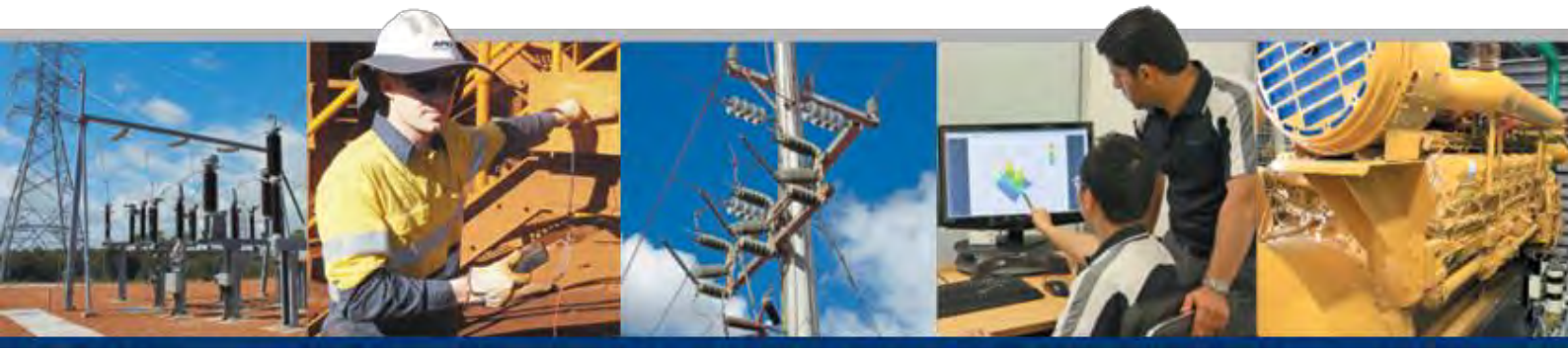

# BHP BILLITON IRON ORE
# NEWMAN TOWNSHIP ELECTRICITY SUPPLY

# ANNUAL COMPLIANCE REPORT
# 2015/2016

REVISION A

26/07/2016

APD Job Number: W_APD04607

APD POWER ENGINEERING

# REVISION HISTORY

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# 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 two 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 the network operator (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 Annual Compliance Report presents the relevant parts of the Code listed above; in particular the Power Quality (PQ) criteria pertaining to Newman's 11kV feeders (a total of 7) and the reportable requirements as outlined in Part 2 and Schedule 1 of the Code, for the 2015/16 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 proven in compliance with the Code's requirements:

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

Note that there are a very limited number of instances (i.e., under 0.1% 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. Also note that the number of non-compliance issues recorded for 2015/16 FY is significantly (i.e., by 5 times) smaller than those of the last FY; hence, an enhanced PQ throughout the Newman's electricity network is observed.

Reportable parameters for Newman Township Electricity Supply over the 2015/16 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 interruptions per FY).
- A total of 3 complaints were received over the 2015/16 FY, which were appeared to be related to the billing issues; hence no complaints made by customer on the quality or reliability of supply.
- Within the 2015/16 FY, a total of $13.2M (AUD) was invested by BHPBIOSA towards Newman network maintenance, reinforcement, expansion and operations works. The investment was to not only address the issues identified by the operator but also to significantly improve the quality and reliability of supply (proven efficient through site measurements and evaluation of network data).
- The key reliability indices are calculated as listed below:
    - *Customer Average Interruption Duration Index* (CAIDI) of 102 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 1.64 interruptions – SAIFI is the number of interruptions that the customers experienced.
    - *Average Service Availability Index* (ASAI) of 99.97% – ASAI is the perceived availability of the network to the customers.
    - *System Average Interruption Duration Index* (SAIDI) of 168 minutes – SAIDI is the average outage duration for each customer served.

The metering data collected from 12 locations throughout the Newman network indicate 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 and significant improvements from the previous 2014/15 FY reporting period are noted.

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# 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 2,938 registered premises comprised of a mixture of residential and commercial customers (compared to 2,546 customers for 2014/15 FY).

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 2015 to 30th of June 2016. 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 in this report.

# 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 (2015/2016 FY).

# 3. METHODOLOGY

The electricity supply compliance review entailed the following processes:

1. The temporary Installation of PQ loggers at the beginning and end of the 11kV feeders emanating from the Town and Southtown Substations (a total of 12 loggers, 2 for each feeder, with the exception of feeders TC2 and TC4 where a single PQ logger was installed). Each PQ logger was installed on the low voltage (LV) side of pad-mounted transformers. The measuring period lasted for between 7 to 8 days in the months between March 2016 and April 2016. The PQ 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 & 3198 PQ Analysers.
3. The receipt of the following information from BHPBIOSA:
    - Network outage information for planned and forced outages for the Newman Township during the 2015/2016 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 PQ 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 PQ 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 12 PQ loggers were deployed at pre-determined locations on TC1, TC2, TC3, TC4, STS1, STS2, and STS6 feeders, as listed in Table 1 (2 logger at each feeder with the exception of TC2 and TC4 where a single PQ logger was installed).

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 | - | PS14 Bondini Drive |
| Township | TC3 | PS108 Kurra Subdivision | PS69 Giles Avenue |
| Township | TC4 | PS125 Bubbacurry Loop | - |
| South Town | STS1 | PS94 Pardoo Street | PS96 Pardoo Street |
| South Town | STS2 | PS60 Forrest Avenue | PS70 Jabbarup Crescent |
| South Town | STS6 | TX12000 Warehouse | PS120 Newman Drive |

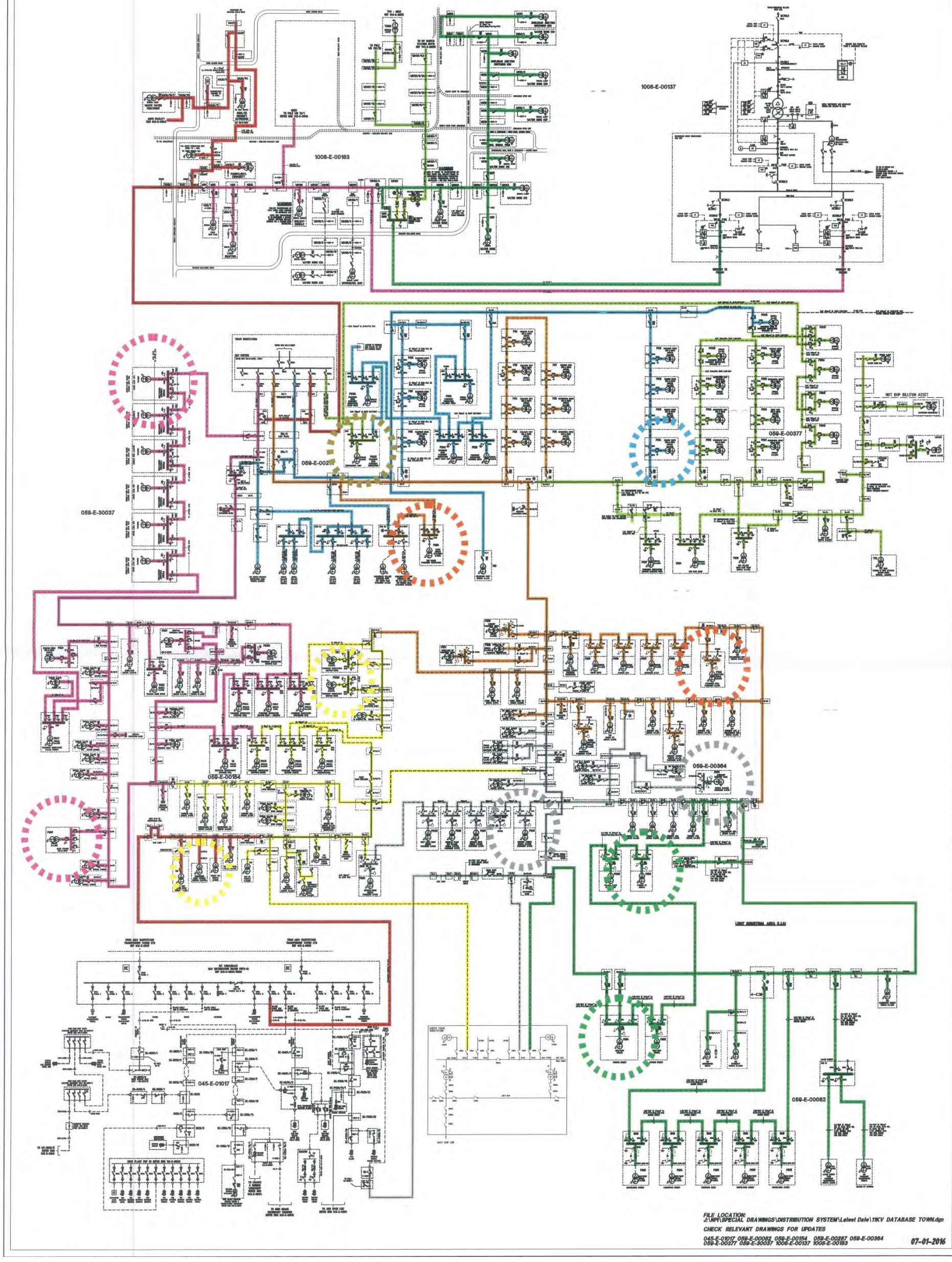



**Figure 1 | Single line diagram of the Newman township (coloured circles indicate the location of PQ loggers**

### 4.2.1. In-services Period

Table 2 presents the times and dates of when the PQ loggers were installed and removed from the Newman LV network by BHPBIOSA.

**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 | 31/03/2016 13:05 | 8/04/2016 10:22 |
| | | End | 31/03/2016 14:21 | 7/04/2016 16:43 |
| | TC2 | Start | - | - |
| | | End | 31/03/2016 7:45 | 8/04/2016 10:57 |
| | TC3 | Start | 30/03/2016 10:15 | 8/04/2016 13:24 |
| | | End | 30/03/2016 9:00 | 7/04/2016 14:35 |
| | TC4 | Start | 31/03/2016 8:20 | 7/04/2016 14:57 |
| | | End | - | - |
| South Town | STS1 | Start | 30/03/2016 13:40 | 7/04/2016 10:55 |
| | | End | 30/03/2016 14:00 | 7/04/2016 12:06 |
| | STS2 | Start | 30/03/2016 11:40 | 7/04/2016 12:23 |
| | | End | 30/03/2016 13:20 | 7/04/2016 12:37 |
| | STS6 | Start | 31/03/2016 9:56 | 8/04/2016 14:38 |
| | | End | 31/03/2016 17:15 | 8/04/2016 11:48 |

## 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.

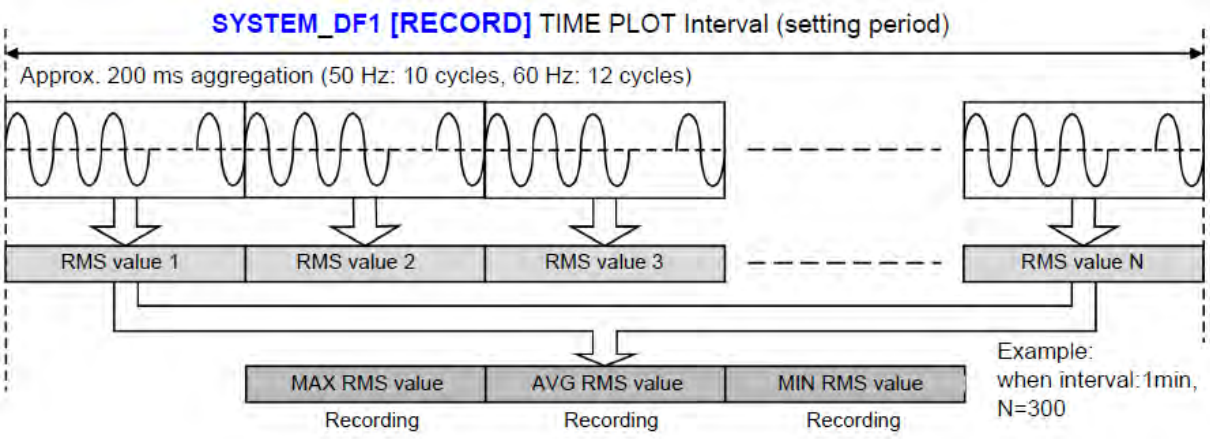



**Figure 2 | Sampling and interval recording philosophy used in the Hioki PQ loggers (from Hioki Manual)**

## 4.4.PQ Device Installation Checklist

For each of the 12 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 (all received and reviewed by APD).

Refer to Appendix C for copies 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.

**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 (e.g. 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.

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

### 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.

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

# 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 31/03/2016 and 8/04/2016, 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 31/03/2016 and 7/04/2016, 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 11 and Figure 14 of Appendix B (page 41) respectively. There were no flicker limit events causing the flicker level to breach The Code's limits (i.e., full compliance with the Code requirements).

### 6.1.2. Voltage

The logged voltage level data for the start and end of feeder-TC1 are shown in Figure 12 and Figure 15 in Appendix B (page 41) 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 13 and Figure 16 in Appendix B (page 41) respectively. There were no notable frequency limit events which caused the frequency 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 17 through Figure 24 in Appendix B (page 42). Note that there are very few non-compliant harmonics measured by the PQ loggers at once instance (on 7$^{th}$ of April 2016), which are of isolated nature and 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. Given the rare, temporary and random nature of the breaches, there are not deemed of any practical concern (i.e., not deemed as compliance issues).

Also note that the harmonic compliance issues observed for 2015/16 FY are over 10 times smaller/less frequent than those recorded for 2014/15 FY, hence a significant improvement in the quality of supply is noted.

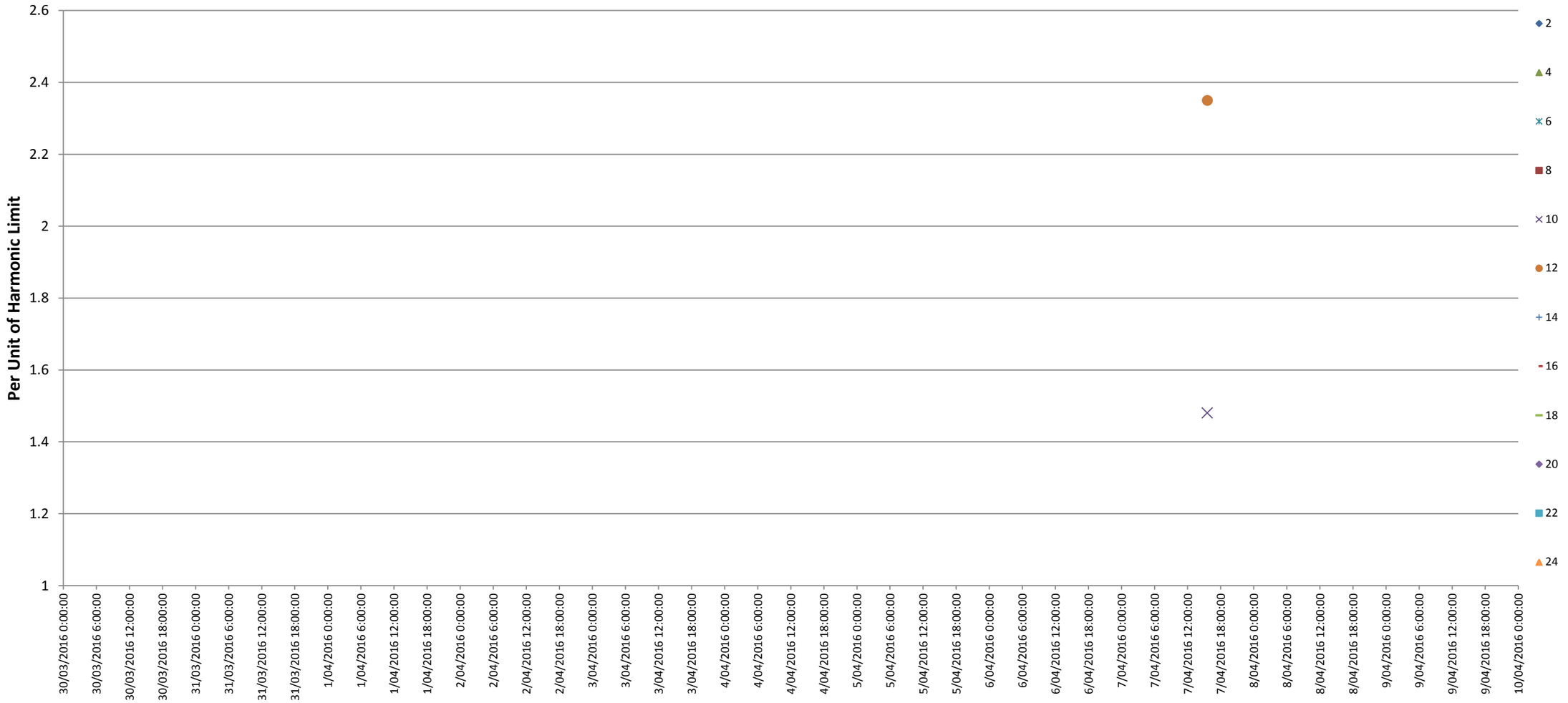



**Figure 3 | TC1- Non-compliant even harmonics**

## 6.2. Feeder TC2

The PQ logger on the TC2 feeder was installed in the PS14 Bondini Drive substation between 31/03/2016 and 8/04/2016, 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 end of feeder-TC2 are shown in Figure 25 of Appendix B (page 43). There were no flicker limit events which caused the flicker level to breach The Code's limits, hence full compliance with the Code requirements.

### 6.2.2. Voltage

The logged voltage level data for the end of feeder-TC2 are shown in Figure 26 in Appendix B (page 43). 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 end of feeder-TC2 are shown in Figure 27 in Appendix B (page 43). There were no notable frequency limit events which caused the frequency 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 28 through Figure 31 in Appendix B (page 44). Note that there are very few non-compliant harmonics measured by the PQ loggers at once instance (on 7$^{th}$ of April 2016)

A summary of non-compliant harmonics and the scale of non-compliance are shown in Figure 4. Given the rare, temporary and random nature of the breaches, there are not deemed of any practical concern (i.e., not deemed as compliance issues).

Also note that the harmonic compliance issues observed for 2015/16 FY are over 10 times smaller/less frequent than those recorded for 2014/15 FY, hence a significant improvement in the quality of supply is noted.

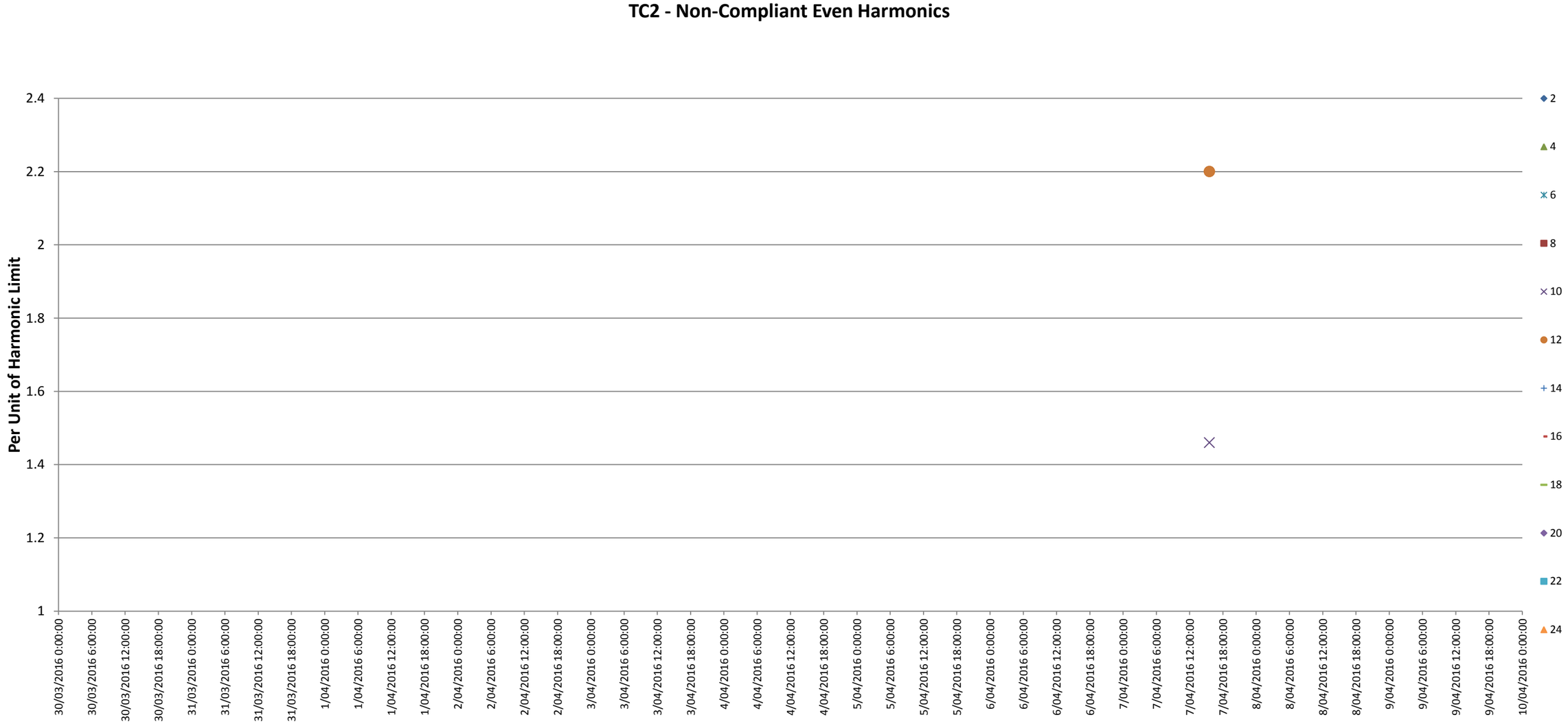



**Figure 4 | TC2- Non-compliant even harmonics**

## 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 30/03/2016 and 8/04/2016, 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 30/03/2016 and 7/04/2016, 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 32 and Figure 35 of Appendix B (page 45), respectively.

Notable non-compliant flicker events and their respective magnitudes and effected-phases are shown in Table 5, which is under 0.1% of the measurement period (hence deemed as no major compliance issues). Comparison of the results with those obtained last FY indicates improved (i.e., attenuated) flicker level in the 2015/16 FY.

**Table 5 | TC3 - Summary of non-compliant flicker measurements**

| Date | Non-compliant Short Term Flicker Events | |
|---|---|---|
| | Feeder – TC3 | |
| | Start of Feeder | End of Feeder |
| | *Pst* | *Pst* |
| 30/03/2016 15:20:00 | | 1.03 (W Phase) |

### 6.3.1. Voltage Levels

The logged voltage level data for the start and end of feeder-TC3 are shown in Figure 33 and Figure 36 in Appendix B (page 45) 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 34 and Figure 37 in Appendix B (page 45) respectively. There were no notable frequency limit events which caused the frequency 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 38 through Figure 45 in Appendix B (page 46). 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 5 and Figure 6 – which are all notably smaller and less frequent than those recorded over 2014/15 FY (hence improved quality of supply).

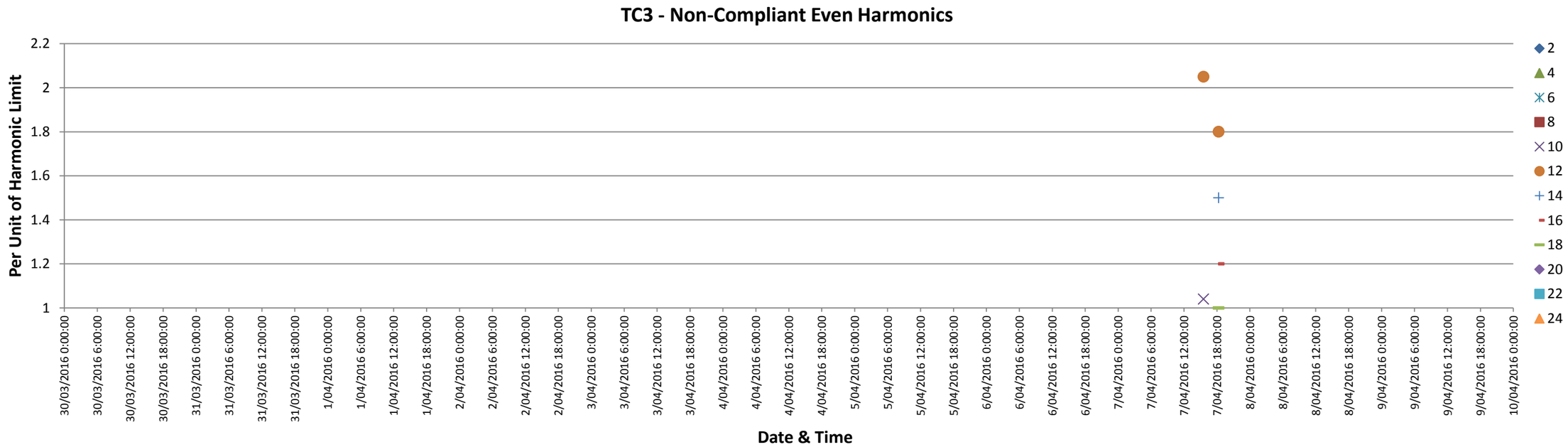



**Figure 5 | TC3- Non-compliant even harmonics**

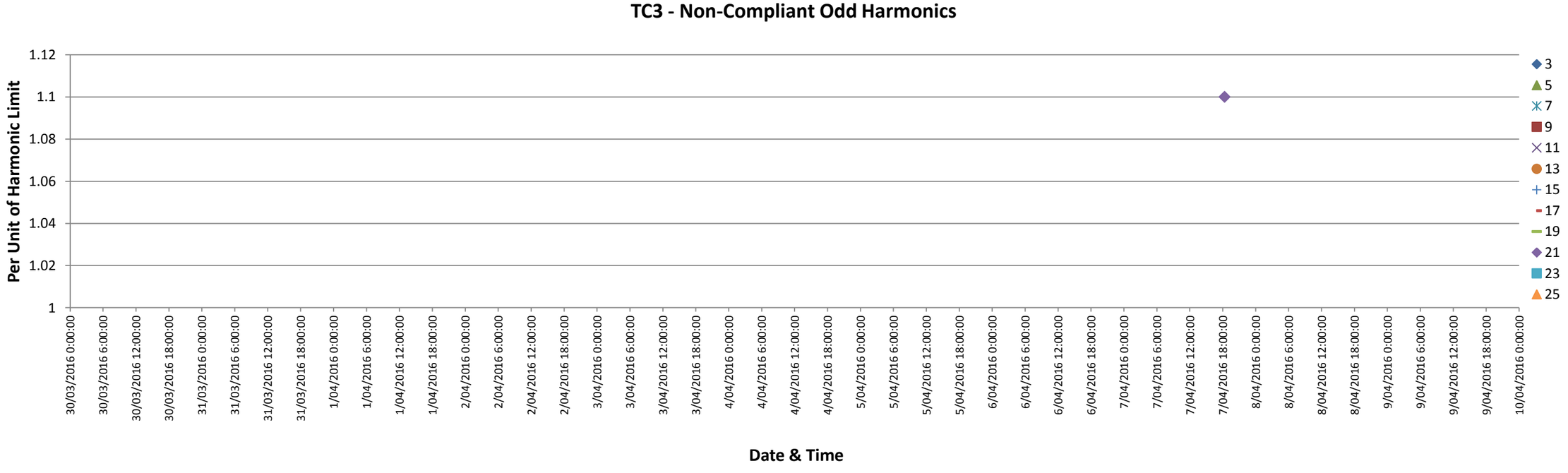



**Figure 6 | TC3 Non-compliant odd harmonics**

## 6.4. Feeder TC4

The PQ logger at the start of the TC4 feeder was installed in the PS125 Bubbacurry Loop pad-mounted substation between 31/03/2016 and 07/04/2016.

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 of feeder-TC4 are shown in Figure 46 of Appendix B (page 47). There were no flicker limit events which caused the flicker level to breach The Code's limits, hence full compliance with the Code requirements.

### 6.4.2. Voltage

The logged voltage level data for the start of feeder-TC4 are shown in Figure 47 in Appendix B (page 47). There were no notable voltage limit events which caused the voltage level to breach The Code's limits, hence full compliance with the Code.

### 6.4.3. Frequency

The logged frequency data for the start of feeder-TC4 are shown in Figure 48 in Appendix B (page 47). There were no notable frequency limit events which caused the frequency level to breach The Code's limits, hence full compliance with the Code.

### 6.4.1. Harmonics

The logged harmonic data for the start and end of feeder TC4 are shown in Figure 49 through Figure 52 in Appendix B (page 48). There were no notable individual harmonic limit events which caused the individual harmonic levels to breach The Code's limits, hence full compliance with the Code.

## 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 30/03/2016 and 7/04/2016, 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 30/03/2016 and 7/04/2016, thus satisfying the 7 days minimum logging duration requirement.

As shown in Figure 1 (green-coloured feeder), STS1 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 53 and Figure 56 of Appendix B (page 49), respectively. There were no flicker limit events which caused the flicker level to breach The Code's limits, hence full compliance with the Code requirements.

### 6.5.1. Voltage

The logged voltage level data for the start and end of feeder-STS1 are shown in Figure 54 and Figure 57 (page 49), 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 55 and Figure 58 in Appendix B (page 49) respectively. There were no notable frequency limit events which caused the frequency 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 59 through Figure 66 in Appendix B (page 50). There were no notable individual harmonic limit events which caused the individual harmonic levels to breach The Code's limits, hence full compliance with the Code.

## 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 30/03/2016 and 7/04/2016, 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 30/03/2016 and 7/04/2016, 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 67 and Figure 70 of Appendix B (page 51) respectively. There were no flicker limit events which caused the flicker level to breach The Code's limits, hence full compliance with the Code requirements.

### 6.6.2. Voltage

The logged voltage level data for the start and end of feeder-STS2 are shown in Figure 68 and Figure 71 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.

### 6.6.1. Frequency

The logged frequency data for the start and end of feeder-STS2 are shown in Figure 69 and Figure 72 in Appendix B (page 51) respectively. There were no notable frequency limit events which caused the frequency 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 73 through Figure 80 in Appendix B (page 52). There were no notable individual harmonic limit events which caused the individual harmonic levels to breach The Code's limits, hence full compliance with the Code.

## 6.7. Feeder STS6

The PQ logger at the start of the STS6 feeder was installed in the TX12000 Warehouse pad-mounted substation between 31/03/2016 and 8/04/2016, thus satisfying the 7 days minimum logging duration requirement.

The PQ logger at the end of the STS6 feeder was installed in the PS121 Newman Drive substation between 31/03/2016 and 8/04/2016, thus satisfying the 7 days minimum logging duration rule.

As shown in Figure 1 (yellow-coloured feeder), STS6 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 81 and Figure 84, respectively. There were no flicker limit events which caused the flicker level to breach The Code's limits, hence full compliance with the Code requirements.

### 6.7.2. Voltage

The logged voltage level data for the start and end of feeder-STS6 are in Figure 82 and Figure 85 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.

### 6.7.1. Frequency

The logged frequency data for the start and end of feeder-STS6 are shown in Figure 83 and Figure 86 in Appendix B (page 53) respectively. There were no notable frequency limit events which caused the frequency 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 87 through Figure 94 in Appendix B (page 54). 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 7.

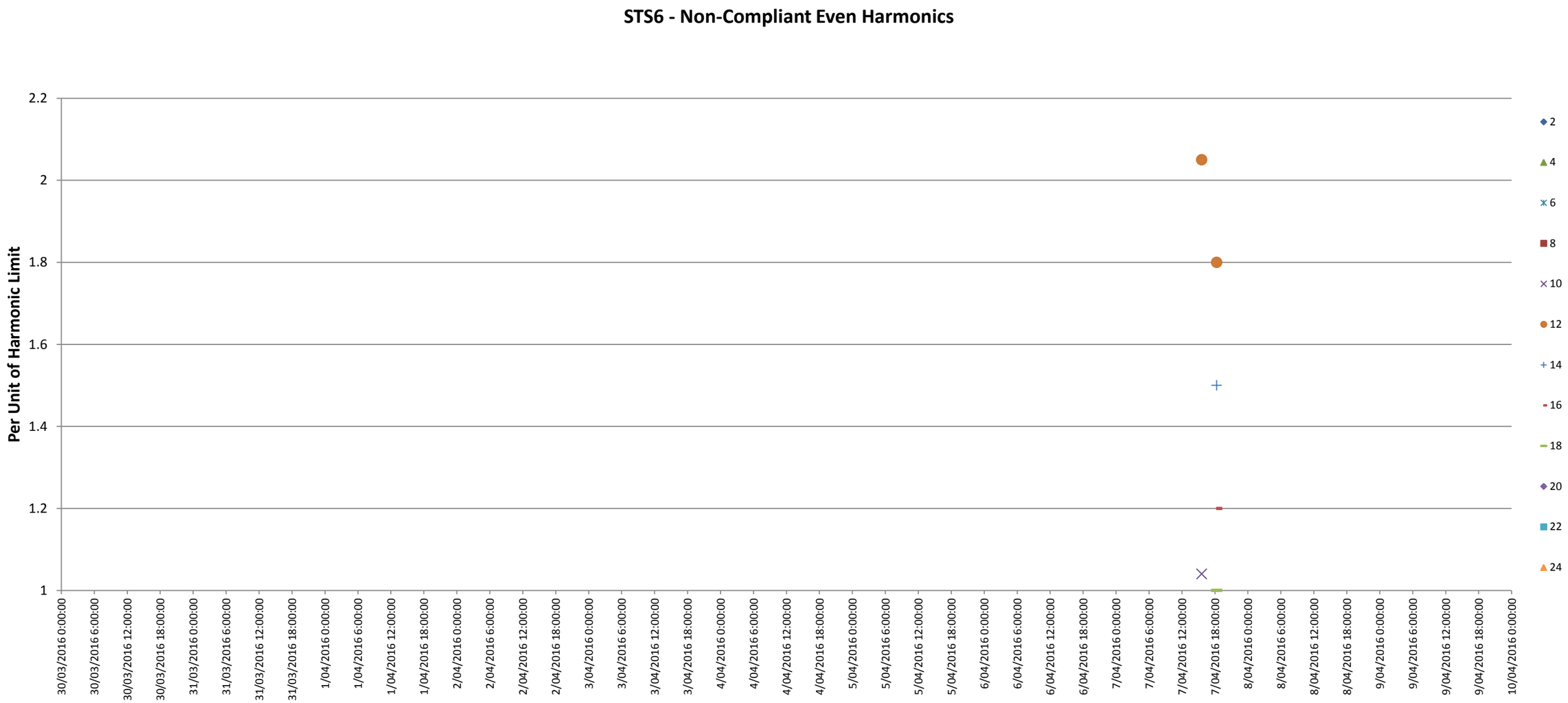



**Figure 7 | STS6- Non-compliant even harmonics**

# 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-term and short-term flicker as described in Section 5.1.1.

The PQ logging results indicate a small number of voltage fluctuation breaches on the TC3 feeder supplying part of the township network during the logged periods. Table 6 presents the results for the previous three reporting periods together with the 2015/2016 result. The dates and times of their occurrence are shown in Table 7.

**Given the results presented in Table 6, a significant improvement is observed over the 2015/16 FY compared to the measurements of the years before.**

**Table 6 | Total number of breaches of voltage fluctuation compatibility levels**

| Description | Reportable Period | | | |
|---|---|---|---|---|
| | 2012/2013 | 2013/2014 | 2014/2015 | 2015/2016 |
| Total number of breaches of *Pst* | 5 | 79 | 5 | 1 |
| Total number of breaches of *Plt* | 1 | 72 | 1 | 0 |

**Table 7 | Dates and times of non-compliant short-term flicker events**

| Date | Time |
|---|---|
| 30/03/2016 | 15:20:00 |

### 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 8 presents the results for the previous three reporting periods together with the 2015/2016 result. In the 2015/2016, no events 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 8 | Total number of breaches of total harmonic distortion limit**

| Description | Reportable Period | | | |
|---|---|---|---|---|
| | 2012/2013 | 2013/2014 | 2014/2015 | 2015/2016 |
| Total number of breaches of Voltage Total Harmonic Distortion (U-THD) | 0 | 0 | 1 | 0 |

### 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 the power quality of supply.

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 240V (end of TC1). Therefore, it is expected that the voltage level at the customer's connection would be within the required range.

Table 9 presents the results for the previous three reporting periods together with the 2015/2016 result. In 2015/2016, there were no instances where the voltage level breached the voltage limits.

**Table 9 | Total number of breaches of voltage level limits**

| Description | Reportable Period | | | |
|---|---|---|---|---|
| | 2012/2013 | 2013/2014 | 2014/2015 | 2015/2016 |
| Total number of breaches of voltage limits | 8 | 0 | 2 | 0 |

### 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 10 presents the results for the previous three reporting periods together with the 2015/2016 result. For the 2015/2016 PQ logging period, there were no instances where the frequency breached the required limits.

**Table 10 | Total number of breaches of frequency limits**

| Description | Reportable Period | | | |
|---|---|---|---|---|
| | 2012/2013 | 2013/2014 | 2014/2015 | 2015/2016 |
| Total number of breaches of frequency limits | 0 | 0 | 1 | 0 |

## 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 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 upgrades including:

- Replacement of 6 distribution transformers in the Township of Newman due to ageing or defects.
- The addition of a Transformer with AVR/Tap Change to reduce voltage related issues associated from the Whaleback supply.
- The installation of a Capacitor Bank for Whaleback.

Additionally, a program to reduce bird strike related trips has been successfully implemented which has significantly reduced the number of outages.

In addition to the asset upgrade programs executed over the 2015/16 FY, BHPBIOSA have managed to improve the internal work process, yielding improved quality and reliability of supply. A brief example of process improvement works already completed or currently in-progress by BHPBIOSA includes the following:

- Purchase of a software package to automate the inspection record keeping, generation of reports and notices required (currently in progress – to be completed by the next FY)
- Upgraded ISP (Inspection System Plan) and ISP Manual documents, already submitted to DMP for approval
- Distribution Maintenance Strategy document re-developed to consider frequency, criticality and failure mode of the equipment, hence achieving smarter investment and work plan.

## 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 11 presents the interruptions over 12 Hours for small use customer, with no such interruptions recorded for 2015/16 FY.

**Table 11 | Total number of premises of small customers interrupted continuously for more than 12 hours**

| Description | Reportable Periods | | | |
|---|---|---|---|---|
| | 2012/2013 | 2013/2014 | 2014/2015 | 2015/2016 |
| Total number of premises that experienced interruptions more than 12 hours | 1 | 5 | 0 | 0 |

### 7.3.2. Frequent Interruptions

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 presented in Table 12 indicates that the no customers were disconnected more than 16 times.

**Table 12 | Total number of premises that experienced more than 16 interruptions**

| Description | Reportable Periods | | | |
|---|---|---|---|---|
| | 2012/2013 | 2013/2014 | 2014/2015 | 2015/2016 |
| 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, with the information provided in Table 6 to Table 12 it is assumed that each complaint was associated with billing issues, hence no complaints received on the reliability or quality of the supply.

Table 13 presents the results for the previous three reporting periods together with the 2015/2016 result.

**Table 13 | Total number of formal complaints lodged to BHPBIOSA**

| Description | Reportable Periods | | | |
|---|---|---|---|---|
| | 2012/2013 | 2013/2014 | 2014/2015 | 2015/2016 |
| 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 2015/16 FY that required BHPBIO's action. However, the complaints related to bill issues which were resolved by the retailing and billing contractor hired by BHPBIOSA (i.e., MBC Global).

## 7.7. Investments over 2015/2016 FY to improve the Reliability of Supply & Power Quality

Table 14 shows the total AUD amount spent in improving the supply quality and reliability and to cater for network expansion. The changes in the network investment over various FY is partly attributed to the re-structuring works taken place in BHPBIOSA over the course of last few years.

**Table 14 | Total amount spent by BHPBIOSA in network improvements**

| Description | Reportable Periods | | | |
|---|---|---|---|---|
| | 2012/2013 | 2013/2014 | 2014/2015 | 2015/2016 |
| Total amount spend in dollars (AUD) | $13.68 million | $14.90 million | $16.90 million | $13.20 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. There was no supply interruptions exceeding 12 hours or small customer being disconnected for over 16 times, hence no payment needed to be made. Table 15 presents the results for the previous three reporting periods together with the 2015/2016 result.

**Table 15 | Total number and amount of payments made under Sections 18 and 19**

| Description | Reportable Periods | | | |
|---|---|---|---|---|
| | 2012/2013 | 2013/2014 | 2014/2015 | 2015/2016 |
| 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 2015/2016 FY and is shown in Table 16 (fairly identical to the average interruption duration for the last 5 years).

**Table 16 | The average length of interruption of supply to customer premises expressed in minutes (CAIDI)**

| Description | Reportable Period | | | | |
|---|---|---|---|---|---|
| | 2012/2013 | 2013/2014 | 2014/2015 | 2015/2016 | Average |
| Average length of interruptions - CAIDI (minutes) | 95 | 132 | 80 | 102 | 102 |

### 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 over the course of the 2015/2016 FY is shown in Table 17 (which appears to be smaller than the average of 2.72 interruptions per year, calculated for the last 5 years).

**Table 17 | The average number of interruptions of supply to customer premises (SAIFI)**

| Description | Reportable Period | | | | |
|---|---|---|---|---|---|
| | 2012/2013 | 2013/2014 | 2014/2015 | 2015/2016 | Average |
| Average supply interruptions – SAIFI (No. of Interruptions) | 2.59 | 2.40 | 4.23 | 1.64 | 2.72 |

### 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 over the course of the 2015/2016 FY is shown in Table 18.

**Table 18 | The average percentage of time that electricity has been supplied to customer premises (ASAI)**

| Description | Reportable Period | | | | |
|---|---|---|---|---|---|
| | 2012/2013 | 2013/2014 | 2014/2015 | 2015/2016 | Average |
| Average number of supply interruptions ASAI (Percentage of | 99.95% | 99.94% | 99.94% | 99.97% | 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 19 (comparatively better than the average of the last 5 years).

**Table 19 | The average total length of all interruptions of supply to customer premises in minutes (SAIDI)**

| Description | Reportable Period | | | | |
|---|---|---|---|---|---|
| | 2012/2013 | 2013/2014 | 2014/2015 | 2015/2016 | Average |
| SAIDI (minutes) | 245 | 318 | 339 | 168 | 268 |

## 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 20 presents the CAIDI results on a percentile basis. Note that for majority (98%) of the outages experienced by customers in Newman Township, the average restoration time is 81 minutes but this would increase to 102 minutes if the remaining 2% of the outages are also included in the calculations.

**Table 20 | Percentile of the average length of interruption of supply to customer premises in 2015/2016**

| Description | 25th | 50th | 75th | 90th | 95th | 98th | 100th |
|---|---|---|---|---|---|---|---|
| Average Length of Interruption (CAIDI) | 81 | 81 | 81 | 81 | 81 | 81 | 102 |

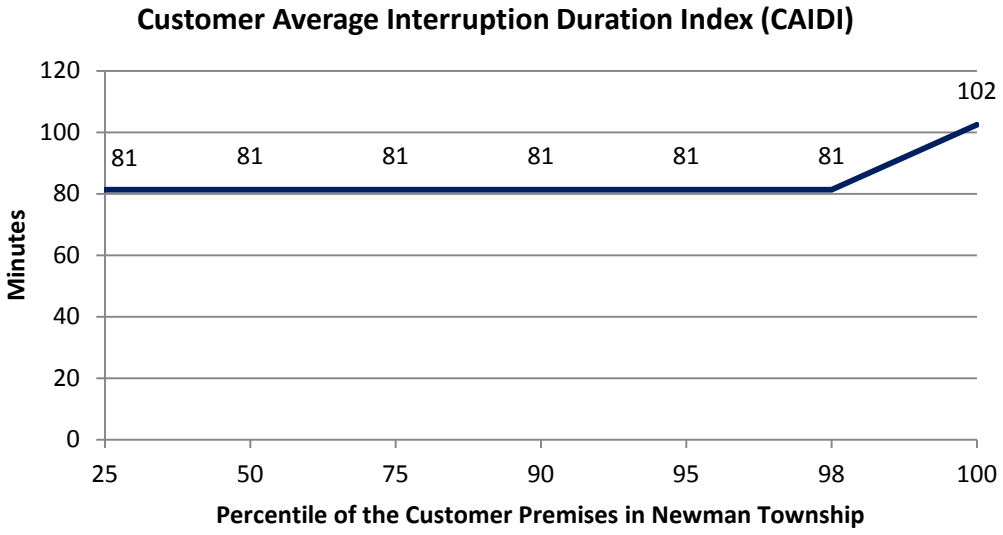



**Figure 8 | The average length of interruption (minutes) of supply to customers over 2015/2016 FY**

### 7.10.2. Percentile - Number of interruptions

As required by 'Schedule 1' of The Code, Table 21 presents the SAIFI results on a percentile basis.

**Table 21 | Percentile values of the number of interruptions in 2015/2016**

| Description | 25th | 50th | 75th | 90th | 95th | 98th | 100th |
|---|---|---|---|---|---|---|---|
| Number of interruptions (SAIFI) | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 1.6 |

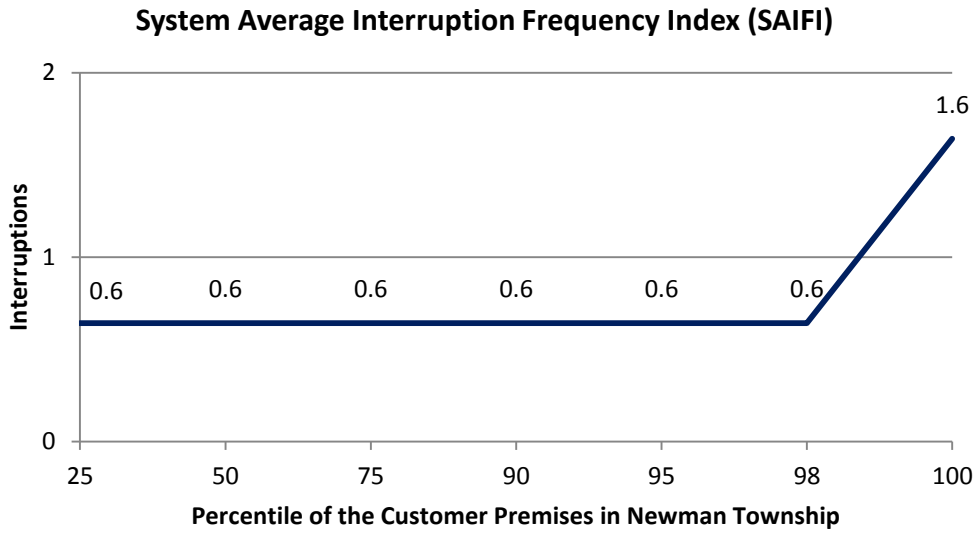



**Figure 9 | Percentile graph showing the number of interruptions in 2015/2016**

### 7.10.3. Percentile - Total Length of Interruptions

As required by 'Schedule 1' of The Code, Table 22 presents the SAIDI results on a percentile basis.

**Table 22 | Percentile values of the total length of interruptions in 2015/2016**

| Description | 25th | 50th | 75th | 90th | 95th | 98th | 100th |
|---|---|---|---|---|---|---|---|
| Total lengths of interruptions (SAIDI) | 52 | 52 | 52 | 52 | 52 | 52 | 168 |

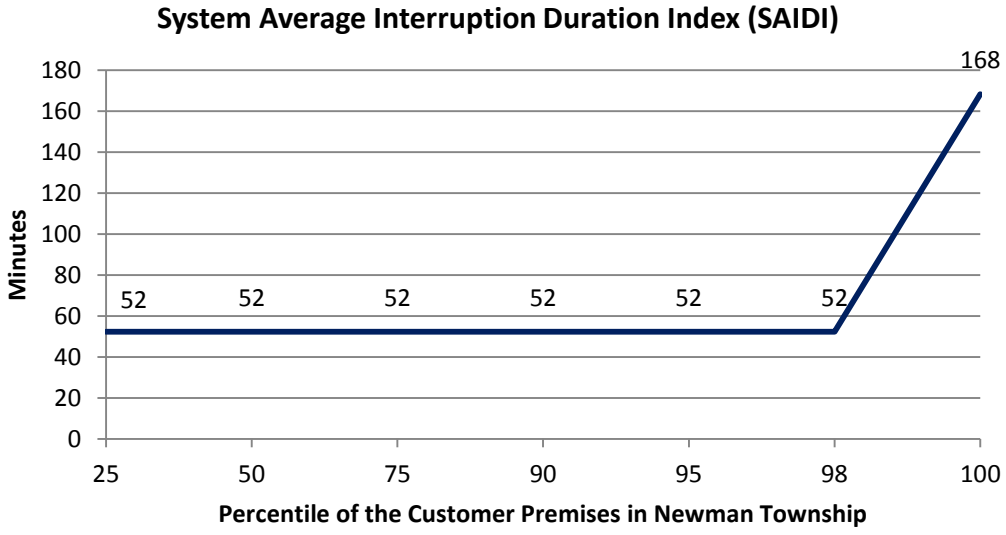



**Figure 10 | Percentile graph showing the total length of interruptions (SAIDI) in 2015/2016**

# 8. CONCLUSION

This report addresses all relevant parts; in particular the PQ 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 0.1% 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. Also note that for large majority of limits invested, site measurements indicate significant improvements in 2015/16 FY compared to those measured for the years before.

Reportable parameters for Newman Township Electricity Supply over the 2015/16 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 assumed to be related to the billing issues; hence no complaints made by customer on the quality or reliability of supply.
- Within the 2015/16 FY, a total of $13.2M (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 102 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 1.64 interruptions – SAIFI is the number of interruptions that the customers experienced.
    - *Average Service Availability Index* (ASAI) of 99.97% – ASAI is the perceived availability of the network to the customers.
    - *System Average Interruption Duration Index* (SAIDI) of 168 minutes – SAIDI is the average outage duration for each customer served.

The metering data collected from 12 locations throughout the Newman network indicate that the power quality, *as so far as is reasonably practical*, is compliant with The Code.

With regards to reliability, the Supply Authority's outage data indicates 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 3198)

Please refer to the following pages.

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-90081

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

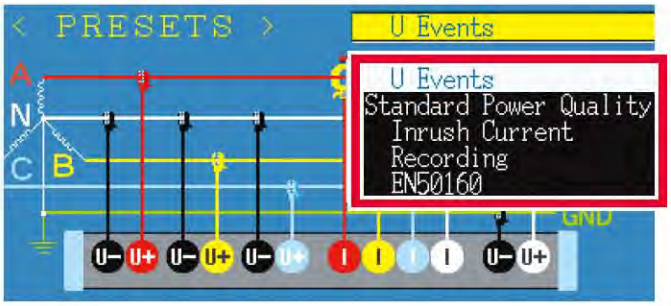
Class A is defined in the international standard IEC61000-4-30, which specifies compatibility with power quality parameters, accuracy, and standards to enable comparison and discussion of the measurement results of different measuring instruments.

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

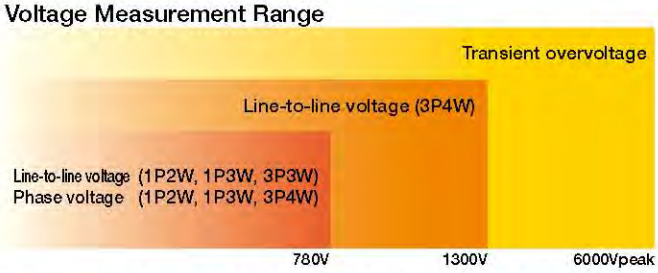



Simply choose the course based on the measurement objective and the necessary configurations will be set automatically.

| | |
|---|---|
| **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. |

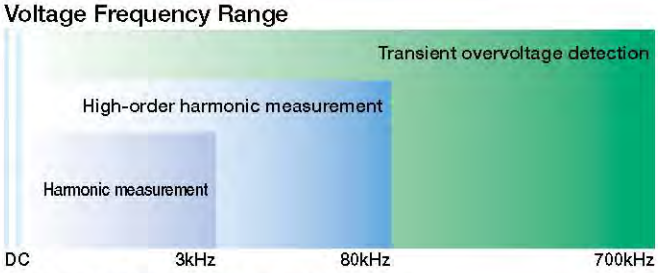
## 4 Highly Accurate, Broadband, Wide Dynamic Range Makes for Reliable Measurements

### Voltage Measurement Range




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

### Voltage Frequency Range



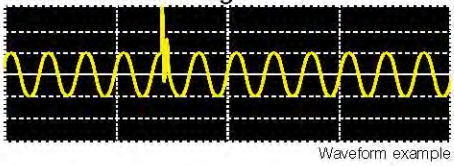

Wide range from DC voltage to 700 kHz

### 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.

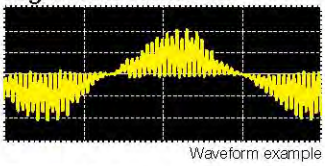
### Transient Overvoltage



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.

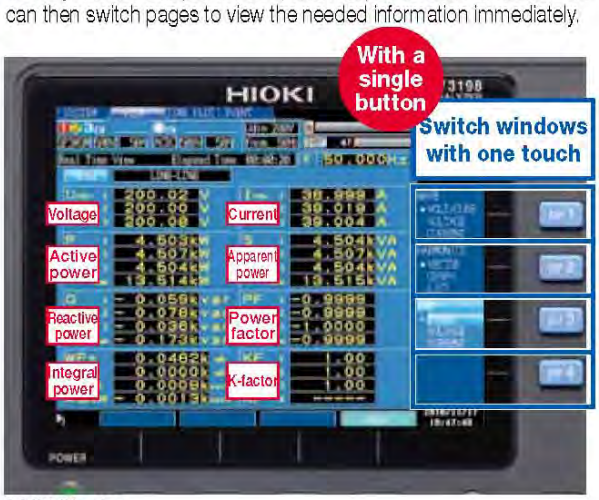
# PW3198 Never Misses the Moment a Power Supply Failure Occurs

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**

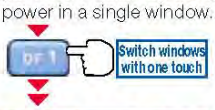
## Acquire the Information You Need Quickly by Switching Pages (RMS Value)

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.

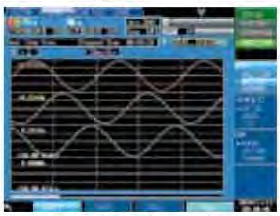



**Waveform Display**

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

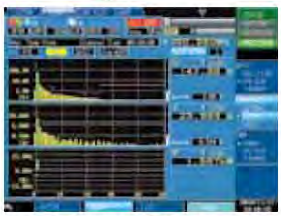

**Vector Display**

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.

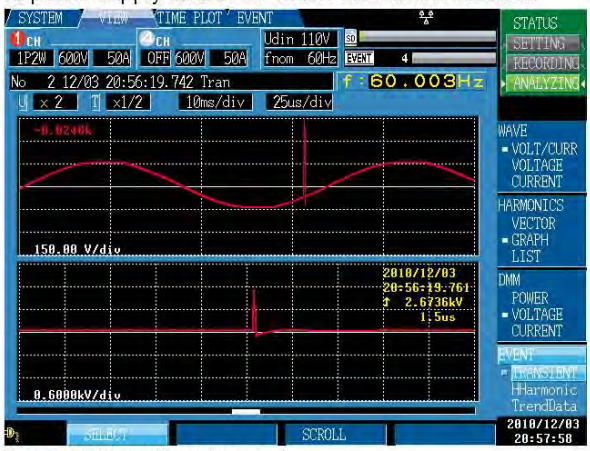



**Harmonic Bar Graph Display**

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

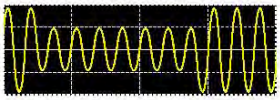
## Reliably Detect Power Supply Failures (Event)

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.



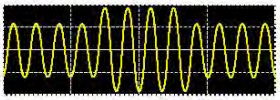

**Transient Overvoltage (Impulse)**

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.



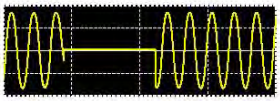
**Voltage Dip (Voltage Drop)**

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



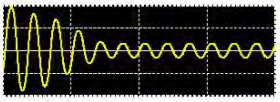
**Voltage Swell (Voltage Rise)**

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.



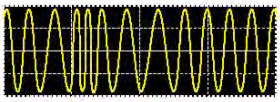
**Interruption**

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.



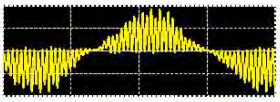
**Inrush Current**

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



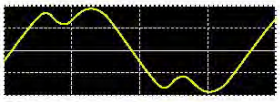
**Frequency Fluctuations**

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



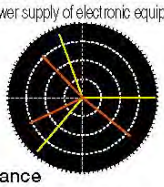
**High-order Harmonic**

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.

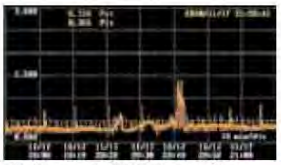
# Simultaneous Recording of TIME PLOT Data and Event Waveforms

## TIME PLOT Data — TIME PLOT Recording of All Parameters

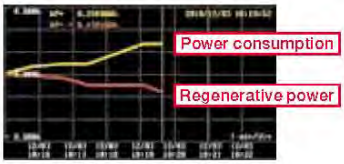
The PW3198 can simultaneously record 8,000 or more parameters, such as voltage, current, power, power factor, frequency, integral power, harmonic, and flicker, at the specified recording interval. The PW3198 never fails to capture the peak because it performs calculations continuously and records the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


Trend Recording
(TIME PLOT Recording)

Harmonic Recording



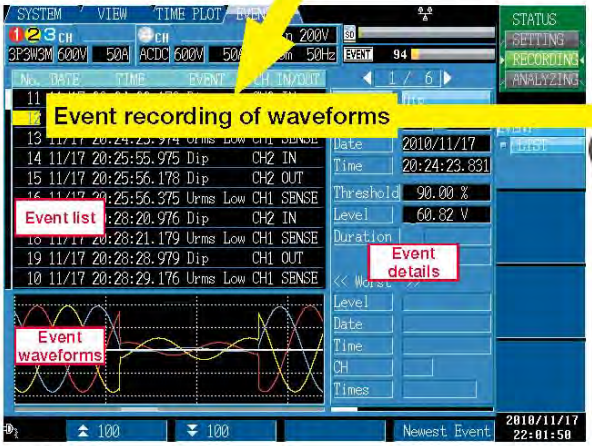
Flicker and ΔV10 Recording




Integral Power Recording

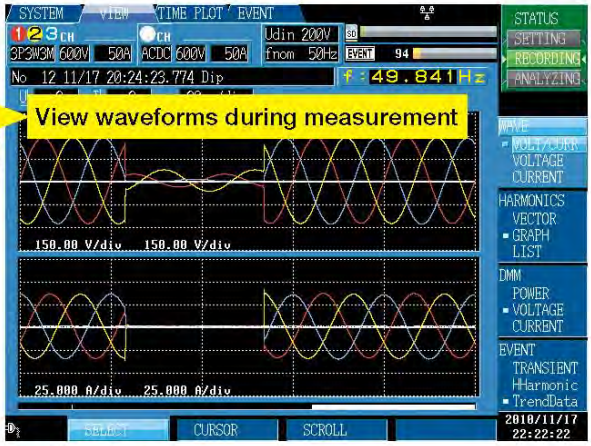
## Event Waveforms — Capture up to 55,000 Instantaneous Waveforms of Power Supply Failures

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.



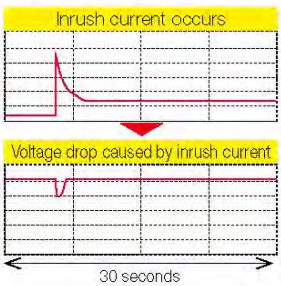

### Event List

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**

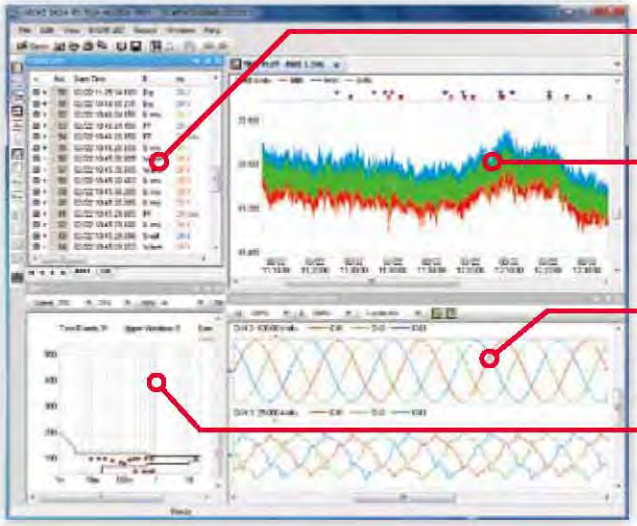
When a voltage drop or inrush current occurs, RMS value changes are recorded over 30 seconds simultaneously. This function can also be used to check the voltage drop caused by inrush current generated by the start of the motor.

# 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.**



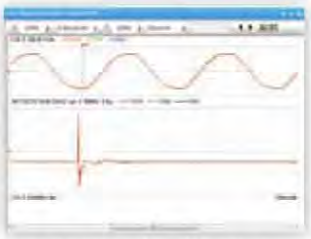
### Event List Window
Display a list of power supply failures (events) that occurred.

### 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.

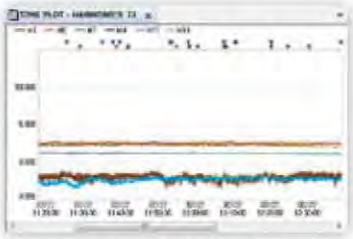
### ITIC Curve Display Window
Analyze the ITIC (CBEMA) curve (tolerance curve) used in the power quality standards in the United States.

Status Window



Transient Waveform Window

Inrush Current Event Graph Window



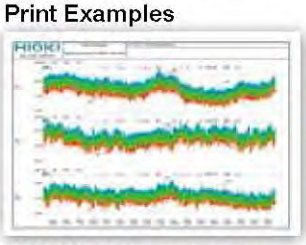
Harmonics TIME PLOT Window

## 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<br>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)<br>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).

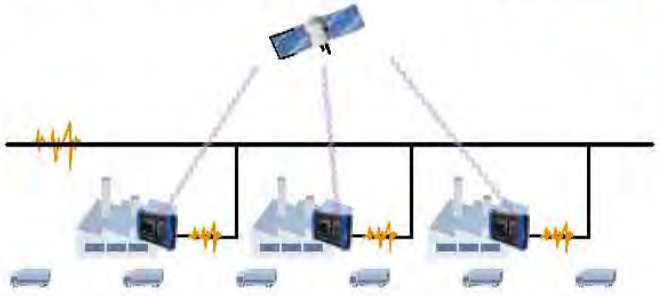

Conduct off-site remote control with a tablet PC using a wireless LAN router

## 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.

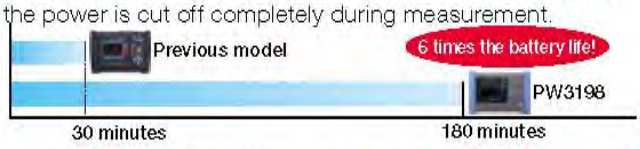
## GPS Time Synchronization

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

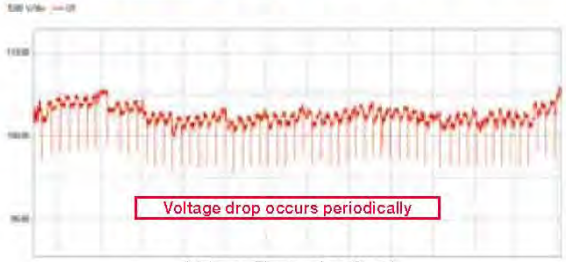
Measure at a power line frequency of 50/60 Hz as well as 400 Hz.

# 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.



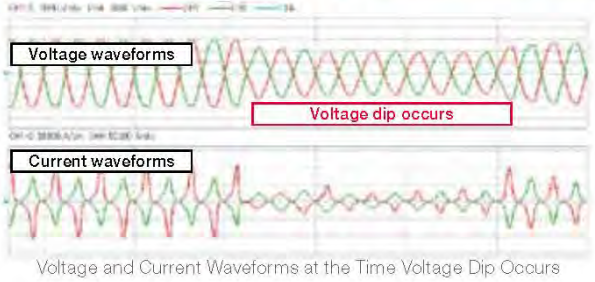

Voltage Fluctuation Graph

**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.



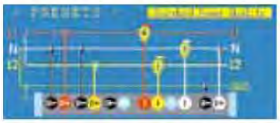

Voltage and Current Waveforms at the Time Voltage Dip Occurs

**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.**

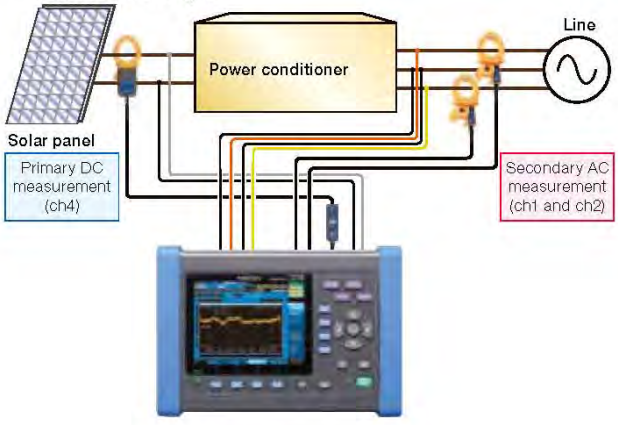
## Surveying a Solar Power Generation System

**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.)

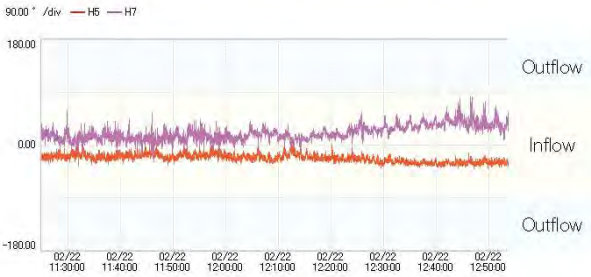
**Measurement Method**
Set up the PW3198 on the site and measure the voltage, current, and power. To survey the power quality, select the "Standard power quality measurement" course in the PRESETS menu. To measure the DC voltage, connect channel 4 to the primary side of the solar panel.



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<br>Frequency<br>DC voltage<br>Harmonic voltage (0 to 50th order)<br>Inter-harmonic voltage (0.5 to 49.5th)<br>Total harmonic voltage distortion factor | Waveform voltage peak<br>Frequency (1 cycle, 10-sec)<br>IEC Flicker (Pst, Plt)<br>Harmonic voltage phase angle (0 to 50th)<br>High order harmonic voltage component<br>Voltage Unbalance factor<br>(Zero-phase /Negative-phase) |
| **Current** measurement items (TIME PLOT Recording) | RMS current<br>Waveform current peak<br>Harmonic current phase angle (0 to 50th)<br>Harmonic current (0 to 50th)<br>Inter-harmonic current (0.5 to 49.5th) | High order harmonic current component<br>Total harmonic current distortion factor<br>Current Unbalance factor<br>(Zero-phase /Negative-phase)<br>K factor<br>DC current (when using compatible sensor) |
| **Power** measurement items (TIME PLOT Recording) | Active power<br>Reactive power<br>Apparent power<br>Power factor | Harmonic power (0 to 50th)<br>Harmonic voltage-current phase angle (0 to 50th)<br>Active energy<br>Reactive energy |
| **EVENT** measurement items (EVENT Recording) | Transient overvoltage<br>Voltage swell<br>Voltage dip<br>Interruption<br>Inrush current | Frequency fluctuations<br>Voltage waveform comparison<br>Timer<br>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<br>**Standard Power Quality** : Record and monitor voltage and current elements, frequency, and harmonics, plus detect events<br>**Inrush Current** : Measure inrush current (basic voltage measurement required)<br>**Recording** : Record only trend data, no event detection<br>**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)<br>**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<br>IEEE1159<br>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<br>Slot : SD standard compliant<br>Compatible card : SD memory card/ SDHC memory card<br>Supported memory capacity : Max. 32 GB with SD Card; only use of the HIOKI 2GB SD Memory Card Model Z4001 is guaranteed by HIOKI.<br>*Contact your HIOKI representative for special order larger capacity cards that offer the HIOKI guarantee.*<br>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)<br>Connector : D-sub9pin<br>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)<br>2. Downloading of data from the SD memory card using the 9624-50 PQA-HiView Pro<br>Connector : RJ-45<br>Transmission method : 10BASE-T,100BASE-TX |
| USB2.0 Interface | 1. Recognizes the SD memory card as a removable disk when connected to a computer.<br>*The instrument cannot be connected during recording (including standby operation) or analysis.*<br>2. Download data from the SD memory card using the 9624-50 PQA-HiView Pro<br>*The instrument cannot be connected during recording (including standby operation) or analysis.*<br>Connector : Series B receptacle<br>Connection destination : Computer [WindowsXP, WindowsVista(32bit), Windows7 (32/64bit)] |
| External control interface | Connector : 4-pin screwless terminal block<br>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<br>Min. pulse width: 30 ms; rated voltage: -0.5 V to +6.0 V<br>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)<br>(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<br>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):<br>Between voltage measurement terminals (U1 to U3) and voltage measurement terminals (U4)<br>4.30 kVrms (1 mA@50/60 Hz, 1 mA sense current):<br>Between voltage input terminal (U1 to U3) and current input terminals/interfaces<br>Between voltage (U4) and current measurement terminals, and interfaces |
| Applicable standards | Safety EN61010<br>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<br>Transient voltage value, Transient width<br>For continuous transient incidents<br>Transient period (Period from transient IN to transient OUT)<br>Max. transient voltage value (Max. peak value during the period)<br>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<br>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<br>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)<br>±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)<br>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<br>Dip : Dip depth, Dip duration<br>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<br>Dip : A dip is detected when the RMS voltage refreshed each half-cycle exceeds the threshold in the negative direction<br>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<br>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)<br>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<br>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)<br>±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)<br>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)<br>maximum and minimum points sampled during approx. 200 ms aggregation |
| Sampling frequency | 200kHz |
| Measurement range, resolution | Voltage waveform peak : ±1200.0 Vpeak, 0.1V<br>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.<br>Sink (consumption) and Source (regeneration)<br>Apparent power : Apparent power of each channel and its sum for multiple channels<br>No polarity<br>Reactive power : Reactive power of each channel and its sum for multiple channels<br>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)<br>Apparent power : Calculated from RMS voltage U and RMS current I<br>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<br>Apparent power : ±1 dgt. for calculations derived from the various measurement values<br>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<br>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)<br>Integrated separately by consumption and regeneration from active power<br>Integrated separately by lag and lead from reactive power<br>Integration starts at the same time as recording<br>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.<br>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<br>Displacement power factor : Calculated from the phase difference between the fundamental voltage wave and the fundamental current wave<br>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<br>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%<br>Current unbalance factor : Component is V and unbalance factor is 0.00% to 100.00% |
| Measurement accuracy | Voltage unbalance factor : ±0.15%<br>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<br>High-order harmonic voltage component value<br>High-order harmonic current component value<br>For continuous incidents<br>High-order harmonic voltage component maximum value<br>High-order harmonic current component maximum value<br>High-order harmonic voltage component period<br>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<br>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.<br>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<br>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<br>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)<br>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<br>(At least 1% of nominal voltage) | Specified with a nominal voltage of at least 100 V<br>Order 0: ±0.3%rdg.±0.08%f.s.<br>Order 1+: ±5.00%rdg |
| Voltage<br>(<1% of nominal voltage) | Specified with a nominal voltage of at least 100 V<br>Order 0: ±0.3%rdg.±0.08%f.s.<br>Order 1+: ±0.05% of nominal voltage |
| Current | Order 0: ±0.5%rdg.±0.5%f.s. +clamp-on sensor accuracy<br>Order 1 to 20th: ±0.5%rdg.±0.2%f.s. +clamp-on sensor accuracy<br>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<br>Order 1 to 20th: ±0.5%rdg.±0.2%f.s. +clamp-on sensor accuracy<br>Order 21 to 30th: ±1.0%rdg.±0.3%f.s. +clamp-on sensor accuracy<br>Order 31 to 40th: ±2.0%rdg.±0.3%f.s. +clamp-on sensor accuracy<br>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.<br>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<br>4th to 50th orders: ±(0.05° × k+2°) +clamp-on sensor accuracy; (k: harmonic orders)<br>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<br>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.<br><1% of harmonic input nominal voltage : ±0.05% of nominal voltage<br>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<br>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.<br>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")x136H(5.31")x21D(0.83")mm, 230g(8.1oz.) | | 78W(3.07")x152H(5.98")x42D(1.65")mm, 380g(13.4oz.) |

*: 45 to 66Hz

| 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 | CAT III 1000 Vrms<br>CAT IV 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 (6.56ft)<br>Circuit to connector: 1m (3.28ft) |
| Measurable conductor diameter | Max. φ56 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)<br>AC ADAPTER 9445-03 (universal 100 to 240VAC , 9W1A output)for Europe) |

*: 45 to 66Hz

| 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 66Hz

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.<br>L range : 10A AC/DC f.s. | H range : 200A AC/DC f.s.<br>L range : 20A AC/DC f.s. | H range : 2000A AC/DC f.s.<br>L range : 200A AC/DC f.s. |
| Sensor combination Output rate | H range : 1mV/A<br>L range : 10mV/A | H range : 1mV/A<br>L range : 10mV/A | H range : 0.1mV/A<br>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)<br>±1.5%rdg.±0.5%f.s. (45 ≤ f ≤ 66Hz, I ≤ 1800A)<br>±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)<br>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<br>(in 100A go and return electric wire) | Max. 1mA<br>(in 10A go and return electric wire) |
| Effect of external magnetic fields | 400A AC/m corresponds to 6mA, 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")×<br>42D(1.65)mm, 380g(13.4oz.) | 60W(2.36")×112.5H(4.43")×<br>23.5D(23.6")mm, 160g(5.6oz.) |

*: 45 to 66Hz

# Options

CE

## Current measurement (see P14 -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
5000A AC/ 5000A AC (selectable),
φ254mm (10"),
Power supply: LR6 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 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 AC/DC SENSOR (Load current, AC/DC)

CT9691-90
100A AC/DC / 10A AC/DC
(selectable),
φ35mm(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 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 M5 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
6 cords, approx. 3m each:
1 each red, yellow, blue, and gray plus 4 black;
6 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 |



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# APPENDIX B PQ Logging Data for 2015/2016 FY

Please refer to the following pages.

## TC1 – Flicker, Voltage and Frequency

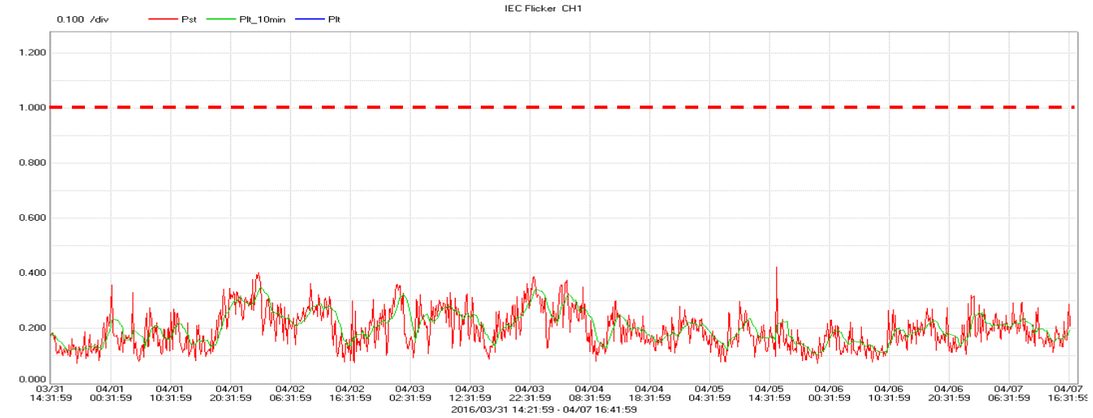


**Figure 11 | TC1 - start of feeder – flicker measurements (Red Phase)**

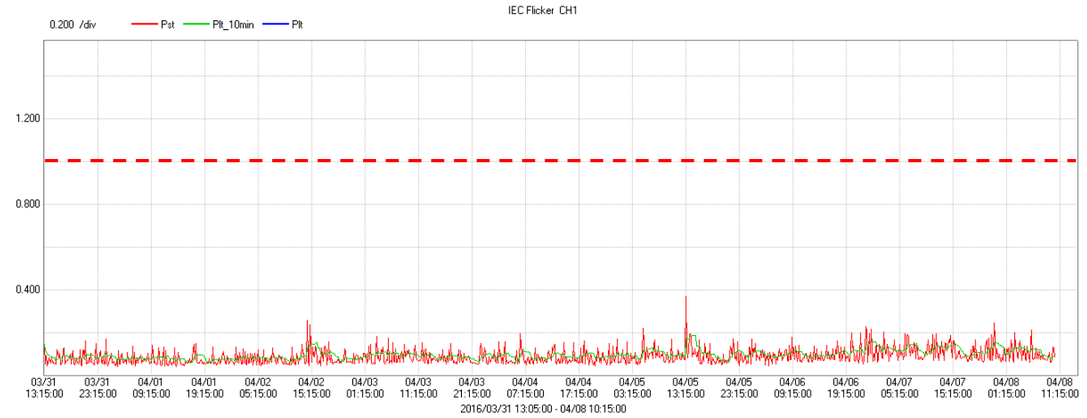


**Figure 14 | TC1 end of feeder - flicker measurements (Red Phase)**

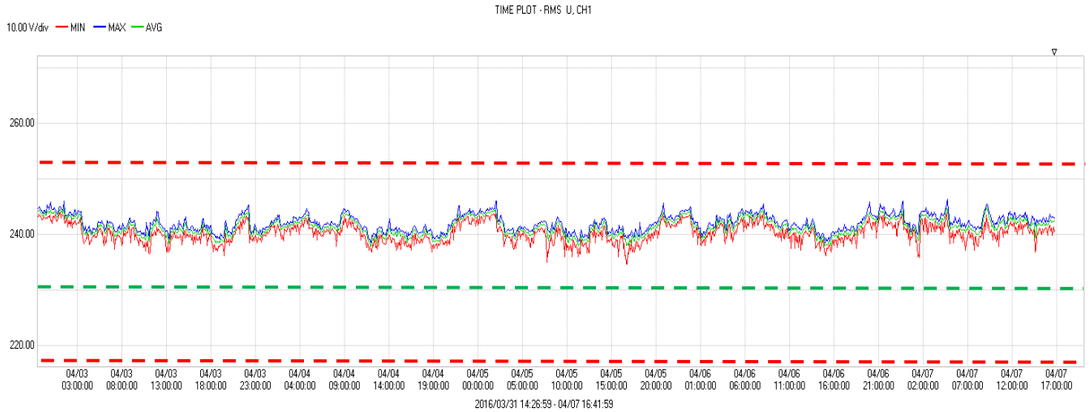


**Figure 12 | TC1 - start of feeder – voltage measurements (Red Phase)**

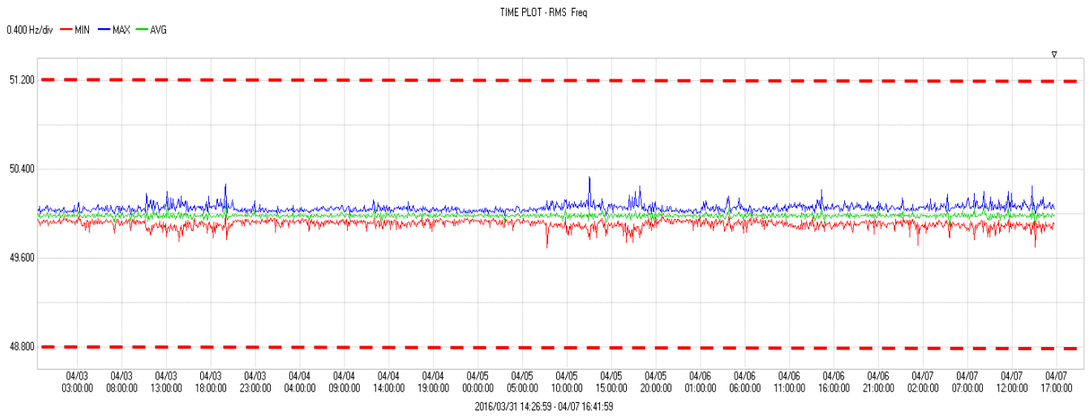


**Figure 13 | TC1 - start of feeder – frequency measurements**

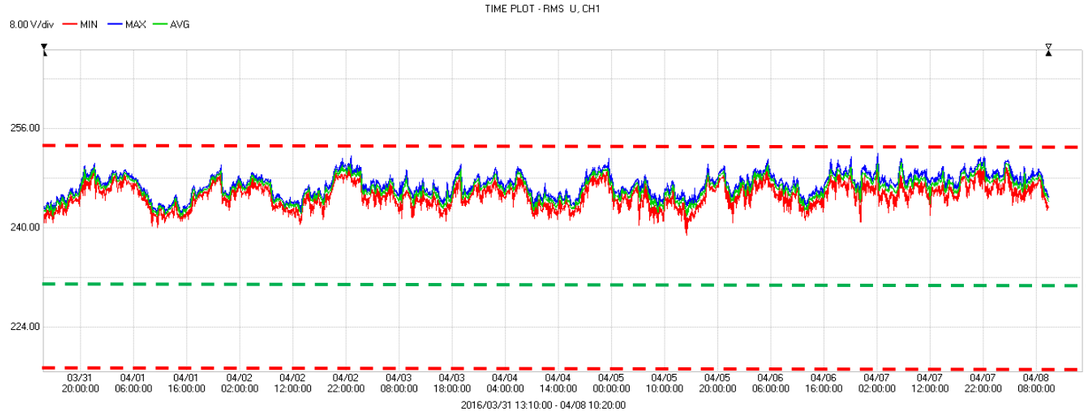


**Figure 15 | TC1 - end of feeder – voltage measurements (Red Phase)**

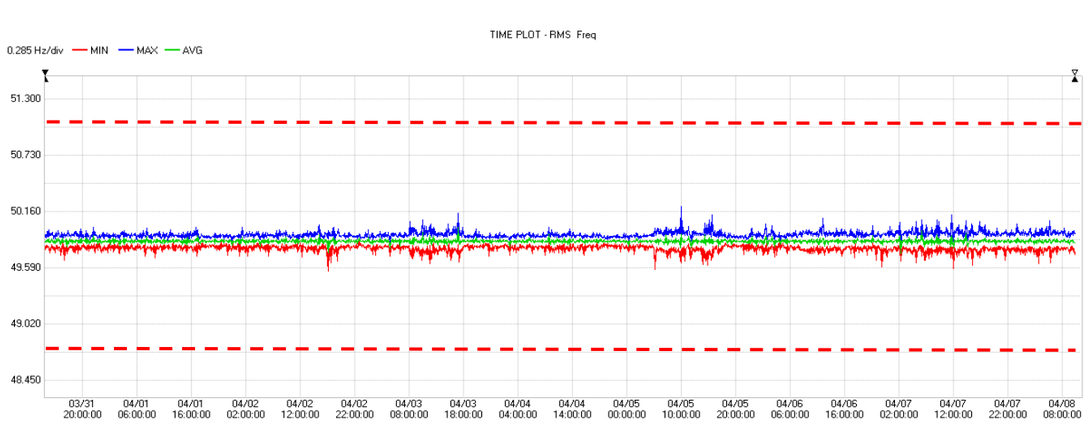


**Figure 16 | TC1 - end of feeder – frequency measurements**

## TC1 – Harmonics

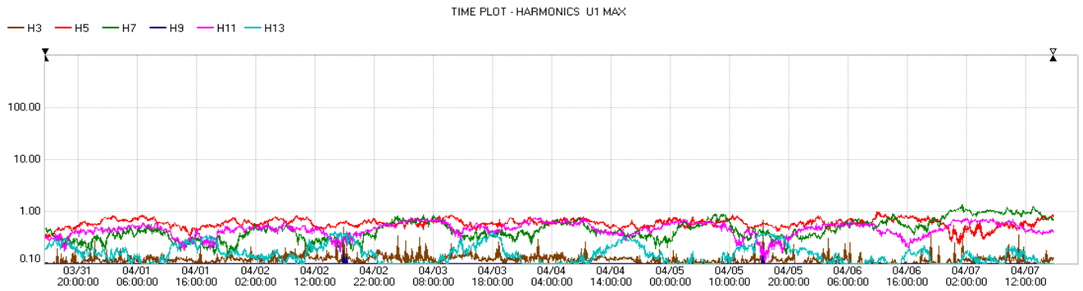


**Figure 17 | TC1 – start of feeder – 3rd to 13th (odd) harmonics**

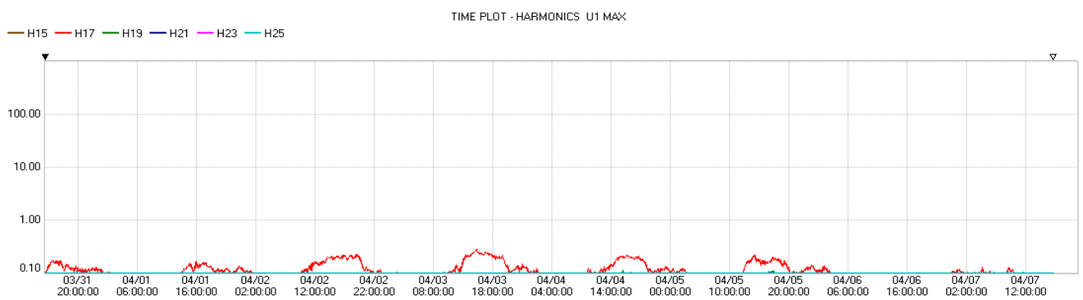


**Figure 18 | TC1 – start of feeder – 15th to 25th (odd) harmonics**

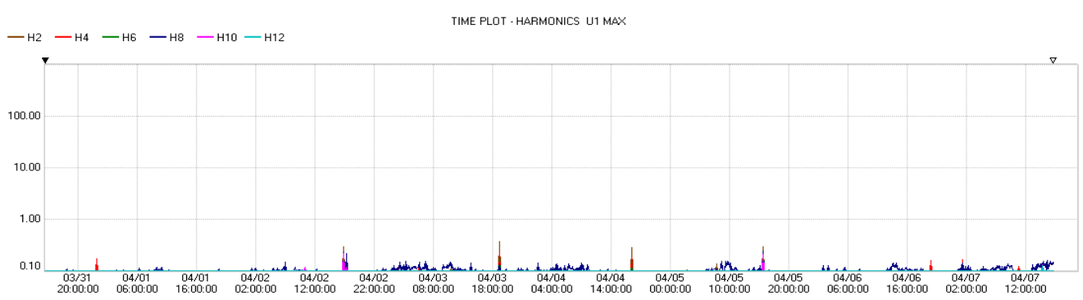


**Figure 19 | TC1 – start of feeder – 2th to 12th (even) harmonics**

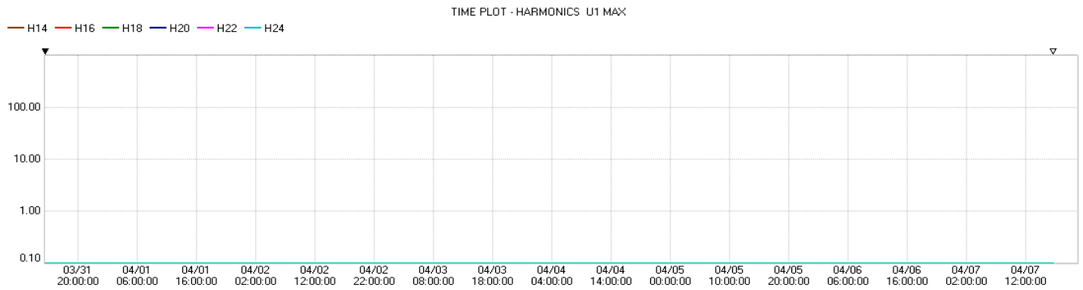


**Figure 20 | TC1 – start of feeder – 14th to 24th (even) harmonics**

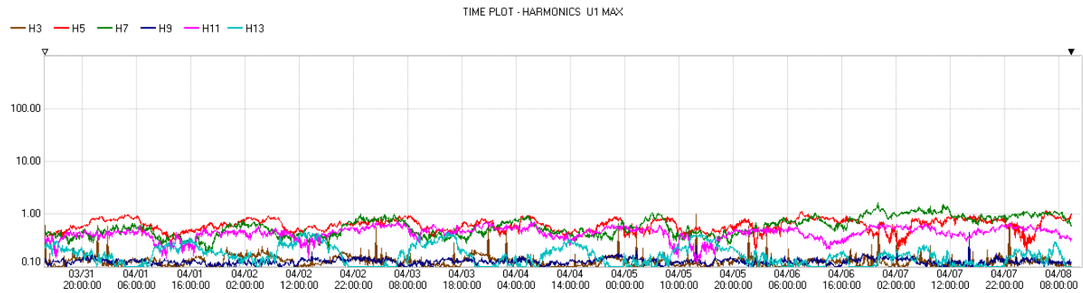


**Figure 21 | TC1 – end of feeder – 3rd to 13th (odd) harmonics**

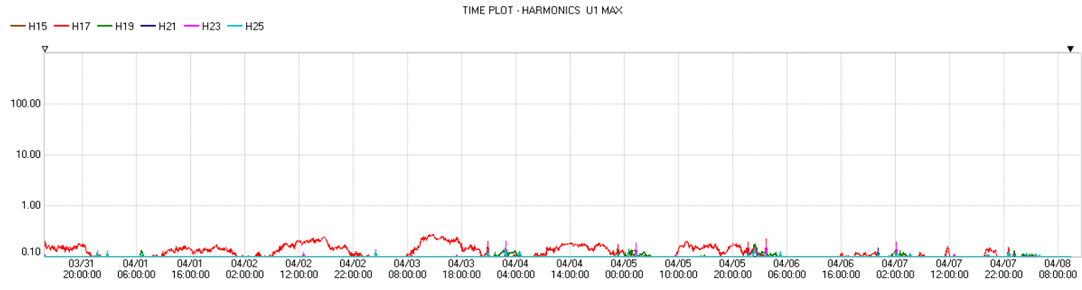


**Figure 22 | TC1 – end of feeder – 15th to 25th (odd) harmonics**

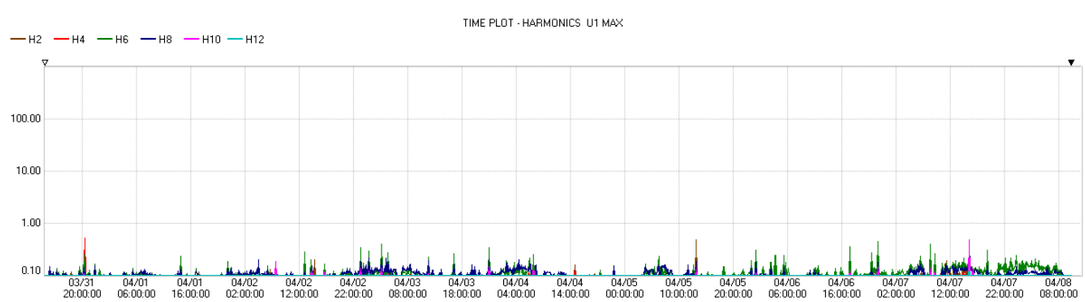


**Figure 23 | TC1 – end of feeder – 2th to 12th (even) harmonics**

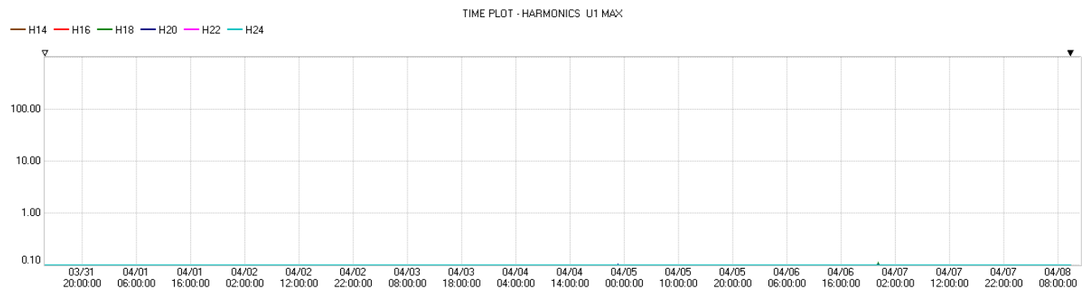


**Figure 24 | TC1 – end of feeder – 14th to 24th (even) harmonics**

## TC2 – Flicker, Voltage and Frequency

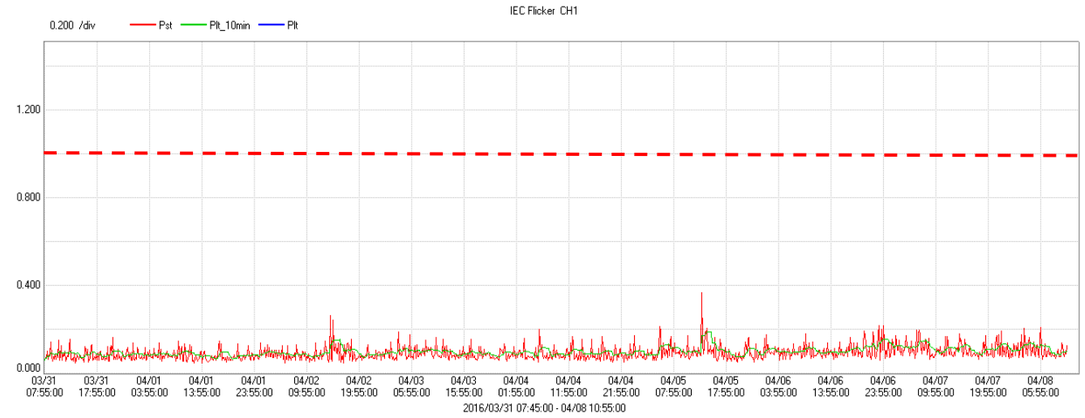


**Figure 25 | TC2 – end of feeder – flicker measurements (Red Phase)**

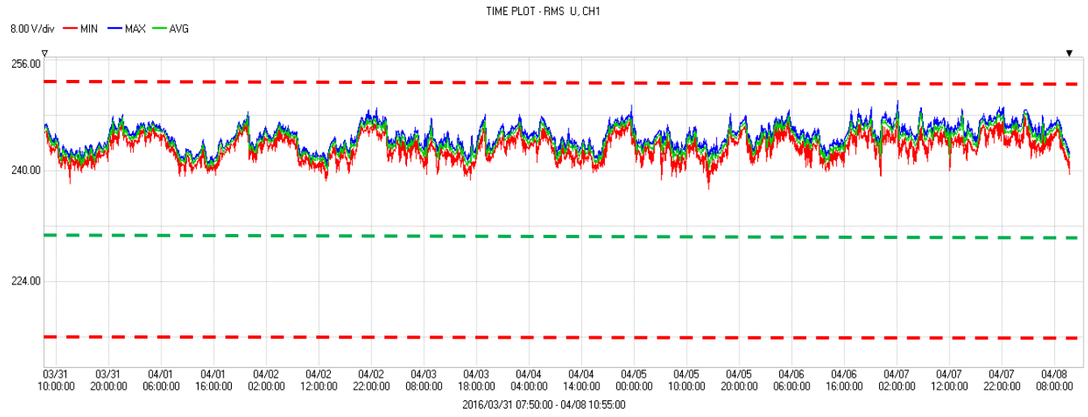


**Figure 26 | TC2 - end of feeder – voltage measurements (Red Phase)**


**Figure 27 | TC2 - end of feeder – frequency measurements**

## TC2 – Harmonics

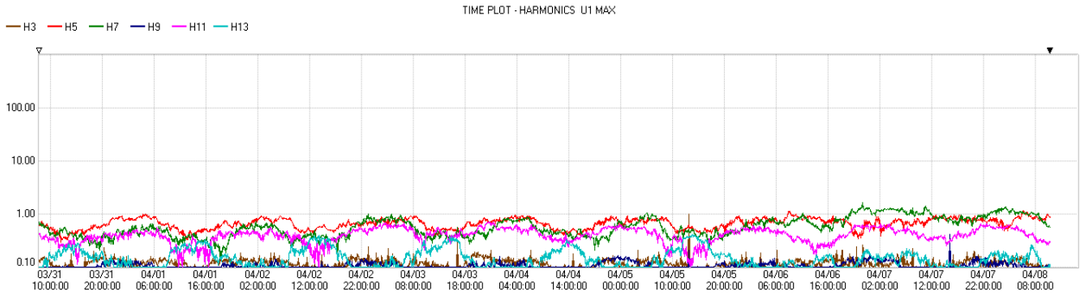


**Figure 28 | TC2 – end of feeder – 3rd to 13th (odd) harmonics**

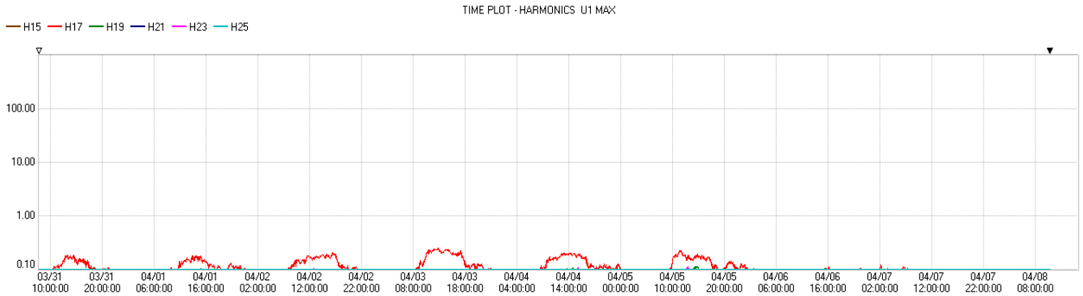


**Figure 29 | TC2 – end of feeder – 15th to 25th (odd) harmonics**

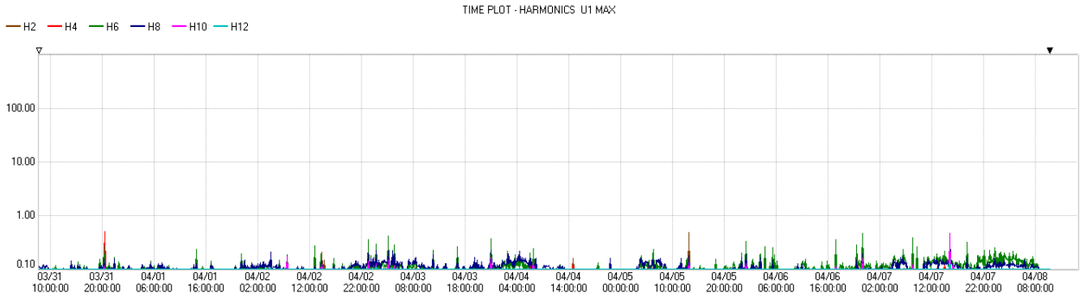


**Figure 30 | TC2 – end of feeder – 2th to 12th (even) harmonics**

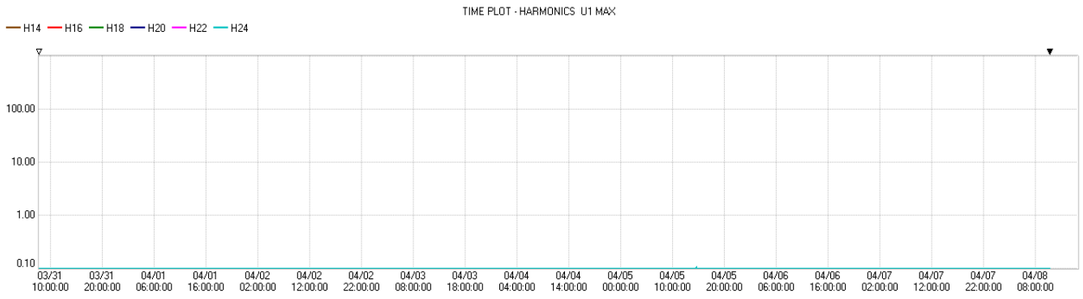


**Figure 31 | TC2 – end of feeder – 14th to 24th (even) harmonics**

## TC3 – Flicker, Voltage and Frequency

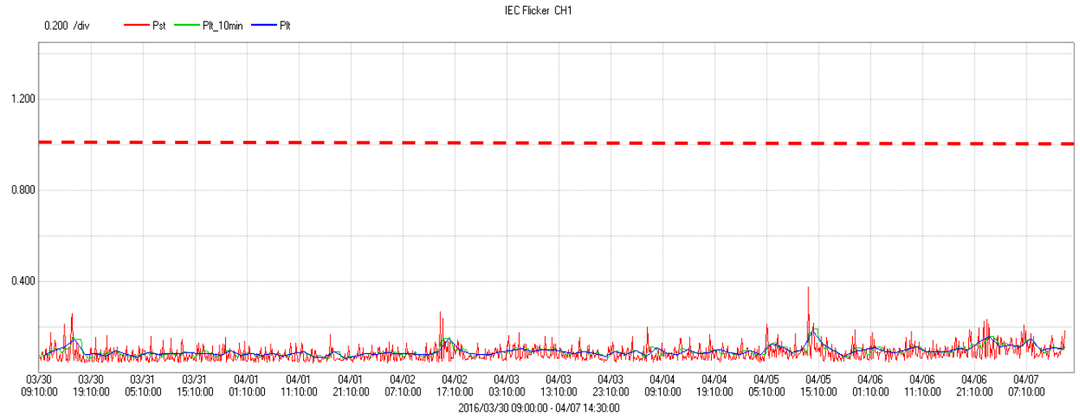


**Figure 32 | TC3 - start of feeder – flicker measurements (Red Phase)**

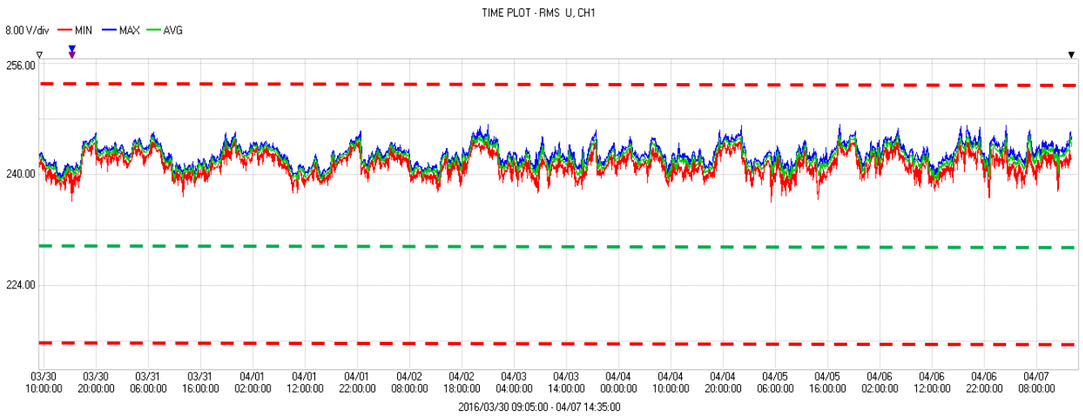


**Figure 33 | TC3 - start of feeder – voltage measurements (Red Phase)**


**Figure 34 | TC3 - start of feeder – frequency measurements**

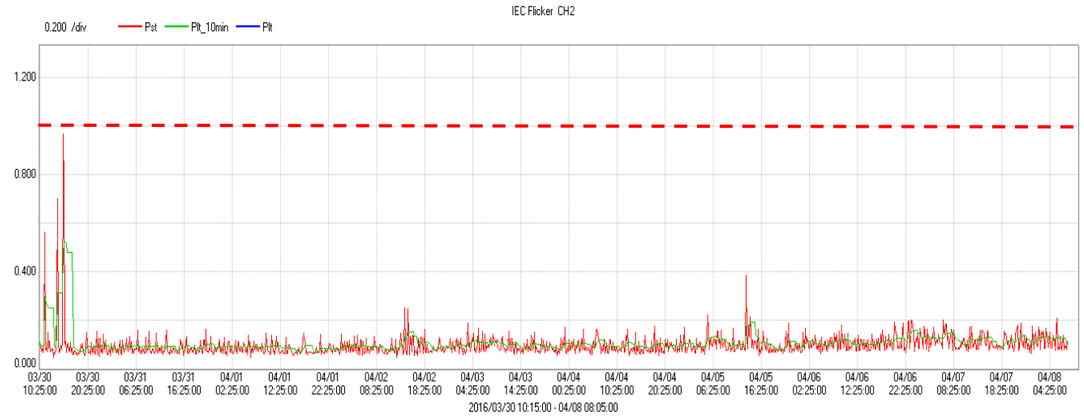


**Figure 35 | TC3 - end of feeder – flicker measurements (Red Phase)**

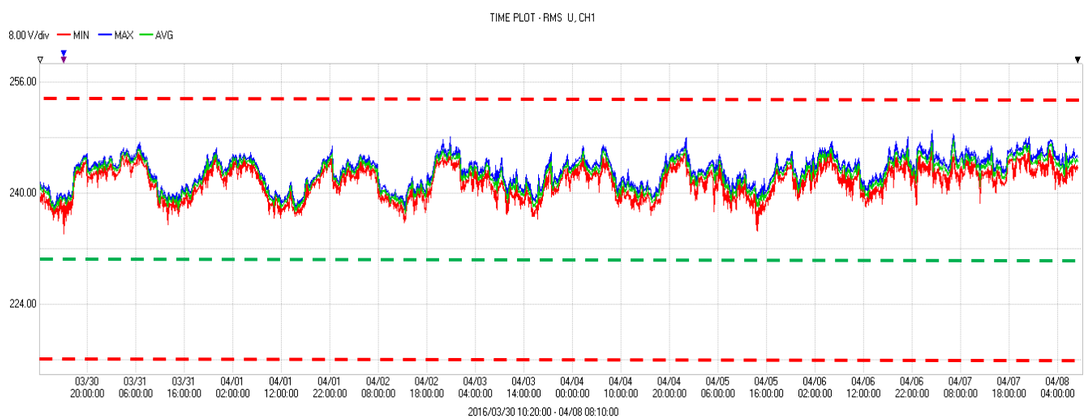


**Figure 36 | TC3 - end of feeder – voltage measurements (Red Phase)**

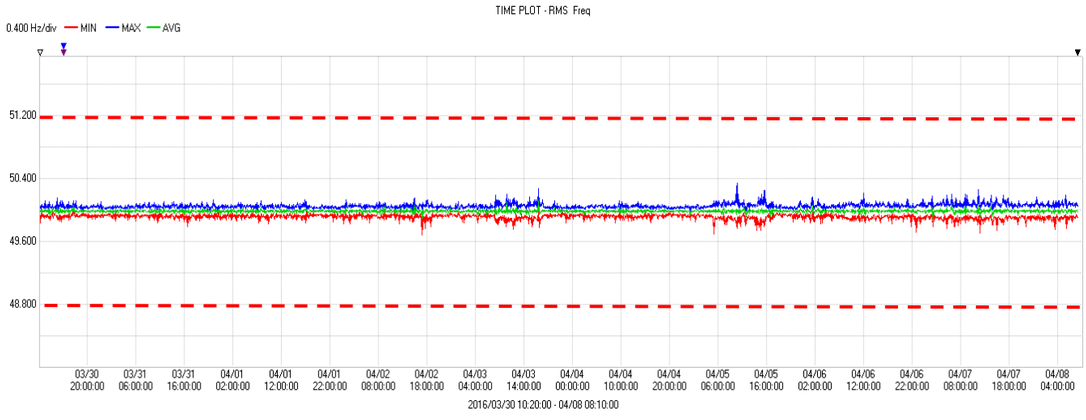


**Figure 37 | TC3 - end of feeder – frequency measurements**

## TC3 – Harmonics

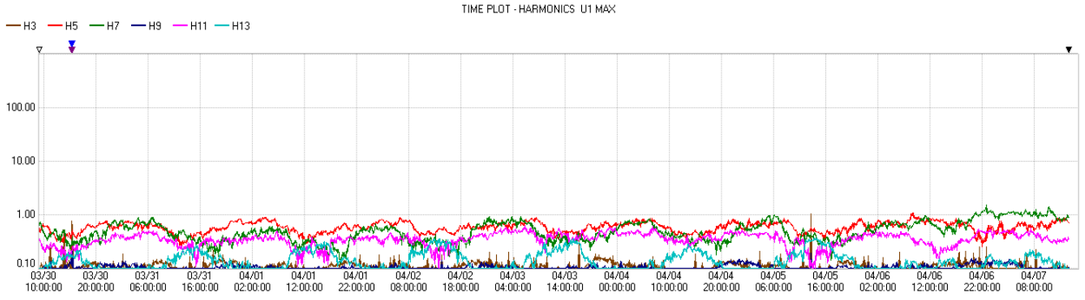


**Figure 38 | TC3 – start of feeder – 3rd to 13th (odd) harmonics**

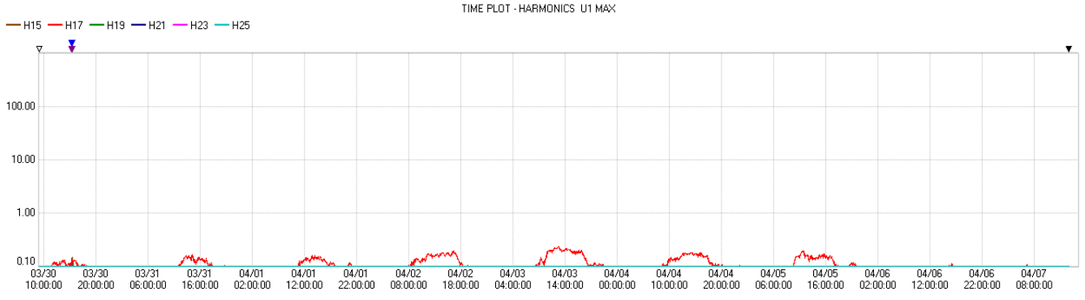


**Figure 39 | TC3 – start of feeder – 15th to 25th (odd) harmonics**

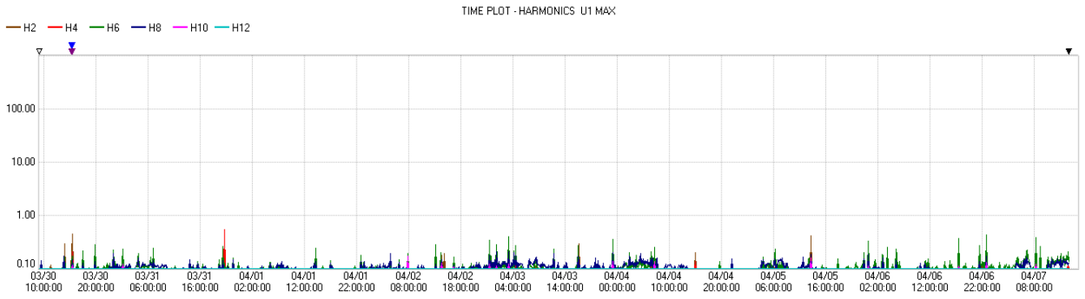


**Figure 40 | TC3 – start of feeder – 2th to 12th (even) harmonics**

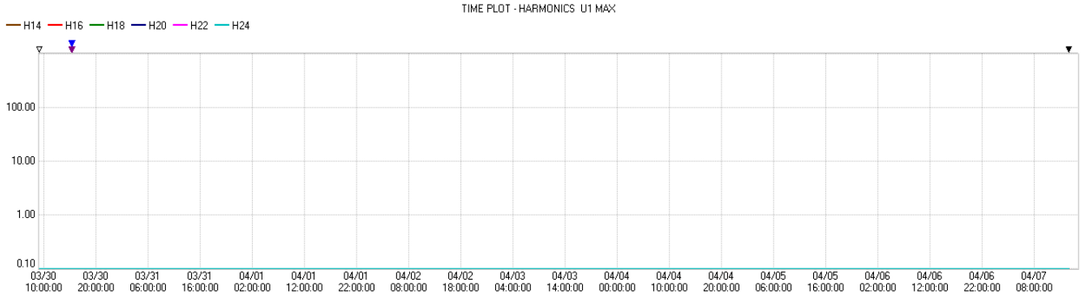


**Figure 41 | TC3 – start of feeder – 14th to 24th (even) harmonics**

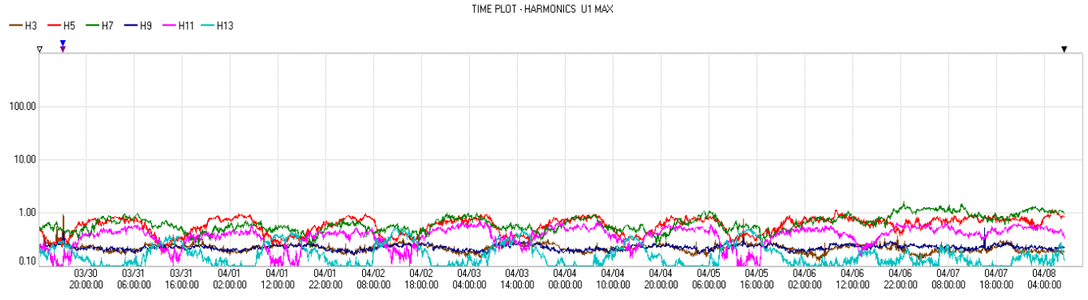


**Figure 42 | TC3 – end of feeder – 3rd to 13th (odd) harmonics**

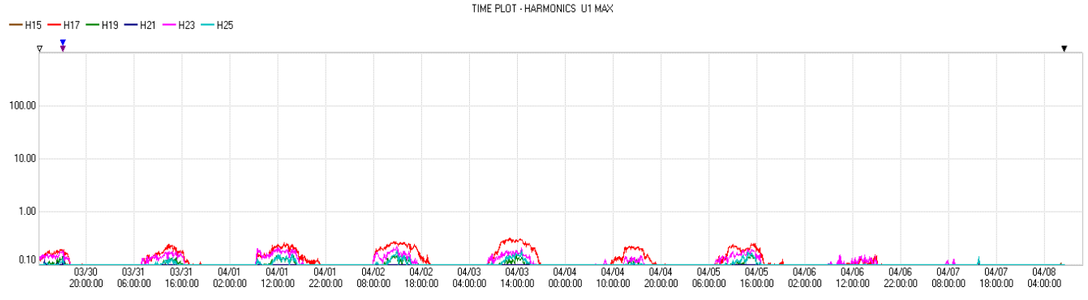


**Figure 43 | TC3 – end of feeder – 15th to 25th (odd) harmonics**

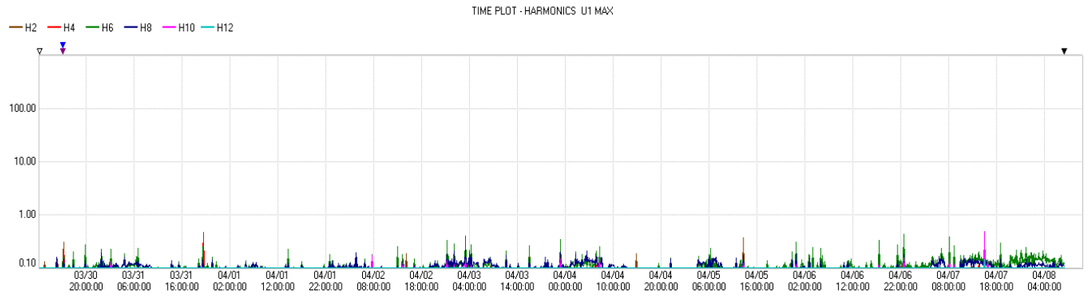


**Figure 44 | TC3 – end of feeder – 2th to 12th (even) harmonics**

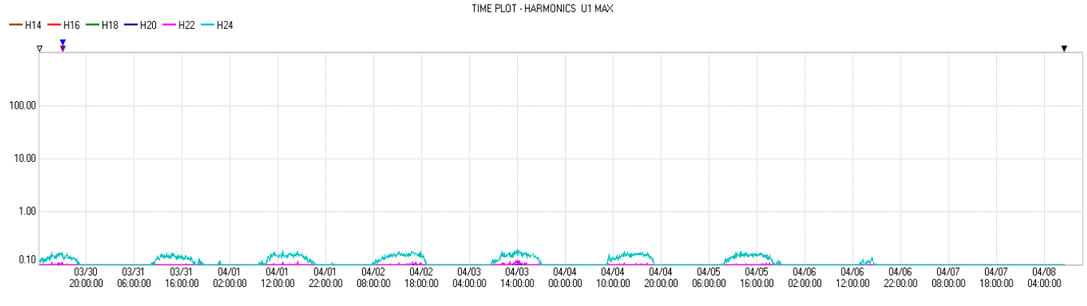


**Figure 45 | TC3 – end of feeder – 14th to 24th (even) harmonics**

## TC4 – Flicker, Voltage and Frequency

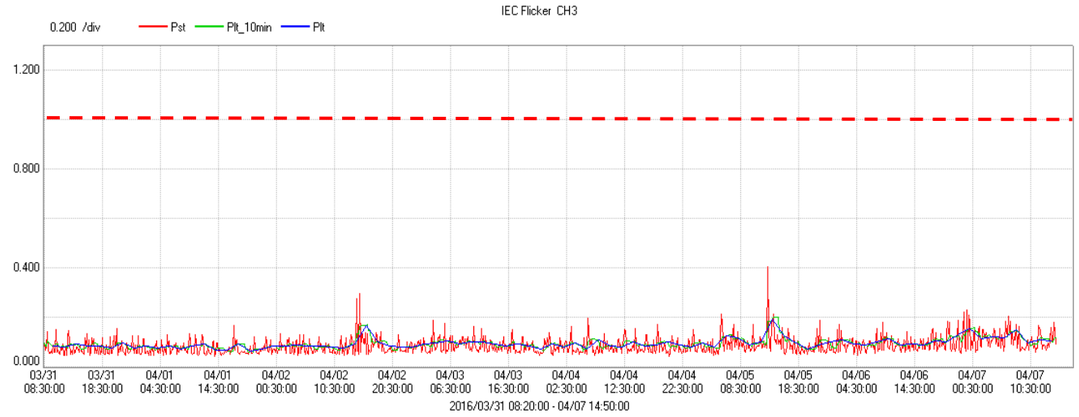


**Figure 46 | TC4 - start of feeder – flicker measurements (Blue Phase)**

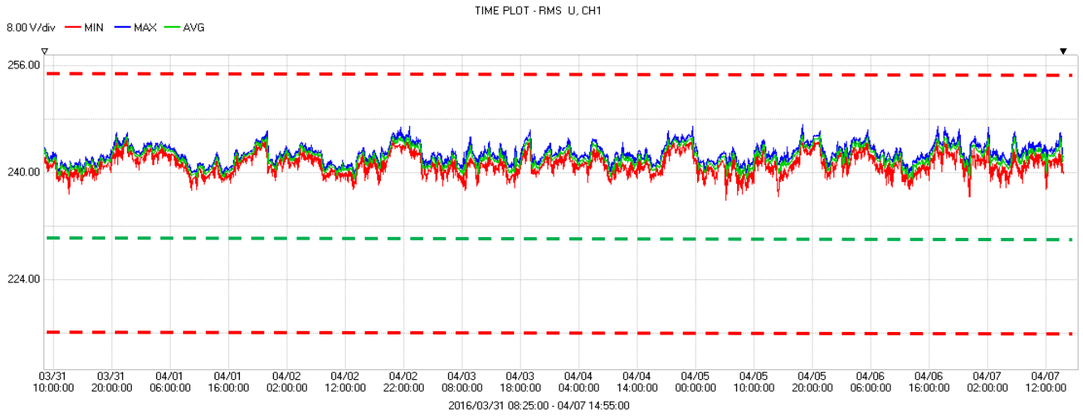


**Figure 47 | TC4 - start of feeder – voltage measurements (Red Phase)**

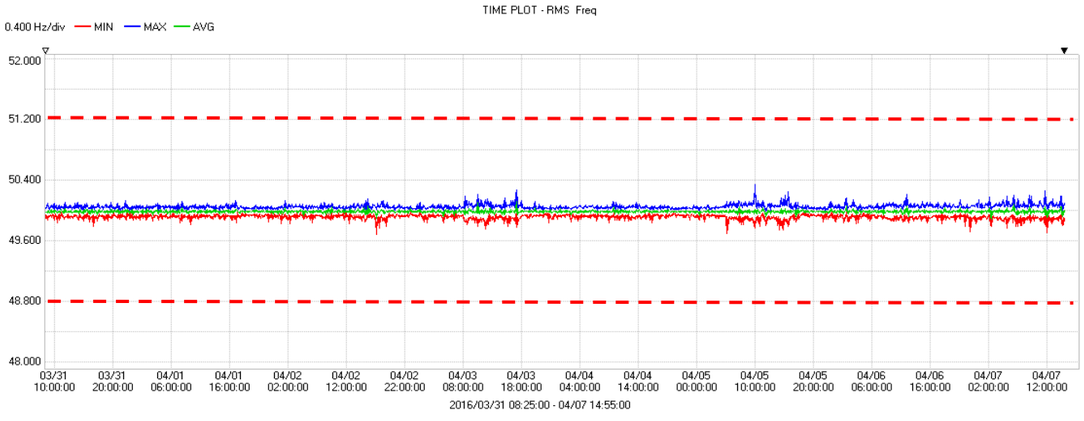


**Figure 48 | TC4 - start of feeder – frequency measurements**

## TC4 – Harmonics

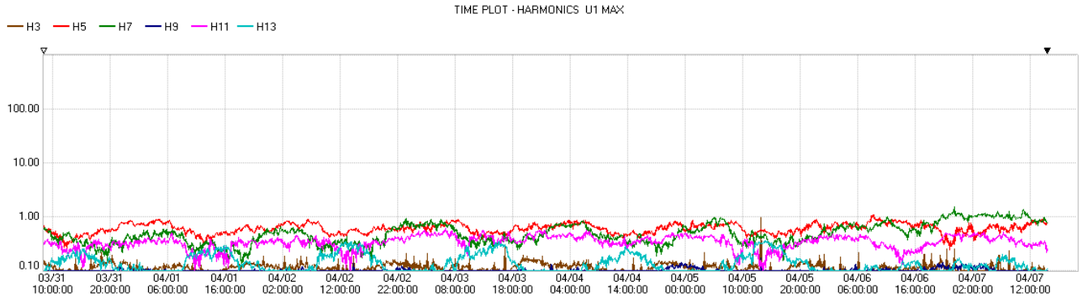


**Figure 49 | TC4 – start of feeder – 3rd to 13th (odd) harmonics**

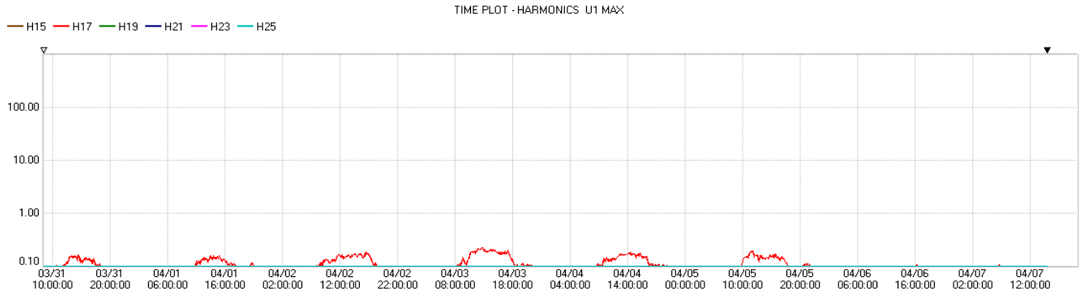


**Figure 50 | TC4 – start of feeder – 15th to 25th (odd) harmonics**

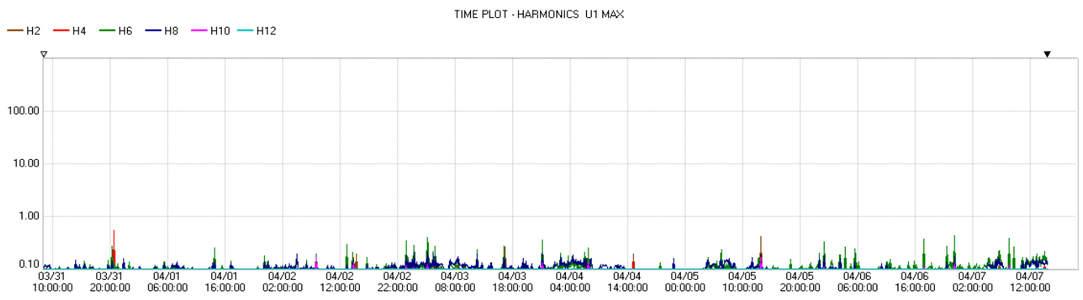


**Figure 51 | TC4 – start of feeder – 2th to 12th (even) harmonics**

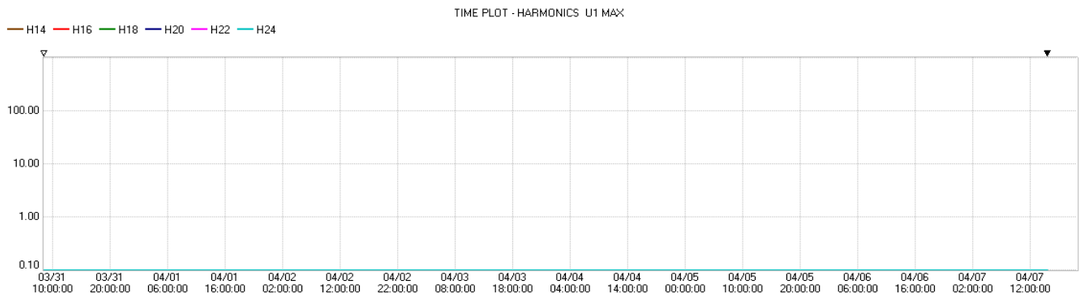


**Figure 52 | TC4 – start of feeder – 14th to 24th (even) harmonics**

## STS1 – Flicker, Voltage and Frequency

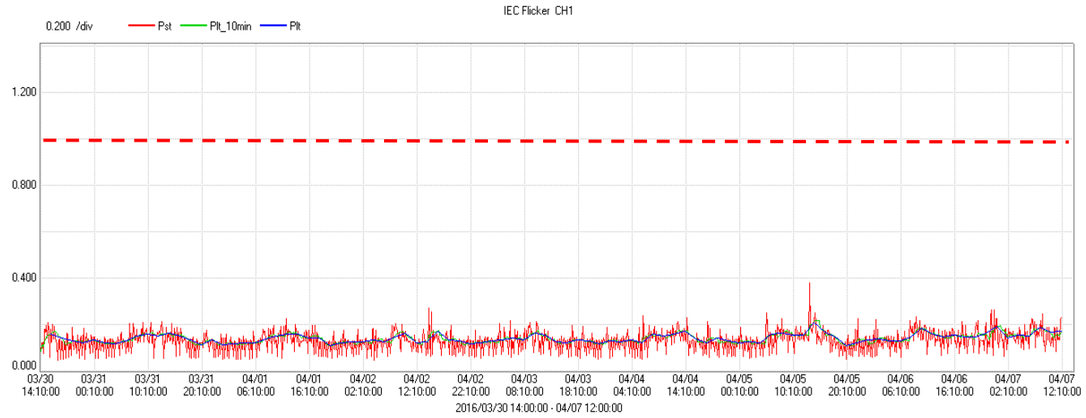


**Figure 53 | STS1 - start of feeder – flicker measurements (Red Phase)**

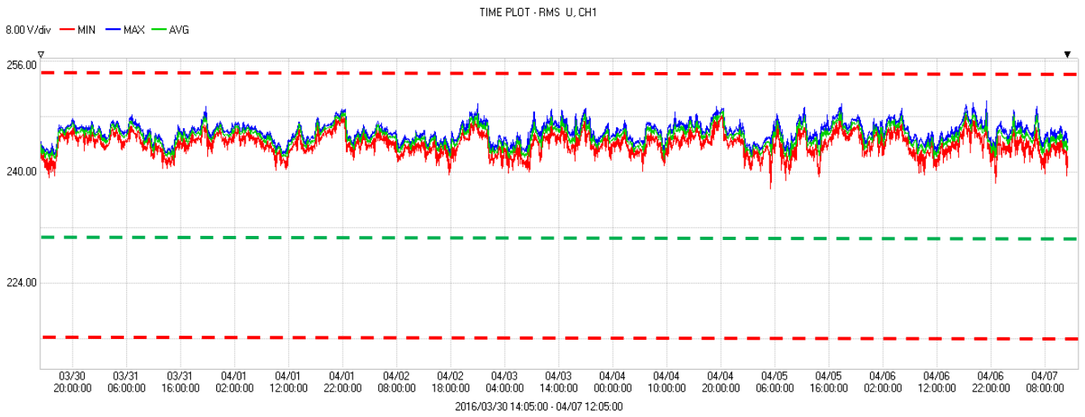


**Figure 54 | STS1 - start of feeder – voltage measurements (Red Phase)**

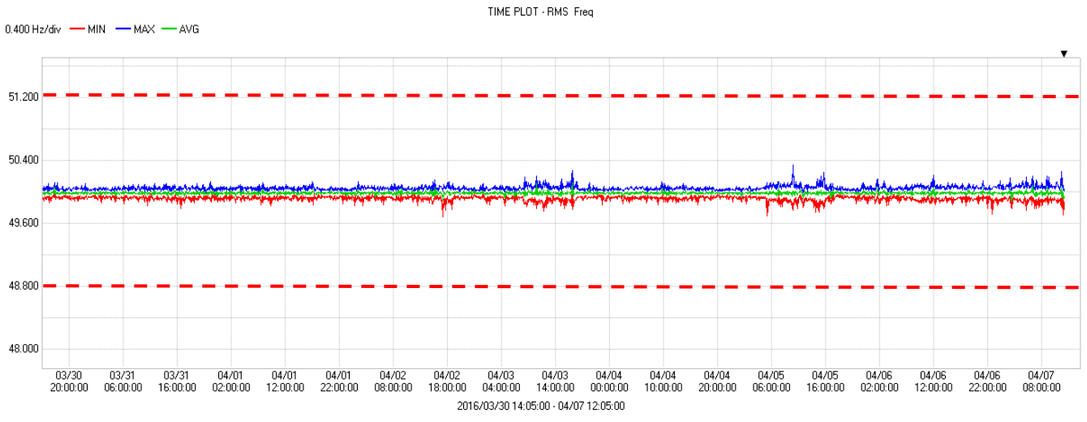


**Figure 55 | STS1 - start of feeder – frequency measurements (Red Phase)**

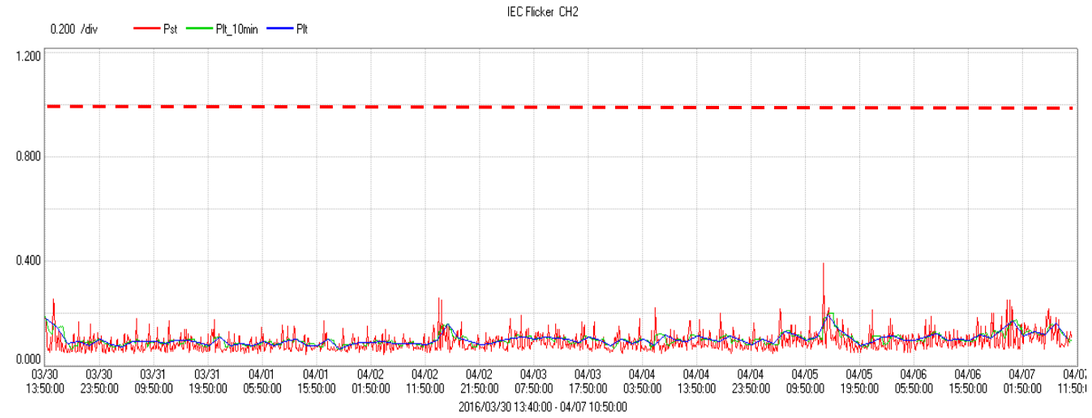


**Figure 56 | STS1 - end of feeder – flicker measurements (White Phase)**

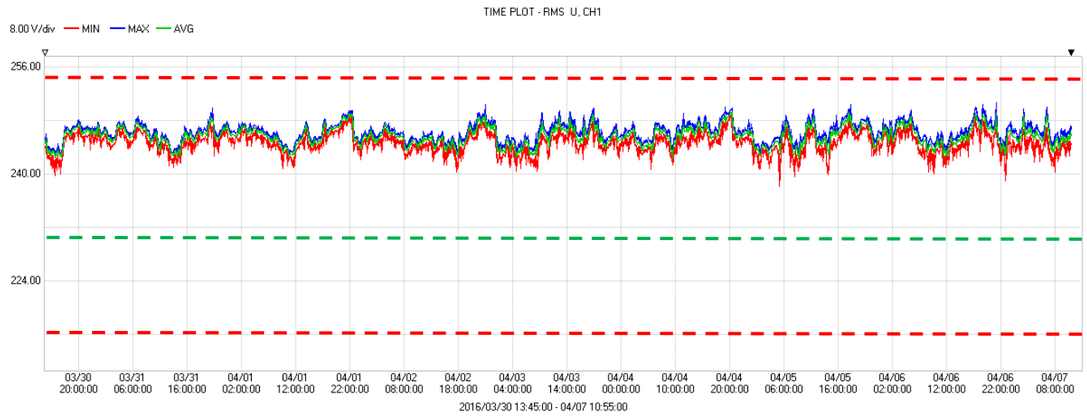


**Figure 57 | STS1 - end of feeder – voltage measurements (Red Phase)**

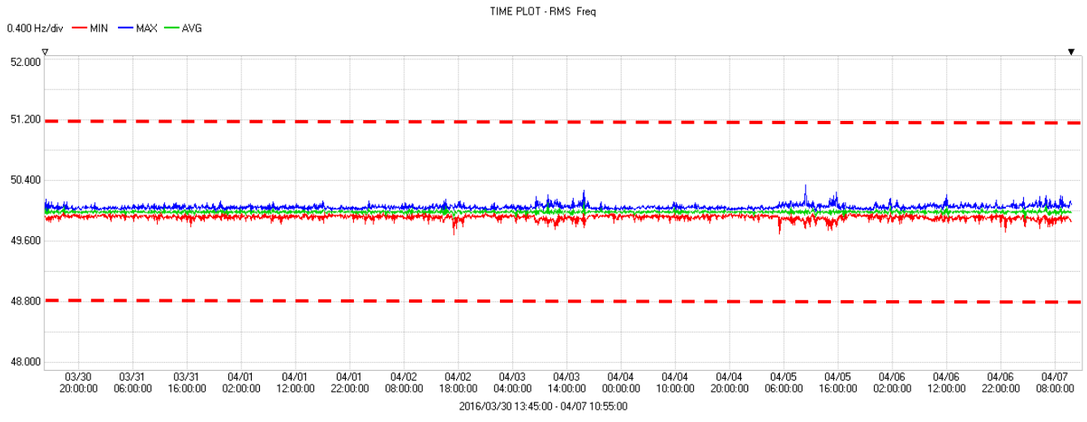


**Figure 58 | STS1 - end of feeder – frequency measurements**

## STS1 – Harmonics

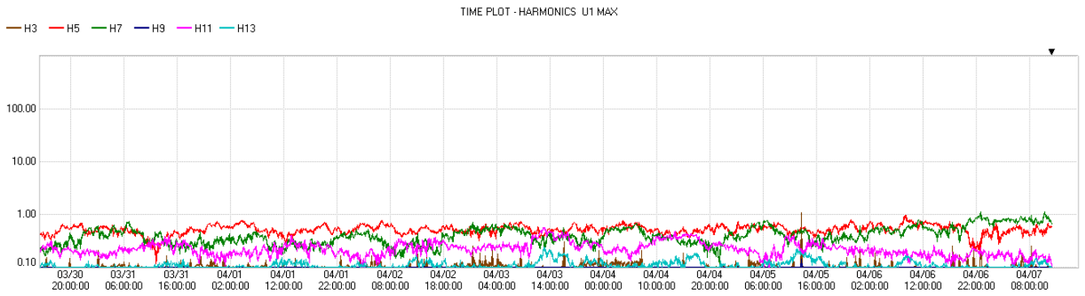


**Figure 59 | STS1 - start of feeder – 3rd to 13th (odd) harmonics**

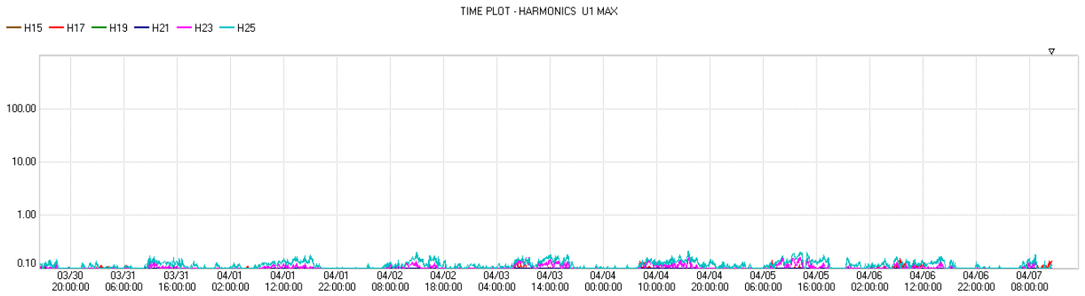


**Figure 60 | STS1 – start of feeder – 15th to 25th (odd) harmonics**

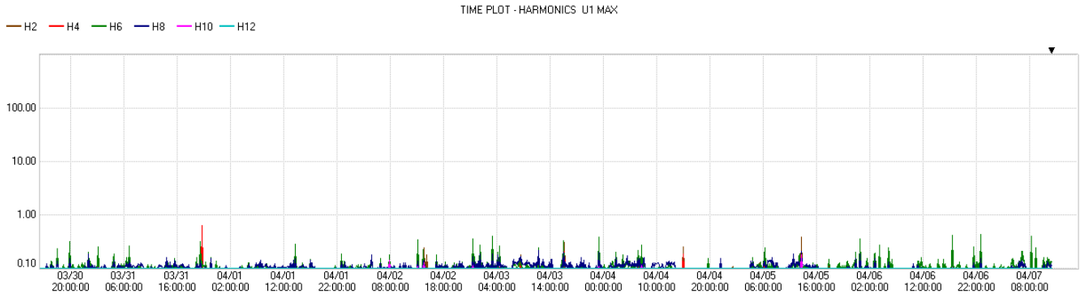


**Figure 61 | STS1 – start of feeder – 2th to 12th (even) harmonics**

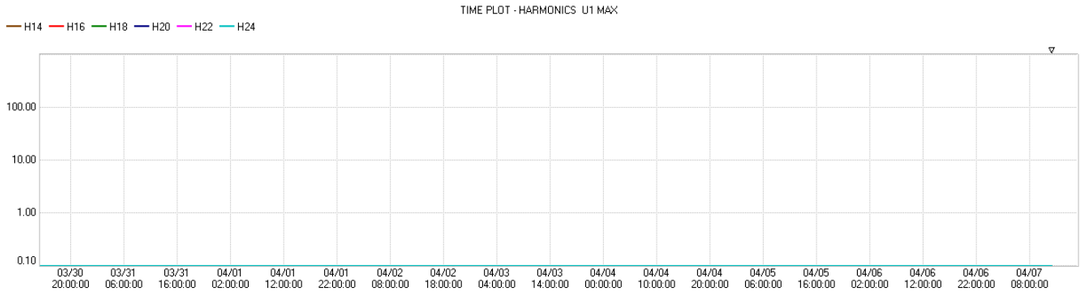


**Figure 62 | STS1 – start of feeder – 14th to 24th (even) harmonics**

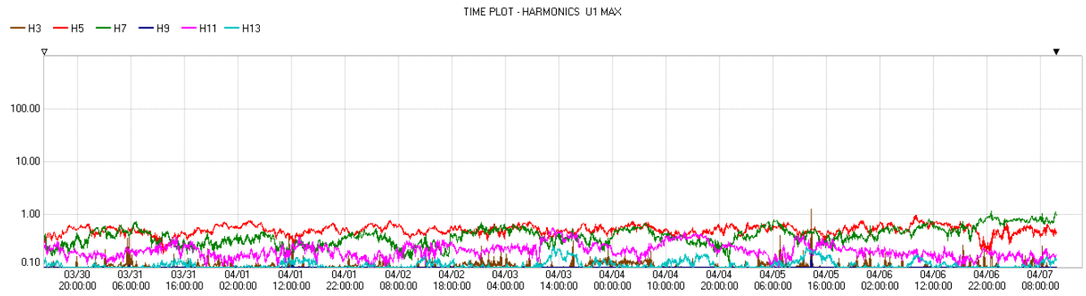


**Figure 63 | STS1 - end of feeder – 3rd to 13th (odd) harmonics**

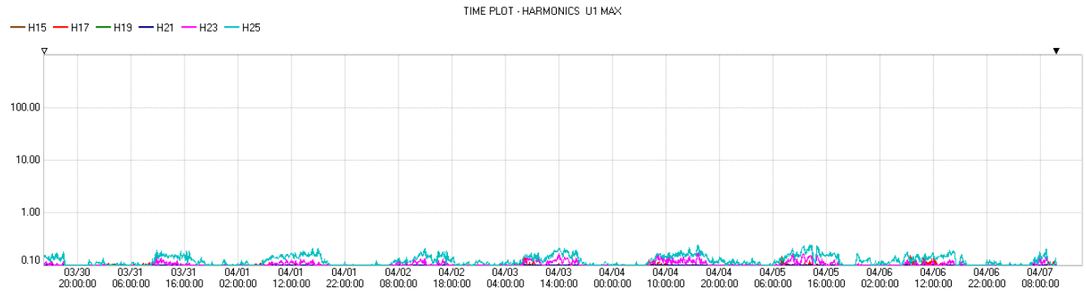


**Figure 64 | STS1 – end of feeder – 15th to 25th (odd) harmonics**

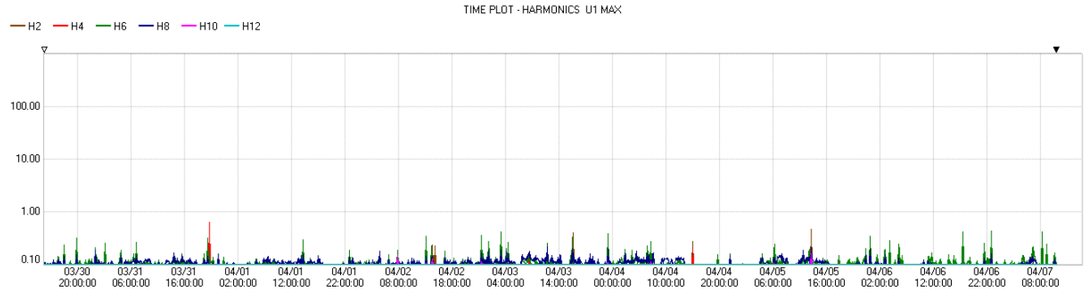


**Figure 65 | STS1 – end of feeder – 2th to 12th (even) harmonics**

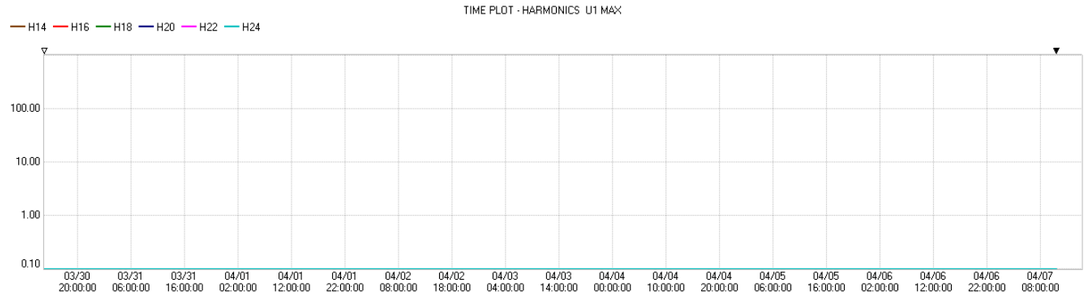


**Figure 66 | STS1 – end of feeder – 14th to 24th (even) harmonics**

## STS2 – Flicker, Voltage and Frequency

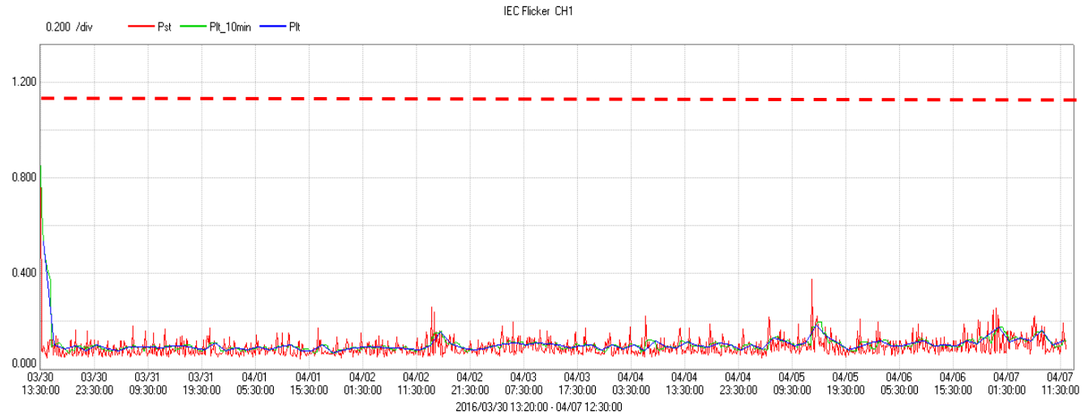


**Figure 67 | STS2 - start of feeder – flicker measurements (Red Phase)**

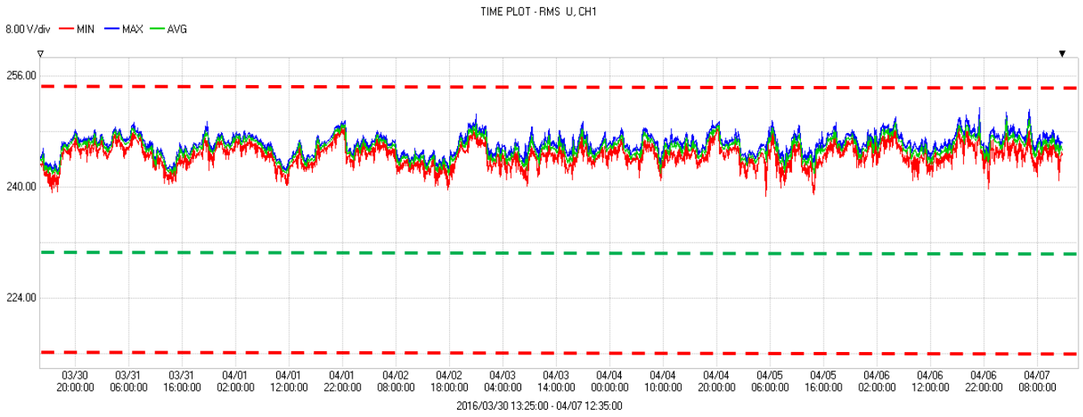


**Figure 68 | STS2 - start of feeder – voltage measurements (Red Phase)**

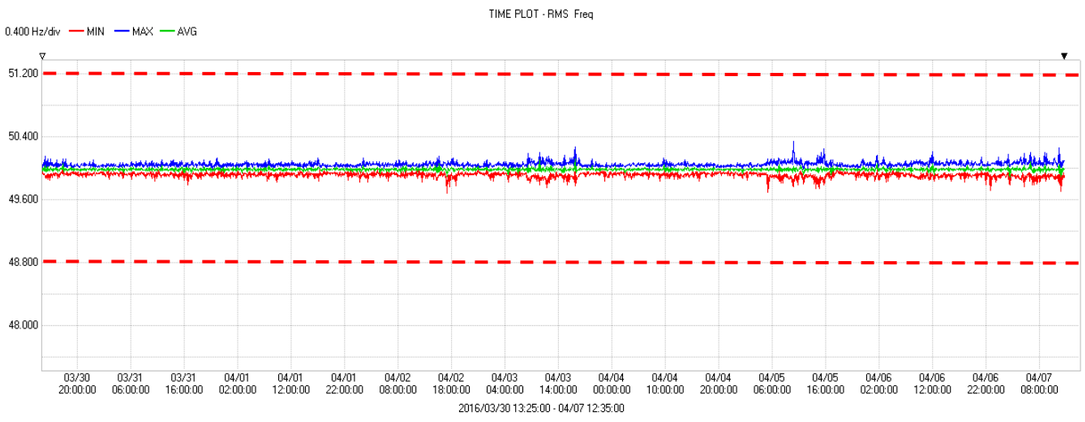


**Figure 69 | STS2 - start of feeder – frequency measurements**

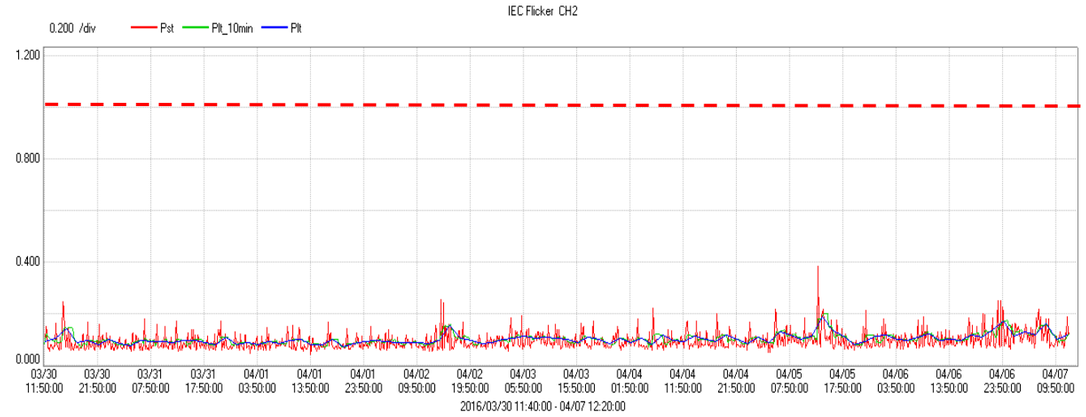


**Figure 70 | STS2 - end of feeder – flicker measurements (White Phase)**

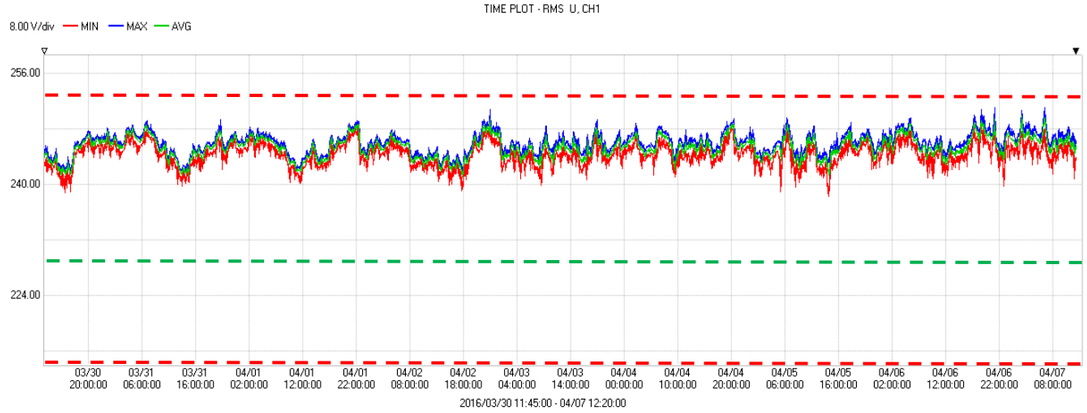


**Figure 71 | STS2 - end of feeder – voltage measurements (Red Phase)**

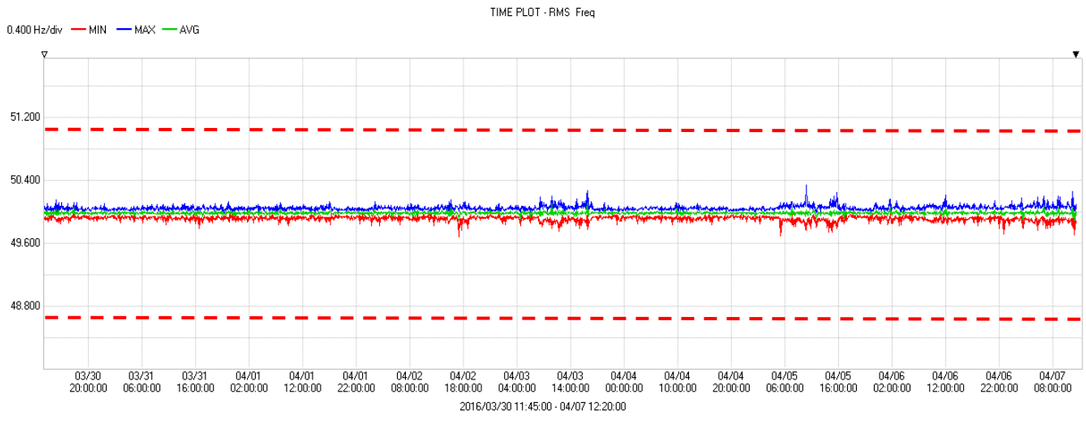


**Figure 72 | STS2 - end of feeder – frequency measurements**

## STS2 – Harmonics

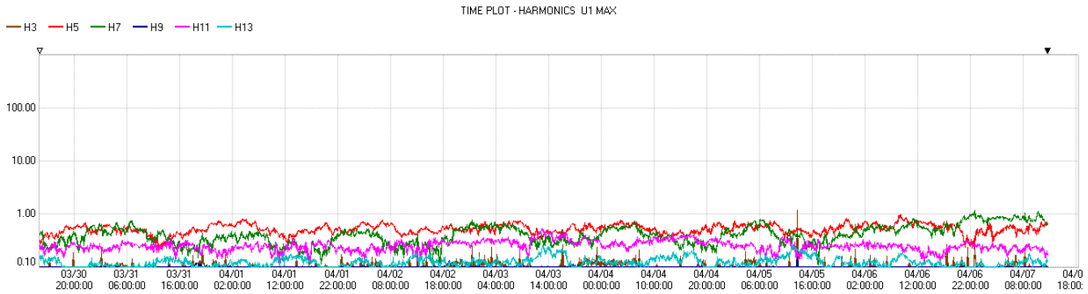


**Figure 73 | STS2 - start of feeder – 3rd to 13th (odd) harmonics**

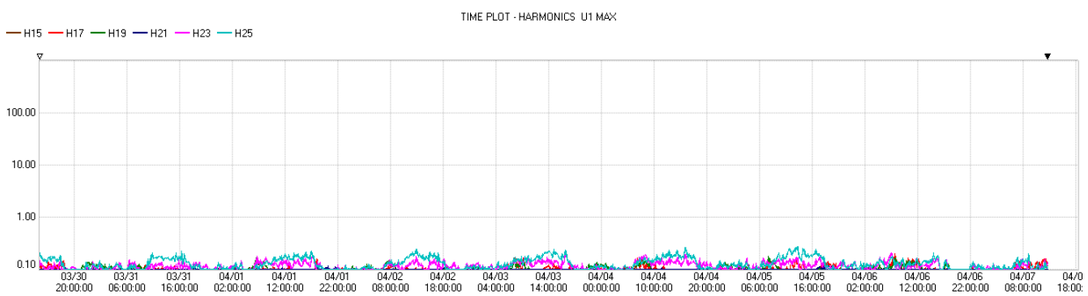


**Figure 74 | STS2 – start of feeder – 15th to 25th (odd) harmonics**

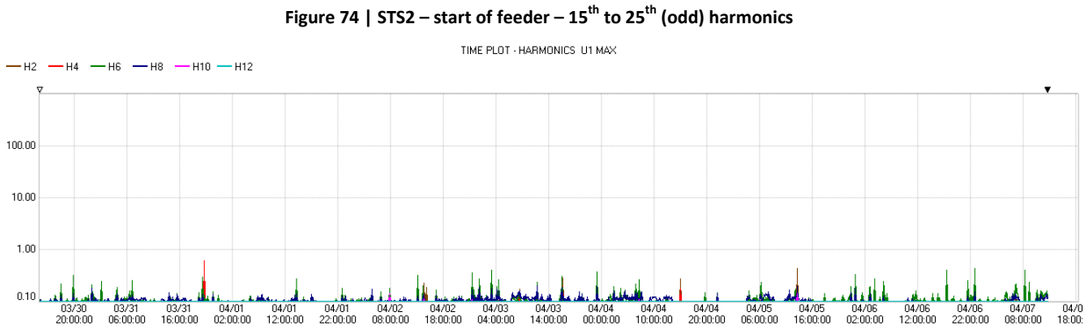


**Figure 75 | STS2 – start of feeder – 2th to 12th (even) harmonics**

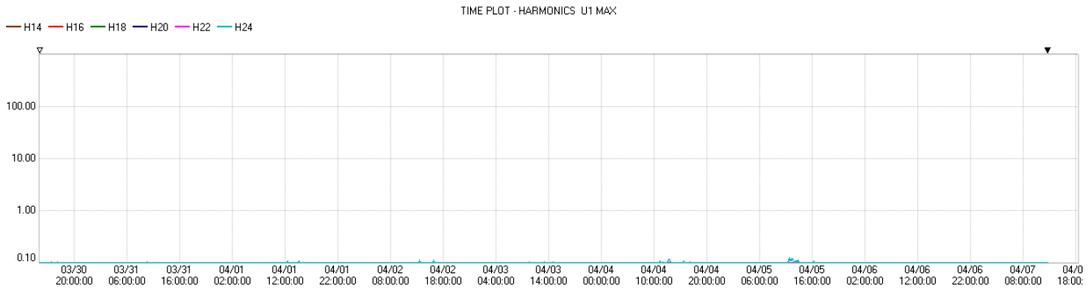


**Figure 76 | STS2 – start of feeder – 14th to 24th (even) harmonics**

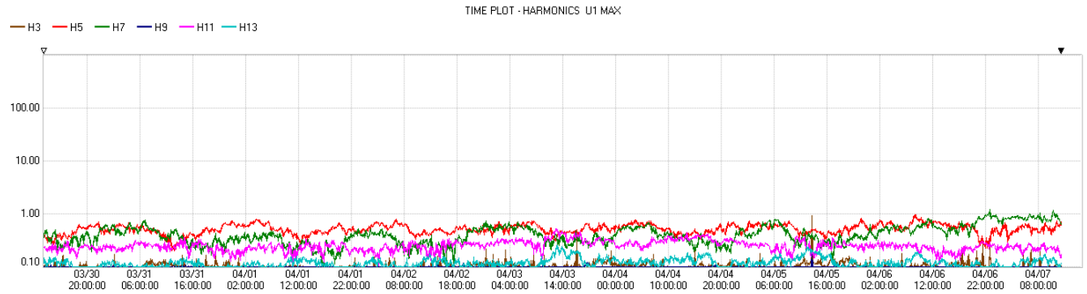


**Figure 77 | STS2 - end of feeder – 3rd to 13th (odd) harmonics**

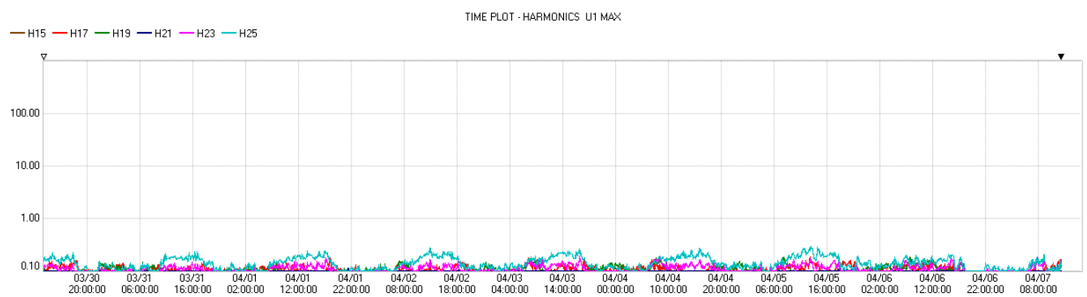


**Figure 78 | STS2 – end of feeder – 15th to 25th (odd) harmonics**

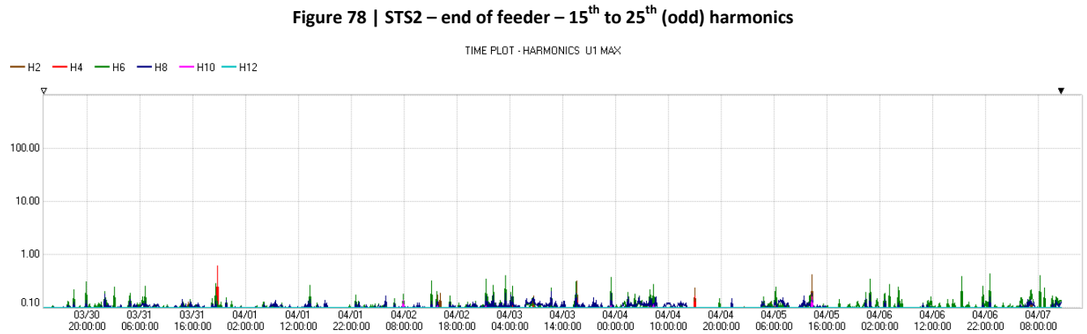


**Figure 79 | STS2 – end of feeder – 2th to 12th (even) harmonics**

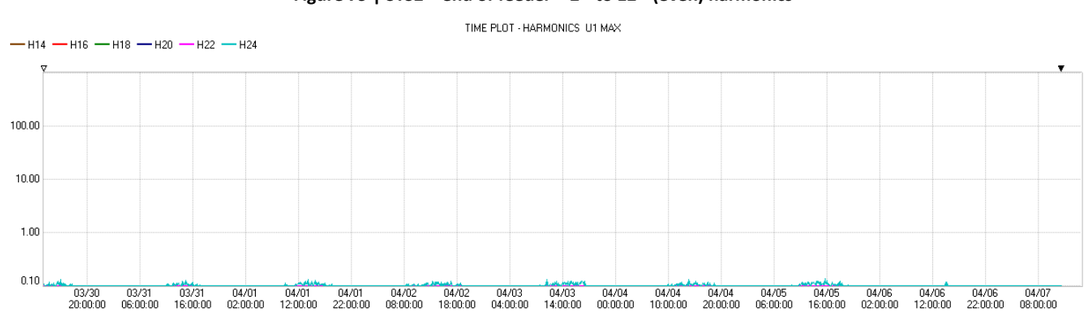


**Figure 80 | STS2 – end of feeder – 14th to 24th (even) harmonics**

## STS6 – Flicker, Voltage and Frequency

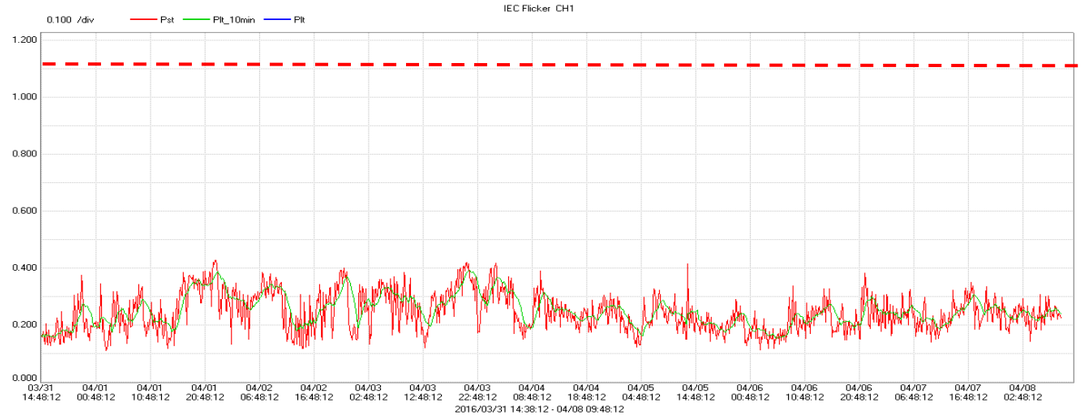


**Figure 81 | STS6 - start of feeder – flicker measurements (Red Phase)**

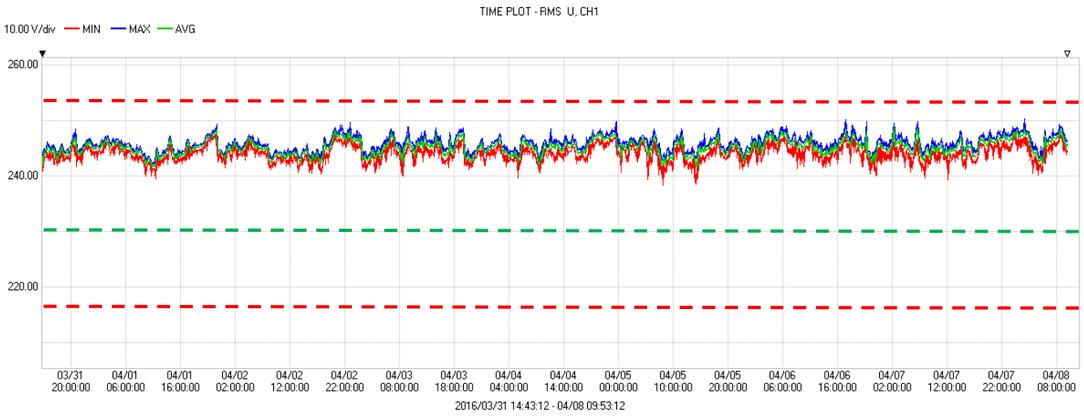


**Figure 82 | STS6 - start of feeder – voltage measurements (Red Phase)**

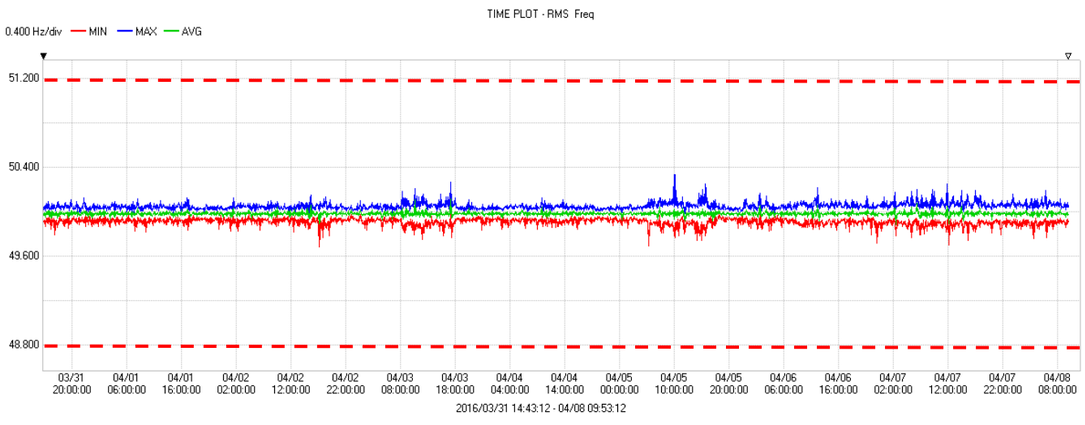


**Figure 83 | STS6 - start of feeder – frequency measurements**

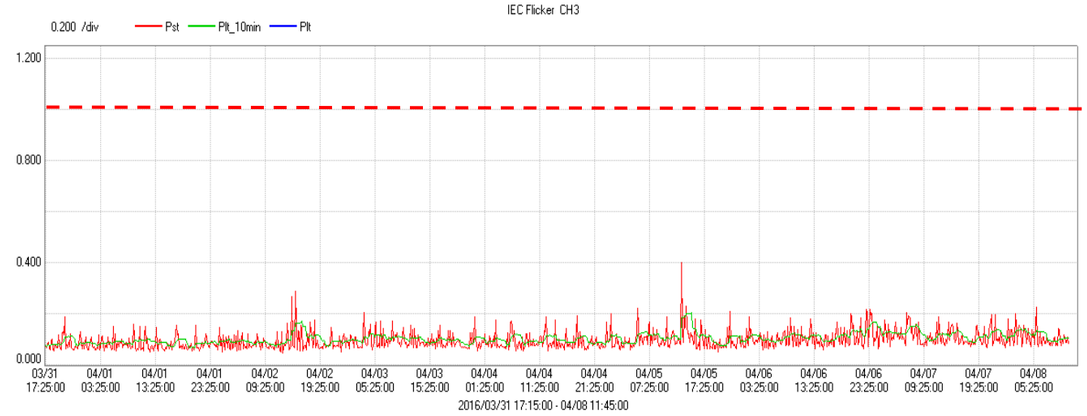


**Figure 84 | STS6 - end of feeder – flicker measurements (Blue Phase)**

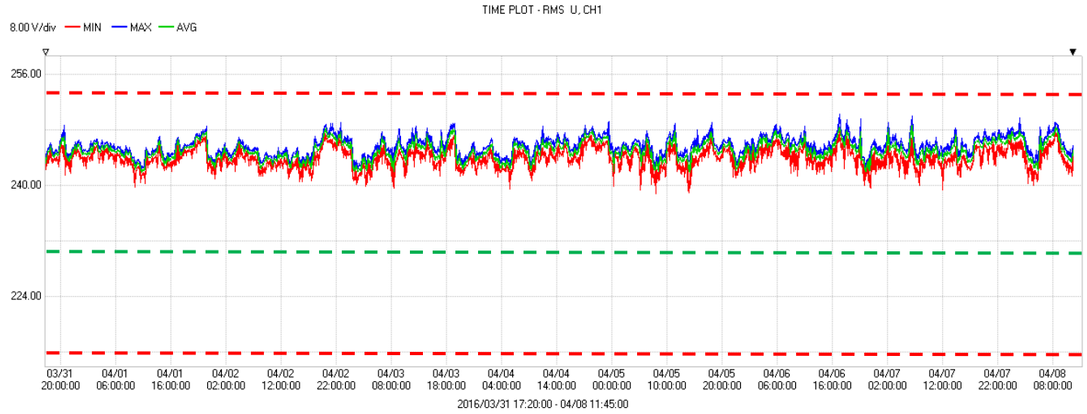


**Figure 85 | STS6 - end of feeder – voltage measurements (Red Phase)**


**Figure 86 | STS6 - end of feeder – frequency measurements**

## STS6 – Harmonics

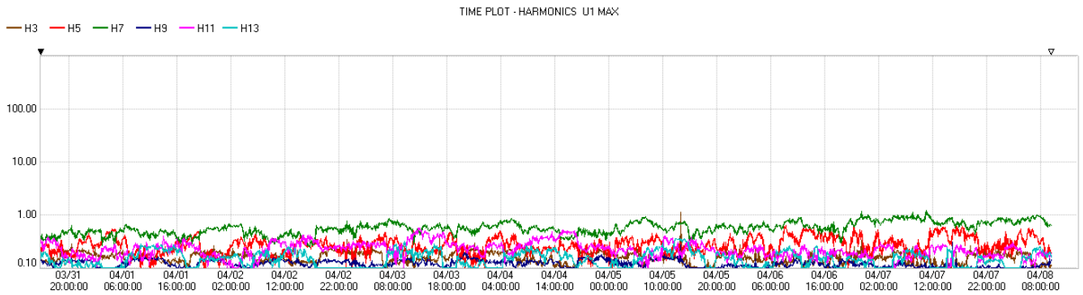


**Figure 87 | STS6 - start of feeder – 3rd to 13th (odd) harmonics**

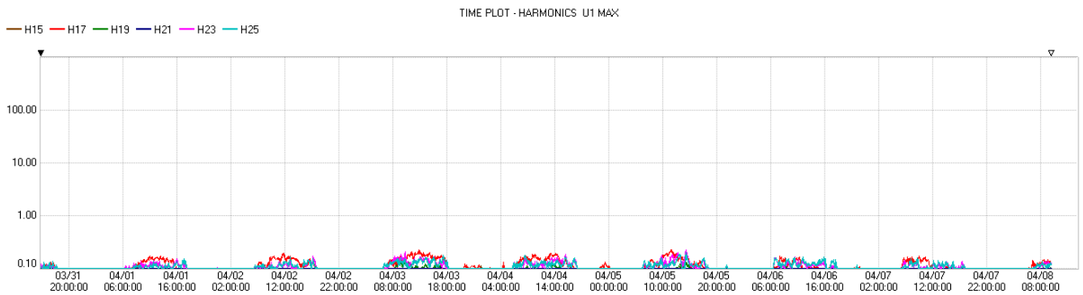


**Figure 88 | STS6 – start of feeder – 15th to 25th (odd) harmonics**

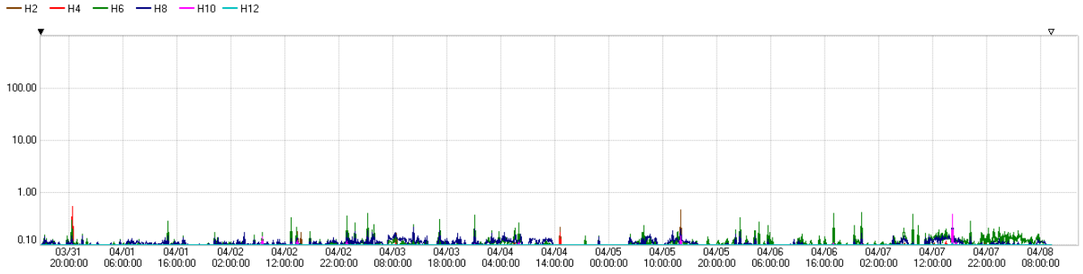


**Figure 89 | STS6 – start of feeder – 2th to 12th (even) harmonics**

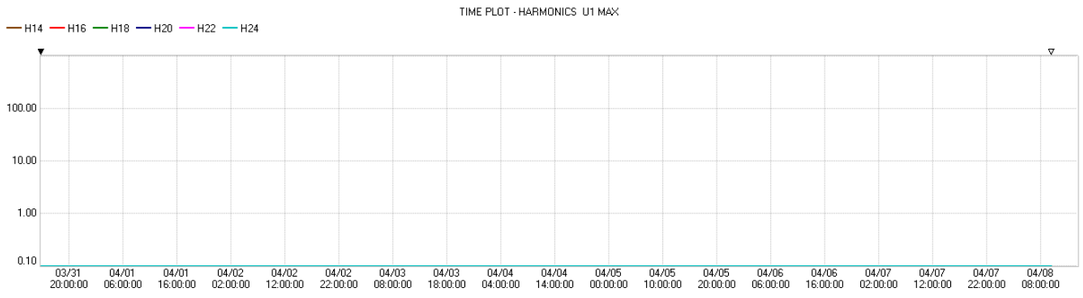


**Figure 90 | STS6 – start of feeder – 14th to 24th (even) harmonics**

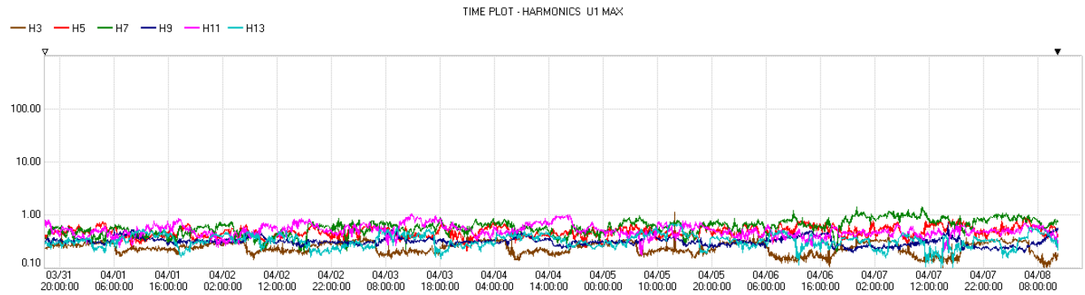


**Figure 91 | STS6 – end of feeder – 3rd to 13th (odd) harmonics**

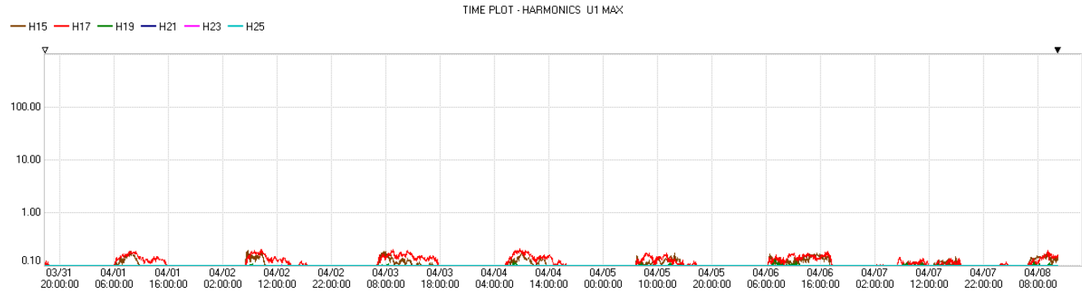


**Figure 92 | STS6 – end of feeder – 15th to 25th (odd) harmonics**

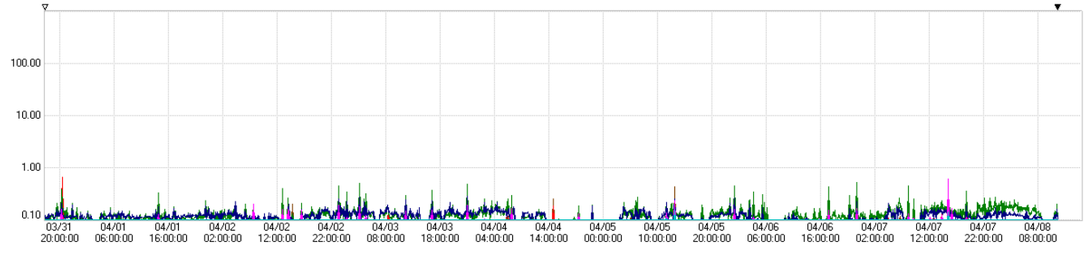


**Figure 93 | STS6 – end of feeder – 2th to 12th (even) harmonics**

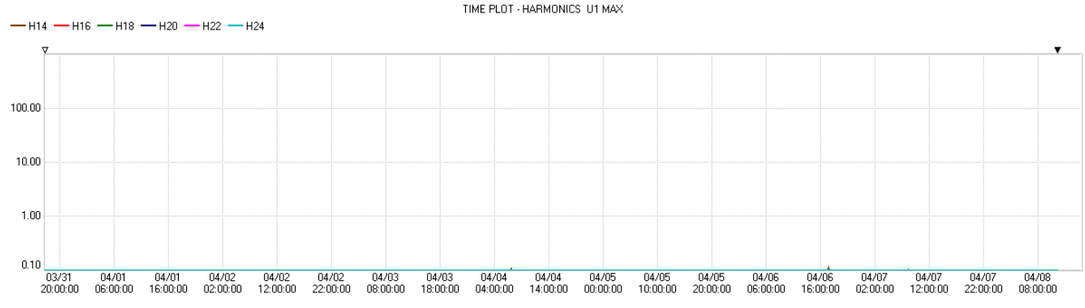


**Figure 94 | STS6 – end of feeder – 14th to 24th (even) harmonics**

# APPENDIX C PQ Device Installation Checklist

Please refer to the following pages.

1/14
PS 108
201447

# BHPBIO NEWMAN
# COMPLIANCE & AUDIT REPORT
# 2015/2016

# PQ LOGGER INSTALLATION CHECKLIST

REVISION K

3/03/2016

Project No.: W_APD04607

APD

# 1. INTRODUCTION

The checklist is mandatory for the installation of loggers and the steps listed in this document are to be completed and signed-off by the electrical contractor.

Contact APD if any query (E-Mail: Mansour.mohseni@apdpower.com.au, P: 9212 1561 & M: 0459 996 022).

Please ensure loggers are sent back within their rental period to avoid incurring additional rental costs.

Refer to item 3.03 for return address.

| | | | |
|---|---|---|---|
| **Electrical Contractor** | | **Name** | JULIAN PRINCEHORN |
| **Logger Serial No.** | 201447 | | |
| **Site Location** | PS108 | | |
| **Transformer/Feeder being Logged** | | | |
| **Transformer Tap Setting** | | | |
| **Date and Time Logging Started** | 30/3 9:00 | **Date and Time Logging Completed** | 7/4/16 14:34 |
| **Photo Id#** | _____ **(Photo after fully installed)** | | |

**IMPORTANT NOTES:**

1. Capture logger's installation photos upon initial installation & send to APD on the first day of installation.

2. Check loggers are still logging after a power outage (fully charged battery lasts approx. 30mins on Hioki 3196 and 180mins on Hioki 3198).

## 2. PRE-INSTALLATION CHECKLIST

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

| Pre-Installation Checklist | | | | |
|---|---|---|---|---|
| **Item** | **Description** | **Y** | **N** | **N/A** |
| 1.01 | ***Ensure the following parts are available, checked and prepared*** | | | |
| | a. HIOKI 3196/3198 PQ logger | ☑ | ☐ | ☐ |
| | b. DC power supply (if applicable) and power cord | ☑ | ☐ | ☐ |
| | c. Logger internal battery | ☑ | ☐ | ☐ |
| | d. PC Card memory | ☑ | ☐ | ☐ |
| | e. Power board with clips/plugs<br>***Safety Note:*** The power board is to only supply the loggers | ☐ | ☐ | ☑ |
| | f. Eight test leads with crocodile clips (if only six are supplied, there should be banana plug jumping cables for the neutral connections) | ☑ | ☐ | ☐ |

## 3. INSTALLATION CHECKLIST

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

| Installation Checklist | | | | |
|---|---|---|---|---|
| **Item** | **Description** | **Y** | **N** | **N/A** |
| 2.01 | Has the safety equipment, including but not limited to, suitable PPE and risk assessment documentation been followed, prepared and checked? | ☑ | ☐ | ☐ |
| 2.02 | Has the equipment been set up properly and operated as intended on site? This includes:<br>a) ensuring logger is powered up for continuous operation for at least 7 days (the Power Lamp should be Green, if it is Red the meter is operating off of the battery)<br>b) PC Card memory is in the logger and ready (do not remove – just visually check it is installed) | ☐<br>☐ | ☐<br>☐ | ☐<br>☐ |
| 2.03 | 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)?<br>Refer to Appendix A.1 and Appendix B | ☐ | ☐ | ☐ |
| 2.04 | Have the cables been connected to Channel 4 U+ and U- terminals for neutral – earth voltage measurement?<br>***Note:*** U- needs to connect to neutral and U+ to the earth bar (or point)<br>Refer to Appendix A.1 | ☐ | ☐ | ☐ |
| 2.05 | Has the 'Start/Stop' button been pressed to trigger the logger?<br>Refer to Appendix A.2 | ☐ | ☐ | ☐ |
| 2.06 | Have you ensured that the logger is currently recording the data?<br>Refer to Appendix A.3 | ☐ | ☐ | ☐ |
| 2.07 | Has all the equipment been adequately placed and positioned safely to ensure non-interrupted operation? | ☐ | ☐ | ☐ |
| 2.08 | Have clear photos of the fully installed loggers been taken and photo ID noted in the space available at start of this checklist on page 1? | ☐ | ☐ | ☐ |
| 2.09 | Before leaving site, have the kiosk doors or other means of access been closed and locked appropriately to constraint access? | ☐ | ☐ | ☐ |

**** IMPORTANT NOTE:*** **Do not adjust, modify or alter settings and configurations of loggers (system) unless specified in this checklist, logging result may differ significantly as a consequence.**

# 4. POST-INSTALLATION CHECKLIST

**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?<br>Refer to Appendix A.3<br>***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<br>Advise APD if any equipment is missing | ☑ | ☐ | ☐ |
| 3.03 | Transport the Loggers directly back to APD Address at<br>***176 Wellington Street, East Perth WA 6004***<br>Contact APD on 9212 1561 or 0459 996 022 for any queries on the return of loggers to Perth | ☐ | ☐ | ☐ |

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

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

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

**Comments:**.....

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PS 69

2/14

201446

# BHPBIO NEWMAN
# COMPLIANCE & AUDIT REPORT
# 2015/2016

# PQ LOGGER INSTALLATION CHECKLIST

REVISION K

3/03/2016

Project No.: W_APD04607

APD

# 1. INTRODUCTION

The checklist is mandatory for the installation of loggers and the steps listed in this document are to be completed and signed-off by the electrical contractor.

Contact APD if any query (E-Mail: Mansour.mohseni@apdpower.com.au, P: 9212 1561 & M: 0459 996 022).

Please ensure loggers are sent back within their rental period to avoid incurring additional rental costs.

Refer to item 3.03 for return address.

| | | | |
|---|---|---|---|
| **Electrical Contractor** | | **Name** | Joe Sivak |
| **Logger Serial No.** | 201446 | | |
| **Site Location** | PS 69 Giles Ave | | |
| **Transformer/Feeder being Logged** | | | |
| **Transformer Tap Setting** | | | |
| **Date and Time Logging Started** | 30/3/16 | **Date and Time Logging Completed** | 8/4/16 8:15 am |
| **Photo Id#** | _____ **(Photo after fully installed)** | | |

**IMPORTANT NOTES:**

1. Capture logger's installation photos upon initial installation & send to APD on the first day of installation.

2. Check loggers are still logging after a power outage (fully charged battery lasts approx. 30mins on Hioki 3196 and 180mins on Hioki 3198).

## 2. PRE-INSTALLATION CHECKLIST

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

| Pre-Installation Checklist | | | | |
|---|---|---|---|---|
| **Item** | **Description** | **Y** | **N** | **N/A** |
| 1.01 | ***Ensure the following parts are available, checked and prepared*** | | | |
| | a. HIOKI 3196/3198 PQ logger | ☑ | ☐ | ☐ |
| | b. DC power supply (if applicable) and power cord | ☑ | ☐ | ☐ |
| | c. Logger internal battery | ☑ | ☐ | ☐ |
| | d. PC Card memory | ☑ | ☐ | ☐ |
| | e. Power board with clips/plugs<br>***Safety Note:*** The power board is to only supply the loggers | ☐ | ☐ | ☑ |
| | f. Eight test leads with crocodile clips (if only six are supplied, there should be banana plug jumping cables for the neutral connections) | ☑ | ☐ | ☐ |

## 3. INSTALLATION CHECKLIST

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

| Installation Checklist | | | | |
|---|---|---|---|---|
| **Item** | **Description** | **Y** | **N** | **N/A** |
| 2.01 | Has the safety equipment, including but not limited to, suitable PPE and risk assessment documentation been followed, prepared and checked? | ☑ | ☐ | ☐ |
| 2.02 | Has the equipment been set up properly and operated as intended on site? This includes:<br>a) ensuring logger is powered up for continuous operation for at least 7 days (the Power Lamp should be Green, if it is Red the meter is operating off of the battery)<br>b) PC Card memory is in the logger and ready (do not remove – just visually check it is installed) | ☑<br>☑ | ☐<br>☐ | ☐<br>☐ |
| 2.03 | 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)?<br>Refer to Appendix A.1 and Appendix B | ☑ | ☐ | ☐ |
| 2.04 | Have the cables been connected to Channel 4 U+ and U- terminals for neutral – earth voltage measurement?<br>***Note:*** U- needs to connect to neutral and U+ to the earth bar (or point)<br>Refer to Appendix A.1 | ☑ | ☐ | ☐ |
| 2.05 | Has the 'Start/Stop' button been pressed to trigger the logger?<br>Refer to Appendix A.2 | ☑ | ☐ | ☐ |
| 2.06 | Have you ensured that the logger is currently recording the data?<br>Refer to Appendix A.3 | ☑ | ☐ | ☐ |
| 2.07 | Has all the equipment been adequately placed and positioned safely to ensure non-interrupted operation? | ☑ | ☐ | ☐ |
| 2.08 | Have clear photos of the fully installed loggers been taken and photo ID noted in the space available at start of this checklist on page 1? | ☑ | ☐ | ☐ |
| 2.09 | Before leaving site, have the kiosk doors or other means of access been closed and locked appropriately to constraint access? | ☑ | ☐ | ☐ |

**** IMPORTANT NOTE:*** **Do not adjust, modify or alter settings and configurations of loggers (system) unless specified in this checklist, logging result may differ significantly as a consequence.**

# 4. POST-INSTALLATION CHECKLIST

**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?<br>Refer to Appendix A.3<br>***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<br>Advise APD if any equipment is missing | ☑ | ☐ | ☐ |
| 3.03 | Transport the Loggers directly back to APD Address at<br>***176 Wellington Street, East Perth WA 6004***<br>Contact APD on 9212 1561 or 0459 996 022 for any queries on the return of loggers to Perth | ☐ | ☐ | ☐ |

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

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

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

**Comments:**.....

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3/14
2018 81

PS 120 Seasons Hotel

# BHPBIO NEWMAN
# COMPLIANCE & AUDIT REPORT
# 2015/2016

# PQ LOGGER INSTALLATION CHECKLIST

REVISION K

3/03/2016

Project No.: W_APD04607

APD

# 1. INTRODUCTION

The checklist is mandatory for the installation of loggers and the steps listed in this document are to be completed and signed-off by the electrical contractor.

Contact APD if any query (E-Mail: Mansour.mohseni@apdpower.com.au, P: 9212 1561 & M: 0459 996 022).

Please ensure loggers are sent back within their rental period to avoid incurring additional rental costs.

Refer to item 3.03 for return address.

| | | | |
|---|---|---|---|
| **Electrical Contractor** | | **Name** | JOE SWAK |
| **Logger Serial No.** | 201081 | | |
| **Site Location** | PS 120 Season's Hotel | | |
| **Transformer/Feeder being Logged** | | | |
| **Transformer Tap Setting** | | | |
| **Date and Time Logging Started** | 31/3/16 1440 | **Date and Time Logging Completed** | 8/4/16 10:00 AM |
| **Photo Id#** | _____ **(Photo after fully installed)** | | |

**IMPORTANT NOTES:**

1. Capture logger's installation photos upon initial installation & send to APD on the first day of installation.

2. Check loggers are still logging after a power outage (fully charged battery lasts approx. 30mins on Hioki 3196 and 180mins on Hioki 3198).

## 2. PRE-INSTALLATION CHECKLIST

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

| Pre-Installation Checklist | | | | |
|---|---|---|---|---|
| **Item** | **Description** | **Y** | **N** | **N/A** |
| 1.01 | ***Ensure the following parts are available, checked and prepared*** | | | |
| | a. HIOKI 3196/3198 PQ logger | ☑ | ☐ | ☐ |
| | b. DC power supply (if applicable) and power cord | ☑ | ☐ | ☐ |
| | c. Logger internal battery | ☑ | ☐ | ☐ |
| | d. PC Card memory | ☑ | ☐ | ☐ |
| | e. Power board with clips/plugs<br>***Safety Note:*** The power board is to only supply the loggers | ☑ | ☐ | ☐ |
| | f. Eight test leads with crocodile clips (if only six are supplied, there should be banana plug jumping cables for the neutral connections) | ☑ | ☐ | ☐ |

## 3. INSTALLATION CHECKLIST

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

| Installation Checklist | | | | |
|---|---|---|---|---|
| **Item** | **Description** | **Y** | **N** | **N/A** |
| 2.01 | Has the safety equipment, including but not limited to, suitable PPE and risk assessment documentation been followed, prepared and checked? | ☑ | ☐ | ☐ |
| 2.02 | Has the equipment been set up properly and operated as intended on site? This includes:<br>a) ensuring logger is powered up for continuous operation for at least 7 days (the Power Lamp should be Green, if it is Red the meter is operating off of the battery)<br>b) PC Card memory is in the logger and ready (<u>do not remove</u> – just visually check it is installed) | ☑<br>☑ | ☐<br>☐ | ☐<br>☐ |
| 2.03 | 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)?<br>Refer to Appendix A.1 and Appendix B | ☑ | ☐ | ☐ |
| 2.04 | Have the cables been connected to Channel 4 U+ and U- terminals for neutral – earth voltage measurement?<br>***<u>Note:</u>*** U- needs to connect to neutral and U+ to the earth bar (or point)<br>Refer to Appendix A.1 | ☑ | ☐ | ☐ |
| 2.05 | Has the 'Start/Stop' button been pressed to trigger the logger?<br>Refer to Appendix A.2 | ☑ | ☐ | ☐ |
| 2.06 | Have you ensured that the logger is currently recording the data?<br>Refer to Appendix A.3 | ☑ | ☐ | ☐ |
| 2.07 | Has all the equipment been adequately placed and positioned safely to ensure non-interrupted operation? | ☑ | ☐ | ☐ |
| 2.08 | Have clear photos of the fully installed loggers been taken and photo ID noted in the space available at start of this checklist on page 1? | ☑ | ☐ | ☐ |
| 2.09 | Before leaving site, have the kiosk doors or other means of access been closed and locked appropriately to constraint access? | ☑ | ☐ | ☐ |

***<u>* IMPORTANT NOTE:</u>*** **Do not adjust, modify or alter settings and configurations of loggers (system) unless specified in this checklist, logging result may differ significantly as a consequence.**

# 4. POST-INSTALLATION CHECKLIST

**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?<br>Refer to Appendix A.3<br>***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<br>Advise APD if any equipment is missing | ☑ | ☐ | ☐ |
| 3.03 | Transport the Loggers directly back to APD Address at<br>***176 Wellington Street, East Perth WA 6004***<br>Contact APD on 9212 1561 or 0459 996 022 for any queries on the return of loggers to Perth | ☐ | ☐ | ☐ |

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

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

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

**Comments:**.....

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Tx 12000 Exploration

# BHPBIO NEWMAN
# COMPLIANCE & AUDIT REPORT
# 2015/2016

# PQ LOGGER INSTALLATION CHECKLIST

REVISION K

3/03/2016

Project No.: W_APD04607

APD

# 1. INTRODUCTION

The checklist is mandatory for the installation of loggers and the steps listed in this document are to be completed and signed-off by the electrical contractor.

Contact APD if any query (E-Mail: Mansour.mohseni@apdpower.com.au, P: 9212 1561 & M: 0459 996 022).

Please ensure loggers are sent back within their rental period to avoid incurring additional rental costs.

Refer to item 3.03 for return address.

| | | | |
|---|---|---|---|
| **Electrical Contractor** | | **Name** | Joe Snyk |
| **Logger Serial No.** | 201448 | | |
| **Site Location** | Tx 1200 Exploration | | |
| **Transformer/Feeder being Logged** | | | |
| **Transformer Tap Setting** | | | |
| **Date and Time Logging Started** | 31/3/16 1730 | **Date and Time Logging Completed** | 8/4/16 11:45 am |
| **Photo Id#** | _____ **(Photo after fully installed)** | | |

**IMPORTANT NOTES:**

1. Capture logger's installation photos upon initial installation & send to APD on the first day of installation.

2. Check loggers are still logging after a power outage (fully charged battery lasts approx. 30mins on Hioki 3196 and 180mins on Hioki 3198).

## 2. PRE-INSTALLATION CHECKLIST

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

| Pre-Installation Checklist | | | | |
|---|---|---|---|---|
| **Item** | **Description** | **Y** | **N** | **N/A** |
| 1.01 | ***Ensure the following parts are available, checked and prepared*** | | | |
| | a. HIOKI 3196/3198 PQ logger | ☑ | ☐ | ☐ |
| | b. DC power supply (if applicable) and power cord | ☑ | ☐ | ☐ |
| | c. Logger internal battery | ☑ | ☐ | ☐ |
| | d. PC Card memory | ☑ | ☐ | ☐ |
| | e. Power board with clips/plugs<br>***Safety Note:*** The power board is to only supply the loggers | ☑ | ☐ | ☐ |
| | f. Eight test leads with crocodile clips (if only six are supplied, there should be banana plug jumping cables for the neutral connections) | ☑ | ☐ | ☐ |

## 3. INSTALLATION CHECKLIST

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

| Installation Checklist | | | | |
|---|---|---|---|---|
| **Item** | **Description** | **Y** | **N** | **N/A** |
| 2.01 | Has the safety equipment, including but not limited to, suitable PPE and risk assessment documentation been followed, prepared and checked? | ☑ | ☐ | ☐ |
| 2.02 | Has the equipment been set up properly and operated as intended on site? This includes:<br>a) ensuring logger is powered up for continuous operation for at least 7 days (the Power Lamp should be Green, if it is Red the meter is operating off of the battery)<br>b) PC Card memory is in the logger and ready (do not remove – just visually check it is installed) | ☑<br>☑ | ☐<br>☐ | ☐<br>☐ |
| 2.03 | 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)?<br>Refer to Appendix A.1 and Appendix B | ☑ | ☐ | ☐ |
| 2.04 | Have the cables been connected to Channel 4 U+ and U- terminals for neutral – earth voltage measurement?<br>***Note:*** U- needs to connect to neutral and U+ to the earth bar (or point)<br>Refer to Appendix A.1 | ☑ | ☐ | ☐ |
| 2.05 | Has the 'Start/Stop' button been pressed to trigger the logger?<br>Refer to Appendix A.2 | ☑ | ☐ | ☐ |
| 2.06 | Have you ensured that the logger is currently recording the data?<br>Refer to Appendix A.3 | ☑ | ☐ | ☐ |
| 2.07 | Has all the equipment been adequately placed and positioned safely to ensure non-interrupted operation? | ☑ | ☐ | ☐ |
| 2.08 | Have clear photos of the fully installed loggers been taken and photo ID noted in the space available at start of this checklist on page 1? | ☑ | ☐ | ☐ |
| 2.09 | Before leaving site, have the kiosk doors or other means of access been closed and locked appropriately to constraint access? | ☑ | ☐ | ☐ |

**** IMPORTANT NOTE:*** **Do not adjust, modify or alter settings and configurations of loggers (system) unless specified in this checklist, logging result may differ significantly as a consequence.**

# 4. POST-INSTALLATION CHECKLIST

**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?<br>Refer to Appendix A.3<br>***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<br>Advise APD if any equipment is missing | ☑ | ☐ | ☐ |
| 3.03 | Transport the Loggers directly back to APD Address at<br>***176 Wellington Street, East Perth WA 6004***<br>Contact APD on 9212 1561 or 0459 996 022 for any queries on the return of loggers to Perth | ☐ | ☐ | ☐ |

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

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

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

**Comments:**.....

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# BHPBIO NEWMAN
# COMPLIANCE & AUDIT REPORT
# 2015/2016

# PQ LOGGER INSTALLATION CHECKLIST

REVISION K

3/03/2016

Project No.: W_APD04607

APD

# 1. INTRODUCTION

The checklist is mandatory for the installation of loggers and the steps listed in this document are to be completed and signed-off by the electrical contractor.

Contact APD if any query (E-Mail: Mansour.mohseni@apdpower.com.au, P: 9212 1561 & M: 0459 996 022).

Please ensure loggers are sent back within their rental period to avoid incurring additional rental costs.

Refer to item 3.03 for return address.

| | | | |
|---|---|---|---|
| **Electrical Contractor** | | **Name** | Joe Sivak |
| **Logger Serial No.** | PE 00018 | | |
| **Site Location** | BS 14 Bardini | | |
| **Transformer/Feeder being Logged** | | | |
| **Transformer Tap Setting** | | | |
| **Date and Time Logging Started** | 31/3/16 7:41 am | **Date and Time Logging Completed** | 8/4/16 10:55 am |
| **Photo Id#** | _____ **(Photo after fully installed)** | | |

**IMPORTANT NOTES:**

1. Capture logger's installation photos upon initial installation & send to APD on the first day of installation.

2. Check loggers are still logging after a power outage (fully charged battery lasts approx. 30mins on Hioki 3196 and 180mins on Hioki 3198).

## 2. PRE-INSTALLATION CHECKLIST

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

| Pre-Installation Checklist | | | | |
|---|---|---|---|---|
| **Item** | **Description** | **Y** | **N** | **N/A** |
| 1.01 | ***Ensure the following parts are available, checked and prepared*** | | | |
| | a. HIOKI 3196/3198 PQ logger | ☑ | ☐ | ☐ |
| | b. DC power supply (if applicable) and power cord | ☑ | ☐ | ☐ |
| | c. Logger internal battery | ☑ | ☐ | ☐ |
| | d. PC Card memory | ☑ | ☐ | ☐ |
| | e. Power board with clips/plugs<br>***Safety Note:*** The power board is to only supply the loggers | ☑ | ☐ | ☐ |
| | f. Eight test leads with crocodile clips (if only six are supplied, there should be banana plug jumping cables for the neutral connections) | ☑ | ☐ | ☐ |

## 3. INSTALLATION CHECKLIST

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

| Installation Checklist | | | | |
|---|---|---|---|---|
| **Item** | **Description** | **Y** | **N** | **N/A** |
| 2.01 | Has the safety equipment, including but not limited to, suitable PPE and risk assessment documentation been followed, prepared and checked? | ☑ | ☐ | ☐ |
| 2.02 | Has the equipment been set up properly and operated as intended on site? This includes:<br>a) ensuring logger is powered up for continuous operation for at least 7 days (the Power Lamp should be Green, if it is Red the meter is operating off of the battery)<br>b) PC Card memory is in the logger and ready (<u>do not remove</u> – just visually check it is installed) | ☑<br>☑ | ☐<br>☐ | ☐<br>☐ |
| 2.03 | 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)?<br>Refer to Appendix A.1 and Appendix B | ☑ | ☐ | ☐ |
| 2.04 | Have the cables been connected to Channel 4 U+ and U- terminals for neutral – earth voltage measurement?<br>***Note:*** U- needs to connect to neutral and U+ to the earth bar (or point)<br>Refer to Appendix A.1 | ☑ | ☐ | ☐ |
| 2.05 | Has the 'Start/Stop' button been pressed to trigger the logger?<br>Refer to Appendix A.2 | ☑ | ☐ | ☐ |
| 2.06 | Have you ensured that the logger is currently recording the data?<br>Refer to Appendix A.3 | ☑ | ☐ | ☐ |
| 2.07 | Has all the equipment been adequately placed and positioned safely to ensure non-interrupted operation? | ☑ | ☐ | ☐ |
| 2.08 | Have clear photos of the fully installed loggers been taken and photo ID noted in the space available at start of this checklist on page 1? | ☑ | ☐ | ☐ |
| 2.09 | Before leaving site, have the kiosk doors or other means of access been closed and locked appropriately to constraint access? | ☑ | ☐ | ☐ |

**** IMPORTANT NOTE:*** **Do not adjust, modify or alter settings and configurations of loggers (system) unless specified in this checklist, logging result may differ significantly as a consequence.**

# 4. POST-INSTALLATION CHECKLIST

**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?<br>Refer to Appendix A.3<br>***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<br>Advise APD if any equipment is missing | ☐ | ☐ | ☐ |
| 3.03 | Transport the Loggers directly back to APD Address at<br>***176 Wellington Street, East Perth WA 6004***<br>Contact APD on 9212 1561 or 0459 996 022 for any queries on the return of loggers to Perth | ☐ | ☐ | ☐ |

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

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

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

**Comments:**.....

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7/14
201945

PS 125 Bubbacurry loop

# BHPBIO NEWMAN
# COMPLIANCE & AUDIT REPORT
# 2015/2016

# PQ LOGGER INSTALLATION CHECKLIST

REVISION K

3/03/2016

Project No.: W_APD04607

APD

# 1. INTRODUCTION

The checklist is mandatory for the installation of loggers and the steps listed in this document are to be completed and signed-off by the electrical contractor.

Contact APD if any query (E-Mail: Mansour.mohseni@apdpower.com.au, P: 9212 1561 & M: 0459 996 022).

Please ensure loggers are sent back within their rental period to avoid incurring additional rental costs.

Refer to item 3.03 for return address.

| | | | |
|---|---|---|---|
| **Electrical Contractor** | | **Name** | Joe Sivak |
| **Logger Serial No.** | 201445 | | |
| **Site Location** | PS 125 Bobbacurry Loop | | |
| **Transformer/Feeder being Logged** | | | |
| **Transformer Tap Setting** | | | |
| **Date and Time Logging Started** | 31/3/16 8:20am | **Date and Time Logging Completed** | 7/4/16 14:50 |
| **Photo Id#** | _____ **(Photo after fully installed)** | | |

**IMPORTANT NOTES:**

1. Capture logger's installation photos upon initial installation & send to APD on the first day of installation.

2. Check loggers are still logging after a power outage (fully charged battery lasts approx. 30mins on Hioki 3196 and 180mins on Hioki 3198).

# 4. POST-INSTALLATION CHECKLIST

**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?<br>Refer to Appendix A.3<br>***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<br>Advise APD if any equipment is missing | ☑ | ☐ | ☐ |
| 3.03 | Transport the Loggers directly back to APD Address at<br>***176 Wellington Street, East Perth WA 6004***<br>Contact APD on 9212 1561 or 0459 996 022 for any queries on the return of loggers to Perth | ☐ | ☐ | ☐ |

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

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

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

**Comments:**.....

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9/14

PS 86 Red Sands 20/0282

# BHPBIO NEWMAN
# COMPLIANCE & AUDIT REPORT
# 2015/2016

# PQ LOGGER INSTALLATION CHECKLIST

REVISION K

3/03/2016

Project No.: W_APD04607

APD

# 1. INTRODUCTION

The checklist is mandatory for the installation of loggers and the steps listed in this document are to be completed and signed-off by the electrical contractor.

Contact APD if any query (E-Mail: Mansour.mohseni@apdpower.com.au, P: 9212 1561 & M: 0459 996 022).

Please ensure loggers are sent back within their rental period to avoid incurring additional rental costs.

Refer to item 3.03 for return address.

| | | | |
|---|---|---|---|
| **Electrical Contractor** | | **Name** | Jon Sivak |
| **Logger Serial No.** | 201082 | | |
| **Site Location** | PS 86 Red Sands | | |
| **Transformer/Feeder being Logged** | | | |
| **Transformer Tap Setting** | | | |
| **Date and Time Logging Started** | 31/3/16 11:50 | **Date and Time Logging Completed** | 7/6/16 14:21 |
| **Photo Id#** | _____ **(Photo after fully installed)** | | |

**IMPORTANT NOTES:**

1. Capture logger's installation photos upon initial installation & send to APD on the first day of installation.

2. Check loggers are still logging after a power outage (fully charged battery lasts approx. 30mins on Hioki 3196 and 180mins on Hioki 3198).

## 2. PRE-INSTALLATION CHECKLIST

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

| Pre-Installation Checklist | | | | |
|---|---|---|---|---|
| **Item** | **Description** | **Y** | **N** | **N/A** |
| 1.01 | ***Ensure the following parts are available, checked and prepared*** | | | |
| | a. HIOKI 3196/3198 PQ logger | ☑ | ☐ | ☐ |
| | b. DC power supply (if applicable) and power cord | ☑ | ☐ | ☐ |
| | c. Logger internal battery | ☑ | ☐ | ☐ |
| | d. PC Card memory | ☑ | ☐ | ☐ |
| | e. Power board with clips/plugs<br>***Safety Note:*** The power board is to only supply the loggers | ☑ | ☐ | ☐ |
| | f. Eight test leads with crocodile clips (if only six are supplied, there should be banana plug jumping cables for the neutral connections) | ☑ | ☐ | ☐ |

## 3. INSTALLATION CHECKLIST

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

| Installation Checklist | | | | |
|---|---|---|---|---|
| **Item** | **Description** | **Y** | **N** | **N/A** |
| 2.01 | Has the safety equipment, including but not limited to, suitable PPE and risk assessment documentation been followed, prepared and checked? | ☑ | ☐ | ☐ |
| 2.02 | Has the equipment been set up properly and operated as intended on site? This includes:<br>a) ensuring logger is powered up for continuous operation for at least 7 days (the Power Lamp should be Green, if it is Red the meter is operating off of the battery)<br>b) PC Card memory is in the logger and ready (do not remove – just visually check it is installed) | ☑<br>☑ | ☐<br>☐ | ☐<br>☐ |
| 2.03 | 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)?<br>Refer to Appendix A.1 and Appendix B | ☑ | ☐ | ☐ |
| 2.04 | Have the cables been connected to Channel 4 U+ and U- terminals for neutral – earth voltage measurement?<br>***Note:*** U- needs to connect to neutral and U+ to the earth bar (or point)<br>Refer to Appendix A.1 | ☑ | ☐ | ☐ |
| 2.05 | Has the 'Start/Stop' button been pressed to trigger the logger?<br>Refer to Appendix A.2 | ☑ | ☐ | ☐ |
| 2.06 | Have you ensured that the logger is currently recording the data?<br>Refer to Appendix A.3 | ☑ | ☐ | ☐ |
| 2.07 | Has all the equipment been adequately placed and positioned safely to ensure non-interrupted operation? | ☑ | ☐ | ☐ |
| 2.08 | Have clear photos of the fully installed loggers been taken and photo ID noted in the space available at start of this checklist on page 1? | ☑ | ☐ | ☐ |
| 2.09 | Before leaving site, have the kiosk doors or other means of access been closed and locked appropriately to constraint access? | ☑ | ☐ | ☐ |

**** IMPORTANT NOTE:*** **Do not adjust, modify or alter settings and configurations of loggers (system) unless specified in this checklist, logging result may differ significantly as a consequence.**

# 4. POST-INSTALLATION CHECKLIST

**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?<br>Refer to Appendix A.3<br>***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<br>Advise APD if any equipment is missing | ☑ | ☐ | ☐ |
| 3.03 | Transport the Loggers directly back to APD Address at<br>***176 Wellington Street, East Perth WA 6004***<br>Contact APD on 9212 1561 or 0459 996 022 for any queries on the return of loggers to Perth | ☐ | ☐ | ☐ |

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

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

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

**Comments:**.....

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10/14

PS 68 Cappy Oval Serial No. 1502 15780

# BHPBIO NEWMAN
# COMPLIANCE & AUDIT REPORT
# 2015/2016

# PQ LOGGER INSTALLATION CHECKLIST

REVISION K

3/03/2016

Project No.: W_APD04607

APD

# 1. INTRODUCTION

The checklist is mandatory for the installation of loggers and the steps listed in this document are to be completed and signed-off by the electrical contractor.

Contact APD if any query (E-Mail: Mansour.mohseni@apdpower.com.au, P: 9212 1561 & M: 0459 996 022).

Please ensure loggers are sent back within their rental period to avoid incurring additional rental costs.

Refer to item 3.03 for return address.

| | | | |
|---|---|---|---|
| **Electrical Contractor** | | **Name** | JOE SIVAK |
| **Logger Serial No.** | none found | | |
| **Site Location** | PS 68 Cappy oval | | |
| **Transformer/Feeder being Logged** | | | |
| **Transformer Tap Setting** | | | |
| **Date and Time Logging Started** | 31/3/16 1300 | **Date and Time Logging Completed** | 8/4/16 10:20AM |
| **Photo Id#** | _____ **(Photo after fully installed)** | | |

**IMPORTANT NOTES:**

1. Capture logger's installation photos upon initial installation & send to APD on the first day of installation.

2. Check loggers are still logging after a power outage (fully charged battery lasts approx. 30mins on Hioki 3196 and 180mins on Hioki 3198).

## 2. PRE-INSTALLATION CHECKLIST

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

| Pre-Installation Checklist | | | | |
|---|---|---|---|---|
| **Item** | **Description** | **Y** | **N** | **N/A** |
| 1.01 | ***Ensure the following parts are available, checked and prepared*** | | | |
| | a. HIOKI 3196/3198 PQ logger | ☑ | ☐ | ☐ |
| | b. DC power supply (if applicable) and power cord | ☑ | ☐ | ☐ |
| | c. Logger internal battery | ☑ | ☐ | ☐ |
| | d. PC Card memory | ☑ | ☐ | ☐ |
| | e. Power board with clips/plugs<br>***Safety Note:*** The power board is to only supply the loggers | ☑ | ☐ | ☐ |
| | f. Eight test leads with crocodile clips (if only six are supplied, there should be banana plug jumping cables for the neutral connections) | ☑ | ☐ | ☐ |

## 3. INSTALLATION CHECKLIST

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

| Installation Checklist | | | | |
|---|---|---|---|---|
| **Item** | **Description** | **Y** | **N** | **N/A** |
| 2.01 | Has the safety equipment, including but not limited to, suitable PPE and risk assessment documentation been followed, prepared and checked? | ☑ | ☐ | ☐ |
| 2.02 | Has the equipment been set up properly and operated as intended on site? This includes:<br>a) ensuring logger is powered up for continuous operation for at least 7 days (the Power Lamp should be Green, if it is Red the meter is operating off of the battery)<br>b) PC Card memory is in the logger and ready (do not remove – just visually check it is installed) | ☑<br>☑ | ☐<br>☐ | ☐<br>☐ |
| 2.03 | 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)?<br>Refer to Appendix A.1 and Appendix B | ☑ | ☐ | ☐ |
| 2.04 | Have the cables been connected to Channel 4 U+ and U- terminals for neutral – earth voltage measurement?<br>***Note:*** U- needs to connect to neutral and U+ to the earth bar (or point)<br>Refer to Appendix A.1 | ☑ | ☐ | ☐ |
| 2.05 | Has the 'Start/Stop' button been pressed to trigger the logger?<br>Refer to Appendix A.2 | ☑ | ☐ | ☐ |
| 2.06 | Have you ensured that the logger is currently recording the data?<br>Refer to Appendix A.3 | ☑ | ☐ | ☐ |
| 2.07 | Has all the equipment been adequately placed and positioned safely to ensure non-interrupted operation? | ☑ | ☐ | ☐ |
| 2.08 | Have clear photos of the fully installed loggers been taken and photo ID noted in the space available at start of this checklist on page 1? | ☑ | ☐ | ☐ |
| 2.09 | Before leaving site, have the kiosk doors or other means of access been closed and locked appropriately to constraint access? | ☑ | ☐ | ☐ |

**** IMPORTANT NOTE:*** **Do not adjust, modify or alter settings and configurations of loggers (system) unless specified in this checklist, logging result may differ significantly as a consequence.**

# 4. POST-INSTALLATION CHECKLIST

**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?<br>Refer to Appendix A.3<br>***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<br>Advise APD if any equipment is missing | ☐ | ☐ | ☐ |
| 3.03 | Transport the Loggers directly back to APD Address at<br>***176 Wellington Street, East Perth WA 6004***<br>Contact APD on 9212 1561 or 0459 996 022 for any queries on the return of loggers to Perth | ☐ | ☐ | ☐ |

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

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

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

**Comments:**.....

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11/14

202054

PS 70

# BHPBIO NEWMAN
# COMPLIANCE & AUDIT REPORT
# 2015/2016

# PQ LOGGER INSTALLATION CHECKLIST

REVISION K

3/03/2016

Project No.: W_APD04607

APD

# 1. INTRODUCTION

The checklist is mandatory for the installation of loggers and the steps listed in this document are to be completed and signed-off by the electrical contractor.

Contact APD if any query (E-Mail: Mansour.mohseni@apdpower.com.au, P: 9212 1561 & M: 0459 996 022).

Please ensure loggers are sent back within their rental period to avoid incurring additional rental costs.

Refer to item 3.03 for return address.

| | | | |
|---|---|---|---|
| **Electrical Contractor** | | **Name** | Joe Siuda |
| **Logger Serial No.** | 202054 | | |
| **Site Location** | PS TO Jabberups | | |
| **Transformer/Feeder being Logged** | | | |
| **Transformer Tap Setting** | | | |
| **Date and Time Logging Started** | 30/3/16 11·40am | **Date and Time Logging Completed** | 7/4/16 12:22 PM |
| **Photo Id#** | _____ **(Photo after fully installed)** | | |

**IMPORTANT NOTES:**

1. Capture logger's installation photos upon initial installation & send to APD on the first day of installation.

2. Check loggers are still logging after a power outage (fully charged battery lasts approx. 30mins on Hioki 3196 and 180mins on Hioki 3198).

## 2. PRE-INSTALLATION CHECKLIST

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

| Pre-Installation Checklist | | | | |
|---|---|---|---|---|
| **Item** | **Description** | **Y** | **N** | **N/A** |
| 1.01 | ***Ensure the following parts are available, checked and prepared*** | | | |
| | a. HIOKI 3196/3198 PQ logger | ☑ | ☐ | ☐ |
| | b. DC power supply (if applicable) and power cord | ☑ | ☐ | ☐ |
| | c. Logger internal battery | ☑ | ☐ | ☐ |
| | d. PC Card memory | ☑ | ☐ | ☐ |
| | e. Power board with clips/plugs<br>***Safety Note:*** The power board is to only supply the loggers | ☑ | ☐ | ☐ |
| | f. Eight test leads with crocodile clips (if only six are supplied, there should be banana plug jumping cables for the neutral connections) | ☑ | ☐ | ☐ |

## 3. INSTALLATION CHECKLIST

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

| Installation Checklist | | | | |
|---|---|---|---|---|
| **Item** | **Description** | **Y** | **N** | **N/A** |
| 2.01 | Has the safety equipment, including but not limited to, suitable PPE and risk assessment documentation been followed, prepared and checked? | ☑ | ☐ | ☐ |
| 2.02 | Has the equipment been set up properly and operated as intended on site? This includes:<br>a) ensuring logger is powered up for continuous operation for at least 7 days (the Power Lamp should be Green, if it is Red the meter is operating off of the battery)<br>b) PC Card memory is in the logger and ready (do not remove – just visually check it is installed) | ☑<br>☑ | ☐<br>☐ | ☐<br>☐ |
| 2.03 | 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)?<br>Refer to Appendix A.1 and Appendix B | ☑ | ☐ | ☐ |
| 2.04 | Have the cables been connected to Channel 4 U+ and U- terminals for neutral – earth voltage measurement?<br>***Note:*** U- needs to connect to neutral and U+ to the earth bar (or point)<br>Refer to Appendix A.1 | ☑ | ☐ | ☐ |
| 2.05 | Has the 'Start/Stop' button been pressed to trigger the logger?<br>Refer to Appendix A.2 | ☑ | ☐ | ☐ |
| 2.06 | Have you ensured that the logger is currently recording the data?<br>Refer to Appendix A.3 | ☑ | ☐ | ☐ |
| 2.07 | Has all the equipment been adequately placed and positioned safely to ensure non-interrupted operation? | ☑ | ☐ | ☐ |
| 2.08 | Have clear photos of the fully installed loggers been taken and photo ID noted in the space available at start of this checklist on page 1? | ☑ | ☐ | ☐ |
| 2.09 | Before leaving site, have the kiosk doors or other means of access been closed and locked appropriately to constraint access? | ☑ | ☐ | ☐ |

**** IMPORTANT NOTE:*** **Do not adjust, modify or alter settings and configurations of loggers (system) unless specified in this checklist, logging result may differ significantly as a consequence.**

## 4. POST-INSTALLATION CHECKLIST

**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?<br>Refer to Appendix A.3<br>***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<br>Advise APD if any equipment is missing | ☑ | ☐ | ☐ |
| 3.03 | Transport the Loggers directly back to APD Address at<br>***176 Wellington Street, East Perth WA 6004***<br>Contact APD on 9212 1561 or 0459 996 022 for any queries on the return of loggers to Perth | ☐ | ☐ | ☐ |

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

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

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

**Comments:**.....

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PS 60 Forrest

12/14

2018 19

# BHPBIO NEWMAN
# COMPLIANCE & AUDIT REPORT
# 2015/2016

# PQ LOGGER INSTALLATION CHECKLIST

REVISION K

3/03/2016

Project No.: W_APD04607

APD

# 1. INTRODUCTION

The checklist is mandatory for the installation of loggers and the steps listed in this document are to be completed and signed-off by the electrical contractor.

Contact APD if any query (E-Mail: Mansour.mohseni@apdpower.com.au, P: 9212 1561 & M: 0459 996 022).

Please ensure loggers are sent back within their rental period to avoid incurring additional rental costs.

Refer to item 3.03 for return address.

| | | | |
|---|---|---|---|
| **Electrical Contractor** | | **Name** | Joe Siwak |
| **Logger Serial No.** | 201819 | | |
| **Site Location** | PS60 Forrest | | |
| **Transformer/Feeder being Logged** | | | |
| **Transformer Tap Setting** | | | |
| **Date and Time Logging Started** | 30/3/16 1325 | **Date and Time Logging Completed** | 7/4/16 12:55 PM |
| **Photo Id#** | _____ **(Photo after fully installed)** | | |

**IMPORTANT NOTES:**

1. Capture logger's installation photos upon initial installation & send to APD on the first day of installation.

2. Check loggers are still logging after a power outage (fully charged battery lasts approx. 30mins on Hioki 3196 and 180mins on Hioki 3198).

## 2. PRE-INSTALLATION CHECKLIST

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

| Pre-Installation Checklist | | | | |
|---|---|---|---|---|
| **Item** | **Description** | **Y** | **N** | **N/A** |
| 1.01 | ***Ensure the following parts are available, checked and prepared*** | | | |
| | a. HIOKI 3196/3198 PQ logger | ☑ | ☐ | ☐ |
| | b. DC power supply (if applicable) and power cord | ☑ | ☐ | ☐ |
| | c. Logger internal battery | ☑ | ☐ | ☐ |
| | d. PC Card memory | ☑ | ☐ | ☐ |
| | e. Power board with clips/plugs<br>***Safety Note:*** The power board is to only supply the loggers | ☑ | ☐ | ☐ |
| | f. Eight test leads with crocodile clips (if only six are supplied, there should be banana plug jumping cables for the neutral connections) | ☑ | ☐ | ☐ |

## 3. INSTALLATION CHECKLIST

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

| Installation Checklist | | | | |
|---|---|---|---|---|
| **Item** | **Description** | **Y** | **N** | **N/A** |
| 2.01 | Has the safety equipment, including but not limited to, suitable PPE and risk assessment documentation been followed, prepared and checked? | ☑ | ☐ | ☐ |
| 2.02 | Has the equipment been set up properly and operated as intended on site? This includes:<br>a) ensuring logger is powered up for continuous operation for at least 7 days (the Power Lamp should be Green, if it is Red the meter is operating off of the battery)<br>b) PC Card memory is in the logger and ready (do not remove – just visually check it is installed) | ☑<br>☑ | ☐<br>☐ | ☐<br>☐ |
| 2.03 | 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)?<br>Refer to Appendix A.1 and Appendix B | ☑ | ☐ | ☐ |
| 2.04 | Have the cables been connected to Channel 4 U+ and U- terminals for neutral – earth voltage measurement?<br>***Note:*** U- needs to connect to neutral and U+ to the earth bar (or point)<br>Refer to Appendix A.1 | ☑ | ☐ | ☐ |
| 2.05 | Has the 'Start/Stop' button been pressed to trigger the logger?<br>Refer to Appendix A.2 | ☑ | ☐ | ☐ |
| 2.06 | Have you ensured that the logger is currently recording the data?<br>Refer to Appendix A.3 | ☑ | ☐ | ☐ |
| 2.07 | Has all the equipment been adequately placed and positioned safely to ensure non-interrupted operation? | ☑ | ☐ | ☐ |
| 2.08 | Have clear photos of the fully installed loggers been taken and photo ID noted in the space available at start of this checklist on page 1? | ☑ | ☐ | ☐ |
| 2.09 | Before leaving site, have the kiosk doors or other means of access been closed and locked appropriately to constraint access? | ☑ | ☐ | ☐ |

**** IMPORTANT NOTE:*** **Do not adjust, modify or alter settings and configurations of loggers (system) unless specified in this checklist, logging result may differ significantly as a consequence.**

# 4. POST-INSTALLATION CHECKLIST

**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?<br>Refer to Appendix A.3<br>***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<br>Advise APD if any equipment is missing | ☑ | ☐ | ☐ |
| 3.03 | Transport the Loggers directly back to APD Address at<br>***176 Wellington Street, East Perth WA 6004***<br>Contact APD on 9212 1561 or 0459 996 022 for any queries on the return of loggers to Perth | ☐ | ☐ | ☐ |

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

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

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

**Comments:**.....

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201444

13/14

PS 96

# BHPBIO NEWMAN
# COMPLIANCE & AUDIT REPORT
# 2015/2016

# PQ LOGGER INSTALLATION CHECKLIST

REVISION K

3/03/2016

Project No.: W_APD04607

APD

# 1. INTRODUCTION

The checklist is mandatory for the installation of loggers and the steps listed in this document are to be completed and signed-off by the electrical contractor.

Contact APD if any query (E-Mail: Mansour.mohseni@apdpower.com.au, P: 9212 1561 & M: 0459 996 022).

Please ensure loggers are sent back within their rental period to avoid incurring additional rental costs.

Refer to item 3.03 for return address.

| | | | |
|---|---|---|---|
| **Electrical Contractor** | | **Name** | JE Sivak |
| **Logger Serial No.** | 201444 | | |
| **Site Location** | PS 96 Pardoo St | | |
| **Transformer/Feeder being Logged** | PS 96 | | |
| **Transformer Tap Setting** | | | |
| **Date and Time Logging Started** | 30/3/16 1340 | **Date and Time Logging Completed** | 7/4/16 10:54 |
| **Photo Id#** | _____ **(Photo after fully installed)** | | |

**IMPORTANT NOTES:**

1. Capture logger's installation photos upon initial installation & send to APD on the first day of installation.

2. Check loggers are still logging after a power outage (fully charged battery lasts approx. 30mins on Hioki 3196 and 180mins on Hioki 3198).

## 2. PRE-INSTALLATION CHECKLIST

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

| Pre-Installation Checklist | | | | |
|---|---|---|---|---|
| **Item** | **Description** | **Y** | **N** | **N/A** |
| 1.01 | ***Ensure the following parts are available, checked and prepared*** | | | |
| | a. HIOKI 3196/3198 PQ logger | ☑ | ☐ | ☐ |
| | b. DC power supply (if applicable) and power cord | ☑ | ☐ | ☐ |
| | c. Logger internal battery | ☑ | ☐ | ☐ |
| | d. PC Card memory | ☑ | ☐ | ☐ |
| | e. Power board with clips/plugs<br>***Safety Note:*** The power board is to only supply the loggers | ☑ | ☐ | ☐ |
| | f. Eight test leads with crocodile clips (if only six are supplied, there should be banana plug jumping cables for the neutral connections) | ☑ | ☐ | ☐ |

## 3. INSTALLATION CHECKLIST

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

| Installation Checklist | | | | |
|---|---|---|---|---|
| **Item** | **Description** | **Y** | **N** | **N/A** |
| 2.01 | Has the safety equipment, including but not limited to, suitable PPE and risk assessment documentation been followed, prepared and checked? | ☑ | ☐ | ☐ |
| 2.02 | Has the equipment been set up properly and operated as intended on site? This includes:<br>a) ensuring logger is powered up for continuous operation for at least 7 days (the Power Lamp should be Green, if it is Red the meter is operating off of the battery)<br>b) PC Card memory is in the logger and ready (do not remove – just visually check it is installed) | ☑<br>☑ | ☐<br>☐ | ☐<br>☐ |
| 2.03 | 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)?<br>Refer to Appendix A.1 and Appendix B | ☑ | ☐ | ☐ |
| 2.04 | Have the cables been connected to Channel 4 U+ and U- terminals for neutral – earth voltage measurement?<br>***Note:*** U- needs to connect to neutral and U+ to the earth bar (or point)<br>Refer to Appendix A.1 | ☑ | ☐ | ☐ |
| 2.05 | Has the 'Start/Stop' button been pressed to trigger the logger?<br>Refer to Appendix A.2 | ☑ | ☐ | ☐ |
| 2.06 | Have you ensured that the logger is currently recording the data?<br>Refer to Appendix A.3 | ☑ | ☐ | ☐ |
| 2.07 | Has all the equipment been adequately placed and positioned safely to ensure non-interrupted operation? | ☑ | ☐ | ☐ |
| 2.08 | Have clear photos of the fully installed loggers been taken and photo ID noted in the space available at start of this checklist on page 1? | ☑ | ☐ | ☐ |
| 2.09 | Before leaving site, have the kiosk doors or other means of access been closed and locked appropriately to constraint access? | ☐ | ☐ | ☐ |

**** IMPORTANT NOTE:*** **Do not adjust, modify or alter settings and configurations of loggers (system) unless specified in this checklist, logging result may differ significantly as a consequence.**

# 4. POST-INSTALLATION CHECKLIST

**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?<br>Refer to Appendix A.3<br>***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<br>Advise APD if any equipment is missing | ☑ | ☐ | ☐ |
| 3.03 | Transport the Loggers directly back to APD Address at<br>***176 Wellington Street, East Perth WA 6004***<br>Contact APD on 9212 1561 or 0459 996 022 for any queries on the return of loggers to Perth | ☐ | ☐ | ☐ |

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

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

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

**Comments:**.....

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201981

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PS 94

# BHPBIO NEWMAN
# COMPLIANCE & AUDIT REPORT
# 2015/2016

# PQ LOGGER INSTALLATION CHECKLIST

REVISION K

3/03/2016

Project No.: W_APD04607

APD

# 1. INTRODUCTION

The checklist is mandatory for the installation of loggers and the steps listed in this document are to be completed and signed-off by the electrical contractor.

Contact APD if any query (E-Mail: Mansour.mohseni@apdpower.com.au, P: 9212 1561 & M: 0459 996 022).

Please ensure loggers are sent back within their rental period to avoid incurring additional rental costs.

Refer to item 3.03 for return address.

| | | | |
|---|---|---|---|
| **Electrical Contractor** | | **Name** | Joe Svak |
| **Logger Serial No.** | 201 981 | | |
| **Site Location** | PS 94 Pordoo | | |
| **Transformer/Feeder being Logged** | | | |
| **Transformer Tap Setting** | | | |
| **Date and Time Logging Started** | 30/3/16 1400 | **Date and Time Logging Completed** | 7-4-16 12:05 |
| **Photo Id#** | _____ **(Photo after fully installed)** | | |

**IMPORTANT NOTES:**

1. Capture logger's installation photos upon initial installation & send to APD on the first day of installation.

2. Check loggers are still logging after a power outage (fully charged battery lasts approx. 30mins on Hioki 3196 and 180mins on Hioki 3198).

## 2. PRE-INSTALLATION CHECKLIST

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

| Pre-Installation Checklist | | | | |
|---|---|---|---|---|
| **Item** | **Description** | **Y** | **N** | **N/A** |
| 1.01 | ***Ensure the following parts are available, checked and prepared*** | | | |
| | a. HIOKI 3196/3198 PQ logger | ☑ | ☐ | ☐ |
| | b. DC power supply (if applicable) and power cord | ☑ | ☐ | ☐ |
| | c. Logger internal battery | ☑ | ☐ | ☐ |
| | d. PC Card memory | ☑ | ☐ | ☐ |
| | e. Power board with clips/plugs<br>***Safety Note:*** The power board is to only supply the loggers | ☑ | ☐ | ☐ |
| | f. Eight test leads with crocodile clips (if only six are supplied, there should be banana plug jumping cables for the neutral connections) | ☑ | ☐ | ☐ |

## 3. INSTALLATION CHECKLIST

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

| Installation Checklist | | | | |
|---|---|---|---|---|
| **Item** | **Description** | **Y** | **N** | **N/A** |
| 2.01 | Has the safety equipment, including but not limited to, suitable PPE and risk assessment documentation been followed, prepared and checked? | ☑ | ☐ | ☐ |
| 2.02 | Has the equipment been set up properly and operated as intended on site? This includes:<br>a) ensuring logger is powered up for continuous operation for at least 7 days (the Power Lamp should be Green, if it is Red the meter is operating off of the battery)<br>b) PC Card memory is in the logger and ready (do not remove – just visually check it is installed) | ☑<br>☑ | ☐<br>☐ | ☐<br>☐ |
| 2.03 | 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)?<br>Refer to Appendix A.1 and Appendix B | ☑ | ☐ | ☐ |
| 2.04 | Have the cables been connected to Channel 4 U+ and U- terminals for neutral – earth voltage measurement?<br>***Note:*** U- needs to connect to neutral and U+ to the earth bar (or point)<br>Refer to Appendix A.1 | ☑ | ☐ | ☐ |
| 2.05 | Has the 'Start/Stop' button been pressed to trigger the logger?<br>Refer to Appendix A.2 | ☑ | ☐ | ☐ |
| 2.06 | Have you ensured that the logger is currently recording the data?<br>Refer to Appendix A.3 | ☑ | ☐ | ☐ |
| 2.07 | Has all the equipment been adequately placed and positioned safely to ensure non-interrupted operation? | ☑ | ☐ | ☐ |
| 2.08 | Have clear photos of the fully installed loggers been taken and photo ID noted in the space available at start of this checklist on page 1? | ☑ | ☐ | ☐ |
| 2.09 | Before leaving site, have the kiosk doors or other means of access been closed and locked appropriately to constraint access? | ☑ | ☐ | ☐ |

**** IMPORTANT NOTE:*** **Do not adjust, modify or alter settings and configurations of loggers (system) unless specified in this checklist, logging result may differ significantly as a consequence.**

# 4. POST-INSTALLATION CHECKLIST

**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?<br>Refer to Appendix A.3<br>***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<br>Advise APD if any equipment is missing | ☑ | ☐ | ☐ |
| 3.03 | Transport the Loggers directly back to APD Address at<br>***176 Wellington Street, East Perth WA 6004***<br>Contact APD on 9212 1561 or 0459 996 022 for any queries on the return of loggers to Perth | ☐ | ☐ | ☐ |

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

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

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

**Comments:**.....

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# APPENDIX D Electrical Faults Log for 2015/16 FY

Please refer to the following pages.

# NPI UTILITIES INLAND TRANSMISSION INCIDENT LOG

| Date (YYYY/MM/DD) | Generation/Feeder/Distribution Description | Outage Duration (mins) | Time off | Time restored | System Voltage (kV) | Effect on operations | Probable/exact Cause | 1SAP notification/s raised | Action/Investigation | 1Doc Failure Investigation RPT Link | DETAILED INFORMATION: Fault Current (Amps) | Fault Duration (Seconds) | Syst Frequency during fault (Hz) | Protection Relay that cleared the fault |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CLICK HERE TO INSERT NEW EVENT ('Enable Content' first) | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 2016/01/18 | Jimblebar T2 FDR3 | 116 | 1855 | (a) Energise Bus A (19H32)<br>(b) Energise NP Sub (19H34)<br>(c) Energise Town Sub (19H36<br>(d) Energise Karnaji Sub ( 19H45)<br>e) Energise Homestead Creek Sub ( 19H46)<br>f) Jimblebar Village Sub (19H47)<br>g) Energise Shovelanna Sub (19H48)<br>h) Energise Junction Sub (19H56)<br>i) Energise Whable Back Sub (20H56)<br>j) Energise South Town Sub (21H05)<br>k) Energise Hub Sub (21H21)<br>l) Energise Yandi FDRS (21H27)<br>m) Energise Jimblebar Sub (22H45) | 132/66 | Entire Network | Black Out | | Revise Procedure for a BLACK START sequence | http://io1doc/webtop/drl/objectId/0b03c41a825d5823 | | | | |
| 2016/01/18 | NCC872 Jimblebar Mine FDR | 118 | 1637 | 1835 | 132/66 | Trip of FDR NCC872 | Llightning Strike | | | http://io1doc/webtop/drl/objectId/0b03c41a825d5704 | 2.75kA | 0.6 | | NCC872 |
| 2015/12/17 | NCC872 Jimblebar Mine FDR | 118 | 1637 | 1835 | 132/66 | Trip of FDR NCC872 | Llightning Strike | | | http://io1doc/webtop/drl/objectId/0b03c41a825d5704 | 2.75kA | 0.6 | | NCC872 |
| 2015/12/17 | Jimblebar T2 FDR3 | 116 | 1310 | 1506 | 132/66 | Loss of power to FDR 3 & 4 | Birdstrike on Pole JM71/501 | | Grading Study to be done on the Jimblebar Substation | http://io1doc/webtop/drl/objectId/0b03c41a82553543 | 4.8kA | 0.58 | | JIM608 & JIM609 |
| 2015/12/8 | Yandi FDR 3 | 484<br>433 | 0:28<br>0:37 | (a) - Yandi Primary Crusher (08H32)<br>(b) TLO YD2 (08H56) | 33 | Loss of power to FDR 3 | O/C Trip | | Undervoltage caused the capacitor banks to trip and increase current. | http://io1doc/webtop/component/main?__dmfClientId=1434 | 410A | | | |
| 2015/12/7 | Jimblebar T2 FDR3 | 515<br>575<br>484<br>433 | 22:05<br><br>0:28<br>0:37 | (a) - OHP1 Primary Crusher 1 (06H40)<br>(b) - OHP1 Primary Crusher 2 (07H39)<br>(c) - Yandi Primary Crusher (08H32)<br>(d) TLO YD2 (08H56) | 33 | Loss of power to FDR 3 & 4 | Birdstrike on Southern Loop | | Monitored fire via site contacts<br>Closed when fire intensity reduced | http://io1doc/webtop/component/main?__dmfClientId=1434 | ~1kA | 0.06 | | |
| 2015/12/2 | NP Yandi 132kV Fdr | 192 | 13:37 | 16:49 | 132 | Loss power to Area C and Yandi | Fire under 132kV line just east of Juction sub | | Monitored fire via site contacts<br>Closed when fire intensity reduced | http://io1doc/webtop/drl/objectId/0b03c41a825078c3 | ~1kA | | | |
| 2015/9/20 | Yandi Feeder 2 | 62 | 16:54 | 17:56 | 33 | Yandi OHL 2 | Self clearing fault, bird suspected | | Yandi Ops patrolled line. All clear no indication of cause.<br>Successfully reclosed line via SCADA. | | 3200 | 0.15 | | F2-F11-X-P143 |
| 2015/07/02 | Whaleback 66kV Substation | 111 | 1131 | 1322 | 66 | Power loss to:<br>- WB Substation<br>- All Whaleback Minesite excluding east | Birdstrike at pole WB-WC71/4 | Event:411766138 | Bird strike occurred across A phase at pole WB-WC71/4 on the WB-HUB overhead line. WB-HUB protection did not trip due to mal-grading. WB subsation incomers tripped and NP FdrB tripped. | http://io1doc/webtop/drl/objectId/0903c41a8216dbdd | ~5kA | 0.327 | ~49.8 Hz | NP 66WL2<br>WB66 FdrA<br>WB66 FdrB |
| 2015/6/6 | Jimblebar Gate House | ~40 | ~1630 | ~1715 | 11 | Power loss to Jimblebar Gatehouse | Accidental trip during protection system tripping from contractor | | From GTS:<br>In the Feeder 3 to Gatehouse Panel, there are MCGG OCEF Protection Relay, and MCSU Sensitive EF (SEF) Protection Relay. We isolated the trip link for MCGG (OCEF) relay, while maintaining MCSU (SEF) relay trip link, in order to keep the backup protection to the system.<br>The MCSU (SEF) relay tripped upon injection test to MCGG relay (OCEF), as it is feeding from the same CT source. It was approximately 40 minutes outage time, before the system was normalised. | | | | | |
| 2015/05/05 | Yarnima | 75<br>77<br><br>75<br>177<br>222<br>227 | 1700 | (a) Newman Town Ship (1639Hrs)<br>(b) Eastern Ridge & Warrawandu Village (1639Hrs)<br>(c) Whaleback (1647)<br>(d) Jimblebar (1841)<br>(e)Area C (1600Hrs)<br>(f) Yandi (2030) | Multiple | Site wide power outages.<br><br>Subsequent Whaleback Equipment Failure (Due to voltages) | Yarnima Tripped during testing of ST2. Causing site wide power outage.<br><br>Alinta was brought online, possible Voltage Excursions from Alinta Caused damage to Whaleback Fixed Plant Equipment. | EVENT: 411332090<br>INV: 432017745 | ICAM for Incident undertaken results at this stage unknown | http://io1doc/webtop/drl/objectId/0903c41a82081d8f | N/A | N/A | <50Hz | N/A |

# NPI UTILITIES INLAND DISTRIBUTION INCIDENT LOG

| Event | Notification Number(1SAP) | Date | Time off (GPS/non GPS) | Time restored (GPS/non GPS) | Outage Duration (mins) | Generation/Feeder/Distribution Description | System Voltage | Protection Relay that cleared the fault | Fault Current (Amps) | Fault Duration (Seconds) | Syst Frequency during fault (Hz) | Effect on operations | Probable/exact Cause | Action/Investigation | 1Doc Failure Investigation RPT Link |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CLICK HERE TO INSERT NEW EVENT ('Enable Content' first) | | | | | | | | | | | | | | | |
| 27 | | | | | 0 | | | | | | | | | | |
| 26 | | | | | | | | | | | | | | | |
| 25 | 414071165 | 2016/06/08 | 7:56:00 | 10:16:00 | 140 | South Mine 11kV Feeder | 11kV | Transformer Low Oil Trip | N/A | N/A | N/A | No overall impact to supply chain. | Major Oil Leak identified | South Mine was unable to supply the feeders so a back feed was required from the WB 11kV sub. | http://io1doc/webtop/drl/objectId/0b03c41a8286d527 |
| 24 | 414087728 | 2016/06/08 | 6:20:00 | 8:04:00 | 104 | Yandi Feeder 2 | 33kV | P143 Yandi F2-F11-X | 2.9kA | 0.02 | 49.76 | No overall impact to supply chain. | Suspect a birdstrike however inspections still required to determine cause of fault. | Site Line patrol was done after the fault. Due heavy rains experienced, there was difficulty in accessing the overhead line routes. It was noticed that a downstream recloser had tripped as well. Line reclose was successful. | http://io1doc/webtop/drl/objectId/0b03c41a8285a950 |
| 23 | 414040599 | 2016/06/03 | 10:55:00 | 2016/06/04 5:24:00 PM | 1099 | MAC (Junction) Feeder 1 | 33kV | P143 Junction F1-F11-X | 3.3kA | 0.6 | 49.99 | Downtime TLO: YD1 - train at OTP (0hrs 56min)<br>MAC TLO - train at OTP - (3hrs 7mins)<br>YD2 - train was loaded with 102 cars (1hr 32min)<br><br>Increase in cycle time as a result<br><br>No overall impact to supply chain. | Blown insulator at Pole JS13 | - Site line patrol conducted<br>- Relay fault reviewed<br>- Reclose successful<br>- By carrying out a protection grading stufy between the Junction Sub to the downstream 33kV relays, the clearance time of the CB may be reduced. | http://io1doc/webtop/drl/objectId/0b03c41a8284930d |
| 22 | 413830674 / 432465774 | 2016/03/05 | 9:17:00 | 10:14:00 | 57 | Yandi Feeder 2 | 33kV | F2-Q51 (F2-F11-XP143) | 3.1kA | 0.1 | 49.99 | - IOWA was isolated to assess the cause of the outage.<br>- Yandi OHP2 Downtime 3hrs 9 mins, Lost Feed Tonnes Ore For Rail (OFR) - 13986 | Bird Strike on Overhead line. | - Site line patrol conducted<br>- Relay fault reviewed<br>- Reclose successful | http://io1doc/webtop/drl/objectId/0b03c41a827c5cab |
| 21 | 413717686 / 432445136 | 2016/04/16 | 7:24:00 | 11:21:00 | 237 | Water Bore Feeder | 11KV | Water Bore Feeder | 6KA | 0.5s | - | -Anfo at Whaleback, ER gatehouse, Homestead borefield, ER site potable water | Somebody had thrown chain into overhead line which wrapped around OH earth and hit B phase | 432445136 - Isolated line, installed wrap to damaged conductor. Newman Police informed. | http://io1doc/webtop/drl/objectId/0b03c41a82785c4b |
| 20 | 413576483 / 413774367 | 2016/03/25 | 15:43:00 | 17:27:00 | 104 | JIMB 33kV FDR 3 & 4 | 33kV | JIM608<br>JIM609<br>JIM806 | 2.1kA | 1.15sec | - | | - Probable Bird Strike.<br>- Site line patrol conducted. - Nil fault found. | - Site line patrol conducted<br>- Relay fault reviewed<br>- Reclose successful<br>- Cary out protection study and implement protection changes to rectify mal-grading. | http://io1doc/webtop/drl/objectId/0b03c41a8270b2a8 |
| 19 | 413538464 / 432411997 | 2016/03/20 | 1:00:00 | 8:00:00 | 420 | - PS11-PS14.<br>- Red Phase on pole 34/19 blown | 11KV | Red Phase Fuse | - | - | - | - Partial loss of power to approx 120 consumers off 4 padsubs PS11-PS14 | - Unknown, same fuse has blown previously, cable has been insulation tested OK. | - Noti 413539142 raised to replace the 200A EDO's as they do not make the fuses for them anymore.<br>- PS11 to PS14 now fed off TC4 rather than TC2 until repairs completed | http://io1doc/webtop/drl/objectId/0b03c41a8271a193 |
| 18 | 413528027 | 2016/03/18 | 11:30:00 | 11:45:00 | 15 | T25 Ethel Creek | 11KV | Red Phase Fuse | - | - | - | - Loss of power to approx 20 consumers on Ethel Creek. | LV over head line clash due to branch hitting outer conductor | Event noti raised, 5Y's completed and attached to noti | http://io1doc/webtop/drl/objectId/0b03c41a8271a192 |
| 17 | 413494087 | 2016/03/13 | 19:08:00 | 23:05:00 | 237 | Yandi Feeder 2 | 33kV | F2-Q51 (F2-F11-XP143) | 2500 | 0.1055 | - | - OHP1: 19H18 to 21H26 (2H08)<br>- OHP3 – Primary Crusher EFE: 19H18 to 23H55 (4H37)<br>- OHP3 – Primary Crusher WFE: 20H27 to 22H14 (1H47)<br>- TLO YD1 – Reclaimer RC640: 19H18 to 23H00 (3H42)<br>- Lost Feed Tonnes: 37489<br>- There has been no reported direct impact to the supply chain. | - 3 Phase Fault.<br>- Instantaneuos O/C | - 1SAP No. 413178422 – Evaluating respective lines that potentially could have an auto reclose enabled on particular feeders. | http://io1doc/webtop/drl/objectId/0b03c41a826c8ccd |
| 16 | 413480474 | 2016/03/10 | 14:02:00 | 15:34:00 | 92 | Yandi Feeder 3 | 33kV | F3-Q51 (F3-F11-XP143) | 446 | 1.618 | - | - OHP1: 14H12 to 15H20 (1H08)<br>- OHP3: 14H10 to 16H40 (2H30)<br>- TLO YD2: 15H30 to 17H25 (1H55)<br>- Lost Feed Tonnes: 22696<br>- There has been no reported direct impact to the supply chain. | - Time O/C trip. | - 1SAP No. 413178422 – Evaluating respective lines that potentially could have an auto reclose enabled on particular feeders.<br>- 1SAP No. 413178421 – Investigate the root cause for the Yandi transmission transformers faulting to MANUAL mode when similar faults occur. Initial findings suspect that the PLC coding is incorrect. | http://io1doc/webtop/drl/objectId/0b03c41a826c8bfd |
| 15 | 413476525 | 2016/03/10 | 2:02:00 | 5:38:00 | 216 | Junction Mine Feeder 1 | 33kV | F1-Q21 | 1640 | 1.268s | - | Site Wide Power Outage to Mining Area C<br>- OHP1: 02H02 to 08H15 (6H13)<br>- OHP2: 02H02 to 07H31 (5H29)<br>- TLO: 02H02 to 06H29 (4H27)<br>- Lost Feed Tonnes: 46134<br>- One (1) train diversion to Yandi and queuing at MAC. | - Snake cause B phase to Earth fault on Recloser 1 | - Junction Team Investigating.<br>- 1SAP No. 413178422 - Evaluating respective lines that potentially could have an AUTO RECLOSE enabled on particular feeders | http://io1doc/webtop/drl/objectId/0b03c41a826c8bfc |
| 14 | 413442240 | 2016/03/05 | 8:09:00 | 10:06:00 | 117 | Yandi Feeder 2 (F2) | 33kV | Yandi 33kV F2-F11-X143 Micom | 1870 | 65msec | - | Yandi OHP2 and OHP1(tripped on recloser due to Powersation 11/33kV Delta Star step up transformer acting as an earth reference).<br>- YD2 TLO Downtime – 2H46mins.<br>- No direct impact caused to Supply chain. | - Verified bird strike Red Phase to earth fault. | - Yandi HV ops investigating | http://io1doc/webtop/drl/objectId/0b03c41a826c8bfb |
| 13 | 413391815 / 432385214 | 2016/02/28 | 6:00:00 | 7:00:00 | 60 | TC4 - REC34/64 - Airport | 11kV | Pole 34/64 Recloser | - | - | - | Supply down stream of recloser without power. | - Recloser not programmed correctly. | - Auto Recloser is to be reprogrammed and commissioned | http://io1doc/webtop/drl/objectId/0b03c41a826c8bfa |

# NPI UTILITIES INLAND DISTRIBUTION INCIDENT LOG

| Event | Notification Number(1SAP) | Date | Time off (GPS/non GPS) | Time restored (GPS/non GPS) | Outage Duration (mins) | Generation/Feeder/Distribution Description | System Voltage | Protection Relay that cleared the fault | Fault Current (Amps) | Fault Duration (Seconds) | Syst Frequency during fault (Hz) | Effect on operations | Probable/exact Cause | Action/Investigation | 1Doc Failure Investigation RPT Link |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 413361014 / 432379920 | 2016/02/23 | 7:19:00 | 8:13:00 | 54 | STS 6 | 11kV | STS6 | 730 | .3 | | Lose of STS 6 Feeder | - Bird Strike | - 1SAP No. 413178422 – Evaluating respective lines that potentially could have an auto reclose enabled on particular feeders.<br>- 1SAP No. 413226278 – Due to previous problems being experience with the SCADA UPS, work is already in progress to replace of the existing UPS. | http://io1doc/webtop/drl/objectId/0b03c41a8268b45f |
| 11 | 413309585 | 2016/02/15 | 12:15:00 | 13:37:00 | 82 | Junction FDR1 | 33kV | F1-Q51(F1-F11X) | 347.7A | | | 1. Ore For Rail (OFR) Tonnes Lost: 13,818<br>2. Ore On Rail (OOR) – No train cancellations.<br>3. No direct impact to the supply chain. | - Time O/C trip.<br>- Area C Cap Banks Out of Service | - Area C production electrical supervisor is to ensure that the capacitor banks are not Out of Service. | http://io1doc/webtop/drl/objectId/0b03c41a82656911 |
| 10 | 413192999 / 413685954 | 2016/01/27 | 17:15:00 | 17:57:00 | 42 | STS2 | 11kV | STS2 | 6700 | .121 | - | Lose of STS 2 Feeder | - Phase to phase.<br>- Instantaneuos O/C Trip.<br>- Lightning Strike | - 1SAP No. 413178422 - Evaluating respective lines that potentially could have an AUTO RECLOSE enabled on particular feeders | http://io1doc/webtop/drl/objectId/0b03c41a82602ffe |
| 9 | 413391815 / 432385214 | 2016/01/27 | 6:30:00 | 7:00:00 | 30 | TC4 - REC34/64 - Airport | 11kV | Pole 34/64 Recloser | - | - | - | Supply down stream of recloser without power. | - Recloser not programmed correctly. | - Auto Recloser is to be reprogrammed and commissioned | |
| 8 | 413161817 | 2016/01/24 | 16:07:00 | 17:40:00 | 93 | Whaleback Hubb | 66kv | CB703A | 2500 | - | - | | - Fault on South Mine Feeder within Whaleback Distribution. | - 1SAP No. 413233564: Modify the bus zone relay differential current summation logic | http://io1doc/webtop/drl/objectId/0b03c41a82602f34 |
| 7 | 413164055 | 2016/01/24 | 16:37:00 | 17:03:00 | 26 | Yandi feeder 2 | 33kV | F2-Q51 | 2800 | - | - | | - Phase to Phase fault.<br>- Instantaneous O/C trip.<br>- Equipment Failure | - None | http://io1doc/webtop/drl/objectId/0b03c41a82602ffc |
| 6 | 413164055 | 2016/01/24 | 15:52:00 | 16:16:00 | 24 | Yandi feeder 2 | 33kV | F2-Q51 | 2700 | - | - | | - Phase to Phase fault.<br>- Instantaneous O/C trip.<br>- Bird strike. | - 1SAP No. 413178422 - Evaluating respective lines that potentially could have an AUTO RECLOSE enabled on particular feeders | http://io1doc/webtop/drl/objectId/0b03c41a82602ffb |
| 5 | 413148939 | 2016/01/22 | - | - | 5 | Recloser 34/38 VT Damaged | 11kV | - | - | - | - | None | - Lightning Strike Blew VT | - Order new replacement VT and install.<br>- Recloser to be tested and recommissioned. | http://io1doc/webtop/drl/objectId/0b03c41a82602ffa |
| 4 | 413152847 | 2016/01/22 | 15:36:00 | 16:13:00 | 37 | Junction Feeder 1 | 33kV | F1-Q51 | 3020 | - | - | | - Birdstrike.<br>- Nil bird found by site | - Site carried out line patrol<br>- Reclosed JIM608 | http://io1doc/webtop/drl/objectId/0b03c41a826030e9 |
| 3 | | 2016/01/19 | 6:00:00 | 7:00:00 | 60 | TC4 - REC34/64 - Airport | 11kV | Pole 34/64 Recloser | - | - | - | Supply down stream of recloser without power. | - Recloser not programmed correctly. | - Auto Recloser is to be reprogrammed and commissioned | http://io1doc/webtop/drl/objectId/0b03c41a82602ff9 |
| 2 | 413125806 | 2016/01/18 | - | - | 0 | WA8 ABS Repairs | 11kV | - | - | - | - | - | - Loose Connection on ABS | - Service ABS & Check for Loose Connections | http://io1doc/webtop/drl/objectId/0b03c41a82602ffd |
| 1 | | 2016/01/01 | 11:43:00 | 12:40:00 | 57 | Jimblebar 33kV Feeder No.4 (JIM608) | 33kV | JIM608 | IA: 292A<br>IB: 2158A<br>IC: 2086A<br>IG: 2227A | 905msec | - | Jimblebar TLO shutdown | - Birdstrike. Nil bird found by site | - Site carried out line patrol<br>- Reclosed JIM608 | http://io1doc/webtop/drl/objectId/0b03c41a825807db |
| 31 | 412930221 / 432298507 | 2015/12/18 | 12:00:00 | 19:30:00 | 450 | 15 Wilara - Red phase out on house - no a/c or power to half house | 415V | | | | | | Red phase fuse holder burnt out | replaced fuse holder | |
| 30 | 412898565 / 432292759 | 2015/12/14 | 2:30:00 | 3:00:00 | 30 | PS25 Feeder | LV | CB | | | | Loss to Laver and willis street | Overcurrent | Change CB Settings to 0.8 I from 0.63 | |
| 29 | 412869936 / 432286753 | 2015/12/10 | 5:30:00 | 7:00:00 | 90 | TC4 - REC34/37 - Airport | 11kV | Pole 34/37 Recloser | A-B Phase O/C Trip | | | Loss power to partial east Newman & airpot | Possible Bird Strike/ Unknown | Engineering to find out if 1 shot on recloser | |
| 28 | 412815614 / 432276976 | 2015/12/02 | 16:30:00 | 18:30:00 | 120 | 3&5 Keedi Street | 415V | | | | | Nil | Reported that OH service to 5 Keedi blown off consumer pole - hit by tree in storm No loss of supply | require tree to be trimmed and service put back onto consumer pole<br>rasied noti for repairs to raiser bracket and pole 412820925 | |
| 27 | 412815702 / 432276978 | 2015/12/02 | 16:42:00 | 18:17:00 | 95 | Water Bores 11kV Line | 11kV | TS WB | IA: 4.8kA<br>IB: 267A<br>IC: 5.6kA<br>Io: 708A | 90msec | | Loss power to:<br>Eastern Ridge Gatehouse<br>Homestead Ck Bores<br>Newman Waste Water Plant<br>Ore Body 25<br>Newman Racecourse<br>Camp Drafting | Disc insualtor failure at pole WB8 (adjacent to FMG plant) during a storm | Patrolled line and identified fault<br>Isolated damaged section<br>Close TS WB feeder<br>Backfed OB25 from Homestead Ck | http://io1doc/webtop/drl/objectId/0b03c41a825078c4 |
| 26 | 412811746 / 432278007 | 2015/12/02 | 4:56:00 | 6:21:00 | 85 | TC4 - East Newman & Airport | 11kV | Pole 34/37 Recloser | A-B Phase O/C Trip | | | Loss power to partial east Newman & airpot | Correla carcass found under airpot line near pole 34/60 | Nil trip TC4 in Town Substation<br>TC4 in TS recorded I> event<br>P34/37 recloser reclosed locally | http://io1doc/webtop/drl/objectId/0b03c41a82503e43 |
| 25 | | 2015/11/29 | | | | Shovelanna | | | | | | | | | |
| 24 | | 2015/11/28 | 14:00:00 | | | PS26 LV Feeder | 415V | MCCB | | | | Loss 415V Distribution | | | |
| 23 | 412737980 / 432262848 | 2015/11/20 | 15:52:00 | 17:40:00 | 108 | Southtown STS6 | 11KV | Micom P127 | A ph: 336A<br>B ph: 838A<br>C ph: 309A | 400msec | | All STS6 & TC3<br>TC3 tied to STS6 due to TC3 fault | Pole 35/35 DOFs W ph blown. Wire expelled and shorted to pole.<br>This was the tie between STS6 and tC3.<br>DOF fatigued during previous day TC3 fault. | Police reported seeing sparks on line.<br>Found blown W ph DOF at pole 35/25 and arcing marks from fuse wire on cross arm.<br>Opened pole 35/35 ABS and reclosed STS6.<br>Recloser 31/46/1A tripped on earth fault.<br>Opened P35/35 fdr at RMU8<br>Closed recloser 31/46/1A | http://io1doc/webtop/drl/objectId/0b03c41a8249f84f |
| 22 | 412850469 / 432283474 | 2015/11/19 | 17:20:00 | | | Camp Drafting Line<br>(off water bores line) | 11kV | DOFs Pole WB9 | ? | ? | | Outage of camp drafting area | Earth wire fallen on line.<br>Storm with lots of flying objects. | Outage reported by local.<br>Line patrolled and defect found.<br>Line isolated. | http://io1doc/webtop/drl/objectId/0b03c41a8249f84e |
| 21 | 412850415 / 432283470 | 2015/11/19 | 17:20:00 | 18:40:00 | 80 | Town Sub - TC3<br>&<br>RMU01 | 11kV | Micom - P127<br><br>Sepam | TC3 A ph: 1377kA<br>TC3 B ph: 4.96<br>TC3 C ph: 2.47 | 125msec | | STS6 and TC3 tied at time of fault.<br>Outage at PS104/105/106/108<br>Visible dip on network | TC3 Earth wire fallen onto A phase beside Kurra Camp.<br>Storm with lots of flying objects. | Line patrolled.<br>Attempted reclose.<br>Line patrolled again and found fault.<br>Kurra ring opened at PS108 and ring closed.<br>Earth wire repaired 21/11/2015.<br>Network returned to normal config. | http://io1doc/webtop/drl/objectId/0b03c41a8249f3ec |
| 20 | | 2015/11/16 | 10:59:00 | 14:10:00 | 191 | Jmb JIM608<br>(FDR No.4) | 33kv | Multilin | A phase 12kA / 6.2kA<br>B phase 278A / 6.3kA<br>C phase 72A / 6.1kA | 630msec | | Loss power JMB Fdr4<br>Overvoltage trip Whaleback 11kV and 6.6kV<br>Multiple OV trips in other plant MCCs<br>Yarnima GT2 trip over freq<br>Yarnima GT3 & ST1 stayed on<br>Alint GT trip reverse power | Nil cause reported by site (JMB).<br>Waveform looks like bird strike | 0msec - A Ph to earth fault Jmb Fdr4 - 12kA<br>124msec - Fault develop to 3 ph - 6.2kA<br>565msec - JIM608 relay initiates Phase TOC1 trip<br>630msec - JIM608 CB opens / clears fault<br>>630msec - 132kV voltage increase to 153kV | http://io1doc/webtop/drl/objectId/0b03c41a8249f3eb |
| 19 | | 2015/10/12 | 11:00:00 | 12:07:00 | 67 | Ynd Fdr2<br>(F2-F11/X) | 33kV | Micom P127 | A Phae - 118A<br>B Phase - 30A<br>C Phase - 3129A | 61msec | N/A | Loss of power to Yandi site Fdr2 | Line patrol by site found nil faults | Yandi site patrolled line & found nil faults<br>NPI downloaed fault record<br>NPI closed Fdr2 when requested by Yandi | http://io1doc/webtop/drl/objectId/0b03c41a823f232b |
| 18 | | 2015/10/10 | 16:11:00 | 17:05:00 | 54 | JIM608 | 33kV | GE F60 | | N/A | N/A | Loss of power to parts of Jimblebar Mine site. | 3 Phase TOC trip.Reports of high winds & lightning in the area | Reclose of JIM608 was done after line was patrolled and no faults identified. | |

| Event | Notification Number(1SAP) | Date | Time off (GPS/non GPS) | Time restored (GPS/non GPS) | Outage Duration (mins) | Generation/Feeder/Distribution Description | System Voltage | SAIDI/SAIFI Calculations | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Substation | Feeder | TX | Total Consumers affected | Fduration (From column C) | SAIDI Mins/Cust | SAIFI | SAIDI Mins/Cust TOTAL ('06/2015 - '06/2016) | SAIFI TOTAL ('06/2015 - '06/2016) |
| CLICK HERE TO INSERT NEW EVENT ('Enable Content' first) | | | | | | | | | | | 0 | 0 | 0.0 | 0.00 | 66.9 | 0.81 |
| 27 | | | | | 0 | | | | | | 0 | 0 | 0.0 | 0.00 | | |
| 26 | | | | | | | | | | | 0 | 0 | 0.0 | 0.00 | | |
| 25 | 414071165 | 2016/06/08 | 7:56:00 | 10:16:00 | 140 | South Mine 11kV Feeder | 11kV | | | | 1 | 140 | 0.1 | 0.00 | | |
| 24 | 414087728 | 2016/06/08 | 6:20:00 | 8:04:00 | 104 | Yandi Feeder 2 | 33kV | | | | 1 | 104 | 0.0 | 0.00 | | |
| 23 | 414040599 | 2016/06/03 | 10:55:00 | 2016/06/04 5:24:00 PM | 1099 | MAC (Junction) Feeder 1 | 33kV | | | | 1 | 1099 | 0.5 | 0.00 | | |
| 22 | 413830674 / 432465774 | 2016/03/05 | 9:17:00 | 10:14:00 | 57 | Yandi Feeder 2 | 33kV | | | | 1 | 57 | 0.0 | 0.00 | | |
| 21 | 413717686 / 432445136 | 2016/04/16 | 7:24:00 | 11:21:00 | 237 | Water Bore Feeder | 11KV | | Water Bore | Newman Sewerage Pl | 10 | 237 | 1.0 | 0.00 | | |
| 20 | 413576483 / 413774367 | 2016/03/25 | 15:43:00 | 17:27:00 | 104 | JIMB 33kV FDR 3 & 4 | 33kV | | | | 1 | 104 | 0.0 | 0.00 | | |
| 19 | 413538464 / 432411997 | 2016/03/20 | 1:00:00 | 8:00:00 | 420 | - PS11-PS14.<br>- Red Phase on pole 34/19 blown | 11KV | | | PS11 - PS14 | 76 | 420 | 13.4 | 0.03 | | |
| 18 | 413528027 | 2016/03/18 | 11:30:00 | 11:45:00 | 15 | T25 Ethel Creek | 11KV | | | T25 | 27 | 15 | 0.2 | 0.01 | | |
| 17 | 413494087 | 2016/03/13 | 19:08:00 | 23:05:00 | 237 | Yandi Feeder 2 | 33kV | | | | 1 | 237 | 0.1 | 0.00 | | |
| 16 | 413480474 | 2016/03/10 | 14:02:00 | 15:34:00 | 92 | Yandi Feeder 3 | 33kV | | | | 1 | 92 | 0.0 | 0.00 | | |
| 15 | 413476525 | 2016/03/10 | 2:02:00 | 5:38:00 | 216 | Junction Mine Feeder 1 | 33kV | | | | 1 | 216 | 0.1 | 0.00 | | |
| 14 | 413442240 | 2016/03/05 | 8:09:00 | 10:06:00 | 117 | Yandi Feeder 2 (F2) | 33kV | | | | 1 | 117 | 0.0 | 0.00 | | |
| 13 | 413391815 / 432385214 | 2016/02/28 | 6:00:00 | 7:00:00 | 60 | TC4 - REC34/64 - Airport | 11kV | | | TC4 - REC34/64 - Airport | 3 | 60 | 0.1 | 0.00 | | |

| Event | Notification Number(1SAP) | Date | Time off (GPS/non GPS) | Time restored (GPS/non GPS) | Outage Duration (mins) | Generation/Feeder/Distribution Description | System Voltage | SAIDI/SAIFI Calculations | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Substation | Feeder | TX | Total Consumers affected | Fduration (From column C) | SAIDI Mins/Cust | SAIFI | SAIDI Mins/Cust TOTAL ('06/2015 - '06/2016) | SAIFI TOTAL ('06/2015 - '06/2016) |
| 12 | 413361014 / 432379920 | 2016/02/23 | 7:19:00 | 8:13:00 | 54 | STS 6 | 11kV | | STS6 | | 211 | 54 | 4.8 | 0.09 | | |
| 11 | 413309585 | 2016/02/15 | 12:15:00 | 13:37:00 | 82 | Junction FDR1 | 33kV | | | | 1 | 82 | 0.0 | 0.00 | | |
| 10 | 413192999 / 413685954 | 2016/01/27 | 17:15:00 | 17:57:00 | 42 | STS2 | 11kV | | STS2 | | 567 | 42 | 10.0 | 0.24 | | |
| 9 | 413391815 / 432385214 | 2016/01/27 | 6:30:00 | 7:00:00 | 30 | TC4 - REC34/64 - Airport | 11kV | | | TC4 - REC34/64 - Airport | 3 | 30 | 0.0 | 0.00 | | |
| 8 | 413161817 | 2016/01/24 | 16:07:00 | 17:40:00 | 93 | Whaleback Hubb | 66kv | | | | 1 | 93 | 0.0 | 0.00 | | |
| 7 | 413164055 | 2016/01/24 | 16:37:00 | 17:03:00 | 26 | Yandi feeder 2 | 33kV | | | | 1 | 26 | 0.0 | 0.00 | | |
| 6 | 413164055 | 2016/01/24 | 15:52:00 | 16:16:00 | 24 | Yandi feeder 2 | 33kV | | | | 1 | 24 | 0.0 | 0.00 | | |
| 5 | 413148939 | 2016/01/22 | - | - | 5 | Recloser 34/38 VT Damaged | 11kV | | | | 0 | 5 | 0.0 | 0.00 | | |
| 4 | 413152847 | 2016/01/22 | 15:36:00 | 16:13:00 | 37 | Junction Feeder 1 | 33kV | | | | 1 | 37 | 0.0 | 0.00 | | |
| 3 | | 2016/01/19 | 6:00:00 | 7:00:00 | 60 | TC4 - REC34/64 - Airport | 11kV | | | TC4 - REC34/64 - Airport | 3 | 60 | 0.1 | 0.00 | | |
| 2 | 413125806 | 2016/01/18 | - | - | 0 | WA8 ABS Repairs | 11kV | | | | 0 | 0 | 0.0 | 0.00 | | |
| 1 | | 2016/01/01 | 11:43:00 | 12:40:00 | 57 | Jimblebar 33kV Feeder No.4 (JIM608) | 33kV | | | | 1 | 57 | 0.0 | 0.00 | | |
| 31 | 412930221 / 432298507 | 2015/12/18 | 12:00:00 | 19:30:00 | 450 | 15 Wilara - Red phase out on house - no a/c or power to half house | 415V | | | | 1 | 450 | 0.2 | 0.00 | | |
| 30 | 412898565 / 432292759 | 2015/12/14 | 2:30:00 | 3:00:00 | 30 | PS25 Feeder | LV | | | PS25 | 20 | 30 | 0.3 | 0.01 | | |
| 29 | 412869936 / 432286753 | 2015/12/10 | 5:30:00 | 7:00:00 | 90 | TC4 - REC34/37 - Airport | 11kV | | | TC4 - REC34/37 - Airport | 3 | 90 | 0.1 | 0.00 | | |
| 28 | 412815614 / 432276976 | 2015/12/02 | 16:30:00 | 18:30:00 | 120 | 3&5 Keedi Street | 415V | | | | 2 | 120 | 0.1 | 0.00 | | |
| 27 | 412815702 / 432276978 | 2015/12/02 | 16:42:00 | 18:17:00 | 95 | Water Bores 11kV Line | 11kV | | Water Bore | | 3 | 95 | 0.1 | 0.00 | | |
| 26 | 412811746 / 432278007 | 2015/12/02 | 4:56:00 | 6:21:00 | 85 | TC4 - East Newman & Airport | 11kV | | TC4 | | 152 | 85 | 5.4 | 0.06 | | |
| 25 | | 2015/11/29 | | | | Shovelanna | | | | | 0 | 0 | 0.0 | 0.00 | | |
| 24 | | 2015/11/28 | 14:00:00 | | | PS26 LV Feeder | 415V | | | | 0 | 0 | 0.0 | 0.00 | | |
| 23 | 412737980 / 432262848 | 2015/11/20 | 15:52:00 | 17:40:00 | 108 | Southtown STS6 | 11KV | | STS6 | | 211 | 108 | 9.6 | 0.09 | | |
| 22 | 412850469 / 432283474 | 2015/11/19 | 17:20:00 | | | Camp Drafting Line (off water bores line) | 11kV | | | | 1 | 0 | 0.0 | 0.00 | | |
| 21 | 412850415 / 432283470 | 2015/11/19 | 17:20:00 | 18:40:00 | 80 | Town Sub - TC3 & RMU01 | 11kV | | TC3 | | 610 | 80 | 20.5 | 0.26 | | |
| 20 | | 2015/11/16 | 10:59:00 | 14:10:00 | 191 | Jmb JIM608 (FDR No.4) | 33kv | | | | 1 | 191 | 0.1 | 0.00 | | |
| 19 | | 2015/10/12 | 11:00:00 | 12:07:00 | 67 | Ynd Fdr2 (F2-F11/X) | 33kV | | | | 1 | 67 | 0.0 | 0.00 | | |
| 18 | | 2015/10/10 | 16:11:00 | 17:05:00 | 54 | JIM608 | 33kV | | | | 1 | 54 | 0.0 | 0.00 | | |