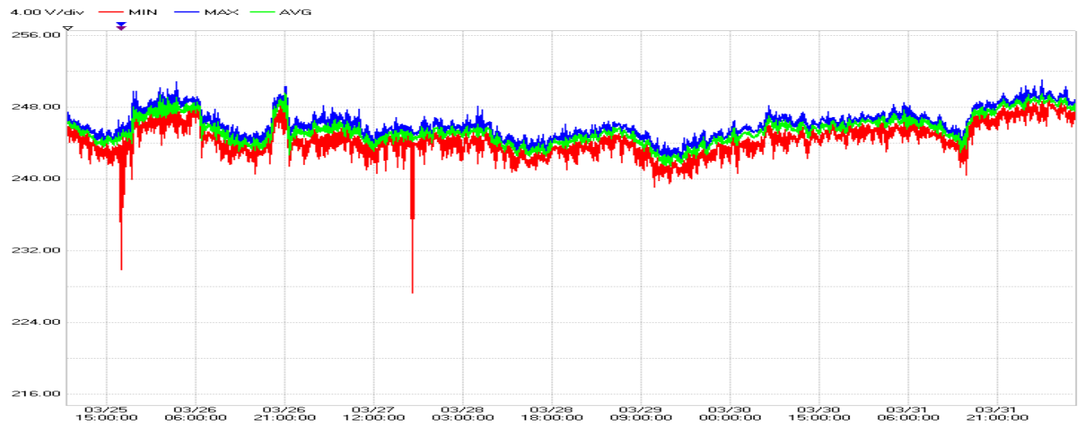


Figure 95 | STS2 - end of feeder – voltage measurements (Red Phase)

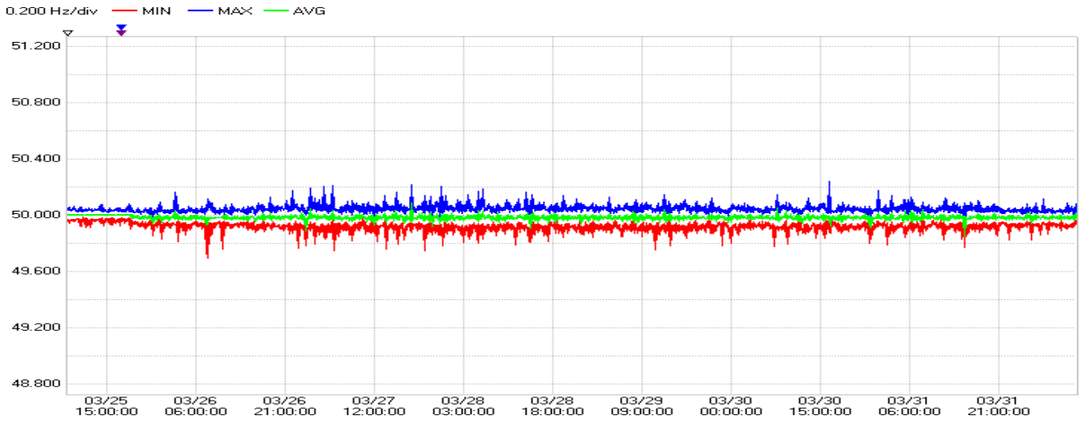


Figure 96 | STS2 - end of feeder – frequency measurements (Red Phase)

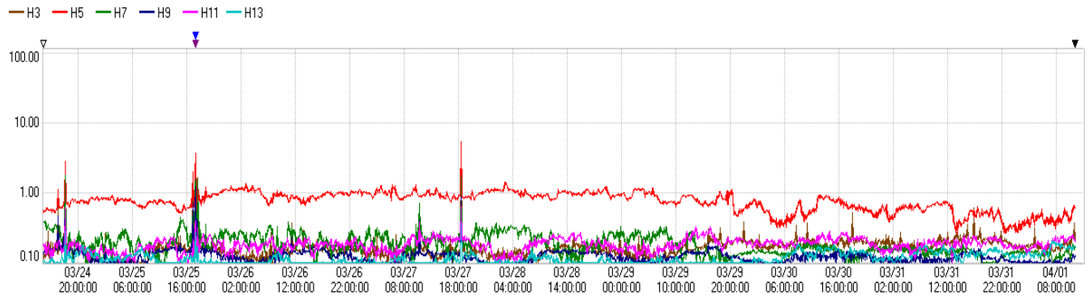


Figure 97 | STS2 - start of feeder – flicker measurements

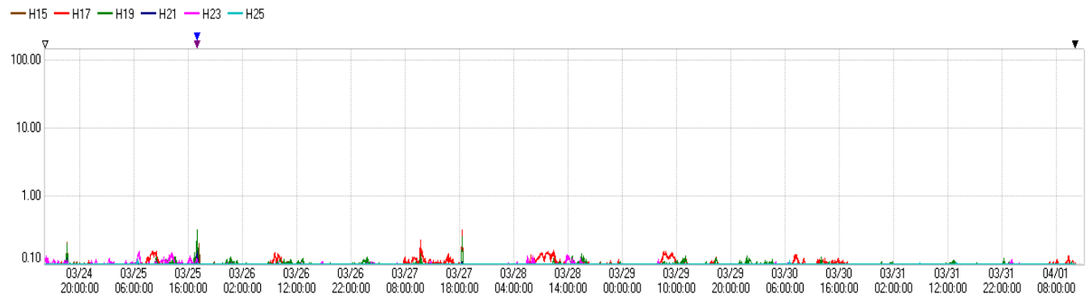


Figure 98 | STS2 – start of feeder – 15th to 25th (odd) harmonics

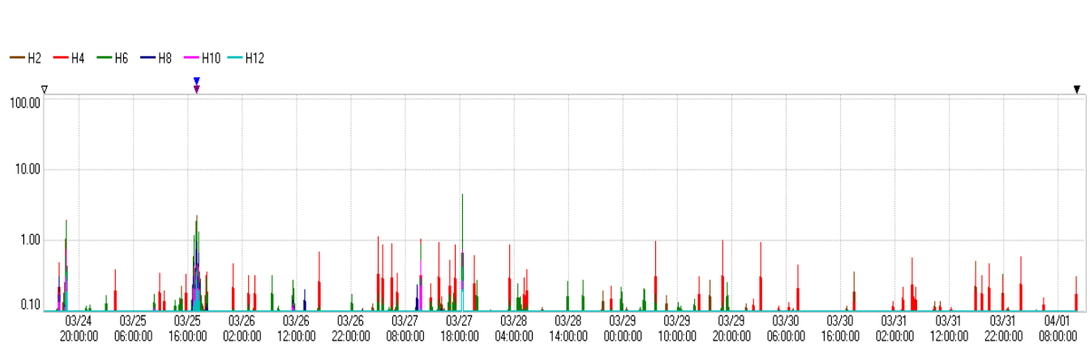


Figure 99 | STS2 – start of feeder – 2th to 12th (even) harmonics

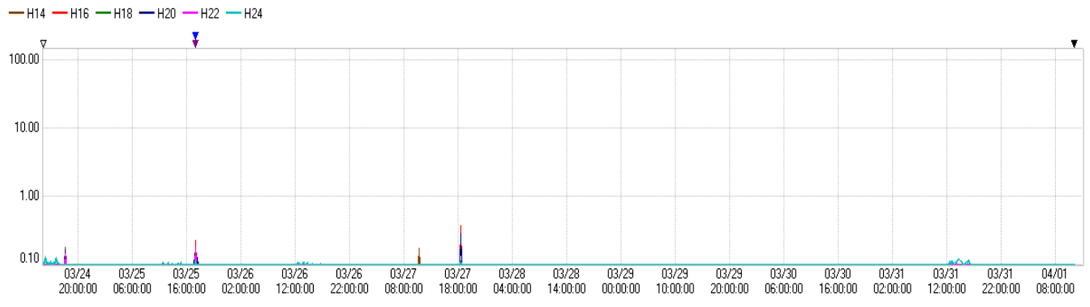


Figure 100 | STS2 – start of feeder – 14th to 24th (even) harmonics

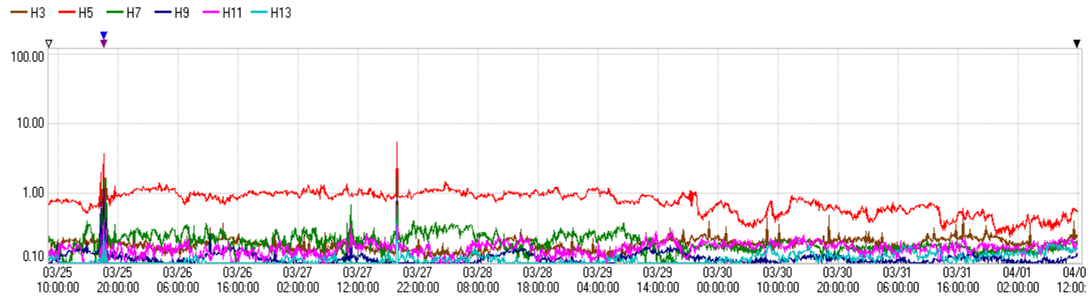


Figure 101 | STS2 - end of feeder – flicker measurements

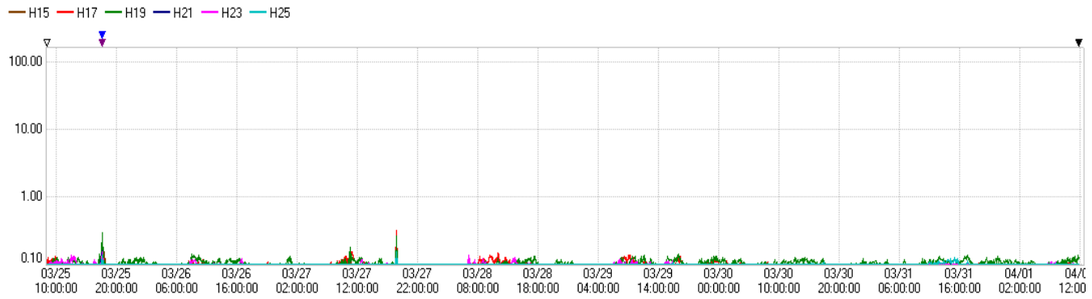


Figure 102 | STS2 – end of feeder – 15th to 25th (odd) harmonics

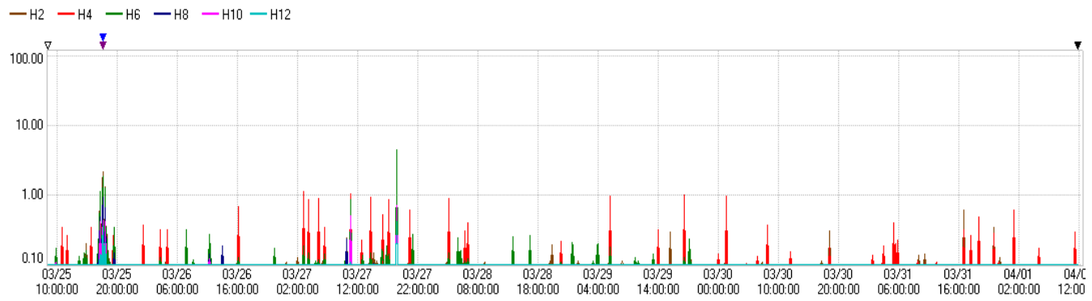


Figure 103 | STS2 – end of feeder – 2th to 12th (even) harmonics

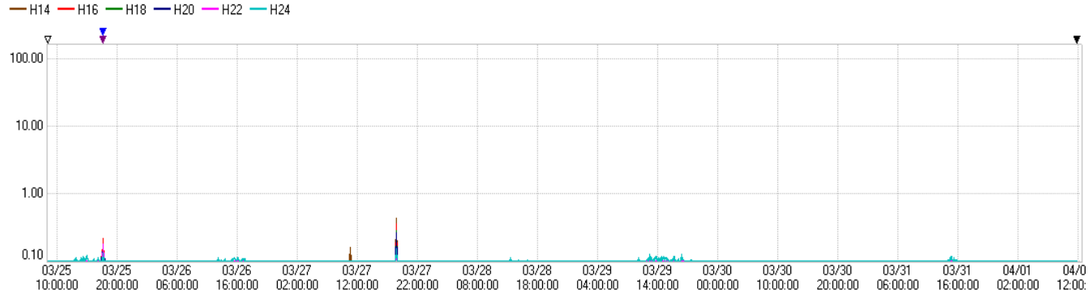


Figure 104 | STS2 – start of feeder – 14th to 24th (even) harmonics

STS6 – Flicker, Voltage and Frequency

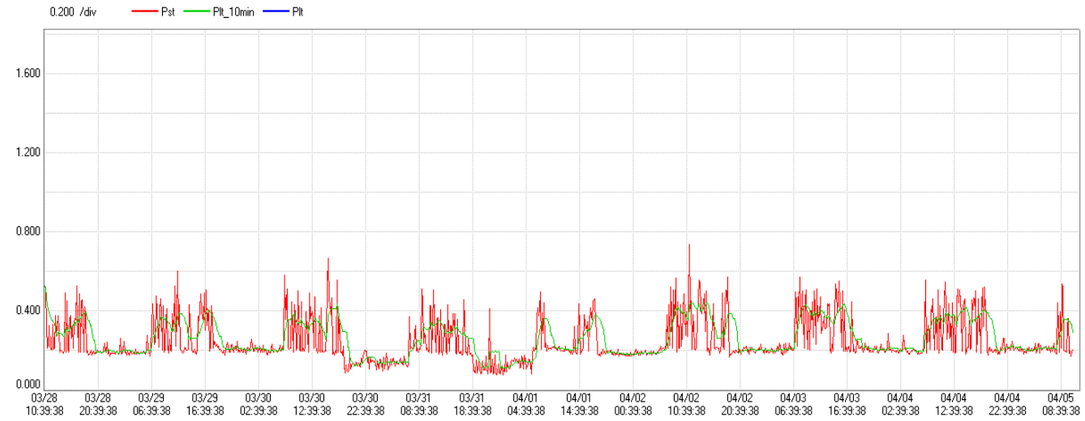


Figure 105 | STS6 - start of feeder – flicker measurements (Red Phase)

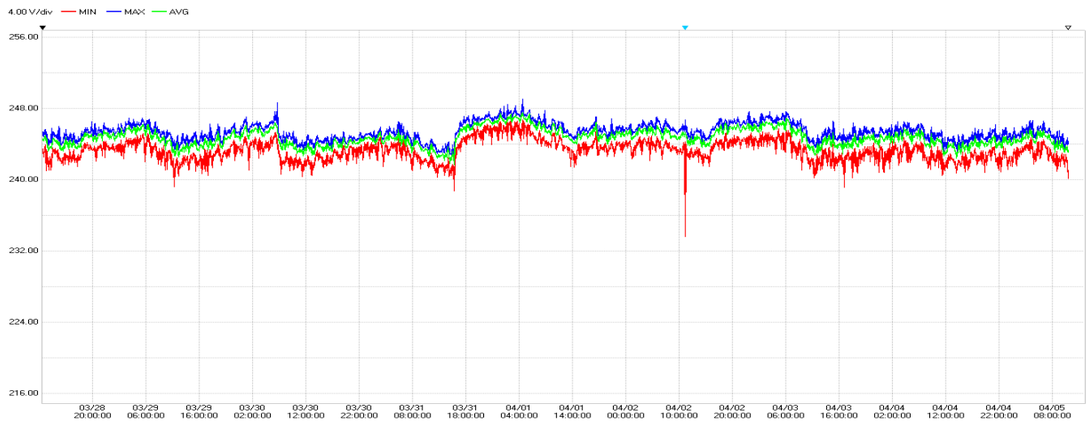


Figure 106 | STS6 - start of feeder – voltage measurements (Red Phase)

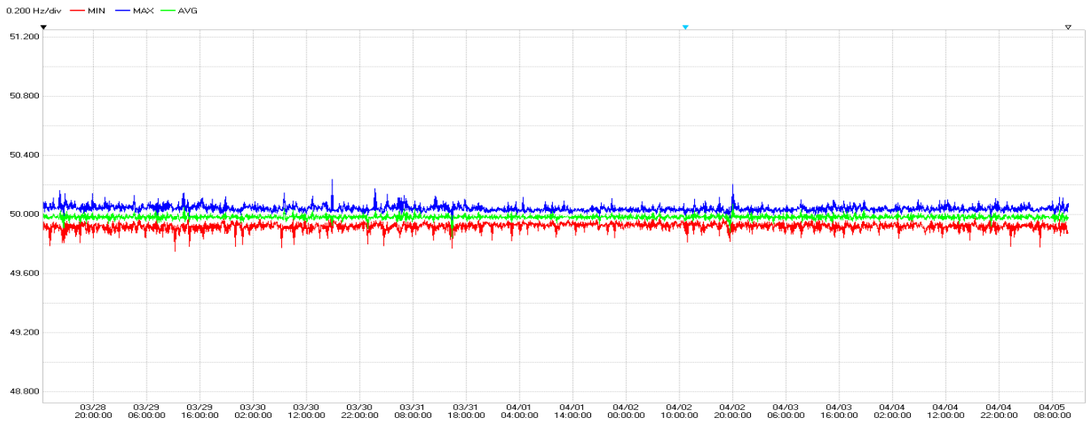


Figure 107 | STS6 - start of feeder – frequency measurements (Red Phase)

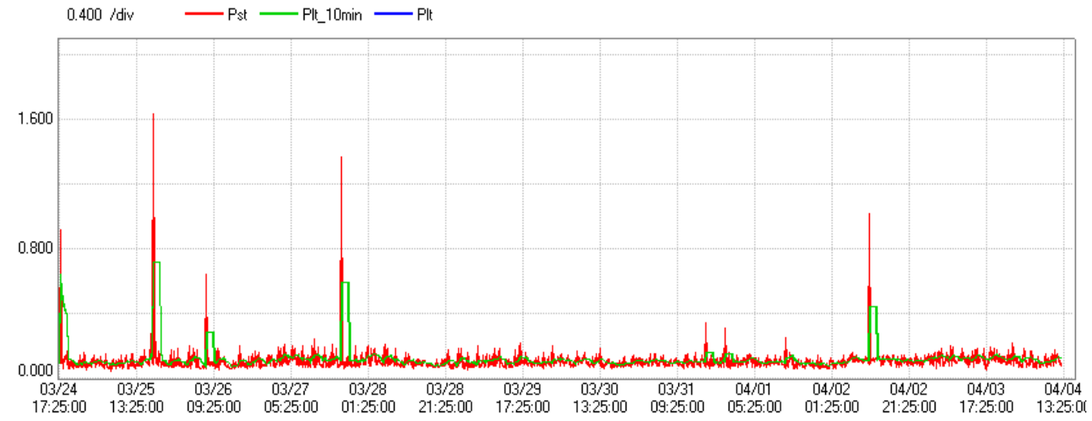


Figure 108 | STS6 - end of feeder – flicker measurements (Red Phase)

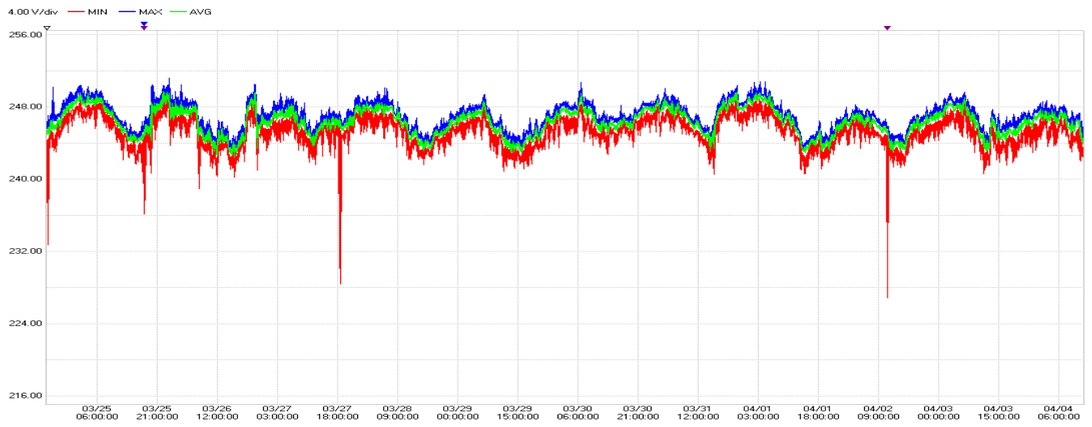


Figure 109 | STS6 - end of feeder – voltage measurements (Red Phase)

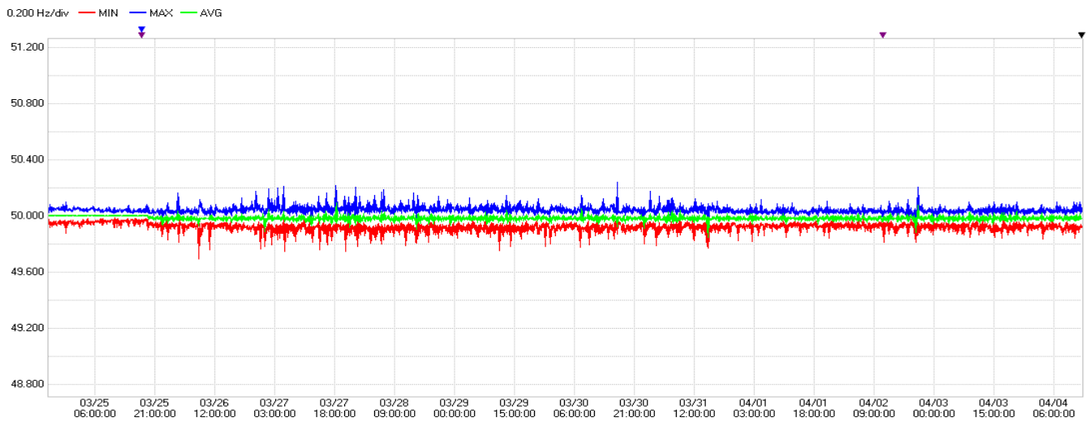


Figure 110 | STS6 - end of feeder – frequency measurements (Red Phase)

STS6 – Harmonics

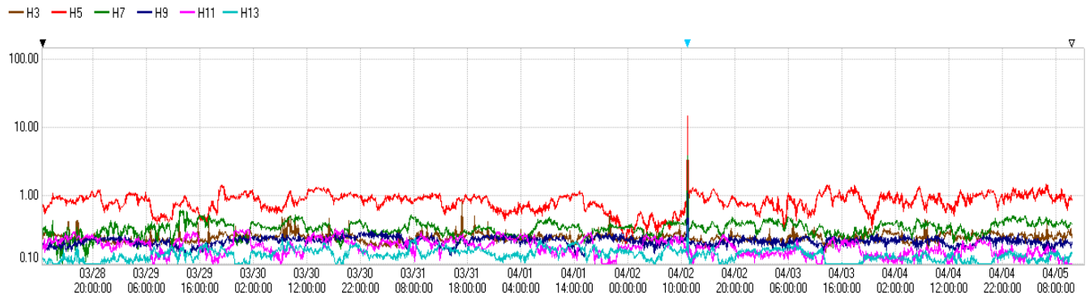


Figure 111 | STS6 - start of feeder – flicker measurements

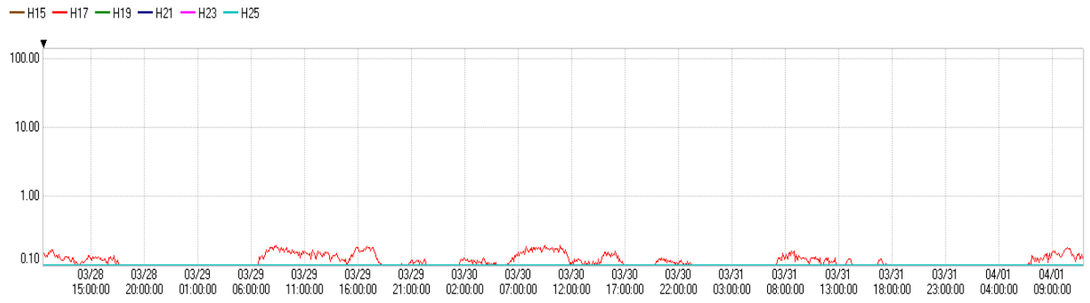


Figure 112 | STS6 – start of feeder – 15th to 25th (odd) harmonics

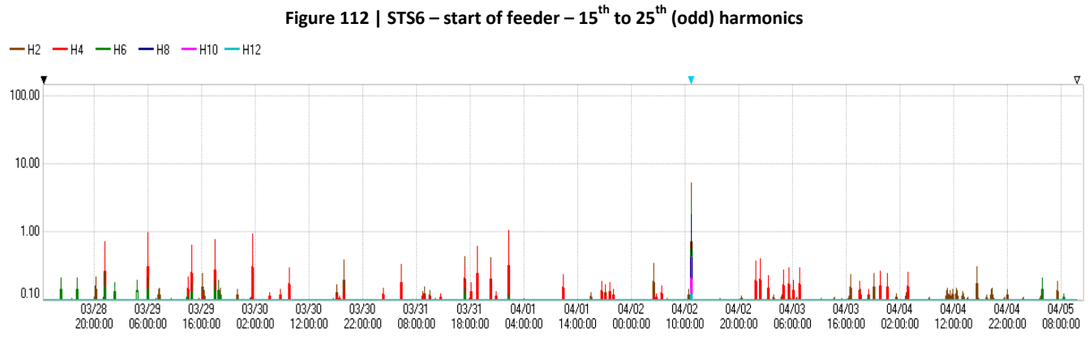


Figure 113 | STS6 – start of feeder – 2th to 12th (even) harmonics

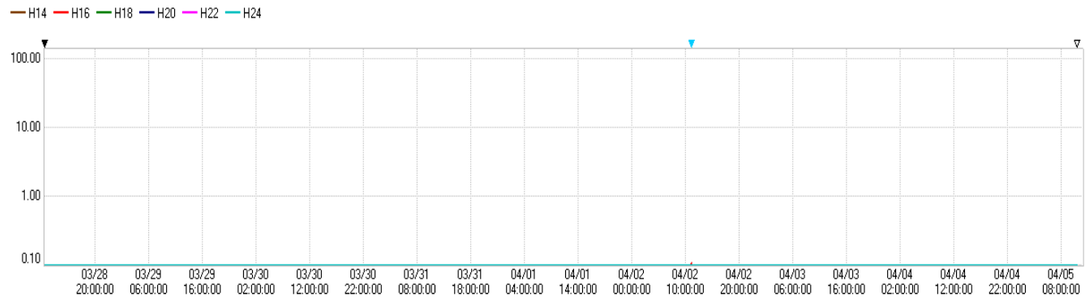


Figure 114 | STS6 – start of feeder – 14th to 24th (even) harmonics

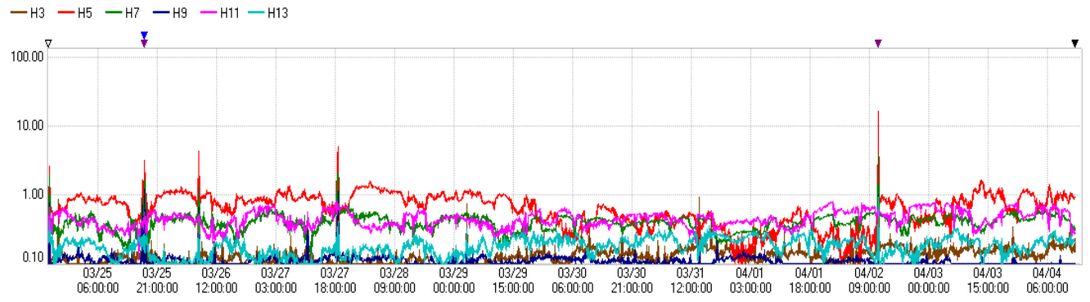


Figure 115 | STS6 – end of feeder – flicker measurements

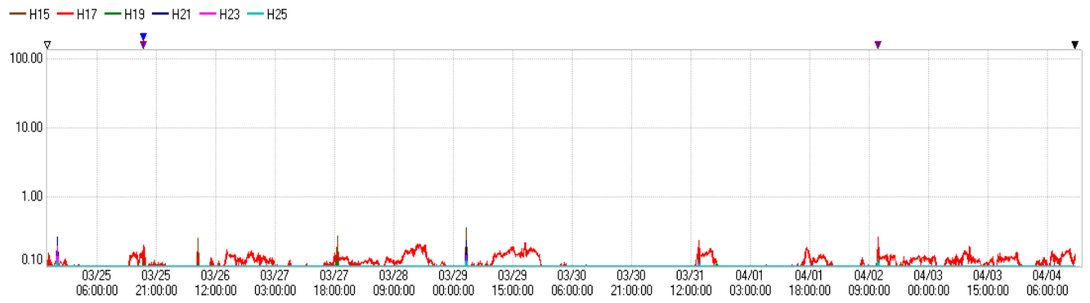


Figure 116 | STS6 – end of feeder – 15th to 25th (odd) harmonics

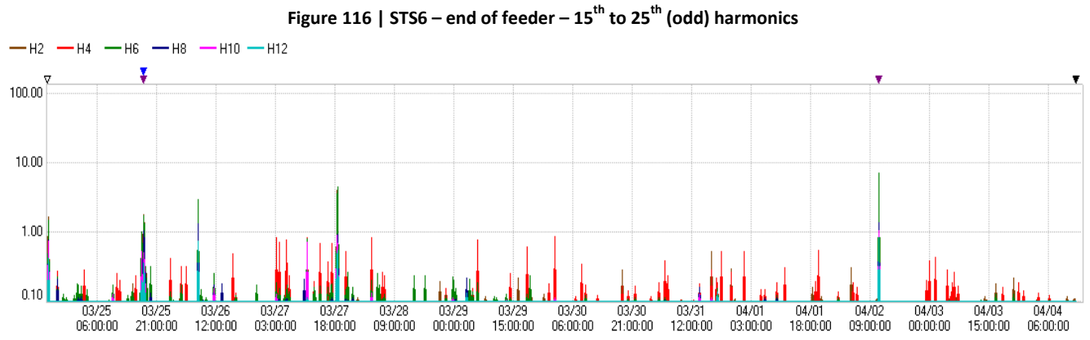


Figure 117 | STS6 – end of feeder – 2th to 12th (even) harmonics

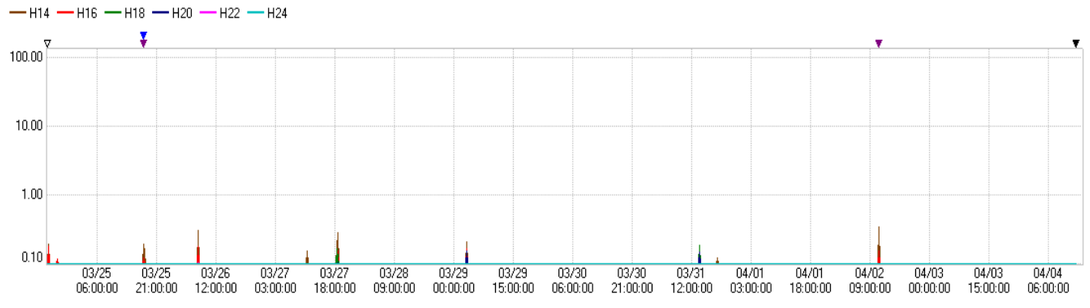
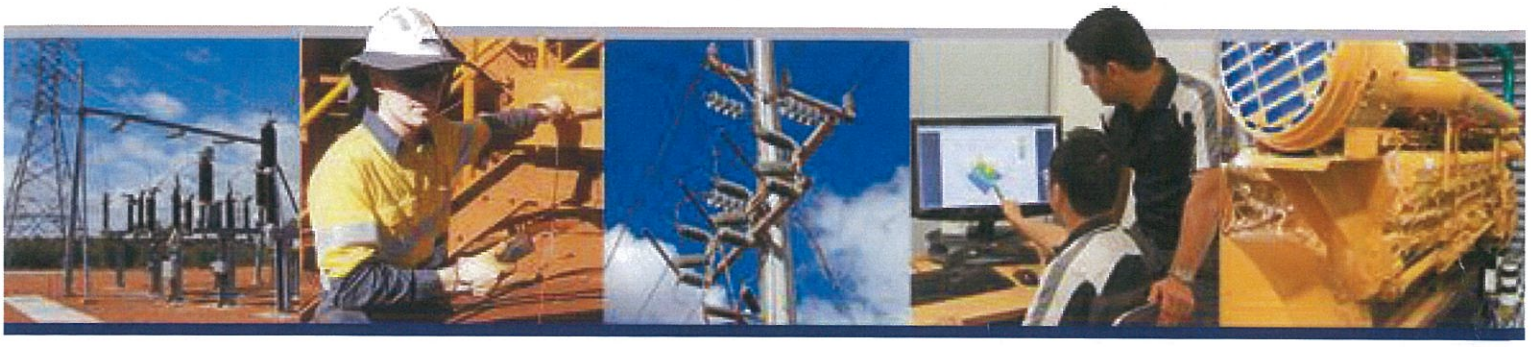


Figure 118 | STS6 – end of feeder – 14th to 24th (even) harmonics

APPENDIX C PQ Device Installation Checklist



BHPBIO NEWMAN
COMPLIANCE & AUDIT REPORT
2014/2015

PS21

PQ LOGGER INSTALLATION CHECKLIST

REVISION J

17/03/2015

APD

Each checklist is mandatory for every logging operation and each action items as defined in this checklist must be checked and signed by the electrical contractor. Contact APD for clarification on checklist on (08) 9212 1500.

Please ensure loggers are sent back within their rental period to avoid incurring additional cost. Refer to item 3.03 for return address.

Electrical Contractor	BHP NPW	**Name**	PAUL MORRISON
Logger Serial No.	201981		
Site Location	NIMINGARRA DR, EAST NEWMAN		
Transformer/Feeder Cable Logged	PS21		
Transformer Tap Setting	5		
Date and Time Start Logging	24/3/15 11.30 am	**Date and Time Stop Logging**	
Photo Id#	_____ (Photo after fully installed)		

Redone it as power was off / 4/4/15 at 10.20am

IMPORTANT NOTES:

1. CAPTURE LOGGERS INSTALLATION PHOTOS UPON INITIAL INSTALLATION AND SEND TO APD ON THE FIRST DAY OF INSTALLATION.

2. CHECK LOGGERS ARE STILL LOGGING UPON A POWER OUTAGE (FULLY CHARGED BATTERY LASTS APPROX. 30MINS ON HIOKI 3196 AND 180MINS ON HIOKI 3198).

Y = Yes **N = No** **N/A = Not Applicable**

EQUIPMENTS PRE-CHECK				
Item	**Description**	**Y**	**N**	**N/A**
1.01	Ensure these equipment are available, checked and prepared, 1. HIOKI 3196/3198 logger device(s) 2. DC power supply (if applicable) and power cord(s) interface 3. Logger internal battery. **NOTE:** ensure battery is 'fresh', if not request the rental company to supply and replace. 4. PC Card memory 5. Suitable clamp-on current sensors – 500A/5000A flexible/1000A clamp-on complete with batteries 6. Additional power cable 7. Red phase voltage supply for item 1 and item 5 above 8. Power board extension (Safety Note: Do not connect other devices to power board other than loggers and their accessories).	☑		☐
1.02	Has the logger device HIOKI 3196/3198 been prepared and fully calibrated ready for use? Check the stamp on device for expiry date. Contact APD if device is due for routine maintenance.	☑		☐
1.03	Has the DC power supply adapter and/or power cords required for the logger been checked? Logger needs external power supply for prolonged continuous operation.	☑		☐
1.04	Have the suitable clamps been chosen for this particular logging operation? Clamps must be rated for the particular logged feeder cable or transformer voltage and current respectively and all devices are set to correct current rating. Any ambiguity contact APD.	☑		☐
1.05	Have other additional equipment as per item 1.01 (6) to (7) been checked for their operational purpose if required?	☑		☐
1.06	Have the safety equipment, including but not limited to, suitable PPE gears, risk assessment documentations, etc. been prepared and checked?	☑		☐

Y = Yes **N = No** **N/A = Not Applicable**

GENERAL PROCEDURE IMPORTANT NOTE: Do not adjust, modify or alter settings and configurations of loggers (system) unless being specified in this checklist, as logging result may differ significantly as a consequence.				
Item	**Description**	**N**	**N**	**N/A**
2.01	Has the relevant safety procedure been followed, such as complete risk assessment document(s) and wearing correct PPE gears?	☑	☐	☐
2.02	Have all the equipment been set up properly and working ok on site? This includes, a) ensuring logger is powered up for continuous operation for at least 7 days (the Power Lamp should be Green), b) CT clamps are secured, the power is on, and suitable settings (500A/5000A for flexible) are selected c) PC Card memory is in the logger and ready (do not remove – just check it is installed) Initially check the reading on logger screen and observe if they appear ok. Any issue contact APD and/or Tech Rental for support. **Important Note:** 500A setting on flexi CT effective range is from 50A to 500A. 5000A setting on flexi CT effective measurement range is from 500A to 5000A. Ensure correct setting is selected to ensure correct data recording.	☑	☐	☐
2.03	Has the flexible CT been installed on the correct orientation following direction of arrow? Ensure that CT is secured properly by the locking mechanism. Refer to Appendix C.	☑	☐	☐
2.04	Have you check the logger "View" screen and observe if power factor (PF) is positive? If PF is negative, this means that CT is not on the correct orientation and must be re-installed following item 2.03. Also refer to Appendix A or B.	☑	☐	☐
2.05	Have all the phase connector cables been connected properly to logger as per their colour coding (Red, Yellow, Blue for phases and Black for neutral)?	☑	☐	☐
2.06	Have all the cables been connected to Channel 4 U+ and U- terminal for neutral – earth voltage measurement? Note that U- needs to connect to neutral and U+ to earth bar (or point). Also refer to Appendix A or B.	☑	☐	☐
2.07	Has the 'start' button been pressed to trigger the logger? Refer to Appendix A or B.	☑	☐	☐
2.08	Have you ensure that logger is currently recording the data? Refer to Appendix A or B.	☐	☐	☐
2.09	Have all the equipment been adequately placed and position safely to ensure non-interrupted operation?	☑	☐	☐
2.10	Have clear photos of fully installed loggers been taken and photo ID have been noted in the space available at start of this checklist (page 1)?	☑	☐	
2.11	Before leaving site, have the kiosk doors or other means of access been checked if they are close and locked appropriately?	☑	☐	☐

Y = Yes N = No N/A = Not Applicable

END OF LOGGING PERIOD				
Item	Description	N	N	N/A
3.01	Has the logger been turned off by following the correct shutting down procedure? Do not directly shut down by flicking the switch off. Instead follow this step, **stop → data reset →enter**. IMPORTANT NOTE: DO NOT REMOVE THE MEMORY CARD (this is to be processed upon return)	☑	☐	☐
3.02	Check all items returned to the associated plastic box and the Tech Rentals checklist is completed. Advise APD if any equipment is missing.	☑	☐	☐
3.03	Transport the Loggers directly back to specified address or to Tech Rentals at 122 Kewdale Road, Kewdale WA 6105. Contact APD (08) 9212 1500 reference the project number for any queries about the delivery back to Tech Rentals.	☑	☐	☐

WAS PUT BACK ON SAT Taken of monday the 6th at 4 00

IMPORTANT NOTES:

1. CAPTURE LOGGERS INSTALLATION PHOTOS UPON INITIAL INSTALLATION AND SEND TO APD ON THE FIRST DAY OF INSTALLATION.

2. CHECK LOGGERS ARE STILL LOGGING UPON A POWER OUTAGE (FULLY CHARGED BATTERY LASTS APPROX. 30MINS ON HIOKI 3196 AND 180MINS ON HIOKI 3198).

This Checklist is to be signed upon completion and returned to APD.

Electrical Contractor : **Signature :** **Date:**

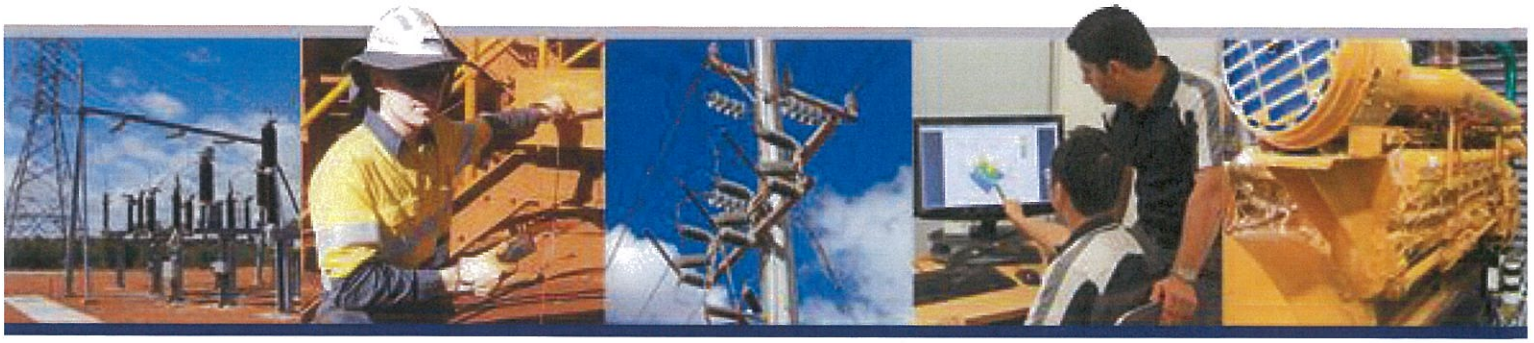
Supervisor: **Signature :** **Date:**

Comments:.....

.....

.....

.....



BHPBIO NEWMAN
COMPLIANCE & AUDIT REPORT
2014/2015

PQ LOGGER INSTALLATION CHECKLIST

REVISION J

17/03/2015

APD

Each checklist is mandatory for every logging operation and each action items as defined in this checklist must be checked and signed by the electrical contractor. Contact APD for clarification on checklist on (08) 9212 1500.

Please ensure loggers are sent back within their rental period to avoid incurring additional cost. Refer to item 3.03 for return address.

Electrical Contractor	THP NPIU	**Name**	PAUL MORRISON
Logger Serial No.	~~20[illegible]~~ 202224		
Site Location	FORREST ST		
Transformer/Feeder Cable Logged	PS60		
Transformer Tap Setting	4		
Date and Time Start Logging	24/3/25 1:30pm	**Date and Time Stop Logging**	
Photo Id#	_____ (Photo after fully installed)		

IMPORTANT NOTES:

1. CAPTURE LOGGERS INSTALLATION PHOTOS UPON INITIAL INSTALLATION AND SEND TO APD ON THE FIRST DAY OF INSTALLATION.

2. CHECK LOGGERS ARE STILL LOGGING UPON A POWER OUTAGE (FULLY CHARGED BATTERY LASTS APPROX. 30MINS ON HIOKI 3196 AND 180MINS ON HIOKI 3198).

Y = Yes N = No N/A = Not Applicable

EQUIPMENTS PRE-CHECK				
Item	**Description**	**Y**	**N**	**N/A**
1.01	Ensure these equipment are available, checked and prepared, 1. HIOKI 3196/3198 logger device(s) 2. DC power supply (if applicable) and power cord(s) interface 3. Logger internal battery. **NOTE:** ensure battery is 'fresh', if not request the rental company to supply and replace. 4. PC Card memory 5. Suitable clamp-on current sensors – 500A/5000A flexible/1000A clamp-on complete with batteries 6. Additional power cable 7. Red phase voltage supply for item 1 and item 5 above 8. Power board extension (Safety Note: Do not connect other devices to power board other than loggers and their accessories).	☑		☐
1.02	Has the logger device HIOKI 3196/3198 been prepared and fully calibrated ready for use? Check the stamp on device for expiry date. Contact APD if device is due for routine maintenance.	☑		☐
1.03	Has the DC power supply adapter and/or power cords required for the logger been checked? Logger needs external power supply for prolonged continuous operation.	☑		☐
1.04	Have the suitable clamps been chosen for this particular logging operation? Clamps must be rated for the particular logged feeder cable or transformer voltage and current respectively and all devices are set to correct current rating. Any ambiguity contact APD.	☑		☐
1.05	Have other additional equipment as per item 1.01 (6) to (7) been checked for their operational purpose if required?	☑		☐
1.06	Have the safety equipment, including but not limited to, suitable PPE gears, risk assessment documentations, etc. been prepared and checked?	☑		☐

Y = Yes **N = No** **N/A = Not Applicable**

GENERAL PROCEDURE IMPORTANT NOTE: Do not adjust, modify or alter settings and configurations of loggers (system) unless being specified in this checklist, as logging result may differ significantly as a consequence.				
Item	**Description**	**N**	**N**	**N/A**
2.01	Has the relevant safety procedure been followed, such as complete risk assessment document(s) and wearing correct PPE gears?	☑		☐
2.02	Have all the equipment been set up properly and working ok on site? This includes, a) ensuring logger is powered up for continuous operation for at least 7 days (the Power Lamp should be Green), b) CT clamps are secured, the power is on, and suitable settings (500A/5000A for flexible) are selected c) PC Card memory is in the logger and ready (do not remove – just check it is installed) Initially check the reading on logger screen and observe if they appear ok. Any issue contact APD and/or Tech Rental for support. **Important Note:** 500A setting on flexi CT effective range is from 50A to 500A. 5000A setting on flexi CT effective measurement range is from 500A to 5000A. Ensure correct setting is selected to ensure correct data recording.	☑	☐	☐
2.03	Has the flexible CT been installed on the correct orientation following direction of arrow? Ensure that CT is secured properly by the locking mechanism. Refer to Appendix C.	☑		☐
2.04	Have you check the logger "View" screen and observe if power factor (PF) is positive? If PF is negative, this means that CT is not on the correct orientation and must be re-installed following item 2.03. Also refer to Appendix A or B.	☑		☐
2.05	Have all the phase connector cables been connected properly to logger as per their colour coding (Red, Yellow, Blue for phases and Black for neutral)?	☑		☐
2.06	Have all the cables been connected to Channel 4 U+ and U- terminal for neutral – earth voltage measurement? Note that U- needs to connect to neutral and U+ to earth bar (or point). Also refer to Appendix A or B.	☑	☐	☐
2.07	Has the 'start' button been pressed to trigger the logger? Refer to Appendix A or B.	☑		☐
2.08	Have you ensure that logger is currently recording the data? Refer to Appendix A or B.	☑		☐
2.09	Have all the equipment been adequately placed and position safely to ensure non-interrupted operation?	☑	☐	☐
2.10	Have clear photos of fully installed loggers been taken and photo ID have been noted in the space available at start of this checklist (page 1)?	☑		
2.11	Before leaving site, have the kiosk doors or other means of access been checked if they are close and locked appropriately?	☑	☐	☐

Y = Yes N = No N/A = Not Applicable

END OF LOGGING PERIOD				
Item	Description	N	N	N/A
3.01	Has the logger been turned off by following the correct shutting down procedure? Do not directly shut down by flicking the switch off. Instead follow this step, **stop → data reset →enter**. IMPORTANT NOTE: DO NOT REMOVE THE MEMORY CARD (this is to be processed upon return)	☑	☐	☐
3.02	Check all items returned to the associated plastic box and the Tech Rentals checklist is completed. Advise APD if any equipment is missing.	☑	☐	☐
3.03	Transport the Loggers directly back to specified address or to Tech Rentals at 122 Kewdale Road, Kewdale WA 6105. Contact APD (08) 9212 1500 reference the project number for any queries about the delivery back to Tech Rentals.	☑	☐	☐

IMPORTANT NOTES:

1. CAPTURE LOGGERS INSTALLATION PHOTOS UPON INITIAL INSTALLATION AND SEND TO APD ON THE FIRST DAY OF INSTALLATION.

2. CHECK LOGGERS ARE STILL LOGGING UPON A POWER OUTAGE (FULLY CHARGED BATTERY LASTS APPROX. 30MINS ON HIOKI 3196 AND 180MINS ON HIOKI 3198).

This Checklist is to be signed upon completion and returned to APD.

Electrical Contractor : P. Morrison **Signature :**  **Date:** 1/4/15

Supervisor: **Signature :** **Date:**

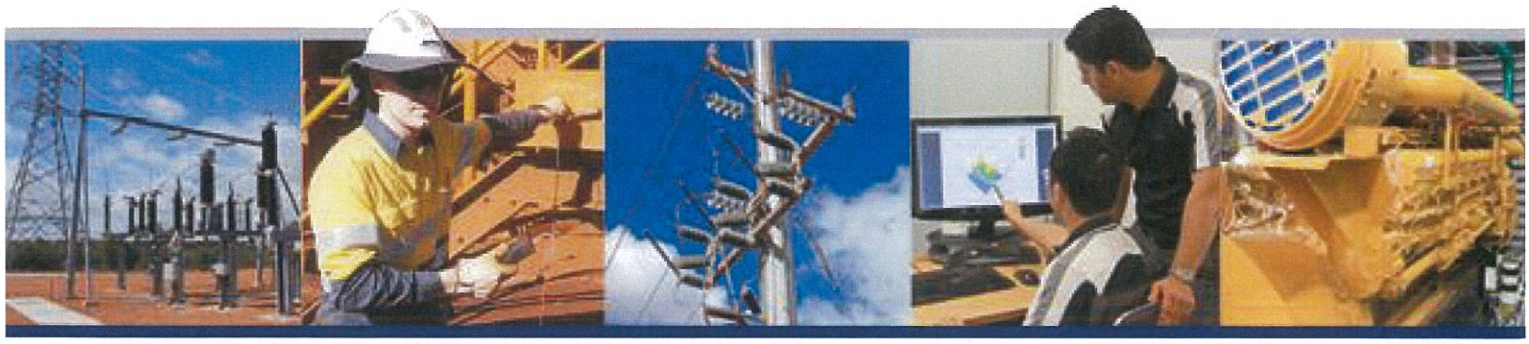
Comments:.....

.....

.....

.....

PS70



BHPBIO NEWMAN
COMPLIANCE & AUDIT REPORT
2014/2015

PQ LOGGER INSTALLATION CHECKLIST

REVISION J

17/03/2015

APD

Each checklist is mandatory for every logging operation and each action items as defined in this checklist must be checked and signed by the electrical contractor. Contact APD for clarification on checklist on (08) 9212 1500.

Please ensure loggers are sent back within their rental period to avoid incurring additional cost. Refer to item 3.03 for return address.

Electrical Contractor		**Name**	
Logger Serial No.	202223		
Site Location	PS 70 JABARRUP CR		
Transformer/Feeder Cable Logged			
Transformer Tap Setting	4		
Date and Time Start Logging	25-3-25 08-25	**Date and Time Stop Logging**	
Photo Id#	_____ (Photo after fully installed)		

IMPORTANT NOTES:

1. CAPTURE LOGGERS INSTALLATION PHOTOS UPON INITIAL INSTALLATION AND SEND TO APD ON THE FIRST DAY OF INSTALLATION.

2. CHECK LOGGERS ARE STILL LOGGING UPON A POWER OUTAGE (FULLY CHARGED BATTERY LASTS APPROX. 30MINS ON HIOKI 3196 AND 180MINS ON HIOKI 3198).

Y = Yes **N = No** **N/A = Not Applicable**

EQUIPMENTS PRE-CHECK				
Item	**Description**	**Y**	**N**	**N/A**
1.01	Ensure these equipment are available, checked and prepared, 1. HIOKI 3196/3198 logger device(s) 2. DC power supply (if applicable) and power cord(s) interface 3. Logger internal battery. **NOTE:** ensure battery is 'fresh', if not request the rental company to supply and replace. 4. PC Card memory 5. Suitable clamp-on current sensors – 500A/5000A flexible/1000A clamp-on complete with batteries 6. Additional power cable 7. Red phase voltage supply for item 1 and item 5 above 8. Power board extension (Safety Note: Do not connect other devices to power board other than loggers and their accessories).	☐		☐
1.02	Has the logger device HIOKI 3196/3198 been prepared and fully calibrated ready for use? Check the stamp on device for expiry date. Contact APD if device is due for routine maintenance.	☐		☐
1.03	Has the DC power supply adapter and/or power cords required for the logger been checked? Logger needs external power supply for prolonged continuous operation.	☐		☐
1.04	Have the suitable clamps been chosen for this particular logging operation? Clamps must be rated for the particular logged feeder cable or transformer voltage and current respectively and all devices are set to correct current rating. Any ambiguity contact APD.	☐		☐
1.05	Have other additional equipment as per item 1.01 (6) to (7) been checked for their operational purpose if required?	☐		☐
1.06	Have the safety equipment, including but not limited to, suitable PPE gears, risk assessment documentations, etc. been prepared and checked?	☐		☐

Y = Yes N = No N/A = Not Applicable

GENERAL PROCEDURE IMPORTANT NOTE: Do not adjust, modify or alter settings and configurations of loggers (system) unless being specified in this checklist, as logging result may differ significantly as a consequence.				
Item	**Description**	**N**	**N**	**N/A**
2.01	Has the relevant safety procedure been followed, such as complete risk assessment document(s) and wearing correct PPE gears?	☐		☐
2.02	Have all the equipment been set up properly and working ok on site? This includes, a) ensuring logger is powered up for continuous operation for at least 7 days (the Power Lamp should be Green), b) CT clamps are secured, the power is on, and suitable settings (500A/5000A for flexible) are selected c) PC Card memory is in the logger and ready (do not remove – just check it is installed) Initially check the reading on logger screen and observe if they appear ok. Any issue contact APD and/or Tech Rental for support. **Important Note:** 500A setting on flexi CT effective range is from 50A to 500A. 5000A setting on flexi CT effective measurement range is from 500A to 5000A. Ensure correct setting is selected to ensure correct data recording.	☐	☐	☐
2.03	Has the flexible CT been installed on the correct orientation following direction of arrow? Ensure that CT is secured properly by the locking mechanism. Refer to Appendix C.	☐		☐
2.04	Have you check the logger "View" screen and observe if power factor (PF) is positive? If PF is negative, this means that CT is not on the correct orientation and must be re-installed following item 2.03. Also refer to Appendix A or B.	☐		☐
2.05	Have all the phase connector cables been connected properly to logger as per their colour coding (Red, Yellow, Blue for phases and Black for neutral)?	☐		☐
2.06	Have all the cables been connected to Channel 4 U+ and U- terminal for neutral – earth voltage measurement? Note that U- needs to connect to neutral and U+ to earth bar (or point). Also refer to Appendix A or B.	☐	☐	☐
2.07	Has the 'start' button been pressed to trigger the logger? Refer to Appendix A or B.	☐		☐
2.08	Have you ensure that logger is currently recording the data? Refer to Appendix A or B.	☐		☐
2.09	Have all the equipment been adequately placed and position safely to ensure non-interrupted operation?	☐	☐	☐
2.10	Have clear photos of fully installed loggers been taken and photo ID have been noted in the space available at start of this checklist (page 1)?	☐		
2.11	Before leaving site, have the kiosk doors or other means of access been checked if they are close and locked appropriately?	☐	☐	☐

Y = Yes N = No N/A = Not Applicable

END OF LOGGING PERIOD				
Item	**Description**	**N**	**N**	**N/A**
3.01	Has the logger been turned off by following the correct shutting down procedure? Do not directly shut down by flicking the switch off. Instead follow this step, **stop → data reset →enter**. IMPORTANT NOTE: DO NOT REMOVE THE MEMORY CARD (this is to be processed upon return)	☐	☐	☐
3.02	Check all items returned to the associated plastic box and the Tech Rentals checklist is completed. Advise APD if any equipment is missing.	☐	☐	☐
3.03	Transport the Loggers directly back to specified address or to Tech Rentals at 122 Kewdale Road, Kewdale WA 6105. Contact APD (08) 9212 1500 reference the project number for any queries about the delivery back to Tech Rentals.	☐	☐	☐

IMPORTANT NOTES:

1. CAPTURE LOGGERS INSTALLATION PHOTOS UPON INITIAL INSTALLATION AND SEND TO APD ON THE FIRST DAY OF INSTALLATION.

2. CHECK LOGGERS ARE STILL LOGGING UPON A POWER OUTAGE (FULLY CHARGED BATTERY LASTS APPROX. 30MINS ON HIOKI 3196 AND 180MINS ON HIOKI 3198).

This Checklist is to be signed upon completion and returned to APD.

Electrical Contractor : P. Morrison **Signature :** **Date:** 1/4/15

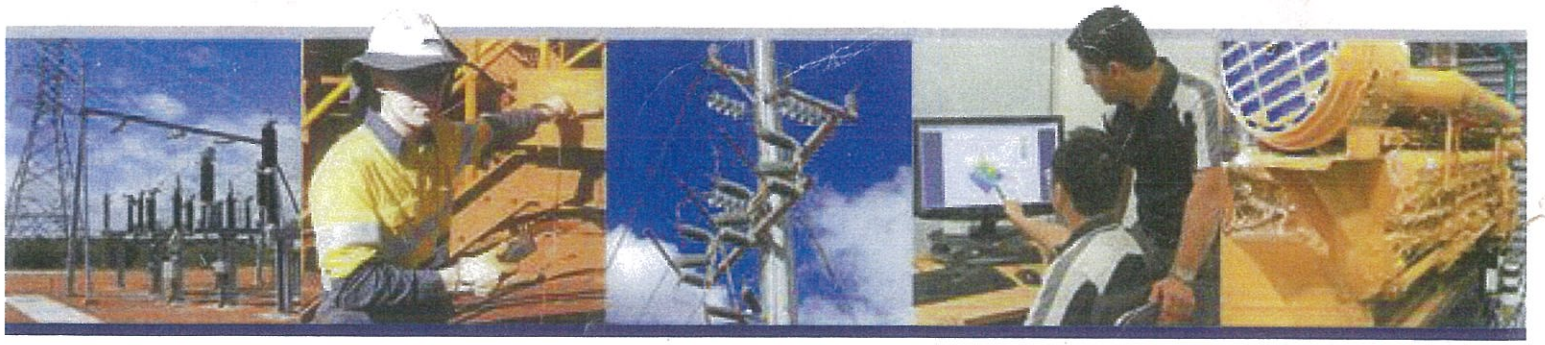
Supervisor: **Signature :** **Date:**

Comments:.....

.....

.....

.....



BHPBIO NEWMAN
COMPLIANCE & AUDIT REPORT
2014/2015

PQ LOGGER INSTALLATION CHECKLIST

REVISION J

17/03/2015

APD

Each checklist is mandatory for every logging operation and each action items as defined in this checklist must be checked and signed by the electrical contractor. Contact APD for clarification on checklist on (08) 9212 1500.

Please ensure loggers are sent back within their rental period to avoid incurring additional cost. Refer to item 3.03 for return address.

Electrical Contractor		Name	
Logger Serial No.	202053		
Site Location	PS 83 / AIRPORT		
Transformer/Feeder Cable Logged			
Transformer Tap Setting	3		
Date and Time Start Logging	28-3-15 12.40	Date and Time Stop Logging	
Photo Id#	_____ (Photo after fully installed)		

IMPORTANT NOTES:

1. **CAPTURE LOGGERS INSTALLATION PHOTOS UPON INITIAL INSTALLATION AND SEND TO APD ON THE FIRST DAY OF INSTALLATION.**
2. **CHECK LOGGERS ARE STILL LOGGING UPON A POWER OUTAGE (FULLY CHARGED BATTERY LASTS APPROX. 30MINS ON HIOKI 3196 AND 180MINS ON HIOKI 3198).**

Y = Yes N = No N/A = Not Applicable

EQUIPMENTS PRE-CHECK				
Item	Description	Y	N	N/A
1.01	Ensure these equipment are available, checked and prepared, 1. HIOKI 3196/3198 logger device(s) 2. DC power supply (if applicable) and power cord(s) interface 3. Logger internal battery. **NOTE:** ensure battery is 'fresh', if not request the rental company to supply and replace. 4. PC Card memory 5. Suitable clamp-on current sensors – 500A/5000A flexible/1000A clamp-on complete with batteries 6. Additional power cable 7. Red phase voltage supply for item 1 and item 5 above 8. Power board extension (Safety Note: Do not connect other devices to power board other than loggers and their accessories).	☑ ☑ ☑ ☑ ☑ ☑ ☑ ☑		☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
1.02	Has the logger device HIOKI 3196/3198 been prepared and fully calibrated ready for use? Check the stamp on device for expiry date. Contact APD if device is due for routine maintenance.	☑		☐
1.03	Has the DC power supply adapter and/or power cords required for the logger been checked? Logger needs external power supply for prolonged continuous operation.	☑		☐
1.04	Have the suitable clamps been chosen for this particular logging operation? Clamps must be rated for the particular logged feeder cable or transformer voltage and current respectively and all devices are set to correct current rating. Any ambiguity contact APD.	☑		☐
1.05	Have other additional equipment as per item 1.01 (6) to (7) been checked for their operational purpose if required?	☑		☐
1.06	Have the safety equipment, including but not limited to, suitable PPE gears, risk assessment documentations, etc. been prepared and checked?	☑		☐

Y = Yes N = No N/A = Not Applicable

GENERAL PROCEDURE IMPORTANT NOTE: Do not adjust, modify or alter settings and configurations of loggers (system) unless being specified in this checklist, as logging result may differ significantly as a consequence.				
Item	Description	Y	N	N/A
2.01	Has the relevant safety procedure been followed, such as complete risk assessment document(s) and wearing correct PPE gears?	☑		☐
2.02	Have all the equipment been set up properly and working ok on site? This includes, a) ensuring logger is powered up for continuous operation for at least 7 days (the Power Lamp should be Green), b) CT clamps are secured, the power is on, and suitable settings (500A/5000A for flexible) are selected c) PC Card memory is in the logger and ready (do not remove – just check it is installed) Initially check the reading on logger screen and observe if they appear ok. Any issue contact APD and/or Tech Rental for support. **Important Note:** 500A setting on flexi CT effective range is from 50A to 500A. 5000A setting on flexi CT effective measurement range is from 500A to 5000A. Ensure correct setting is selected to ensure correct data recording.	☑	☐	☐
2.03	Has the flexible CT been installed on the correct orientation following direction of arrow? Ensure that CT is secured properly by the locking mechanism. Refer to Appendix C.	☑		☐
2.04	Have you check the logger "View" screen and observe if power factor (PF) is positive? If PF is negative, this means that CT is not on the correct orientation and must be re-installed following item 2.03. Also refer to Appendix A or B.	☑		☐
2.05	Have all the phase connector cables been connected properly to logger as per their colour coding (Red, Yellow, Blue for phases and Black for neutral)?	☑		☐
2.06	Have all the cables been connected to Channel 4 U+ and U- terminal for neutral – earth voltage measurement? Note that U- needs to connect to neutral and U+ to earth bar (or point). Also refer to Appendix A or B.	☑	☐	☐
2.07	Has the 'start' button been pressed to trigger the logger? Refer to Appendix A or B.	☑		☐
2.08	Have you ensure that logger is currently recording the data? Refer to Appendix A or B.	☑		☐
2.09	Have all the equipment been adequately placed and position safely to ensure non-interrupted operation?	☑	☐	☐
2.10	Have clear photos of fully installed loggers been taken and photo ID have been noted in the space available at start of this checklist (page 1)?	☑		
2.11	Before leaving site, have the kiosk doors or other means of access been checked if they are close and locked appropriately?	☑	☐	☐

Y = Yes N = No N/A = Not Applicable

END OF LOGGING PERIOD				
Item	Description	N	N	N/A
3.01	Has the logger been turned off by following the correct shutting down procedure? Do not directly shut down by flicking the switch off. Instead follow this step, **stop → data reset →enter**. IMPORTANT NOTE: DO NOT REMOVE THE MEMORY CARD (this is to be processed upon return)	☐	☐	☐
3.02	Check all items returned to the associated plastic box and the Tech Rentals checklist is completed. Advise APD if any equipment is missing.	☐	☐	☐
3.03	Transport the Loggers directly back to specified address or to Tech Rentals at 122 Kewdale Road, Kewdale WA 6105. Contact APD (08) 9212 1500 reference the project number for any queries about the delivery back to Tech Rentals.	☐	☐	☐

removed 1:40 Sunday

IMPORTANT NOTES:

1. CAPTURE LOGGERS INSTALLATION PHOTOS UPON INITIAL INSTALLATION AND SEND TO APD ON THE FIRST DAY OF INSTALLATION.

2. CHECK LOGGERS ARE STILL LOGGING UPON A POWER OUTAGE (FULLY CHARGED BATTERY LASTS APPROX. 30MINS ON HIOKI 3196 AND 180MINS ON HIOKI 3198).

This Checklist is to be signed upon completion and returned to APD.

Electrical Contractor : **Signature :** **Date:**

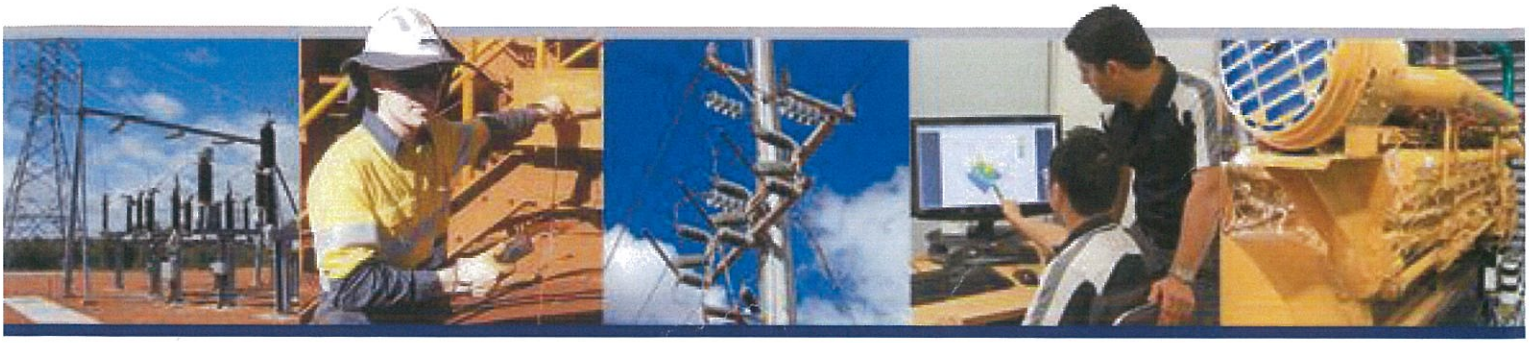
Supervisor: **Signature :** **Date:**

Comments:.....

.....

.....

.....



BHPBIO NEWMAN
COMPLIANCE & AUDIT REPORT
2014/2015

PQ LOGGER INSTALLATION CHECKLIST

REVISION J

17/03/2015

APD

Each checklist is mandatory for every logging operation and each action items as defined in this checklist must be checked and signed by the electrical contractor. Contact APD for clarification on checklist on (08) 9212 1500.

Please ensure loggers are sent back within their rental period to avoid incurring additional cost. Refer to item 3.03 for return address.

Electrical Contractor		Name	
Logger Serial No.	93977		
Site Location	T 80 WHALEBACK DVE (OFF LINEYARD)		
Transformer/Feeder Cable Logged			
Transformer Tap Setting			
Date and Time Start Logging	28-3-15 10-30	Date and Time Stop Logging	
Photo Id#	_____ (Photo after fully installed)		

IMPORTANT NOTES:

1. CAPTURE LOGGERS INSTALLATION PHOTOS UPON INITIAL INSTALLATION AND SEND TO APD ON THE FIRST DAY OF INSTALLATION.

2. CHECK LOGGERS ARE STILL LOGGING UPON A POWER OUTAGE (FULLY CHARGED BATTERY LASTS APPROX. 30MINS ON HIOKI 3196 AND 180MINS ON HIOKI 3198).

Y = Yes N = No N/A = Not Applicable

EQUIPMENTS PRE-CHECK				
Item	**Description**	**Y**	**N**	**N/A**
1.01	Ensure these equipment are available, checked and prepared, 1. HIOKI 3196/3198 logger device(s) 2. DC power supply (if applicable) and power cord(s) interface 3. Logger internal battery. **NOTE:** ensure battery is 'fresh', if not request the rental company to supply and replace. 4. PC Card memory 5. Suitable clamp-on current sensors – 500A/5000A flexible/1000A clamp-on complete with batteries 6. Additional power cable 7. Red phase voltage supply for item 1 and item 5 above 8. Power board extension (Safety Note: Do not connect other devices to power board other than loggers and their accessories).	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐		☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
1.02	Has the logger device HIOKI 3196/3198 been prepared and fully calibrated ready for use? Check the stamp on device for expiry date. Contact APD if device is due for routine maintenance.	☐		☐
1.03	Has the DC power supply adapter and/or power cords required for the logger been checked? Logger needs external power supply for prolonged continuous operation.	☐		☐
1.04	Have the suitable clamps been chosen for this particular logging operation? Clamps must be rated for the particular logged feeder cable or transformer voltage and current respectively and all devices are set to correct current rating. Any ambiguity contact APD.	☐		☐
1.05	Have other additional equipment as per item 1.01 (6) to (7) been checked for their operational purpose if required?	☐		☐
1.06	Have the safety equipment, including but not limited to, suitable PPE gears, risk assessment documentations, etc. been prepared and checked?	☐		☐

Y = Yes N = No N/A = Not Applicable

GENERAL PROCEDURE IMPORTANT NOTE: Do not adjust, modify or alter settings and configurations of loggers (system) unless being specified in this checklist, as logging result may differ significantly as a consequence.				
Item	**Description**	**N**	**N**	**N/A**
2.01	Has the relevant safety procedure been followed, such as complete risk assessment document(s) and wearing correct PPE gears?	☐		☐
2.02	Have all the equipment been set up properly and working ok on site? This includes, a) ensuring logger is powered up for continuous operation for at least 7 days (the Power Lamp should be Green), b) CT clamps are secured, the power is on, and suitable settings (500A/5000A for flexible) are selected c) PC Card memory is in the logger and ready (do not remove – just check it is installed) Initially check the reading on logger screen and observe if they appear ok. Any issue contact APD and/or Tech Rental for support. **Important Note:** 500A setting on flexi CT effective range is from 50A to 500A. 5000A setting on flexi CT effective measurement range is from 500A to 5000A. Ensure correct setting is selected to ensure correct data recording.	☐	☐	☐
2.03	Has the flexible CT been installed on the correct orientation following direction of arrow? Ensure that CT is secured properly by the locking mechanism. Refer to Appendix C.	☐		☐
2.04	Have you check the logger "View" screen and observe if power factor (PF) is positive? If PF is negative, this means that CT is not on the correct orientation and must be re-installed following item 2.03. Also refer to Appendix A or B.	☐		☐
2.05	Have all the phase connector cables been connected properly to logger as per their colour coding (Red, Yellow, Blue for phases and Black for neutral)?	☐		☐
2.06	Have all the cables been connected to Channel 4 U+ and U- terminal for neutral – earth voltage measurement? Note that U- needs to connect to neutral and U+ to earth bar (or point). Also refer to Appendix A or B.	☐	☐	☐
2.07	Has the 'start' button been pressed to trigger the logger? Refer to Appendix A or B.	☐		☐
2.08	Have you ensure that logger is currently recording the data? Refer to Appendix A or B.	☐		☐
2.09	Have all the equipment been adequately placed and position safely to ensure non-interrupted operation?	☐	☐	☐
2.10	Have clear photos of fully installed loggers been taken and photo ID have been noted in the space available at start of this checklist (page 1)?	☐		
2.11	Before leaving site, have the kiosk doors or other means of access been checked if they are close and locked appropriately?	☐	☐	☐

Y = Yes N = No N/A = Not Applicable

END OF LOGGING PERIOD				
Item	**Description**	**N**	**N**	**N/A**
3.01	Has the logger been turned off by following the correct shutting down procedure? Do not directly shut down by flicking the switch off. Instead follow this step, **stop → data reset →enter**. IMPORTANT NOTE: DO NOT REMOVE THE MEMORY CARD (this is to be processed upon return)	☑	☐	☐
3.02	Check all items returned to the associated plastic box and the Tech Rentals checklist is completed. Advise APD if any equipment is missing.	☑	☐	☐
3.03	Transport the Loggers directly back to specified address or to Tech Rentals at 122 Kewdale Road, Kewdale WA 6105. Contact APD (08) 9212 1500 reference the project number for any queries about the delivery back to Tech Rentals.	☑	☐	☐

taken off 10:55am 1/08

IMPORTANT NOTES:

1. CAPTURE LOGGERS INSTALLATION PHOTOS UPON INITIAL INSTALLATION AND SEND TO APD ON THE FIRST DAY OF INSTALLATION.

2. CHECK LOGGERS ARE STILL LOGGING UPON A POWER OUTAGE (FULLY CHARGED BATTERY LASTS APPROX. 30MINS ON HIOKI 3196 AND 180MINS ON HIOKI 3198).

This Checklist is to be signed upon completion and returned to APD.

Electrical Contractor : **Signature :** **Date:**

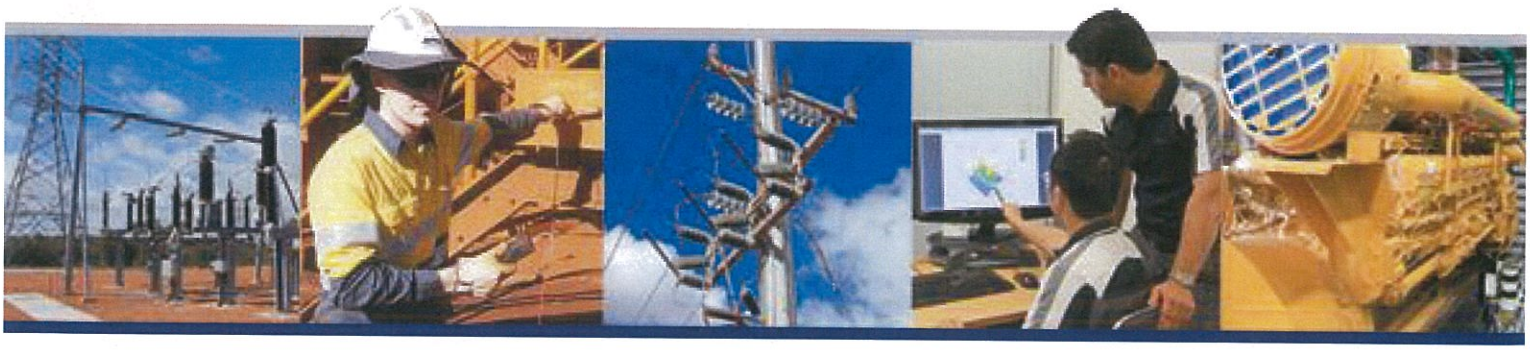
Supervisor: **Signature :** **Date:**

Comments:.....

.....

.....

.....



BHPBIO NEWMAN
COMPLIANCE & AUDIT REPORT
2014/2015

PQ LOGGER INSTALLATION CHECKLIST

REVISION J

17/03/2015

APD

Each checklist is mandatory for every logging operation and each action items as defined in this checklist must be checked and signed by the electrical contractor. Contact APD for clarification on checklist on (08) 9212 1500.

Please ensure loggers are sent back within their rental period to avoid incurring additional cost. Refer to item 3.03 for return address.

Electrical Contractor	6	Name	
Logger Serial No.	125055		
Site Location	T 81 KURRA ST (BETWEEN KURRA VILLAGE CAR PARK + KURRA ST		
Transformer/Feeder Cable Logged			
Transformer Tap Setting	1		
Date and Time Start Logging	28.3.15 11.17	Date and Time Stop Logging	
Photo Id#	_____ (Photo after fully installed)		

IMPORTANT NOTES:

1. CAPTURE LOGGERS INSTALLATION PHOTOS UPON INITIAL INSTALLATION AND SEND TO APD ON THE FIRST DAY OF INSTALLATION.

2. CHECK LOGGERS ARE STILL LOGGING UPON A POWER OUTAGE (FULLY CHARGED BATTERY LASTS APPROX. 30MINS ON HIOKI 3196 AND 180MINS ON HIOKI 3198).

Y = Yes **N = No** **N/A = Not Applicable**

EQUIPMENTS PRE-CHECK				
Item	**Description**	**Y**	**N**	**N/A**
1.01	Ensure these equipment are available, checked and prepared, 1. HIOKI 3196/3198 logger device(s) 2. DC power supply (if applicable) and power cord(s) interface 3. Logger internal battery. **NOTE:** ensure battery is 'fresh', if not request the rental company to supply and replace. 4. PC Card memory 5. Suitable clamp-on current sensors – 500A/5000A flexible/1000A clamp-on complete with batteries 6. Additional power cable 7. Red phase voltage supply for item 1 and item 5 above 8. Power board extension (Safety Note: Do not connect other devices to power board other than loggers and their accessories).	☑ ☑ ☑ ☑ ☑ ☑ ☑ ☑		☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
1.02	Has the logger device HIOKI 3196/3198 been prepared and fully calibrated ready for use? Check the stamp on device for expiry date. Contact APD if device is due for routine maintenance.	☑		☐
1.03	Has the DC power supply adapter and/or power cords required for the logger been checked? Logger needs external power supply for prolonged continuous operation.	☑		☐
1.04	Have the suitable clamps been chosen for this particular logging operation? Clamps must be rated for the particular logged feeder cable or transformer voltage and current respectively and all devices are set to correct current rating. Any ambiguity contact APD.	☑		☐
1.05	Have other additional equipment as per item 1.01 (6) to (7) been checked for their operational purpose if required?	☑		☐
1.06	Have the safety equipment, including but not limited to, suitable PPE gears, risk assessment documentations, etc. been prepared and checked?	☑		☐

Y = Yes N = No N/A = Not Applicable

GENERAL PROCEDURE IMPORTANT NOTE: Do not adjust, modify or alter settings and configurations of loggers (system) unless being specified in this checklist, as logging result may differ significantly as a consequence.				
Item	**Description**	**N**	**N**	**N/A**
2.01	Has the relevant safety procedure been followed, such as complete risk assessment document(s) and wearing correct PPE gears?	☑	☐	☐
2.02	Have all the equipment been set up properly and working ok on site? This includes, a) ensuring logger is powered up for continuous operation for at least 7 days (the Power Lamp should be Green), b) CT clamps are secured, the power is on, and suitable settings (500A/5000A for flexible) are selected c) PC Card memory is in the logger and ready (do not remove – just check it is installed) Initially check the reading on logger screen and observe if they appear ok. Any issue contact APD and/or Tech Rental for support. **Important Note:** 500A setting on flexi CT effective range is from 50A to 500A. 5000A setting on flexi CT effective measurement range is from 500A to 5000A. Ensure correct setting is selected to ensure correct data recording.	☑	☐	☐
2.03	Has the flexible CT been installed on the correct orientation following direction of arrow? Ensure that CT is secured properly by the locking mechanism. Refer to Appendix C.	☑	☐	☐
2.04	Have you check the logger "View" screen and observe if power factor (PF) is positive? If PF is negative, this means that CT is not on the correct orientation and must be re-installed following item 2.03. Also refer to Appendix A or B.	☑	☐	☐
2.05	Have all the phase connector cables been connected properly to logger as per their colour coding (Red, Yellow, Blue for phases and Black for neutral)?	☑	☐	☐
2.06	Have all the cables been connected to Channel 4 U+ and U- terminal for neutral – earth voltage measurement? Note that U- needs to connect to neutral and U+ to earth bar (or point). Also refer to Appendix A or B.	☑	☐	☐
2.07	Has the 'start' button been pressed to trigger the logger? Refer to Appendix A or B.	☑	☐	☐
2.08	Have you ensure that logger is currently recording the data? Refer to Appendix A or B.	☑	☐	☐
2.09	Have all the equipment been adequately placed and position safely to ensure non-interrupted operation?	☑	☐	☐
2.10	Have clear photos of fully installed loggers been taken and photo ID have been noted in the space available at start of this checklist (page 1)?	☑	☐	
2.11	Before leaving site, have the kiosk doors or other means of access been checked if they are close and locked appropriately?	☑	☐	☐

Y = Yes N = No N/A = Not Applicable

END OF LOGGING PERIOD				
Item	Description	Y	N	N/A
3.01	Has the logger been turned off by following the correct shutting down procedure? Do not directly shut down by flicking the switch off. Instead follow this step, **stop → data reset →enter**. IMPORTANT NOTE: DO NOT REMOVE THE MEMORY CARD (this is to be processed upon return)	☑	☐	☐
3.02	Check all items returned to the associated plastic box and the Tech Rentals checklist is completed. Advise APD if any equipment is missing.	☑	☐	☐
3.03	Transport the Loggers directly back to specified address or to Tech Rentals at 122 Kewdale Road, Kewdale WA 6105. Contact APD (08) 9212 1500 reference the project number for any queries about the delivery back to Tech Rentals.	☑	☐	☐

IMPORTANT NOTES:

1. CAPTURE LOGGERS INSTALLATION PHOTOS UPON INITIAL INSTALLATION AND SEND TO APD ON THE FIRST DAY OF INSTALLATION.

2. CHECK LOGGERS ARE STILL LOGGING UPON A POWER OUTAGE (FULLY CHARGED BATTERY LASTS APPROX. 30MINS ON HIOKI 3196 AND 180MINS ON HIOKI 3198).

This Checklist is to be signed upon completion and returned to APD.

Electrical Contractor : **Signature :** **Date:**

Supervisor: **Signature :** **Date:**

Comments:.....

.....

.....

.....

APPENDIX D Electrical Faults Log for 2014/15 FY

Jul-14

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Fault No Fault Planned Outage																															

Fault Detail

Date	Description	Minutes
02/07/2014	Alinta Plant B Fdr	82
09/07/14	BC303.4 TRIP SEF HCS	180
20/7/14	HUB outage + Plant A WB outage to tag	123 min 141 mins.

Planned Outage Detail

Date	Description	Minutes

Please ensure that Fault Register is updated in 1Doc

Jul-14

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Faults																															
Planned																															

Fault Details

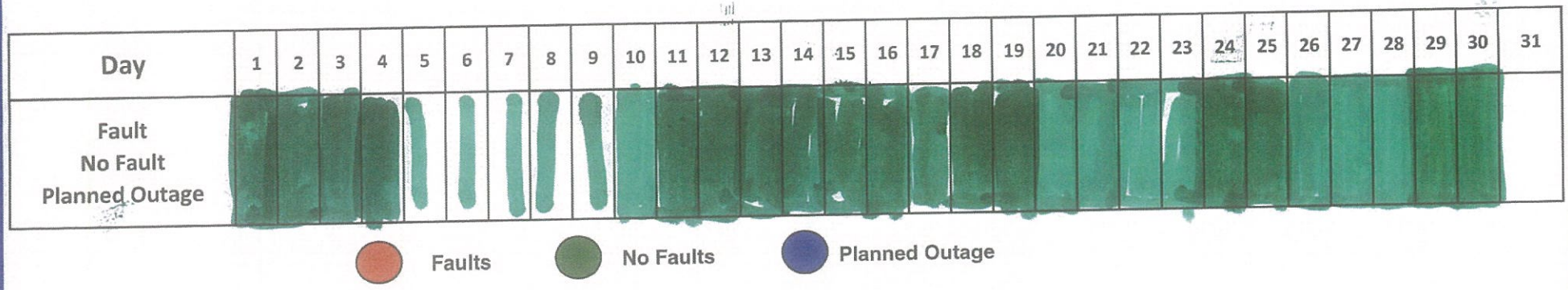
Date	Time	Minutes	Description	Fault Details	Pole/Transformer Number	Work Order	Further Repairs?	Address	Reported By
15/7	1400	290	Power to shopping centre	'B' PHASE DROP OUT, FUSE FAILED @ P35/22/9	AFFECTED T573 + DOF P35/23/9	431457728	Yes DOF REQUIRES REPLACING		
16/7	14:20	120	OP109, 109, 110	Broken waterpipe injuring under ink at phase between Drawn 109	OP103/09	431466973	Yes, cable rep insulation & test	Cobb Leeds Pl	GM
19/7	9am	540+	T37 Forrest Ave.	Insulator on DOF failed	T37 Forrest		NO		CM
23/7	9PM.	90.	3/5A KNOX WAY LOSS POWER.	FUSES.	-	-	No.		CH.
26/7	1500	1510	STS TRIP.	PROTECTION ISSUES.	STS 66KV FEEDER.		ONGOING.		

Planned Outages

Date	Time	Minutes	Description	Fault Details	Pole/Transformer Number	Work Order	Further Repairs?	Address	Reported By
27/7	14:00 13:00	30 EA	TX 11 TX 23	Shutdown Repairs	TX11 TX23		NIL NIL	—	BS
28/7	1400 1530	90hrs	TX 3	Diaphragm repairs	TX 3			-	JS

Planned Outage Faults No Faults

Aug-14



Fault Detail

Date	Description	Minutes
3/4	Transducer Fail Junction T1	-

Planned Outage Detail

Date	Description	Minutes

Please ensure that Fault Register is updated in 1Doc

Mine Power: Faults & Scheduled Outages

Town Electrical Level 1 KPI Board

Aug-14

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Faults																															
Planned																															

Fault Details

Date	Time	Minutes	Description	Fault Details	Pole/Transformer Number	Work Order	Further Repairs?	Address	Reported By
7/8/14	1230HRS	240	DAMAGED LV CABLE PS44.	DAMAGED LV CABLE PS44 TO SHOPS.	PS44.	[redacted]	NONE AT THIS STAGE.	PS44	SP.
14/8/14	1530	90	BLOWN SPD + MELTED FUSE HOLDER IN METER PANEL	DAMAGED FUSE BASE	—		REPLACED SPD CARRIER + BASE	31 NUMAGAK	BW
20/8/14	1800	60	Service pole hit cable dropped	service cable dropped Bolts failed	Barman St		Rmds inspect.	Barman	MJ.

Planned Outages

Date	Time	Minutes	Description	Fault Details	Pole/Transformer Number	Work Order	Further Repairs?	Address	Reported By
7/8/14	0800	90	T37 CT removal	CT Removal	32/51 T37	[redacted]	—	Forest	SS.
10/8/14	0800	180	T27	RCR	T27				AW
21/8.	0800	180.	REPLACE PILLAR SS ICEGO1.	— 6 HOUSES.	—	412382901	—	ICEGO1.	SP.
22/8	1230	180	REPLACE DP 110.	4 HOUSES.		411673412		ELECTC PLACE.	SP.

Planned Outage Faults No Faults

Sep-14

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Fault No Fault Planned Outage																															

Fault Detail

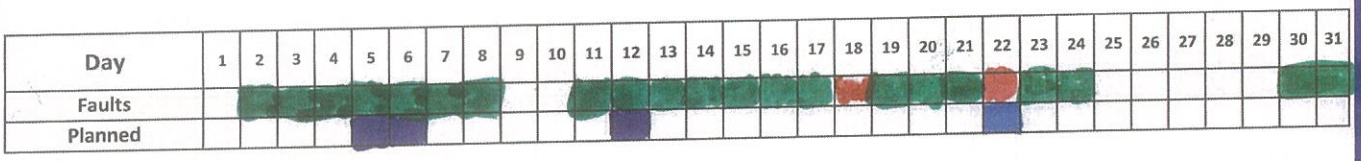
Date	Description	Minutes

Planned Outage Detail

Date	Description	Minutes

Please ensure that Fault Register is updated in 1Doc

Sep-14



Fault Details

Date	Time	Minutes	Description	Fault Details	Pole/Transformer Number	Work Order	Further Repairs?	Address	Reported By
18/9	10:00	60		Blown fascia fuse White		431585299	—	3 Ethel Creek St	Housing
18/9	11:30	60		Blown Service fuse white		431585068	—	St Hemingway unit 4	Housing
21/9	20:02	60	HOT JOINT	17 SNELL			Replace fuse holder.		BJ
22/9	3:00	60	blown fascia fuse	16 Kookyna				16 Kookyna	
22/9	16:00	[illegible]	* Half power	39 Bindini Phase missing				39 Bindini	SS
22/9	18:10	45	1C3 TRIP	BIRD STRIKE TX WICARA ST	TRIPPED AT RMU 01		CLEARED BIRDS LINE PATROL CLOSED RMU01	TURNER ST	SE

Planned Outages

Date	Time	Minutes	Description	Fault Details	Pole/Transformer Number	Work Order	Further Repairs?	Address	Reported By
5/9	0800	30		REPAIR & BYPASS MAIN LV ISOLATOR.	PS 53.		NO.		
6/9	0800	120	planned outage CT removal Silica gel	Maintenance CT removal & Silica gel	Tx 49		No		
12/9	1025	75	Planned outage CT Removal Silica Gel	Maintenance -30 houses	T48	412522710	NO	Gardeners multigrab	Jules Ben
22/9	0800	240	DP 49 replacement	DP49 replacement	DP 49		NO	Bindini	—

Planned Outage Faults No Faults

Oct-14

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Fault No Fault Planned Outage																															

Fault Detail

Date	Description	Minutes
9/10	C452 CB @ WB Fault.	30min
9/10	STS 702 trip diff proc	11min.
16/10	YANDI FEEDER 3 Notify AT 10Pm	240min
25/10	Yandi Feeder 2, Birdstrike	47mins
26/10.	Yandi Feeder 2, device failure	19MIN.

Planned Outage Detail

Date	Description	Minutes

Please ensure that Fault Register is updated in 1Doc

April ~~Mar~~-15

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Fault No Fault Planned Outage																															

Fault Detail

Date	Description	Minutes
5/4	Feeder 1 Trip due to fault	On going
	on MAC ABS. Red please	
	cable Hour off	
6/4	Feeder 1 TRIP DUE TO	
	BIRD STRIKE	
19/4	JIM 33KV FDR 4 EF	120
	SELF CLEARING. EXACT	
	CAUSE NOT FOUND	

Planned Outage Detail

Date	Description	Minutes

Please ensure that Fault Register is updated in 1Doc

Mar-15

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Fault No Fault Planned Outage																															

Fault Detail

Date	Description	Minutes
01	F3 Yandi overload.	44 min
02	HSC FEEDER TO TPS	20 min.
03	F2 YANDI Ø-E	149 min.
14	AREA C OVERLOAD	

Planned Outage Detail

Date	Description	Minutes
22	EASTERN RIDGE	180 MINS

Please ensure that Fault Register is updated in 1Doc

Oct-14

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Faults																															
Planned																															

Fault Details

Date	Time	Minutes	Description	Fault Details	Pole/Transformer Number	Work Order	Further Repairs?	Address	Reported By
14/10/14	8:06	9.30		EARTH FAULT BIRD STRIKE	STS 2		NIL	STS2	SE
15/10/14	6.30			DOF Blew, Fault unknown	34/52		NIL	Newman Caravan Park	CP
09/10/2014	1023	7hrs		Transformer Diff Protection Trip.	Feeder STS1 and STS2		Diff protection need checks		EB.
16/10/14	1700	50min		TC3 Trip BIRD STUCK ON LINES.	COR OF WILMER & TURNERS ST.		—	-	SP.
19/10/14	2100	60		service fuse RED PHASE.	BOONARA #3.		NOTIFICATION Required to replace service.		A
20/10	1100	5HRS		CDO'S ON POLE 31/64 THAT FEEDS SD3 & 69.			HAVE TO FIX THAT While here.		
25/10	0940	68		STS Fire alarm initiated trip to TX01 incomer and STS1 and STS2.	STS 1 and STS 2		Investigate protection of Fire Alarm System.	STS	K. Jukic
26/10	1530	40		4 CARNEY, FASCIA FUSE BLEW, Arrow Fault.	HOUSEHOLD		Repaired on-site.	4 CARNEY	MJ Arrow

Planned Outages

Date	Time	Minutes	Description	Fault Details	Pole/Transformer Number	Work Order	Further Repairs?	Address	Reported By
17/10	0830	180	TREE LOPPING.	—	YALBAREE AREA.	411909411	NO		
31/10/14	1000HRS	140	PADSUB 121 INSTALL ABS & EDO Repairs		T6, PS97, T6		NONE.	NEWMAN DRIVE	A

Planned Outage Faults No Faults

Nov-14

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Fault No Fault Planned Outage																															

Fault Detail

Date	Description	Minutes
7/11	Yandi F2 Birdstike	75
9/11	Yandi F2, Junction F1	51, 12
20/11	Junction F1, Area C	1 hr.
28/11	JIMBLEBAR TRIP	2 HRS.

Planned Outage Detail

Date	Description	Minutes

Please ensure that Fault Register is updated in 1Doc

Nov-14

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Faults																															
Planned																															

Fault Details

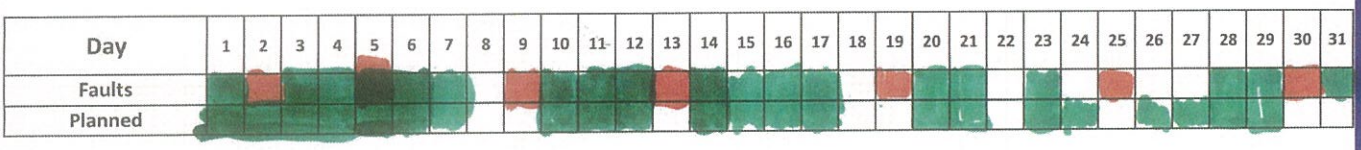
Date	Time	Minutes	Description	Fault Details	Pole/Transformer Number	Work Order	Further Repairs?	Address	Reported By
3/11	1600	60	7 Barara	Fuse holder broken	7 Barara	4316707397	No		Cm
5/11	15:30	60	10 Culldorah	white, blue fuses blown	10 Culldorah.	.	No		.
7/11	0615	35	STS2 Trip	Bird stuck upon pole in Barara	STS 2		No		BB
10/11	1800	45	Fascia fuse 17 Ruddal st	fascia fuse bumb up & needed replacement			No	5	JP
14/11	720a	35	STS1 - L1A	Earth fault P-E 'C' phase	STS1	4316922268	No		Cm
16/11	6:20	30	House fuse blown	hot joint in fuse base at facia	—		NO	21 Wehl	BJ
17/11	5:00	30	No power	c/B trip.	—		NO	21 Cowra	BJ
17/11	1400hrs	60	LOSS OF POWER TO 12 TREVALLYN.	Fuse Holder required replacement.			power.	12 Trevallyn	CM.
22/11	06:00	5hrs	PS78 L1A	Trip O/C	T78	N/A	No		GP
22/11	11.00	1hrs	Blew Fuse	O/C Blue phase	—	N/A	NO	16 Foolagh	CM
29/11	12:41	2hrs 20min	C phase lost 2hrs 20min All phase lost 1hr 42min.	Hot joint at pole 32/47.	pole 32/47.		Yes to DOFs.	—	K.McKay
26/11	7.00am	1hr	LOST BLUE PHASE	BELIEF IN FALCAN CHECK TODAY	14 GEOGRA until 4		Yes		
27/11	1400	30MIN	10 MINDARRA LOST POWER.	2 BLOWN FACIA FUSES	10 MINDARRA		NO.		SP.
28/11	1300	30MIN	BLOWN FUSE	FUSE	22 WILARA.	4317186623	No.		SP.
30/11	1430	1530	BLOWN HV FUSE POLE 33/18	UNKNOWN. - SHORT TO EARTH.	33/18.		NO.		SP.

Planned Outages

Date	Time	Minutes	Description	Fault Details	Pole/Transformer Number	Work Order	Further Repairs?	Address	Reported By
2/11	0800	180	CALTEX TX JOB	—	—				

Planned Outage Faults No Faults

Dec-14



Fault Details

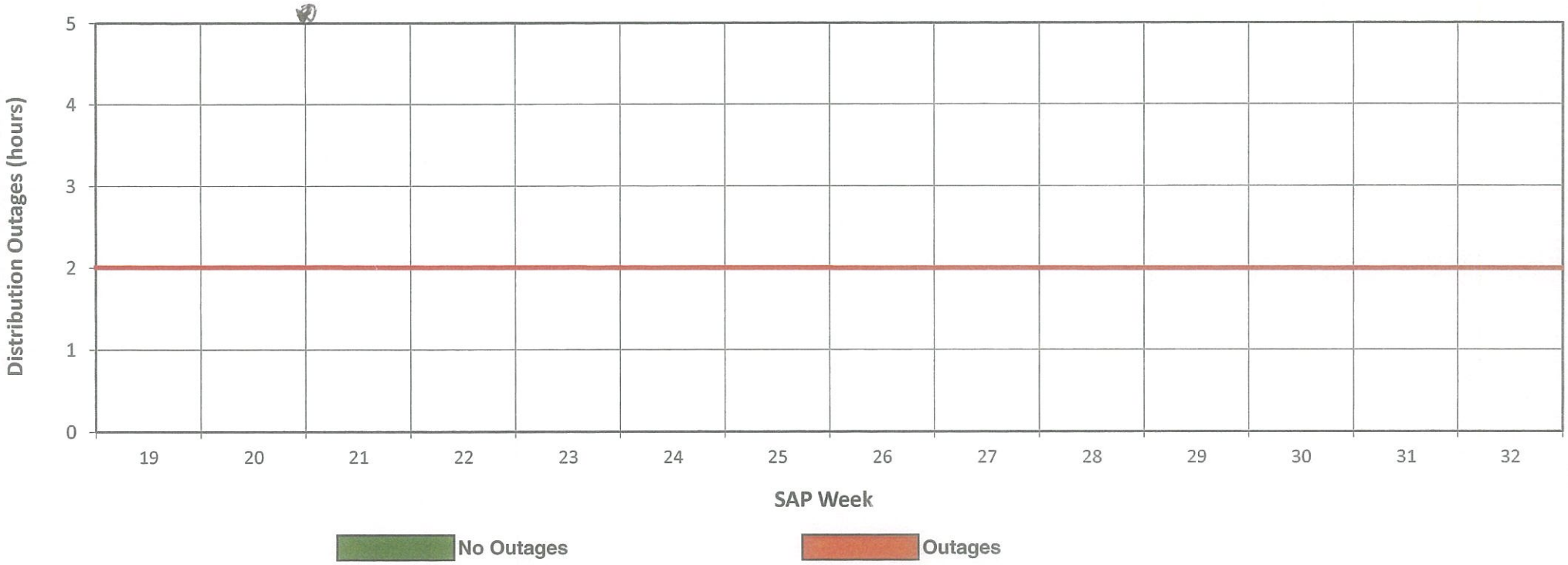
Date	Time	Minutes	Description	Fault Details	Pole/Transformer Number	Work Order	Further Repairs?	Address	Reported By
2/12	15:10	25	Power loss	Blown fuse	-		Nil - 34 Reedi		BJ
5/12	1426	30	Power Loss	LV BREAKER TRIP OVERLOAD	PS79		CHANGED SETTINGS TO IMPROVE DISCRIMINATION		BW
8/12	1400	30	Power Loss	TRIPPED ON OVERLOAD	PJT8		RESET MCB		BW
9/12	2030	30	"	BLOWN FUSE	4 CARNEY		NIL.		BW
13/12	1530	45	Power loss	Blown fuse	4 Carney		Nil		JS
18/12	0130	90	Power loss EAST NEWMAN	Blown HV fuse B PHASE	Pole 33/18		Thermo Fuse holder to check if Hot joint		DM
19/2	1522	22	TOWN SUB Outage.	Fire System Testing fault.	All of town Sub load.		NIL.		BJ.
24/12	1800	45	Power loss	Recloser tripped	Cappy RECLOSER		Nil		JS.
25/12	1830	90	Power Loss	C/B TRIPPED	25 McLENNAN		NIL		SC
30/12	1500	30	Power Loss	BLOWN FACIA FUSE (LIGHTS)	12 TROTMAN		REPLACED FACIA FUSE ASSEMBLEY		BW

Planned Outages

Date	Time	Minutes	Description	Fault Details	Pole/Transformer Number	Work Order	Further Repairs?	Address	Reported By

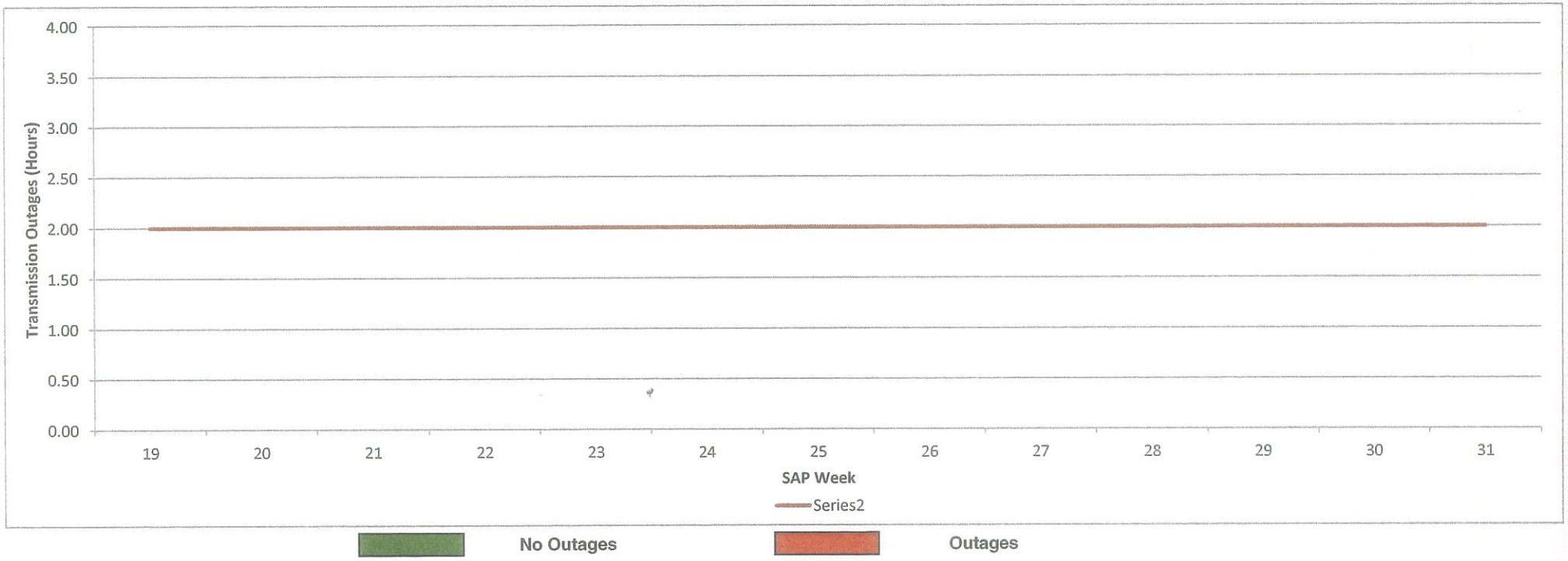
Planned Outage Faults No Faults

Q4



Date	Description	Duration
20/5/15.	kalgan Rest Pod Sub 27. Test RMU Remote Unit, Replaced coil	(4hrs Planned) 5hr 20mn
29/5/15	REPLACE Tx 24. ETHEL CRK ST AREA. APPROX 100 HOUSES	4 HRS. - PLANNED
8/6/2015	JINDERAN GATE HOUSE 11KV O/H LINE	APPROX 40MINS 1630

Q4



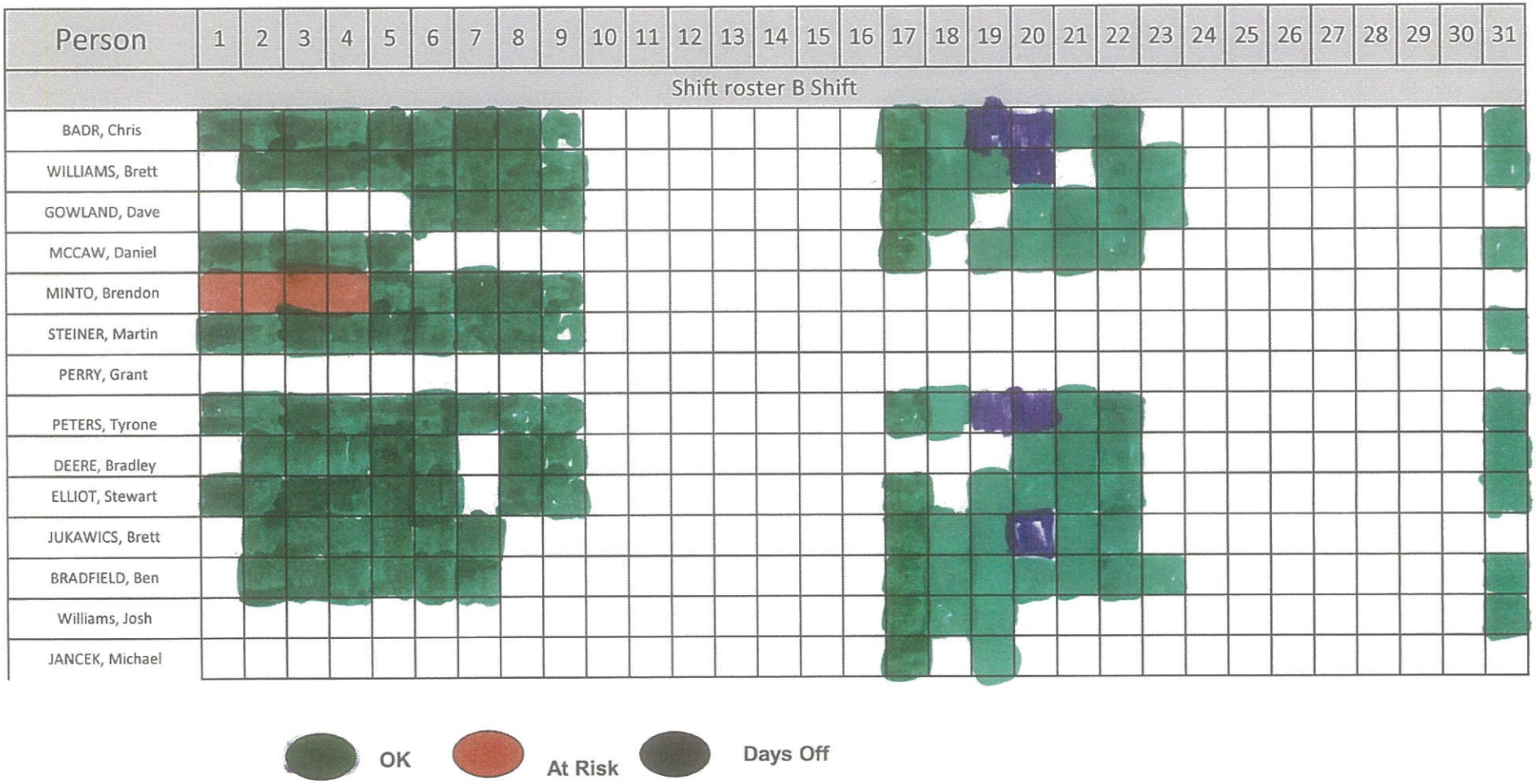
Date	Description	Duration
6/6/15.	Jimblebar Gatehouse. - GTS tripped Protection Relay During Injection testing	40 mins

Level 1

B Shift

Dec-14

Q1. How much sleep have you had in the last 12 hours? (>7= Moderate & <6 High)
Q2. How much sleep have you had in the last 48 hours? (>13 = Moderate & <12 High)
Q3. How many hours will you have been awake for at the end of your current shift? (<14 Moderate & >15 High)
Q4. Do you have concerns about your ability to stay alert and work safely? (No = Low Risk & Yes = High Risk)



Fatigue Assessment

Town Electrical Level 1 KPI Board

Mar-15

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Faults																															
Planned																															

Fault Details

Date	Time	Minutes	Description	Fault Details	Pole/Transformer Number	Work Order	Further Repairs?	Address	Reported By
5/3			10 Ross Ave	Faulty HWS blew Fascia Fuse.		431905056	No		JM/SC
14/3		2HRS	ABS - WA8	REPAIR ABS.			THERMOGRAPHIC CHECK		SE
16/3		58mins	Suction O/L Feeder 1	Tripped on O/L		43192229	No		GP
21/3	935a	60	Distribution Cable	Distribution cable hit outside 21 Mindarra feeding units by ~~L~~ 17 Mindarra	35/41	43935791	Yes. CREC to go to lower cable as not deep enough	Anthony Lancaster 0409 084 270	CM
23/3	1500	120	14 Marloo	Hot joint on Blue phase PG Clamp.			No	14 Marloo	CM
24/3	0800	120	47 Fortesque	Burnt off lead at Pole top. Red phase	T55	431939731	Sub Noti Raised for new service		BJ

Planned Outages

Date	Time	Minutes	Description	Fault Details	Pole/Transformer Number	Work Order	Further Repairs?	Address	Reported By
8/3/15	1100	60	T26 OUTAGE	REPLACEMENTS	T26		N/A	NEWMAN DRIVE	CH
22/3/15	0800	120	EASTERN RIDGE OFF BODY 25.	INSTALL BREAK. AT WB 73.	HOMESTEAD TO TOWN.		N/A.		

Planned Outage Faults No Faults

Town Power: Faults & Scheduled Outages

Town Electrical Level 1 KPI Board

April

April Mar-15

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Faults																															
Planned																															

Fault Details

Date	Time	Minutes	Description	Fault Details	Pole/Transformer Number	Work Order	Further Repairs?	Address	Reported By
7/4/15	11.00	~~Super~~ 25 mins	LOST SUPPLY AT SERGENTS TYRES	-100A CB TRIPPED IN PILLAR. INSTALLATION CHECKED OK.	32/38/23		- MAY REQUIRE AN INSULATION RESISTANCE TEST IF IT TRIPS AGAIN		PG
8/4/15	13:30	80 mins	Partial loss of supply reported by Allan Copco	Blue Phase DOF had dropped on T20 due to wear, replaced with better condition DOF	T20 31/48/3				BM
17/4/15	1700	30	7 PILLARA 2 LOST PHASES.				NIL.		CFC.
21-4-15	2020	180	ST56 Tripped - Newman Dr lost power	- 11kV cable under rail on mine failed	ST56		Cable to be repaired 31/15 by mine HV crew		BB
23-4-15	0800	180	Eagle Rock Turn - Single phase	Pillar cable short to earth A+B-neutral	Eagle Rock near #15		Cable to be replaced to PS32 - pillar		BW

Planned Outages

Date	Time	Minutes	Description	Fault Details	Pole/Transformer Number	Work Order	Further Repairs?	Address	Reported By
17/4/15	1000	140.	Portescue Stay JOB.	PLANNED			NIL.		AW
18/4/15	0700	0900	TOWN CENTRE	CABLE WORKS.			NIL		SP
24-4-15	1300	1430	Network change out LV Links 05/32/4	LV Links replaced	05/32/4		NIL		BB

Planned Outage Faults No Faults

Town Power: Faults & Scheduled Outages

Town Electrical Level 1 KPI Board

May-15

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Faults																															
Planned																															

Fault Details

Date	Time	Minutes	Description	Fault Details	Pole/Transformer Number	Work Order	Further Repairs?	Address	Reported By
4/5	345p	80	Yarnima Outage						CM

Planned Outages

Date	Time	Minutes	Description	Fault Details	Pole/Transformer Number	Work Order	Further Repairs?	Address	Reported By
2/5	0800	180	OB25 restring	←	WB Water Feeder				CM

Planned Outage Faults No Faults

Town Power: Faults & Scheduled Outages

Town Electrical Level 1 KPI Board

Jan-15

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Fault No Fault Planned Outage																															

Fault Detail

Date	Description	Minutes
15/1/15	Whalbeck sub 1503 Incomer	LOTS
25/1/15	Junction Feeder 1-33KV	30mins
26/1	JBV, JB608.0, STS2, S/ANNA	2hrs

Planned Outage Detail

Date	Description	Minutes

Please ensure that Fault Register is updated in 1Doc

Mine Power: Faults & Scheduled Outages

Town Electrical Level 1 KPI Board

Jan-15

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Faults																															
Planned																															

Fault Details

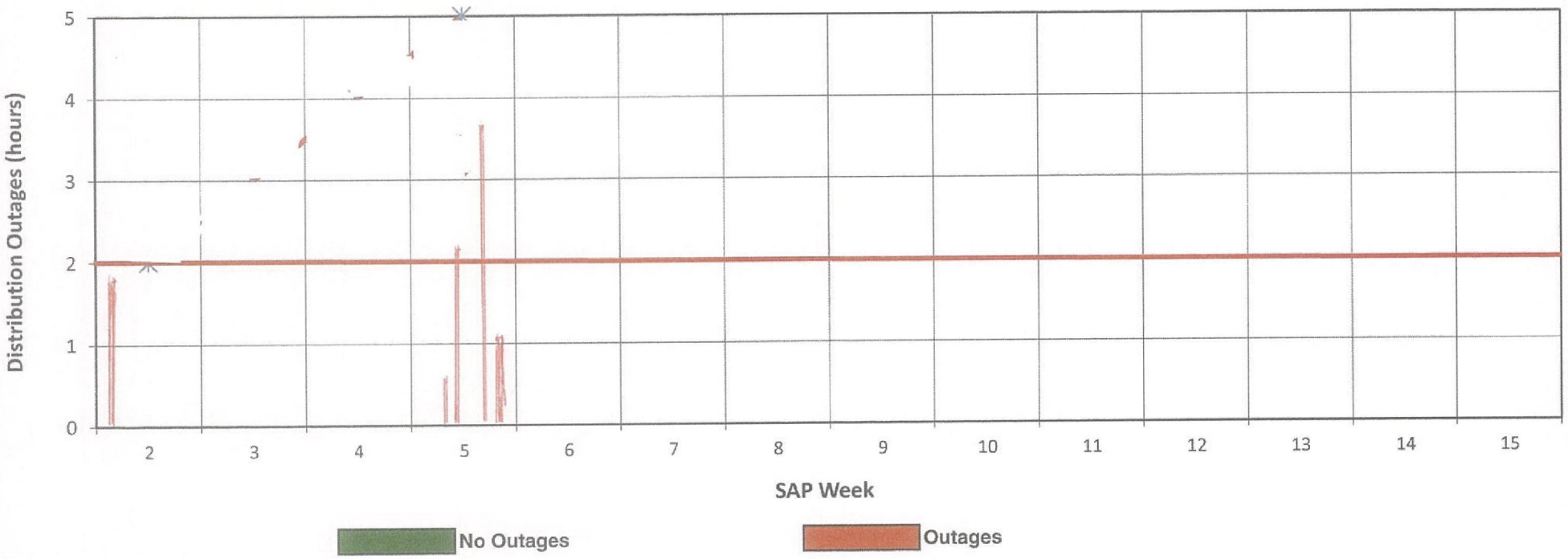
Date	Time	Minutes	Description	Fault Details	Pole/Transformer Number	Work Order	Further Repairs?	Address	Reported By
2/1/15			Loss of Generation	Yarrima Gas Loss					BW
5/1/15			Lost Feeder STS6 3hours	under ground cable blew on pole 31/46 loading to pole 33/51.	31/46	431786660			CP
6/1/15			Loss of phase 49 Fortescue Av	Customer lost a phase at property 49 Fortescue Av	NO 49	431788637			BW
7/1/15	6:30		Loss of Phase East Newman	White Phase ON HV failed at DOF	34/42	431790296	Replace DOF Retainer		GH
11/1/15	1330.	30MIN	5 CARNEY LOSS PHASE.	BLOWN FACIM FUSE WHITE PHASE.	5 CARNEY.		—		SP.
13/1/15	1934	900 Minute	LOSS OF BLUE PHASE TO EAGLE ROCK TURN	U/G CABLE BETWEEN DP 210 + 211 IS OPEN CIRCUIT	EAST NEWMAN EAGLE ROCK TURN BRUMBY MEWS A32	431804058	U/G CABLE REQUIRES Replacing		DM
14/1/15	0300	280	HV ~~Fuse~~ blown At 33/18	White phase Hot joint	33/18	431804337	Yes DOF'S KEEP TO BE Replaced		DM
14/1/15	2050	60	Blow FACIA FUSE WHITE PHASE	Blown FUSE	27 CARMAN	NOT 410003896	NO		DM
19/1	0300 ~~0600~~	—	FIRE Q 10 NARDOO LOOP	Pulled Fuse white phase	10 NARDOO		Yes		DM
20/1	16:45	120	16 Gregory Ave	Consumer Mains to Pillar 125 Incorrect Position Temp.	Generator	431816494	NO		GH
21/1	1900	36hrs	lightning Brought down HV Running Earth on Cap Line	Phase - Earth	multiple Poles	431820341	Yes, but not by us. (SCEE)		GN
24/1	2:00 AM	60	Trotman Ave Caltex	ABS Forced open (had Isolation Hasp through Locking Hole)		431823689	NO		GH
24/1	07:15am		5 Carney	Loss of Phase	5 Carney	431823815	Requires Investigation by EHP Housing this fault is ongoing.		GN
27/1	8:00PM	9HRS	EDJ RIDGE SECURITY SHIT FARM, ANFO	3 & HV EASTERN RIDGE SECURITY 3 NYABLEE Lost PHASE		431831181	REPLACE 3x HV FUSES RETERMINATE RED &		SE
28/1	12:00pm	2HRS	66KV HUB REPORTED OFF	NO FAULT					

~~Planned Outages~~

Date	Time	Minutes	Description	Fault Details	Pole/Transformer Number	Work Order	Further Repairs?	Address	Reported By
29/1	6:30-9PM		NO POWER W/BLINE EITHER SIDE OF OPEN POINT	EDOS Brown Lb11 303 BREAKER HOMESTEAD TRF			NIL NIL		.

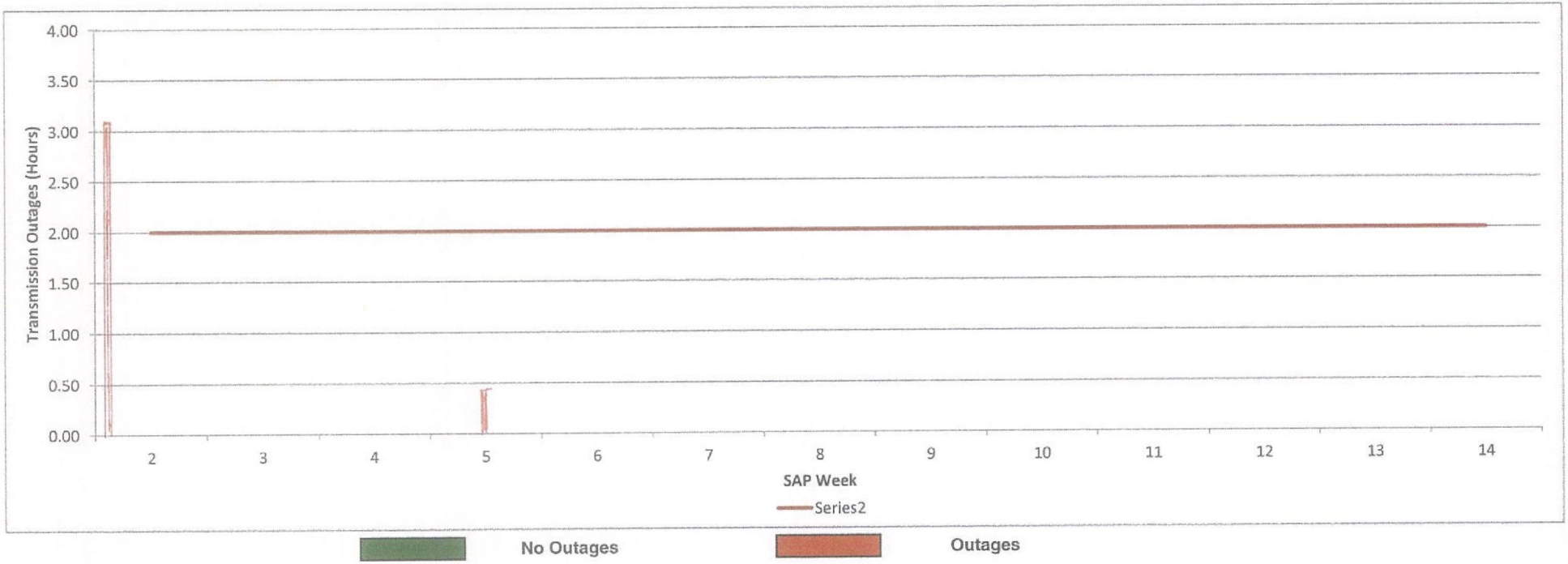
Planned Outage Faults No Faults

Q1



Date	Description	Duration
05/01/2015	STS6 Cable damage Pole 31/46 to Pole 33/51 (11kV)	175 min
29/01/2015	Town Sub Water bore Fdr - blown fuses. WA11 (11kV)	65 min
26/01/2015	JIM608 - Lighting Strike 33kV	72 min
26/01/2015	STS2 - Lighting Strike 11kV	12 min
29/01/2015	HC303.0 (11kV) OB25, TPS and bores.	209 min

Q1



Date	Description	Duration
02/01/2015	Yarrima GTs trip, Alinta GTs Trip	185 mins
26/01/2015	JV703CB & SH703CB 66kV, Lighting Strike	45 mins

Transmission Outages

Feb-15

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Fault No Fault Planned Outage																															

Fault Detail

Date	Description	Minutes
5/02/	Junction F1	64
19/2/15	Eastern Ridge "Gate House"	180
28/2/15	Jim 33kV FOR4	approx 2hrs → TBC

Planned Outage Detail

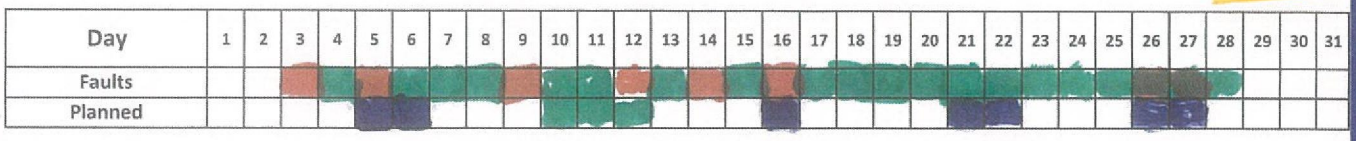
Date	Description	Minutes

Please ensure that Fault Register is updated in 1Doc

Mine Power: Faults & Scheduled Outages

Town Electrical Level 1 KPI Board

Feb-15



Fault Details

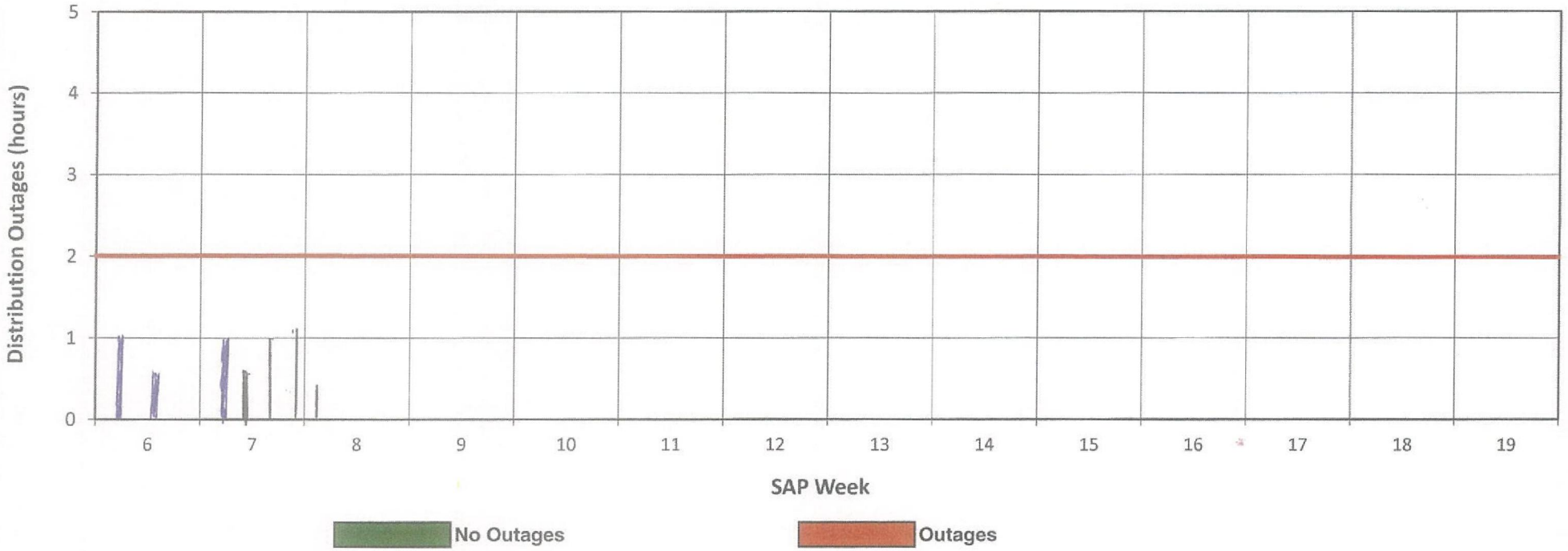
Date	Time	Minutes	Description	Fault Details	Pole/Transformer Number	Work Order	Further Repairs?	Address	Reported By
3/2/15	1pm	60	27 WARLMAN	BLOWN FACIA FUSE	[illegible]		N/A		-
5/2/15	2.45	30	7 Minkalup	U/S Fuse Carrier		4318479 21	N/A		
9/2/15	10PM	60	5 Carney	Facia Fuse, WHITE PHASE		4318567[illegible]	YES		
12/2/15	11AM	15	YELLOW SCHOOL	630A BREAKER TRIPPED	T8	43186735			SE
12/2/15	11-30	30	YELLOW SCHOOL	RESET SETTINGS TRIP SETTINGS TO LOW	T8	11	YES INSPECTORS ORDER		SE
14/2/15		60	5 CARNEY ST	U/S FUSE CARRIER			REPLACED FACIA FUSE CARRIER		BW
16/2/15		20	3 KEEDI ST	U/S FUSE CARRIER		43186961 7	REPLACE FACIA FUSE CARRIER		BW
26-2-15	7:15	60	Pole 34/46 Kalgan Dr.	Blown Drop Out Fuse	T15 - PS23		Reload Fuse.		BJ.
27/2/15	1600	1DAY	40 GILES AVE	Blown white phase fuse due to lightning	—	—	No		DM

Planned Outages

Date	Time	Minutes	Description	Fault Details	Pole/Transformer Number	Work Order	Further Repairs?	Address	Reported By
5/2	2HRS		3 BOONARA.	REPLACED OLD SERVICE.					
6/2	2HRS		REPLACE EARTH INSULATORS ON TJILLA ST.	150 HOUSES AFFECTED					
21/2	4HRS		PS80. INSTALLATION OF POWER LOCATORS	LIA. (WEEKEND)					
22/2	4HRS		PS78, 79. INSTALLATION OF POWER LOCATORS	LIA (WEEKEND)					
26-2	1hr		Culdorch	LV LINKS UPGRADE					
27-2	2hr		T9 Keedi	TX REPAIRS					

Planned Outage Faults No Faults

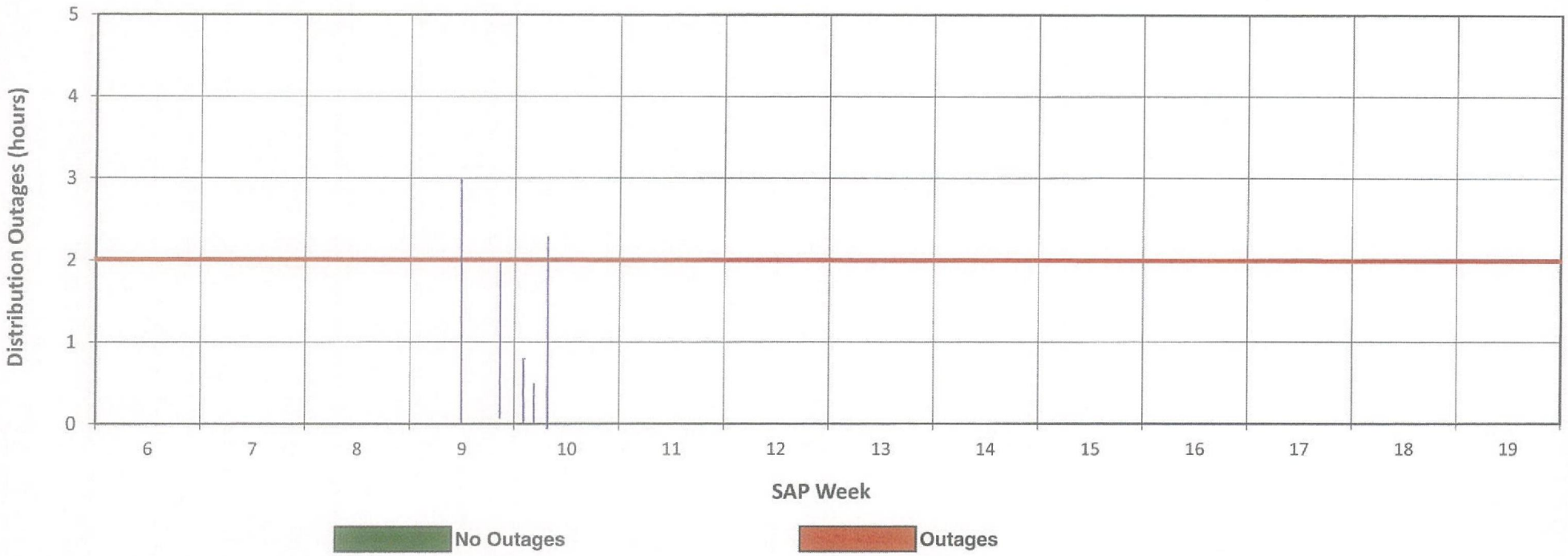
Q1



Date	Description	Duration
03/02/2015	27 Warman - Blown fada Fuse	60 min
05/02/2015	7 Mimbalup - Fuse Carrier	30 min
09/02/2015	5 Carney St. Facia Fuse - White Phase	60 min
12/02/2015 12/02/2015	Yellow School, 630A CB Tripped, grading	~~15min~~ 15min ~~30min~~ 30 min
14/02/15	5 Carney St. Facia Fuse Carrier	60min
16/02/15	31 Keedl St Facia Fuse Carrier	20 min.
15/02/15	Junction Fl	54 min

Distribution Outages

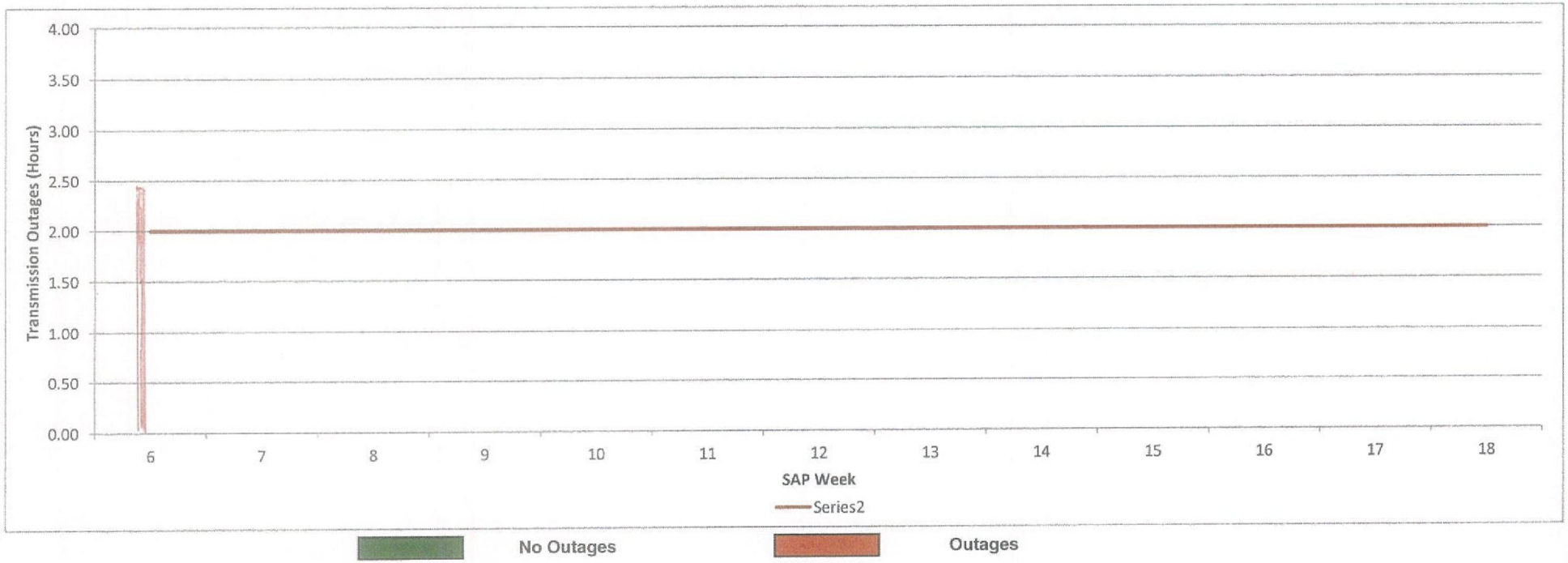
Q1



Date	Description	Duration
19/02/2015	Eastern Ridge Gatehouse	180 mins.
28/02/2015	Jim Fdr 608 33kV Fdr 4 (awaiting information)	approx 2hrs.
01/03/2015	Yandi F3 - Overload	44 min
02/03/2015	HSC Feeder to TPS	20mins
03/03/2015	Yandi F2 - EF	149 min

Distribution Outages

Q1



Date	Description	Duration
02/02/2015	Alinta GT Trip 66kV Fdr Town Sub	appox 2hr40min.

Transmission Outages