
# ENERGY AUDIT AT THYCATTUSSEERI INTAKE PUMP HOUSE , PIRAVAM"

## Energy Audit Report

## Year: 2020-21

**Energy Management Centre – Kerala**
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# ENERGY AUDIT REPORT

# THYCATTUSSEERI INTAKE PUMPHOUSE

## PIRAVAM

**Energy Audit Report**

**INTAKE PUMPHOUSE, PIRAVAM**

**Report No: EA 584**

2020-October

**Energy Audit Team:**

Suresh Babu B V, Accredited Energy Auditor, AEA 33
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Abin Baby, Project Engineer
Mahesh Ramachandran E, Project Engineer
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Empaneled Energy Auditor, EMCEEA-0211F,
Energy Management Centre
Government of Kerala.

# Acknowledgment

We were privileged to work together with the administration and staff of Kerala Water Authority Intake Pump House, Aluva for their timely help extended to complete the study and bringing out this report on Energy Audit.

We are happy to acknowledge the help extended by Sri. Sojan Jacob, AE, HW Section, Thycattussery and his colleagues for their quality interactions and advices to make this audit complete.

We thank our consultants, engineers and backup staff for their dedication to bring this report.

Thank you.

B V Suresh Babu
Accredited Energy Auditor
AEA 33, Bureau of Energy Efficiency
For OTTOTRACTIONS

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# Certification

**This is to certify that**

The data collection has been carried out diligently and truthfully;

All data monitoring devices are in good working condition and have been calibrated or certified by approved agencies authorised and no tampering of such devices has occurred;

All reasonable professional skill, care and diligence had been taken in preparing the energy audit report and the contents thereof are a true representation of the facts;

Adequate training provided to personnel involved in daily operations after implementation of recommendations; and

The energy audit has been carried out in accordance with the Bureau of Energy Efficiency (Manner and Intervals of Time for the Conduct of Energy Audit) Regulations, 2010.

SURESH BABU B V
ACCREDITED ENERGY AUDITOR (AEA 33)

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| OTTOTRACTIONS- ENERGY AUDIT | | | | | | |
|---|---|---|---|---|---|---|
| Executive Summary | | | | | | |
| Consolidated Cost Benefit Analysis of Energy Efficiency Improvement Projects | | | | | | |
| KWA RAW WATER PUMPING STATION, PIRAVAM | | | | | | |
| Sl No | Projects | Investment | Cost saving | SPB | Energy saved | |
| | | (Lakhs Rs) | (Rs)/Yr | Months | kWh/Yr | toE/Yr |
| 1 | Energy Saving in Lighting by replacing existing 28 No's T8 Lamps to 18W LED Tube | 0.10 | 0.27 | 4.43 | 6623 | 0.57 |
| 2 | Energy Efficiency in Existing Pumping system by replacing inefficient motor (RWPH HT 2) | 67.65 | 102.93 | 7.89 | 1413864 | 121.59 |
| 3 | Energy Efficiency in Existing Pumping system by replacing inefficient motor (RWPH HT 3) | 67.65 | 79.00 | 10.28 | 1316628 | 113.23 |
| 4 | Energy Efficiency in Existing Pumping system by replacing inefficient motor (RWPH HT 4) | 67.65 | 88.98 | 9.12 | 1483068 | 127.54 |
| | Total | 203 | 271 | 8 | 4220183 | 363 |

# 1

# Introduction

A detailed energy audit has been carried out at **KERALA WATER AUTHORITY RAW WATER PUMPING STATION, PIRAVAM** in September 2020. **Energy Management Centre – Kerala (EMC) has entrusted** OTTOTRACTIONS an Accredited Energy Auditor of Bureau of Energy Efficiency and Empaneled Energy Auditor of Energy Management Centre, Government of Kerala to conduct this audit for EMC. The energy audit has identified energy conservation opportunities and recommended projects to improve energy efficiency of the facility.

## About EMC-Kerala

Kerala Government has become the first State Government in India to establish an **Energy Management Centre (EMC)** at State level, aiming primarily to remould and instrumentalise energy sector as a catalyst in promoting a development process which is econo-ecologically sustainable. With a view to making energy sector achieve such a lead and catalytic role, EMC has evolved a novel and comprehensive energy management approach and institutional philosophy encompassing management of energy technology systems - both conventional and non-conventional, energy conservation in all sectors of the economy, energy resource management, rural and urban energy systems, energy education and training, energy generation and conservation based employment and poverty alleviation programmes.

India, one of the most affected countries in terms of energy shortage and increasing energy price became one such country in the world to adopt energy management measures at the earliest in all sectors of the economy on a priority basis, including popularising and promoting renewable energy technology and resources.

When liberalization and globalization of economy take effect, energy management aimed at enhancing total energy efficiency in all sectors of the economy becomes a major factor in determining the comprehensive competitiveness of the economy.

Giving due consideration to this energy-economy interaction process/scenario, the Government of Kerala took leadership initiatives for establishing a multi-disciplinary Energy Management Centre under the Department of Power.

This energy audit report complies with the clauses in *Energy Conservation Act, 2001* on mandatory energy audit (**Form 4** [refer regulation 6(2)] guidelines for preparation of energy audit report) and complies with the G.O (Rt) No.2/2011/PD dated 01.01.2011 issued by Government of Kerala on mandatory energy audit.

## 1.1. General plant/establishment details and descriptions

Kerala water authority was established in first April 1984 under Kerala water and waste water ordinance. The Aluva PH Head works subdivision with consumer numbers 10/1010 (1355670000844) & 23/2357 (1355670001036) have four plants. Plant -1 established in the year 1965, Plant – 2 in 1977, Plant-3 in 1992 and plant-4 in 2002 at the head works Aluva. It has an installed capacity of 225 MLD (million liters per day) with 365 days working for all four plants together.

| Base line Data (Electrical System) | |
|---|---|
| Code | EA 584 |
| Facility | RAW WATER PUMP HOUSE |
| Provider | KSEB Ltd |
| Consumer No | 1355970011349 |
| Contract Demand (kVA) | 921 |
| Tariff | HT1(A) Industrial |
| Energy Charge Rs/ kWh Z1 | 5.5 |
| Energy Charge Rs/ kWh Z2 | 8.25 |
| Energy Charge Rs/ kWh Z3 | 4.125 |
| Demand Charge Rs/ kVA | 300 |
| Excess Demand Rs/kVA | 150 |
| Energy Bill Analysis interval | 2018-19 |

## 1.2. Energy audit team

The Energy Audit team is listed below. Besides this list various domine experts also participated in this project.

1. Suresh Babu B V, Accredited Energy Auditor, AEA 33
2. B. Zachariah, Chief Technical Consultant
3. Abhijith M R, Certified Energy Auditor
4. Abin Baby, Project Engineer
5. Mahesh Ramachandran E, Project Engineer
6. Mohammed Aneez, Project Engineer

## 1.3. Component of production cost

1. Energy (Electricity)
2. Manpower (Permanent & Contract)
3. Consumables
4. Overhead & others

## 1.4. Major energy use areas

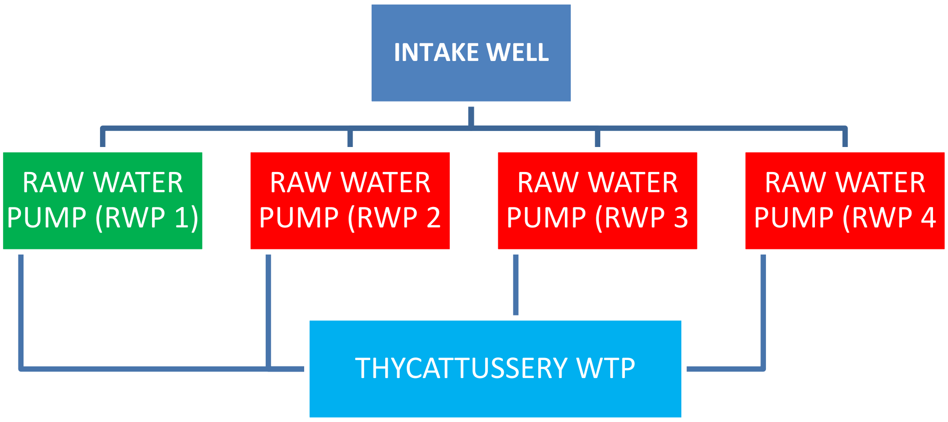
Electricity from KSEB 100% holds the share in the total energy consumed in this facility.

# 2

# Production process description

The Raw water Pump house located at Piravam have an installed capacity of 107 MLD. The plant commissioned in 2012, is feedig raw water to the WTP located at Thycattussery. It has four raw water pumps having 400kW rating. At a time only one pump is in operation now and now delivering approximately 27000 $m^3$ of treated raw water into the WTP Thycattussery. Taking water from the Movatupuzha river.

The single line diagram of the system is given below.



# 3

# Energy and utility system description

KWA Intake Pump House, Piravam

## 3.1. List of utilities

Electricity is only fuel used in the facility.

## 3.2 Brief description of each utility

### 3.2.1 Electricity

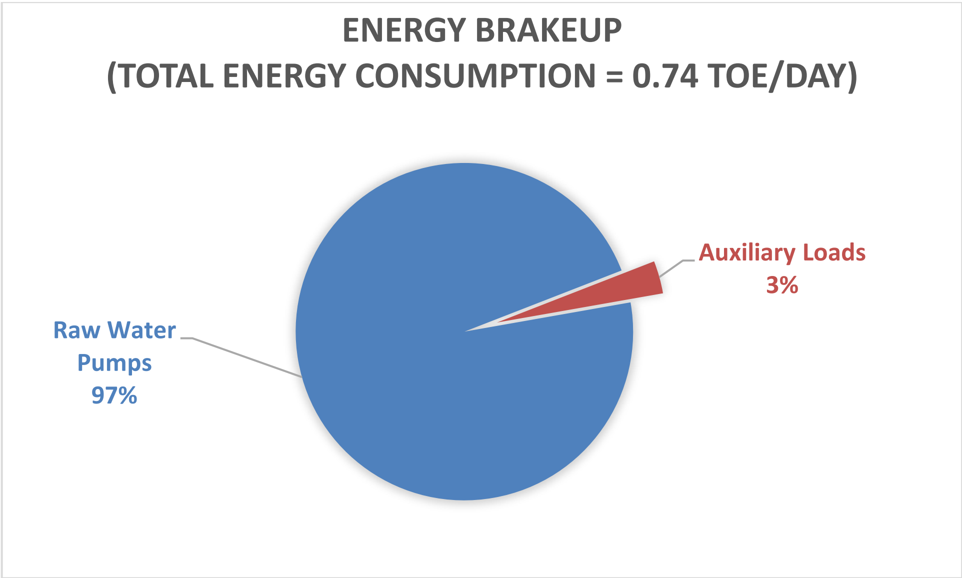
The facility is a consumer of Kerala State Electricity Board (KSEB) under HT – I (A) Industrial Tariff category at 11 kV. The facility having two HT connections with contract demand of 921 kVA. The details of transformer installed in the facility are given below.

| Details of Transformers | | | | |
|---|---|---|---|---|
| Sl.No | Make | Year of manufacturing | Rating (kVA ) | Voltage (kV) |
| 1 | INDO TECH | 2009 | 1600 | 3.300 |
| 2 | INDO TECH | 2009 | 1600 | 3.300 |
| 3 | INDO TECH | 2009 | 600 | 0.440 |
| 4 | INDO TECH | 2009 | 600 | 0.440 |

The power factor is being maintained as .97 in this facility. The electrical load study and power quality analysis has been conducted and the results and reports are given in the “Technical Supplement” of this report.

# 4

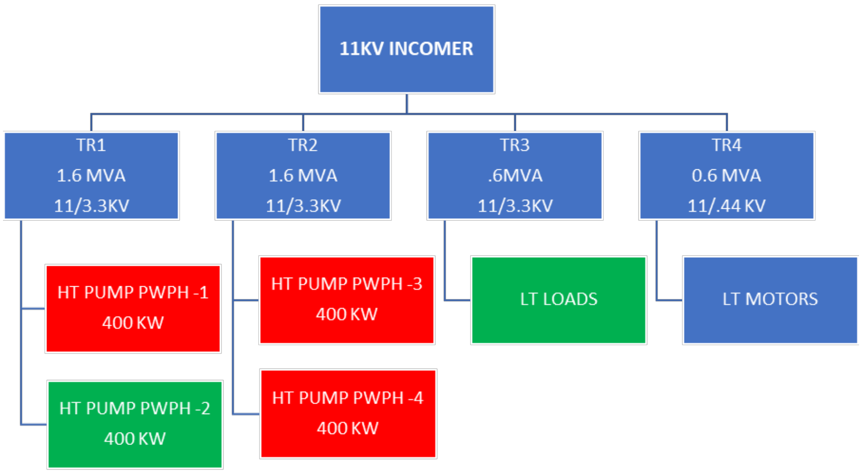
# Detailed process flow diagram and energy and material balance




The energy balance of this facility is given above. The auxiliary loads cater 3% of the total load

## Plant Operation

The Pumping Station has 4 transformers, out of 2 numbers are 11kV/3.3kV HT transformers and 2 numbers are 11kV / 440 V LT transformers.



# 5

# Performance evaluation of major utilities and process equipment's/systems.

## 5.1. List of equipment and process where performance testing was done.

- Electrical System
- Pumps
- Lighting System
- Renewable Energy

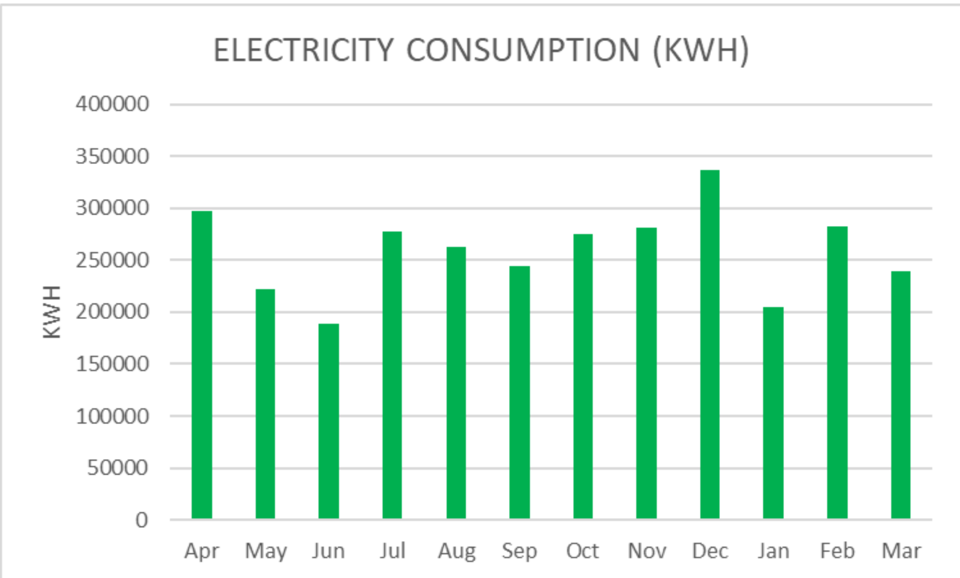
## 5.2. Results of performance testing

### 5.2.1. Electrical System

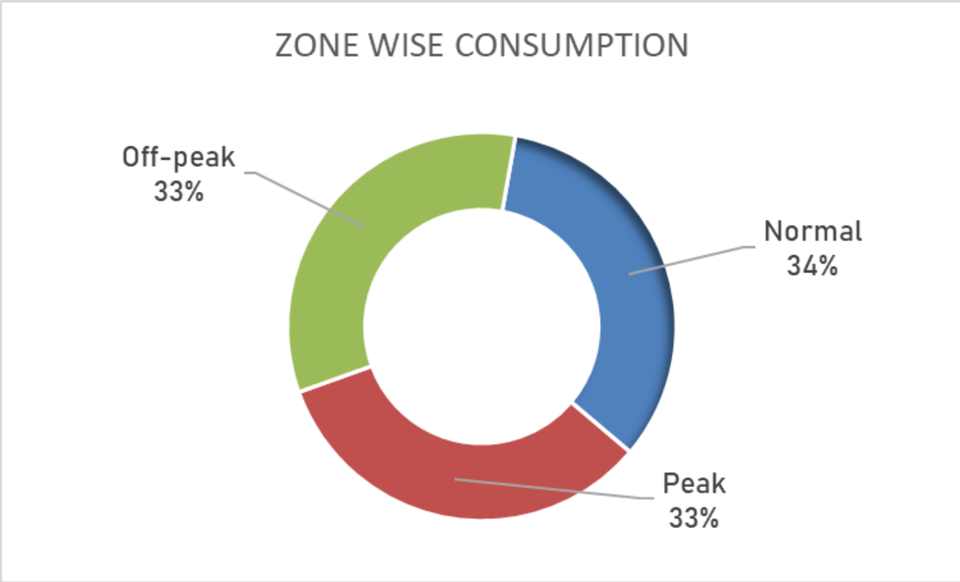
The average unit cost of electricity is **7.28 Rs/kWh**. This is taken as the basis for the financial analysis of electrical energy efficiency projects. The information on average energy consumption is taken from the historical electricity bill analysis. The electricity is fed from centralized substations. The Maximum demand observed during electricity bill analysis was 431 kVA.

#### Electricity Consumption

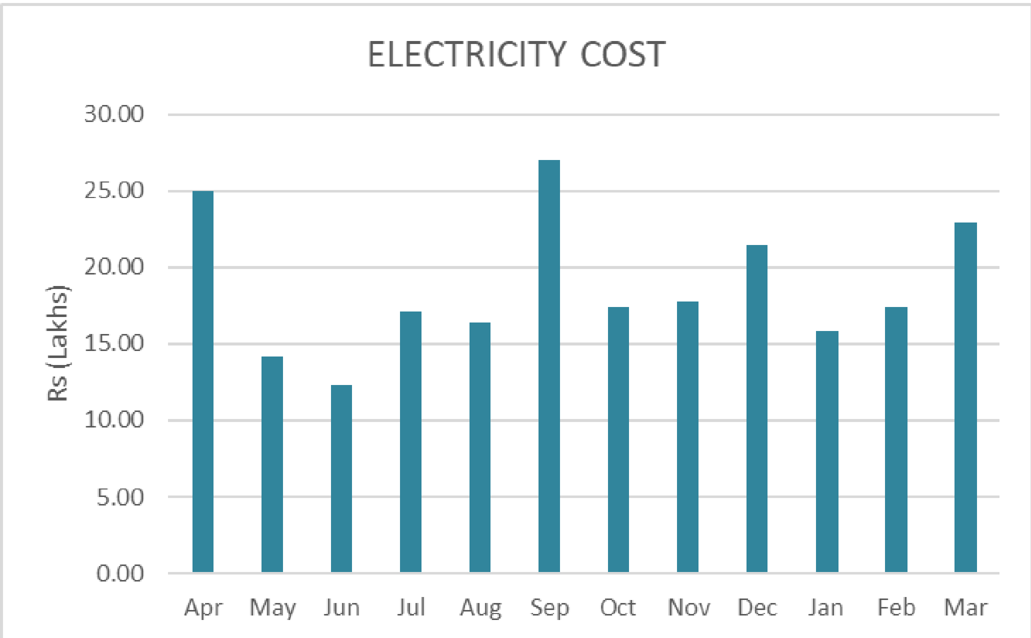
The Electricity consumption details for the financial year 2018-19 is plotted below. The Total consumption was found to be 31.09 Lakhs Units in the year 18-19.



The Zone wise Energy Consumption Profile is shown below ,which shows 38% of total energy consumption in a day is at normal hours, 30% at peak hours and 32% at non peak hours.



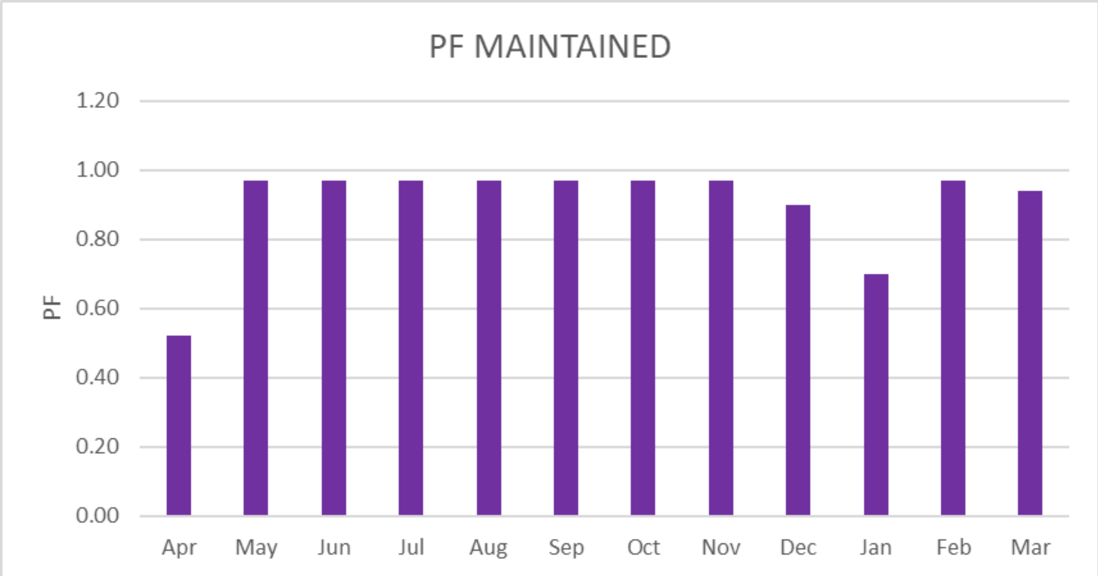

The electricity cost profile for the year 2018-19 is given below.




The details of production and flow readings are given in the technical supplement

## Power Factor

The average power factor observed is 0.97 which is very low. From load study the required capacitance rating is 40kvar. It is strongly recommended to add capacitors to improve power factor to unity. The power factor variation for the financial year 2018-19 is shown below.




During load study it is observed that the power factor average is 0.97(see technical supplement)

## Capacitors

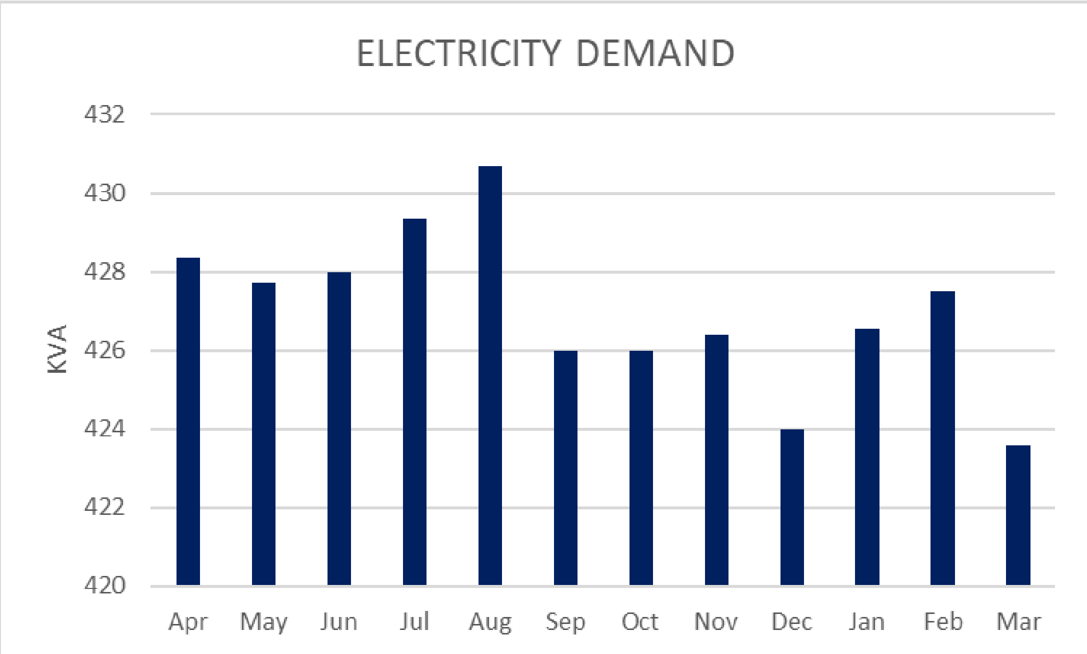
The performance study of Capacitor is given below

| Capacitor Requirment | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sl.No | Motors | HP | Make | KW (Rated) | kW (Measured) | Existing PF | Proposed PF | Required kVAR |
| 1 | HT Motor No 1 | 536 | KBL | 400 | 359 | 0.97 | 1 | 90.109 |
| 2 | HT Motor No 2 | 536 | KBL | 400 | 346 | 0.97 | 1 | 86.846 |
| 3 | HT Motor No 3 | 536 | KBL | 400 | 365 | 0.97 | 1 | 91.615 |

268 kVAr is the required to improve the power factor to unity.

### Demand Control

The facility has a contract demand of 921kVA. As mentioned above the present average power factor of the plant is 0.97 and the average recorded maximum demand is 431 kVA as per historical energy consumption analysis. The electricity demand variation for the financial year 2018-19 is shown below. Demand can be controlled by improving power factor to unity.




## 5.2.2. Pumps

The list of pumps is given below.

| Sl.No | | HP | Flow ($m^3$/hr) | Make | |
|---|---|---|---|---|---|
| | | | | Pump | Motor |
| 1 | RWP-1 | 536 | 2312.5 | Kirloskar | Alstrom |
| 2 | RWP-2 | 536 | 2312.5 | Kirloskar | Alstrom |
| 3 | RWP-3 | 536 | 2312.5 | Kirloskar | Alstrom |
| 4 | RWP-4 | 536 | 2312.5 | Kirloskar | Alstrom |

Performance tests of Raw water pumps 1, 2 and 4 were conducted as pump 3 was not working during the audit.

| Performance Evaluation of Pumps | | | | | |
|---|---|---|---|---|---|
| Raw Water Pump House 1 - HT Pump 1 | | | | | |
| r Water | | | Description | Unit | Parameters |
| Design Details | General | 1 | Unit code | KWA PIRAVOM | |
| | | 2 | Pump ID | RWP 1 | |
| | | 3 | Pump Application | Raw water | |
| | | 4 | Water Quality | Raw | |
| | | 5 | Rated head of pump | m | 51 |
| | Motors | 6 | Rated load of the motor | kW | 400 |
| | | 7 | Measured load of the motor | kW | 359 |
| | | 8 | Efficiency of standard motor | % | 94 |
| | | 9 | Type of Motor | | SRIM |
| | | 10 | Motor power | kW | 359.00 |
| | Pumps | 11 | Make | | KBL |
| | | 12 | HP | | 457 |
| | | 13 | Efficiency | % | 85 |
| | | 14 | Combined efficiency of the system (rated) | % | 79.90 |
| | | 15 | Combined efficiency of the system (actual) | % | 49.69 |
| | | 16 | Volt | KV | 3.3 |
| | | 17 | Amps | A | 65 |
| | | 18 | rpm | rpm | 991 |
| | Pipe Line | 19 | Material | | CI |
| | | 20 | Size | mm | 1200.00 |
| | | 21 | Length | m | NA |
| Operating Details | Output | 22 | Water Pumping Details of station (rated Flow) | $m^3/hr$ | 2312.50 |
| | | 23 | Head | m | 29 |
| | | 24 | Flow | $m^3/s$ | 0.627 |
| | | 25 | Density of water | $kg/m^3$ | 1000 |
| | | 26 | Gravitational Constant | $m/s^2$ | 9.81 |
| | | 27 | Hydraulic Power | kW | 178.38 |
| | | 28 | Type of Flow Control Mechanism | | Throttling |
| | | 29 | Discharge throttle valve position % open | % | 100 |
| | | 30 | Flow Control Frequency | | NIL |
| | | 31 | Working hours per day | Hrs | 24 |
| | | 32 | % loading of pump on flow | % | 2.34 |
| | | 33 | % loading of pump on head | % | 56.86 |
| | | 34 | % loading of motor | % | 89.75 |

| Performance Evaluation of Pumps | | | | | |
|---|---|---|---|---|---|
| Raw Water Pump House 1 - HT Pump 2 | | | | | |
| r Water | | | Description | Unit | Parameters |
| Design Details | General | 1 | Unit code | KWA PIRAVOM | |
| | | 2 | Pump ID | RWP 2 | |
| | | 3 | Pump Application | Raw water | |
| | | 4 | Water Quality | Raw | |
| | | 5 | Rated head of pump | m | 51 |
| | Motors | 6 | Rated load of the motor | kW | 400 |
| | | 7 | Measured load of the motor | kW | 346 |
| | | 8 | Efficiency of standard motor | % | 94 |
| | | 9 | Type of Motor | | SRIM |
| | | 10 | Motor power | kW | 346.00 |
| | Pumps | 11 | Make | | KBL |
| | | 12 | HP | | 457 |
| | | 13 | Efficiency | % | 85 |
| | | 14 | Combined efficiency of the system (rated) | % | 79.90 |
| | | 15 | Combined efficiency of the system (actual) | % | 51.05 |
| | | 16 | Volt | KV | 3.3 |
| | | 17 | Amps | A | 62.5 |
| | | 18 | rpm | rpm | 991 |
| | Pipe Line | 19 | Material | | CI |
| | | 20 | Size | mm | 1200.00 |
| | | 21 | Length | m | NA |
| Operating Details | Output | 22 | Water Pumping Details of station (rated Flow) | $m^3/hr$ | 2312.50 |
| | | 23 | Head | m | 28.9 |
| | | 24 | Flow | $m^3/s$ | 0.623 |
| | | 25 | Density of water | $kg/m^3$ | 1000 |
| | | 26 | Gravitational Constant | $m/s^2$ | 9.81 |
| | | 27 | Hydraulic Power | kW | 176.63 |
| | | 28 | Type of Flow Control Mechanism | | Throttling |
| | | 29 | Discharge throttle valve position % open | % | 100 |
| | | 30 | Flow Control Frequency | | NIL |
| | | 31 | Working hours per day | Hrs | 24 |
| | | 32 | % loading of pump on flow | % | 2.33 |
| | | 33 | % loading of pump on head | % | 56.67 |
| | | 34 | % loading of motor | % | 86.50 |

| Performance Evaluation of Pumps | | | | | |
|---|---|---|---|---|---|
| Raw Water Pump House 1 - HT Pump 4 | | | | | |
| r Water | | | Description | Unit | Parameters |
| Design Details | General | 1 | Unit code | KWA PIRAVOM | |
| | | 2 | Pump ID | RWP 4 | |
| | | 3 | Pump Application | Raw water | |
| | | 4 | Water Quality | Raw | |
| | | 5 | Rated head of pump | m | 51 |
| | Motors | 6 | Rated load of the motor | kW | 400 |
| | | 7 | Measured load of the motor | kW | 365 |
| | | 8 | Efficiency of standard motor | % | 94 |
| | | 9 | Type of Motor | | SRIM |
| | | 10 | Motor power | kW | 365.00 |
| | Pumps | 11 | Make | | KBL |
| | | 12 | HP | | 457 |
| | | 13 | Efficiency | % | 85 |
| | | 14 | Combined efficiency of the system (rated) | % | 79.90 |
| | | 15 | Combined efficiency of the system (actual) | % | 49.68 |
| | | 16 | Volt | KV | 3.3 |
| | | 17 | Amps | A | 66 |
| | | 18 | rpm | rpm | 991 |
| | Pipe Line | 19 | Material | | CI |
| | | 20 | Size | mm | 1200.00 |
| | | 21 | Length | m | NA |
| Operating Details | Output | 22 | Water Pumping Details of station (rated Flow) | $m^3/hr$ | 2312.50 |
| | | 23 | Head | m | 29.2 |
| | | 24 | Flow | $m^3/s$ | 0.633 |
| | | 25 | Density of water | $kg/m^3$ | 1000 |
| | | 26 | Gravitational Constant | $m/s^2$ | 9.81 |
| | | 27 | Hydraulic Power | kW | 181.32 |
| | | 28 | Type of Flow Control Mechanism | | Throttling |
| | | 29 | Discharge throttle valve position % open | % | 100 |
| | | 30 | Flow Control Frequency | | NIL |
| | | 31 | Working hours per day | Hrs | 24 |
| | | 32 | % loading of pump on flow | % | 2.37 |
| | | 33 | % loading of pump on head | % | 57.25 |
| | | 34 | % loading of motor | % | 91.25 |

## 5.2.3. Lighting system

Lighting is one of the major electrical loads connected in the system. T12 and T8 tubes are extensively used in most of the areas and Sodium vapor, Fluorescent etc. in factory/ street lighting. Hardly any LED lights or tubes are used. This is a good component of the load of the facility and replacing these T12 & T 8 tubes with LED tubes can lead to a significant reduction in the load. Good lighting design can reduce costs and have the added benefit of decreasing internal heat gains, thus reducing the need for air conditioning too.

| List of Light Loads | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sl. No.** | **Location** | **T12** | **T8** | **T5** | **CFL** | **LED-B** | **LED-B (40W)** | **LED-T** | **CF** | **EF** | **PF** | **PC** | **AC (1.5T)** |
| 1 | Office | | 4 | | | | | | 4 | | | 2 | 2 |
| 2 | Substation 1 | | 17 | | | | | | 8 | 2 | | | |
| 8 | Raw Water PH | | 8 | | | 1 | | 1 | 1 | | | | |
| **Total** | | **0** | **29** | **0** | **0** | **1** | **0** | **1** | **13** | **2** | **0** | **2** | **2** |

All T8 and T12 Lamps shall be replaced with LED tubes or even T5 and the existing CFLs may be shifted to LED in phased manner. Since lighting does not have a separate feeder, the voltage stabilizer cannot be used specifically for this purpose.

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# 6

# Energy efficiency in utility and process system

## Specific Energy Consumption (SEC)

| OTTOTRACTIONS- ENERGY AUDIT | | |
|---|---|---|
| Energy Performance Index | | |
| 1 | Total Production in (MLD) | 58 |
| 2 | Actual annual production $M^3$ | 21170000 |
| 3 | Annual Electricity Consumption (kWh) | 3108150 |
| 4 | **Specific Energy Consumption kWh/$m^3$** | **0.15** |
| 5 | **Specific Energy Consumption $m^3$/kWh** | 6.81 |

## The specific Energy Consumption is 0.15kWh/$m^3$ for this plant or it may be read as 6.81 $m^3$/kWh consumed.

This value may be taken as internal bench mark for future reference and improvement. As the common headers are used separate SEC for individual pumps are not taken but combined SEC is established. The SEC established includes auxiliary consumption also.

# 7

# Evaluation of energy management system




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## Energy management policy

There is no written energy policy available. A draft energy management policy is given below. The management may constitute an energy management policy and display the same in the plant to motivate the staff.

KERALA WATER AUTHORITY

PH DIVISION, ALUVA

*ENERGY POLICY*

*(Draft)*

*We are committed to optimally utilize various forms of energy in a cost effective manner to effect conservation of energy resources. We are committed to conserve the energy which is a scarce resource with the requisite consistency in the efficiency, effectiveness in the cost involved in the operations and ensuring that production quality and quantity, environment, safety, health of people are maintained. We are also committed to increase the renewable energy share of the total energy we use.*

***We are also committed to monitor continuously the saving achieved and reduce its specific energy consumption by minimum of 2% every year.***

*Date ----------------------*

*Head of the Institution*

## 7.1. Energy management monitoring system

- **Energy Management Cell** has to be constituted with an objective to revise action plan for energy conservation thereby reducing the production cost.
- Energy conservation tips/ posters are displayed in crucial points.
- Use of renewable energy has to be encouraged.
- Flow meters and energy meters shall be installed in all major pumps. The meter reading shall be recorded in regular frequencies. It is recommended to install meters with communication capability to get real-time energy performance data and monitoring of pump performance.

## 7.2. Training to staff responsible for operational and Documentation.

- The staff need to be made more aware of the importance of energy saving and management.
- Log books shall be maintained to record Electricity Consumption and Diesel consumption.
- TOD reading shall be taken and compared with KSEB regularly.

## 7.3. Renewable Energy

- No renewable energy projects implemented.

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# 8

# Energy Conservation Measures and Recommendations

## 8.1. Electrical System

- Electrical safety measures have to be implemented.
- All the raw water pumps are operating 24hr a day, the scheduling may be done based on the performance test results given in the 5th chapter. The motors with combined efficiency near the design efficiency may be used for regular applications and the lowest performing pumps may be used as standby.
- As per the electrical load studies conducted the capacitance requirement in demand side (motor end) is 268 kVAR, which may cost around 1.2 lakhs Rs. For PF improvement. This will help increasing the PF to unity and will get incentives for the same. The demand will also come down due to better power factor.
- **FCMA** starters are used here which are harmonic free, rugged magnetic soft **starters** for motor starting. **FCMA** is an acronym for flux compensated magnetic amplifier which is basically a modulated inductive impedance. When connected in series with the motor the **FCMA** reduces the starting current to a low value. It is advised to switch all the starters to FCMA to save energy as well as to improve Switch gears & starters,
- Sub meters with communication facility shall be implemented for the effective monitoring of energy and water.
- Pumping machinery is subjected to wear & tear, erosion and corrosion due to its nature of functioning, and therefore it is vulnerable to failures. Generally, failures or interruptions are mostly attributed to pumping machinery rather than any other component. Therefore, correct operation and timely maintenance and upkeep of pumping stations and pumping machinery are of vital importance. Sudden failures can be avoided by timely inspection, follow up actions on observations of inspection and planned periodical maintenance. Downtime can be reduced by maintaining inventory of fast-moving spare parts. Obviously due attention needs to be paid to all such aspects for efficient and reliable functioning of pumping machinery.

| OTTOTRACTIONS- ENERGY AUDIT | |
|---|---|
| Energy Saving Proposal Code EA 581.01 | |
| Energy Saving in Lighting by replacing existing 28 No's T8 Lamps to 18W LED Tube | |
| **Existing Scenario** | |
| There are 28 numbers of T8 lamps installed in this facility. During discussion with officers it is observed that the average utility of these fittings are of 80%. | |
| **Proposed System** | |
| The existing T8 may be replaced to LED tube of 18 W in phased manner and the savings will be of 67 % (inclusive of improved light output and reduced energy consumption) | |
| **Financial Analysis** | |
| Annual working hours (hr) | 6570 |
| No of fittings | 28 |
| Total load (kW) | 1.26 |
| Annual Energy Consumption (kWh) | 6623 |
| Expected Annual Energy saving for replacing all fittings (kWh) | 3642 |
| Cost of Power | 7.28 |
| Annual saving in Lakhs Rs (1st year) | 0.27 |
| Investment required for complete replacements [@Rs 350 per fittings](Lakhs Rs) | 0.10 |
| Simple Pay Back (in Months) | 4.43 |

| Energy Saving Calculation | | | | | | |
|---|---|---|---|---|---|---|
| Energy Efficiency in Existing Pumping system by replacing inefficient motor (RWPH HT 2) | | | | | | |
| Sl No | | | Description | Unit | Existing System | New System |
| Design Parameters | Motors | 1 | Total number of motors to be replaced | 1 | Standard | IE2 |
| | | 2 | Rated load of the motor | kW | 400 | 330 |
| | | 3 | Efficiency of standard motor | % | 94 | 95 |
| | | 4 | Type of Motor | | Standard | IE2 |
| | | 5 | Motor power | kW | 359.00 | 197.60 |
| | | 6 | Efficiency | % | 85 | 95 |
| | | 7 | Combined efficiency of the system (rated) | % | 79.9 | 90 |
| | | 8 | Combined efficiency of the system (measured) | % | 50 | 90 |
| | | 9 | **Head** | **m** | **29** | **29** |
| | | 10 | **Flow** | **$m^3/s$** | **0.627** | **0.627** |
| | | 11 | **Density of water** | **$kg/m^3$** | **1000** | **1000** |
| | | 12 | **Gravitational Constant** | **$m/s^2$** | **9.81** | **9.81** |
| | | 13 | **Hydraulic Power** | **kW** | **178.38** | **178.38** |
| | Input | 14 | Total Electrical Power drawn | kW | 359.00 | 197.60 |
| | | 15 | Unit Cost | Rs./kWh | 7.28 | 7.28 |
| | | 16 | Annual operating Hours | Hours | 8760 | 8760 |
| | | 17 | Annual energy consumption | kWh/year | 3144840 | 1730976 |
| | | 18 | Annual power Savings, kWh | kWh | | 1413864 |
| | | 19 | Annual Savings | Rs. In Lakhs | | **102.93** |
| | | 20 | Investment for Pumps (as per KWA guideline @15525 per hp) | Rs/kW | | 20500 |
| | | 21 | Proposed pump load | kW | | **330.00** |
| | | 22 | Investment | Rs. In Lakhs | | **67.65** |
| | | 23 | Simple Payback period | **Months** | | **7.89** |

<table>
<tr><th colspan="7">Energy Saving Calculation</th></tr>
<tr><th colspan="7">Energy Efficiency in Existing Pumping system by replacing inefficient motor (RWPH HT 3)</th></tr>
<tr><th colspan="3">Sl No</th><th>Description</th><th>Unit</th><th>Old System</th><th>New System</th></tr>
<tr><td rowspan="7">Design Parameters</td><td rowspan="5">Motors</td><td>1</td><td>Total number of motors to be replaced</td><td>1</td><td>Standard</td><td>IE2</td></tr>
<tr><td>2</td><td>Rated load of the motor</td><td>kW</td><td>400</td><td>330</td></tr>
<tr><td>3</td><td>Efficiency of standard motor</td><td>%</td><td>94</td><td>95</td></tr>
<tr><td>4</td><td>Type of Motor</td><td></td><td>Standard</td><td>IE2</td></tr>
<tr><td>5</td><td>Motor power</td><td>kW</td><td>346.00</td><td>195.70</td></tr>
<tr><td rowspan="2"></td><td>6</td><td>Efficiency</td><td>%</td><td>85</td><td>95</td></tr>
<tr><td>7</td><td>Combined efficiency of the system (rated)</td><td>%</td><td>80</td><td>90.25</td></tr>
<tr><td></td><td></td><td>8</td><td>Combined efficiency of the system (measured)</td><td>%</td><td>51</td><td>90.25</td></tr>
<tr><td rowspan="15"></td><td rowspan="5"></td><td>9</td><td>Head</td><td>m</td><td>28.9</td><td>28.9</td></tr>
<tr><td>10</td><td>Flow</td><td>$m^3/s$</td><td>0.623</td><td>0.623</td></tr>
<tr><td>11</td><td>Density of water</td><td>$kg/m^3$</td><td>1000</td><td>1000</td></tr>
<tr><td>12</td><td>Gravitational Constant</td><td>$m/s^2$</td><td>9.81</td><td>9.81</td></tr>
<tr><td>13</td><td>Hydraulic Power</td><td>kW</td><td>176.63</td><td>176.63</td></tr>
<tr><td rowspan="10">Input</td><td>14</td><td>Total Electrical Power drawn</td><td>kW</td><td>346.00</td><td>195.70</td></tr>
<tr><td>15</td><td>Unit Cost</td><td>Rs./kWh</td><td>6</td><td>6</td></tr>
<tr><td>16</td><td>Annual operating Hours</td><td>Hours</td><td>8760</td><td>8760</td></tr>
<tr><td>17</td><td>Annual energy consumption</td><td>kWh/year</td><td>3030960</td><td>1714332</td></tr>
<tr><td>18</td><td>Annual power Savings, kWh</td><td>kWh</td><td></td><td>1316628</td></tr>
<tr><td>19</td><td>Annual Savings</td><td>Rs. In Lakhs</td><td></td><td>79.00</td></tr>
<tr><td>20</td><td>Investment for Pumps (as per KWA guideline @15525 per hp)</td><td>Rs/kW</td><td></td><td>20500</td></tr>
<tr><td>21</td><td>Proposed pump load</td><td>kW</td><td></td><td>330.00</td></tr>
<tr><td>22</td><td>Investment</td><td>Rs. In Lakhs</td><td></td><td>67.65</td></tr>
<tr><td>23</td><td>Simple Payback period</td><td>Months</td><td></td><td>10.28</td></tr>
</table>

| Energy Saving Calculation | | | | | | |
|---|---|---|---|---|---|---|
| Energy Efficiency in Existing Pumping system by replacing inefficient motor (RWPH HT 4) | | | | | | |
| Sl No | | | Description | Unit | Old System | New System |
| Design Parameters | Motors | 1 | Total number of motors to be replaced | 1 | Standard | IE2 |
| | | 2 | Rated load of the motor | kW | 400 | 330 |
| | | 3 | Efficiency of standard motor | % | 94 | 95 |
| | | 4 | Type of Motor | | Standard | IE2 |
| | | 5 | Motor power | kW | 365.00 | 195.70 |
| | | 6 | Efficiency | % | 85 | 95 |
| | | 7 | Combined efficiency of the system (rated) | % | 80 | 90.25 |
| | | 8 | Combined efficiency of the system (measured) | % | 48 | 90.25 |
| | | 9 | **Head** | **m** | **28.9** | **28.9** |
| | | 10 | **Flow** | **$m^3/s$** | **0.623** | **0.623** |
| | | 11 | **Density of water** | **$kg/m^3$** | **1000** | **1000** |
| | | 12 | **Gravitational Constant** | **$m/s^2$** | **9.81** | **9.81** |
| | | 13 | **Hydraulic Power** | **kW** | **176.63** | **176.63** |
| | Input | 14 | Total Electrical Power drawn | kW | 365.00 | 195.70 |
| | | 15 | Unit Cost | Rs./kWh | 6 | 6 |
| | | 16 | Annual operating Hours | Hours | 8760 | 8760 |
| | | 17 | Annual energy consumption | kWh/year | 3197400 | 1714332 |
| | | 18 | Annual power Savings, kWh | kWh | | 1483068 |
| | | 19 | Annual Savings | Rs. In Lakhs | | **88.98** |
| | | 20 | Investment for Pumps (as per KWA guideline @15525 per hp) | Rs/kW | | 20500 |
| | | 21 | Proposed pump load | kW | | **330.00** |
| | | 22 | Investment | Rs. In Lakhs | | **67.65** |
| | | 23 | Simple Payback period | **Months** | | **9.12** |

| OTTOTRACTIONS- ENERGY AUDIT | | | | | | |
|---|---|---|---|---|---|---|
| KWA RAW WATER PUMPING STATION, PIRAVAM | | | | | | |
| Greenhouse Gas Mitigation through Major Energy Efficiency Projects | | | | | | |
| Sl No | Projects | Energy saved(Yearly) | | Sustainability (Years) | First year ton of CO2 mitigated | Expected Tons of CO2 mitigated through out life cycle |
| | | (kWh) | MWh | Years | | |
| 1 | Energy Saving in Lighting by replacing existing 28 No's T12 Lamps to 18W LED Tube | 6623 | 6.62 | 10 | 4.83 | 48.34 |
| 2 | Energy Efficiency in Existing Pumping system by replacing inefficient motor (RWPH HT 2) | 1413864 | 1413.86 | 10 | 1032.12 | 10321.21 |
| 3 | Energy Efficiency in Existing Pumping system by replacing inefficient motor (RWPH HT 3) | 1316628 | 1316.63 | 10 | 961.14 | 9611.38 |
| 4 | Energy Efficiency in Existing Pumping system by replacing inefficient motor (RWPH HT 4) | 1483068 | 1483.07 | 10 | 1082.64 | 10826.40 |
| | | 4220182.56 | 4220.18 | 10.00 | 3080.73 | 30807.33 |

| Implementation Schedule | | | |
|---|---|---|---|
| KWA RAW WATER PUMPING STATION, PIRAVAM | | | |
| Sl No | Projects | SPB | Implementation Schedule |
| 1 | Energy Saving in Lighting by replacing existing 28 No's T12 Lamps to 18W LED Tube | 4.43 | Medium Term |
| 2 | Energy Efficiency in Existing Pumping system by replacing inefficient motor (RWPH HT 2) | 7.89 | Medium Term |
| 3 | Energy Efficiency in Existing Pumping system by replacing inefficient motor (RWPH HT 3) | 10.28 | Medium Term |
| 4 | Energy Efficiency in Existing Pumping system by replacing inefficient motor (RWPH HT 4) | 9.12 | Medium Term |

# 9

# Technical Supplement

| Electricity Bill Details (2018-2019) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | Name of the Consumer | | | | KERALA WATER AUTHORITY, KWA, JICA, CHERTHALA | | | | | | | | |
| | Contract demnad (kVA) | | 921 | | Consumer number & Section | | | | 1355970011349 | | | | |
| | Tariff | | HT I (A) INDUSTRIAL | | | | | | Piravam | | | | |
| | kWh | | | | kVA | | | | PF | PF Penalty / Incentive | Cost (Rs) | Cost in Lakhs Rs | Rs/kwh |
| | Z1 | Z2 | Z3 | Total | Z1 | Z2 | Z3 | Max | | | | | |
| Apr | 147280 | 49600 | 99770 | 296650 | 411 | 428 | 425 | 428 | 0.52 | 619998.5 | 2495954.75 | 24.96 | **8.41** |
| May | 107700 | 37130 | 76660 | 221490 | 428 | 427 | 423 | 428 | 0.97 | -42658 | 1411142 | 14.11 | **6.37** |
| Jun | 95820 | 29980 | 62340 | 188140 | 428 | 427 | 423 | 428 | 0.97 | -36216 | 1229370.55 | 12.29 | **6.53** |
| Jul | 138430 | 48190 | 90970 | 277590 | 429 | 426 | 426 | 429 | 0.97 | -53436 | 1715307 | 17.15 | **6.18** |
| Aug | 133090 | 45000 | 84600 | 262690 | 431 | 425 | 427 | 431 | 0.97 | -50567 | 1634363 | 16.34 | **6.22** |
| Sep | 125120 | 41430 | 77360 | 243910 | 426 | 421 | 425 | 426 | 0.97 | -34602 | 2696848 | 26.97 | **11.06** |
| Oct | 136910 | 47420 | 90590 | 274920 | 426 | 425 | 423 | 426 | 0.97 | -52922.1 | 1742040.9 | 17.42 | **6.34** |
| Nov | 139820 | 47520 | 93330 | 280670 | 426 | 423 | 422 | 426 | 0.97 | -54028 | 1774140.28 | 17.74 | **6.32** |
| Dec | 132150 | 41570 | 162570 | 336290 | 424 | 424 | 422 | 424 | 0.90 | 0 | 2149374.75 | 21.49 | **6.39** |
| Jan | 137380 | 49380 | 17770 | 204530 | 426 | 427 | 421 | 427 | 0.70 | 224983 | 1582764.25 | 15.83 | **7.74** |
| Feb | 140620 | 48670 | 92980 | 282270 | 428 | 422 | 422 | 428 | 0.97 | -54336.97 | 1740732 | 17.41 | **6.17** |
| Mar | 119170 | 39940 | 79890 | 239000 | 424 | 423 | 426 | 424 | 0.94 | -39652.8 | 2297347 | 22.97 | **9.61** |
| | | | | 3108150 | 5106 | 5098 | 5083 | | 0.90 | | 22469384.3 | | 7.28 |

| Time | Incomer | | Pump IV | | | | | Power Factor | KWH | UNITS/HRS |
|---|---|---|---|---|---|---|---|---|---|---|
| | KV | HZ | KV | A | PR | WT. | BT. | | | |
| 1.00 | 11.01 | 50.10 | 3.3 | 65 | 2.89 | 95.6 | 62.7 | 0.974 | 2136933 | 41 |
| 2.00 | 11.05 | 50.06 | 3.3 | 65 | 2.89 | 95.9 | 63.3 | 0.974 | 2136975 | 42 |
| 3.00 | 11.03 | 50.09 | 3.3 | 65 | 2.89 | 96.1 | 63.8 | 0.974 | 2137015 | 40 |
| 4.00 | 10.99 | 50.03 | 3.3 | 65 | 2.89 | 96.3 | 64.1 | 0.974 | 2137056 | 41 |
| 5.00 | 10.95 | 50.05 | 3.3 | 65 | 2.89 | 96.7 | 64.5 | 0.973 | 2137096 | 40 |
| 6.00 | 10.92 | 50.01 | 3.3 | 65 | 2.89 | 96.8 | 64.7 | 0.972 | 2137136 | 40 |
| 7.00 | 10.84 | 50.00 | 3.3 | 65 | 2.89 | 96.9 | 64.5 | 0.972 | 2137178 | 42 |
| 8.00 | 10.76 | 49.99 | 3.3 | 65 | 2.89 | 97.3 | 63.7 | 0.97 | 2137218 | 40 |
| 9.00 | 10.71 | 49.97 | 3.3 | 65 | 2.89 | 97.6 | 63.2 | 0.969 | 2137258 | 40 |
| 10.00 | 10.68 | 49.95 | 3.3 | 65 | 2.89 | 98.3 | 63.8 | 0.97 | 2137300 | 42 |
| 11.00 | 10.78 | 49.89 | 3.3 | 65 | 2.89 | 98.9 | 64.6 | 0.97 | 2137342 | 42 |
| 12.00 | 10.77 | 50.07 | 3.3 | 65 | 2.89 | 99.6 | 65.1 | 0.972 | 2137383 | 41 |
| 13.00 | 10.79 | 49.99 | 3.3 | 65 | 2.89 | 100.3 | 66.1 | 0.973 | 2137424 | 41 |
| 14.00 | 10.84 | 50.13 | 3.3 | 65 | 2.89 | 100.7 | 64.4 | 0.975 | 2137467 | 43 |
| 15.00 | 10.69 | 50.02 | 3.3 | 65 | 2.89 | 101.2 | 64.7 | 0.973 | 2137509 | 42 |
| 16.00 | 10.77 | 49.95 | 3.3 | 65 | 2.88 | 101.4 | 66.6 | 0.973 | 2137547 | 38 |
| 17.00 | 10.62 | 50.02 | 3.3 | 65 | 2.89 | 101.5 | 66.4 | 0.973 | 2137589 | 42 |
| 18.00 | 10.68 | 50.01 | 3.3 | 65 | 2.88 | 101.4 | 65.9 | 0.972 | 2137631 | 42 |
| 19.00 | 10.75 | 50.04 | 3.3 | 65 | 2.88 | 101.2 | 65.6 | 0.975 | 2137673 | 42 |
| 20.00 | 10.76 | 50.02 | 3.3 | 65 | 2.89 | 100.9 | 65.3 | 0.974 | 2137712 | 34 |
| 21.00 | 10.77 | 49.96 | 3.3 | 65 | 2.89 | 100.1 | 64.4 | 0.975 | 2137754 | 42 |
| 22.00 | 10.94 | 50.03 | 3.3 | 65 | 2.90 | 99.3 | 63.9 | 0.974 | 2137743 | 39 |
| 23.00 | 10.97 | 50.07 | 3.3 | 65 | 2.91 | 98.7 | 63 | 0.973 | 2137832 | 39 |
| 24.00 | 11.00 | 50.02 | 3.3 | 65 | 2.91 | 98.6 | 62.9 | 0.973 | 2137870 | 38 |

| Time | Incomer | | Pump IV | | | | | Power Factor | KWH | UNITS/HRS |
|---|---|---|---|---|---|---|---|---|---|---|
| | KV | HZ | KV | A | PR | WT. | BT. | | | |
| 1.00 | 11.02 | 50.07 | 3.3 | 65 | 2.91 | 98.3 | 62.6 | 0.972 | 2137912 | 42 |
| 2.00 | 11.04 | 49.90 | 3.3 | 65 | 2.91 | 98.0 | 62.5 | 0.971 | 2137954 | 42 |
| 3.00 | 11.07 | 50.06 | 3.3 | 65 | 2.91 | 97.9 | 61.9 | 0.972 | 2137994 | 40 |
| 4.00 | 11.02 | 50.02 | 3.3 | 65 | 2.91 | 97.2 | 61.7 | 0.977 | 2138032 | 38 |
| 5.00 | 11.05 | 49.99 | 3.3 | 65 | 2.91 | 96.7 | 61 | 0.977 | 2138070 | 38 |
| 6.00 | 10.94 | 49.92 | 3.3 | 65 | 2.91 | 96.5 | 61.2 | 0.973 | 2138108 | 38 |
| 7.00 | 10.92 | 49.98 | 3.3 | 65 | 2.91 | 96.3 | 61 | 0.971 | 2138146 | 38 |
| 8.00 | 10.86 | 50.00 | 3.3 | 65 | 2.91 | 96.2 | 62 | 0.972 | 2138188 | 42 |
| 9.00 | 10.66 | 50.02 | 3.3 | 65 | 2.91 | 97.6 | 62 | 0.973 | 2138232 | 43 |
| 10.00 | | | | | | | | | | |
| 11.00 | 10.45 | 50.07 | 3.3 | 65 | 2.91 | 93.4 | 64.5 | 0.971 | 2138291 | 60 |
| 12.00 | 10.83 | 49.94 | 3.3 | 65 | 2.92 | 94.2 | 65.7 | 0.973 | 2138333 | 42 |
| 13.00 | | | | | | | | | | |
| 14.00 | 11.08 | 50.09 | 3.3 | 65 | 2.9 | 92.4 | 66 | 0.971 | 2138374 | |
| 15.00 | 10.93 | 50.01 | 3.3 | 65 | 2.9 | 92.7 | 66.3 | 0.973 | 2138414 | 40 |
| 16.00 | 10.9 | 50.05 | 3.3 | 65 | 2.89 | 97.7 | 66.5 | 0.971 | 2138454 | 40 |
| 17.00 | 10.89 | 50.00 | 3.3 | 65 | 2.89 | 98.3 | 66.7 | 0.971 | 2138494 | 40 |
| 18.00 | 10.93 | 50.03 | 3.3 | 65 | 2.89 | 99 | 66.8 | 0.974 | 2138535 | 41 |
| 19.00 | 10.95 | 50.06 | 3.3 | 65 | 2.89 | 99.7 | 66.5 | 0.974 | 2138575 | 40 |
| 20.00 | 10.97 | 50.04 | 3.3 | 65 | 2.89 | 100.2 | 66.4 | 0.974 | 2138615 | 40 |
| 21.00 | 10.79 | 50.01 | 3.3 | 65 | 2.91 | 100 | 66 | 0.971 | 2138655 | 40 |
| 22.00 | | | | | | | | | | |
| 23.00 | 10.7 | 50.05 | 3.3 | 65 | 2.92 | 94.1 | 64.3 | 0.974 | 2138706 | 51 |
| 24.00 | 10.72 | 50.05 | 3.3 | 65 | 2.93 | 95.0 | 63.5 | 0.974 | 2138745 | 39 |

| Time | Incomer | | Pump IV | | | | | Power Factor | KWH | UNITS/HRS |
|---|---|---|---|---|---|---|---|---|---|---|
| | KV | HZ | KV | A | PR | WT. | BT. | | | |
| 1.00 | 10.89 | 50.01 | 3.3 | 65 | 2.93 | 95.6 | 63.3 | 0.970 | 2138745 | 42 |
| 2.00 | 10.91 | 49.97 | 3.3 | 65 | 2.93 | 95.8 | 63.1 | 0.971 | 2138826 | 39 |
| 3.00 | 10.92 | 50.00 | 3.3 | 65 | 2.93 | 96.2 | 62.9 | 0.971 | 2138869 | 43 |
| 4.00 | 10.87 | 49.98 | 3.3 | 65 | 2.93 | 96.3 | 62.7 | 0.971 | 2138907 | 38 |
| 5.00 | 10.8 | 49.91 | 3.3 | 65 | 2.93 | 96.1 | 62.6 | 0.97 | 2138949 | 42 |
| 6.00 | 10.76 | 49.94 | 3.3 | 65 | 2.93 | 96 | 62.6 | 0.973 | 2138989 | 40 |
| 7.00 | 10.54 | 50.01 | 3.3 | 65 | 2.93 | 96.1 | 62.9 | 0.972 | 2139031 | 42 |
| 8.00 | 10.55 | 49.97 | 3.3 | 65 | 2.93 | 96.3 | 63.4 | 0.972 | 2139070 | 39 |
| 9.00 | 10.57 | 49.98 | 3.3 | 65 | 2.93 | 96.8 | 64.1 | 0.972 | 2139113 | 43 |
| 10.00 | 10.63 | 50.08 | 3.3 | 65 | 2.93 | 97.5 | 64.9 | 0.974 | 2139152 | 39 |
| 11.00 | 10.81 | 50.02 | 3.3 | 65 | 2.92 | 98.2 | 65.4 | 0.973 | 2139194 | 42 |
| 12.00 | 10.78 | 50.06 | 3.3 | 65 | 2.92 | 99.4 | 66.6 | 0.971 | 2139234 | 40 |
| 13.00 | 11.06 | 50.06 | 3.3 | 65 | 2.92 | 100.4 | 67.2 | 0.972 | 2139277 | 43 |
| 14.00 | 10.85 | 49.95 | 3.3 | 65 | 2.91 | 101.4 | 67.9 | 0.973 | 2139320 | 43 |
| 15.00 | 10.84 | 50.04 | 3.3 | 65 | 2.91 | 102.2 | 68.4 | 0.973 | 2139360 | 40 |
| 16.00 | 10.87 | 49.96 | 3.3 | 65 | 2.91 | 102.2 | 68 | 0.972 | 2139400 | 40 |
| 17.00 | 10.91 | 50.04 | 3.3 | 65 | 2.91 | 102.1 | 67.9 | 0.972 | 2139440 | 40 |
| 18.00 | 11.08 | 50.10 | 3.3 | 65 | 2.91 | 102 | 67.6 | 0.974 | 2139482 | 42 |
| 19.00 | 10.64 | 50.07 | 3.3 | 65 | 2.91 | 101.8 | 67 | 0.974 | 2139521 | 39 |
| 20.00 | 10.87 | 50.03 | 3.3 | 65 | 2.92 | 100.9 | 66.1 | 0.975 | 2139563 | 42 |
| 21.00 | 10.92 | 49.98 | 3.3 | 65 | 2.92 | 100.5 | 65.8 | 0.973 | 2139606 | 43 |
| 22.00 | 10.91 | 50.01 | 3.3 | 65 | 2.92 | 99.5 | 65.2 | 0.973 | 2139648 | 42 |
| 23.00 | | | | | | | | | | |
| 24.00 | 10.88 | 49.91 | 3.3 | 65 | 2.93 | 90.7 | 66.9 | 0.974 | 2139686 | 38 |

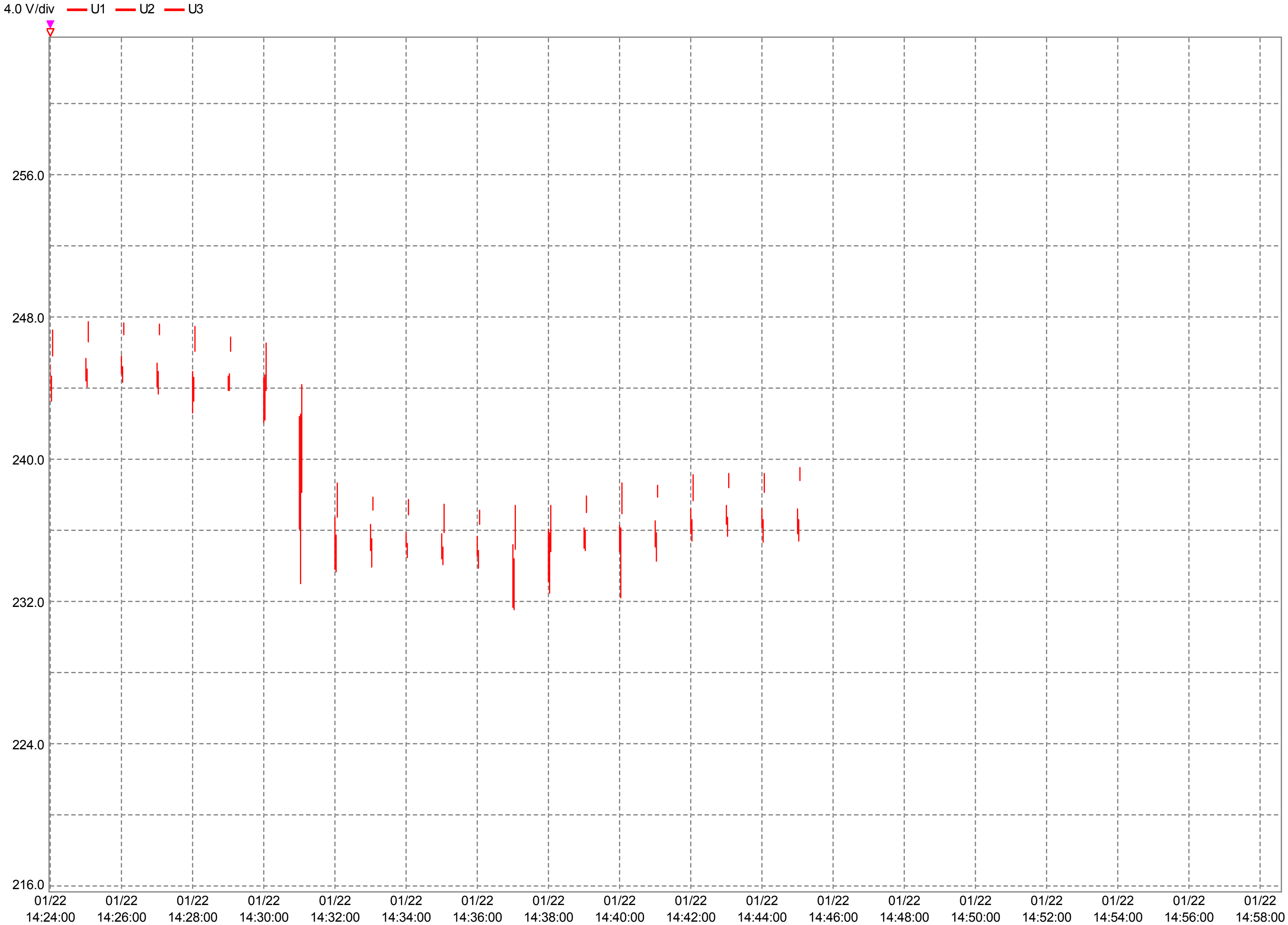
| Time | Incomer | | Pump IV | | | | | Power Factor | KWH | UNITS/HRS |
|---|---|---|---|---|---|---|---|---|---|---|
| | KV | HZ | KV | A | PR | WT. | BT. | | | |
| 1.00 | 10.8 | 50.07 | 3.3 | 65 | 2.92 | 92.6 | 67.4 | 0.923 | 2139727 | 41 |
| 2.00 | 10.69 | 50.01 | 3.3 | 65 | 2.92 | 94 | 67.5 | 0.972 | 2139767 | 40 |
| 3.00 | 10.75 | 50.03 | 3.3 | 65 | 2.92 | 94.2 | 65 | 0.972 | 2139807 | 40 |
| 4.00 | 10.64 | 50.11 | 3.3 | 65 | 2.92 | 93.7 | 64.3 | 0.921 | 2139846 | 39 |
| 5.00 | 10.7 | 50.05 | 3.3 | 65 | 2.92 | 93 | 63.4 | 0.973 | 2139888 | 42 |
| 6.00 | 10.78 | 50.07 | 3.3 | 65 | 2.92 | 93.5 | 62.7 | 0.973 | 2139929 | 41 |
| 7.00 | 10.74 | 50.07 | 3.3 | 65 | 2.92 | 94.7 | 63.1 | 0.974 | 2139967 | 38 |
| 8.00 | 10.73 | 50.04 | 3.3 | 65 | 2.92 | 95.5 | 63.6 | 0.972 | 2140005 | 38 |
| 9.00 | 10.75 | 50.05 | 3.3 | 65 | 2.92 | 96.9 | 64 | 0.973 | 2140044 | 39 |
| 10.00 | 10.79 | 50.02 | 3.3 | 65 | 2.92 | 97.7 | 64.9 | 0.972 | 2140O94 | 40 |
| 11.00 | 10.69 | 50.05 | 3.3 | 65 | 2.92 | 98.9 | 65.9 | 0.971 | 2140137 | 43 |
| 12.00 | 10.8 | 50.09 | 3.3 | 65 | 2.91 | 94.9 | 66.8 | 0.974 | 2140176 | 39 |
| 13.00 | 11.05 | 50.11 | 3.3 | 65 | 2.92 | 100.6 | 67.5 | 0.974 | 2140218 | 42 |
| 14.00 | | | | | | | | | | |

| Time | Incomer | | Pump II | | | | | Power Factor | KWH | UNITS/HRS |
|---|---|---|---|---|---|---|---|---|---|---|
| | KV | HZ | KV | A | PR | WT. | BT. | | | |
| 1.00 | 11.02 | 50.02 | 3.3 | 65 | 2.89 | 92.1 | 65.7 | 0.970 | 2106446 | 40 |
| 2.00 | 11.01 | 49.91 | 3.3 | 65 | 2.89 | 91.5 | 65 | 0.973 | 2106484 | 38 |
| 3.00 | 10.89 | 50.00 | 3.3 | 65 | 2.89 | 90.4 | 64.3 | 0.971 | 2106525 | 41 |
| 4.00 | 10.91 | 50.01 | 3.3 | 65 | 2.88 | 90.2 | 64 | 0.971 | 2106565 | 40 |
| 5.00 | 10.94 | 49.97 | 3.3 | 65 | 2.89 | 90.9 | 64.7 | 0.971 | 2106605 | 40 |
| 6.00 | 10.95 | 49.92 | 3.3 | 65 | 2.89 | 91.4 | 65.1 | 0.97 | 2106646 | 41 |
| 7.00 | 10.91 | 49.95 | 3.3 | 65 | 2.89 | 91.5 | 65.1 | 0.971 | 2106687 | 41 |
| 8.00 | 10.89 | 49.91 | 3.3 | 65 | 2.88 | 91.7 | 64.2 | 0.972 | 2106727 | 40 |
| 9.00 | 10.97 | 49.98 | 3.3 | 65 | 2.88 | 92 | 64 | 0.97 | 2106767 | 40 |
| 10.00 | 10.9 | 50.00 | 3.3 | 65 | 2.88 | 92.3 | 63.1 | 0.972 | 2106808 | 41 |
| 11.00 | 10.91 | 49.99 | 3.3 | 65 | 2.88 | 92.5 | 61.4 | 0.971 | 2106849 | 41 |
| 12.00 | 11.03 | 50.04 | 3.3 | 65 | 2.88 | 93.1 | 65.2 | 0.971 | 2106889 | 40 |
| 13.00 | 11.08 | 50.06 | 3.3 | 65 | 2.88 | 94.4 | 64.1 | 0.972 | 2106930 | 41 |
| 14.00 | 10.86 | 49.92 | 3.3 | 65 | 2.88 | 95.7 | 70.1 | 0.970 | 2106970 | 40 |
| 15.00 | 10.88 | 49.95 | 3.3 | 65 | 2.88 | 96 | 70.5 | 0.970 | 2107010 | 40 |
| 16.00 | 10.92 | 49.97 | 3.3 | 65 | 2.88 | 96.3 | 71 | 0.970 | 2107050 | 40 |
| 17.00 | 10.94 | 50.00 | 3.3 | 65 | 2.88 | 96.5 | 70.5 | 0.970 | 2107090 | 40 |
| 18.00 | 10.95 | 50.01 | 3.3 | 65 | 2.88 | 96 | 70.1 | 0.971 | 2107128 | 38 |
| 19.00 | 10.9 | 50.03 | 3.3 | 65 | 2.88 | 95.5 | 69 | 0.971 | 2107168 | 40 |
| 20.00 | 10.93 | 50.05 | 3.3 | 65 | 2.88 | 95.1 | 68.2 | 0.971 | 2107207 | 39 |
| 21.00 | 10.99 | 50.06 | 3.3 | 65 | 2.88 | 94.3 | 67.7 | 0.971 | 2107298 | 41 |
| 22.00 | 10.92 | 50.13 | 3.3 | 65 | 2.88 | 93.5 | 67 | 0.97 | 2107290 | 42 |
| 23.00 | 11.02 | 50.02 | 3.3 | 65 | 2.87 | 93 | 66.6 | 0.971 | 2107332 | 42 |
| 24.00 | 11.14 | 50.03 | 3.3 | 65 | 2.87 | 92.3 | 66.1 | 0.971 | 2107334 | 42 |

| OTTOTRACTIONS | Time Plot Graph<br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |
|---|---|---|

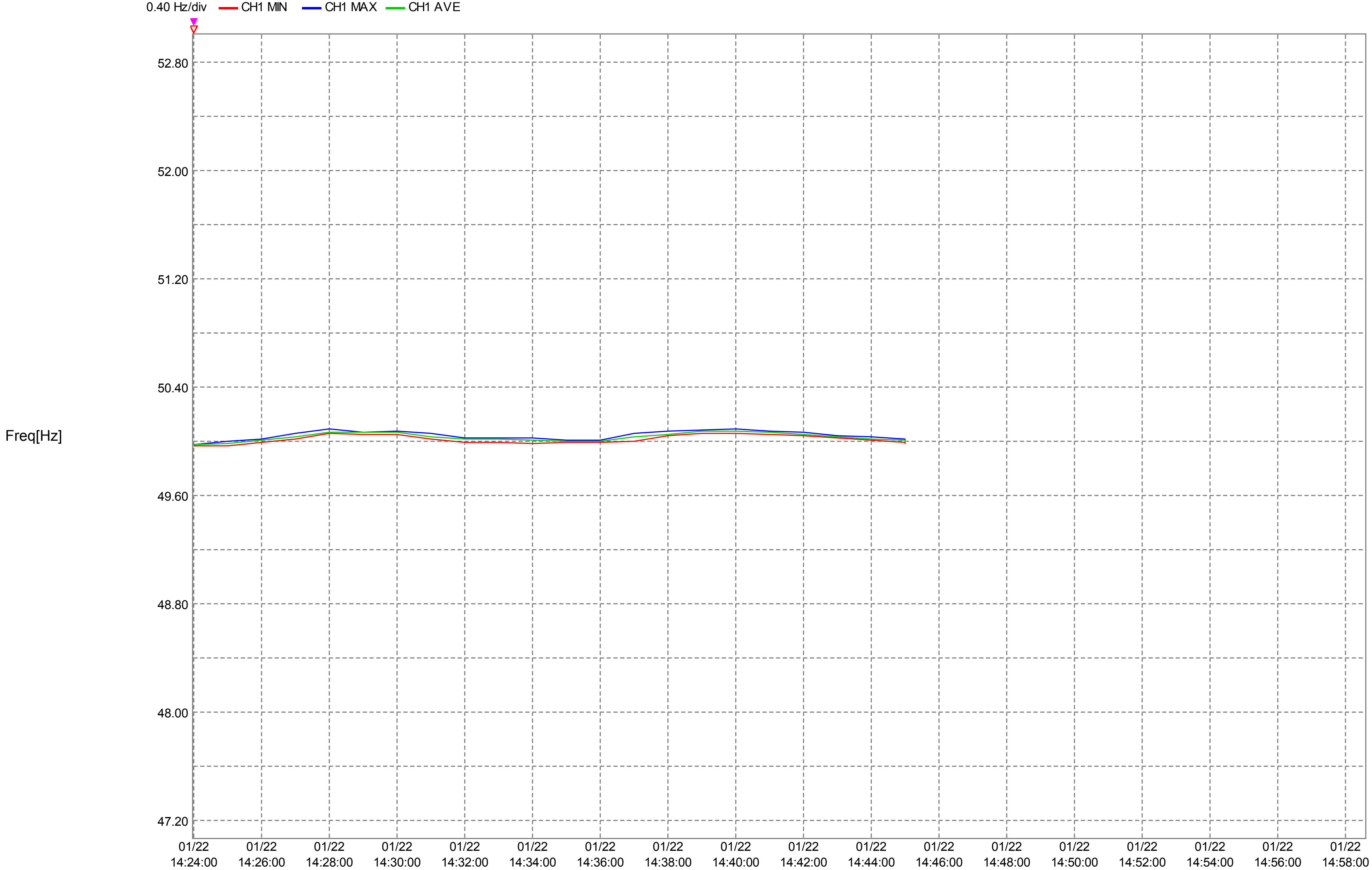
**2020/01/22 14:24:00 - 2020/01/22 14:45:00**

VOLTAGE

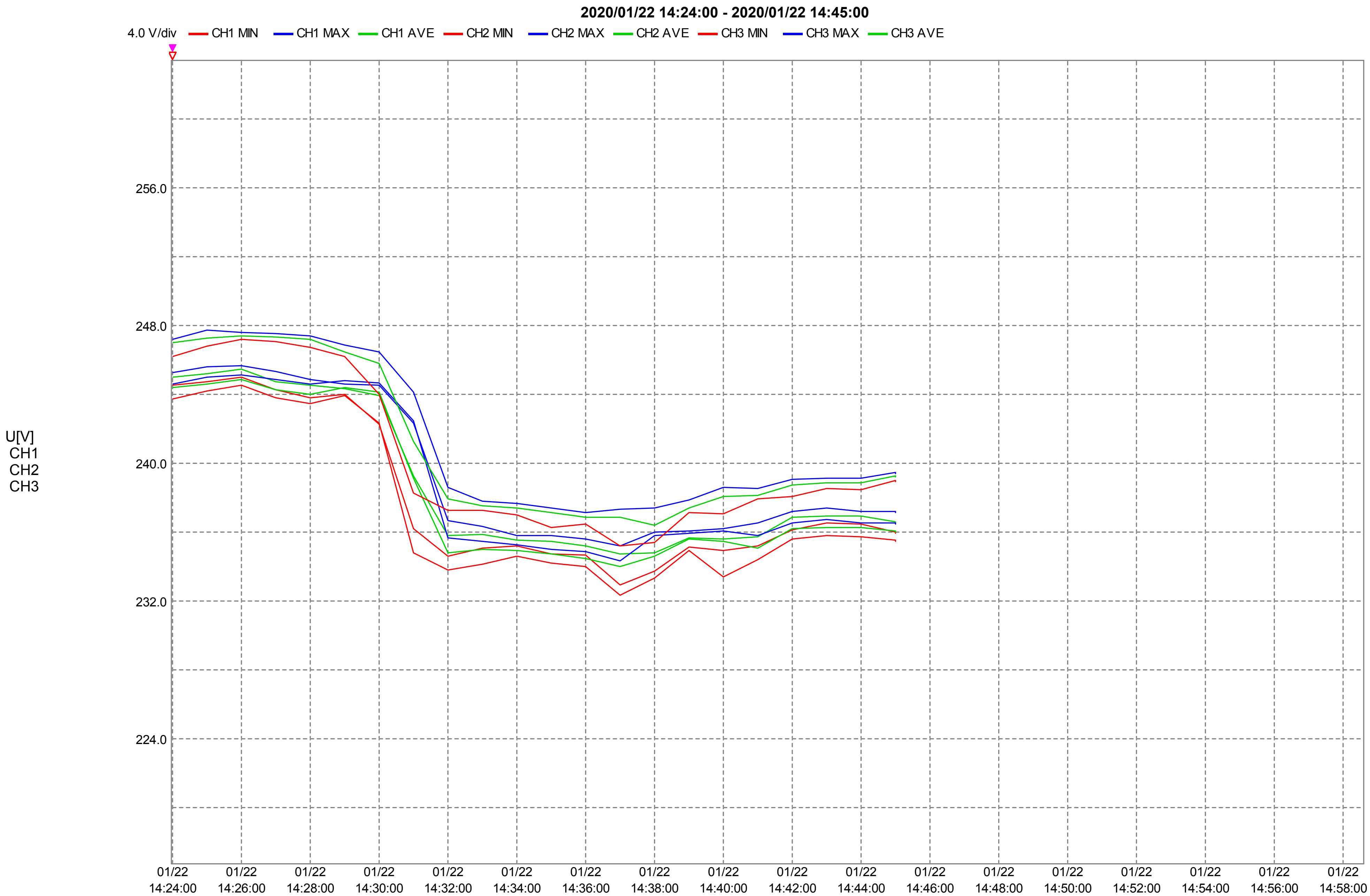


| OTTOTRACTIONS | Time Plot Graph<br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |
|---|---|---|

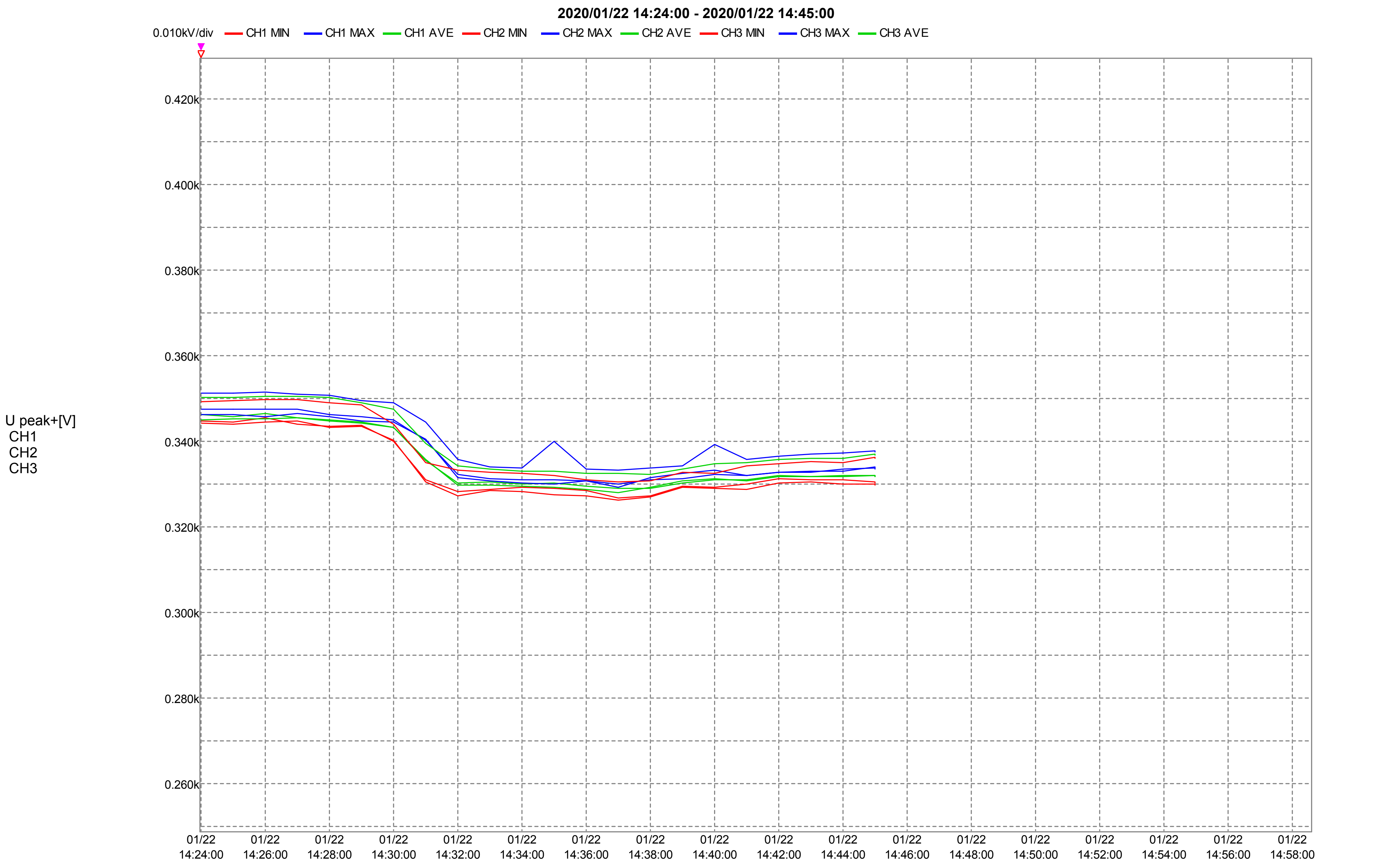
**2020/01/22 14:24:00 - 2020/01/22 14:45:00**



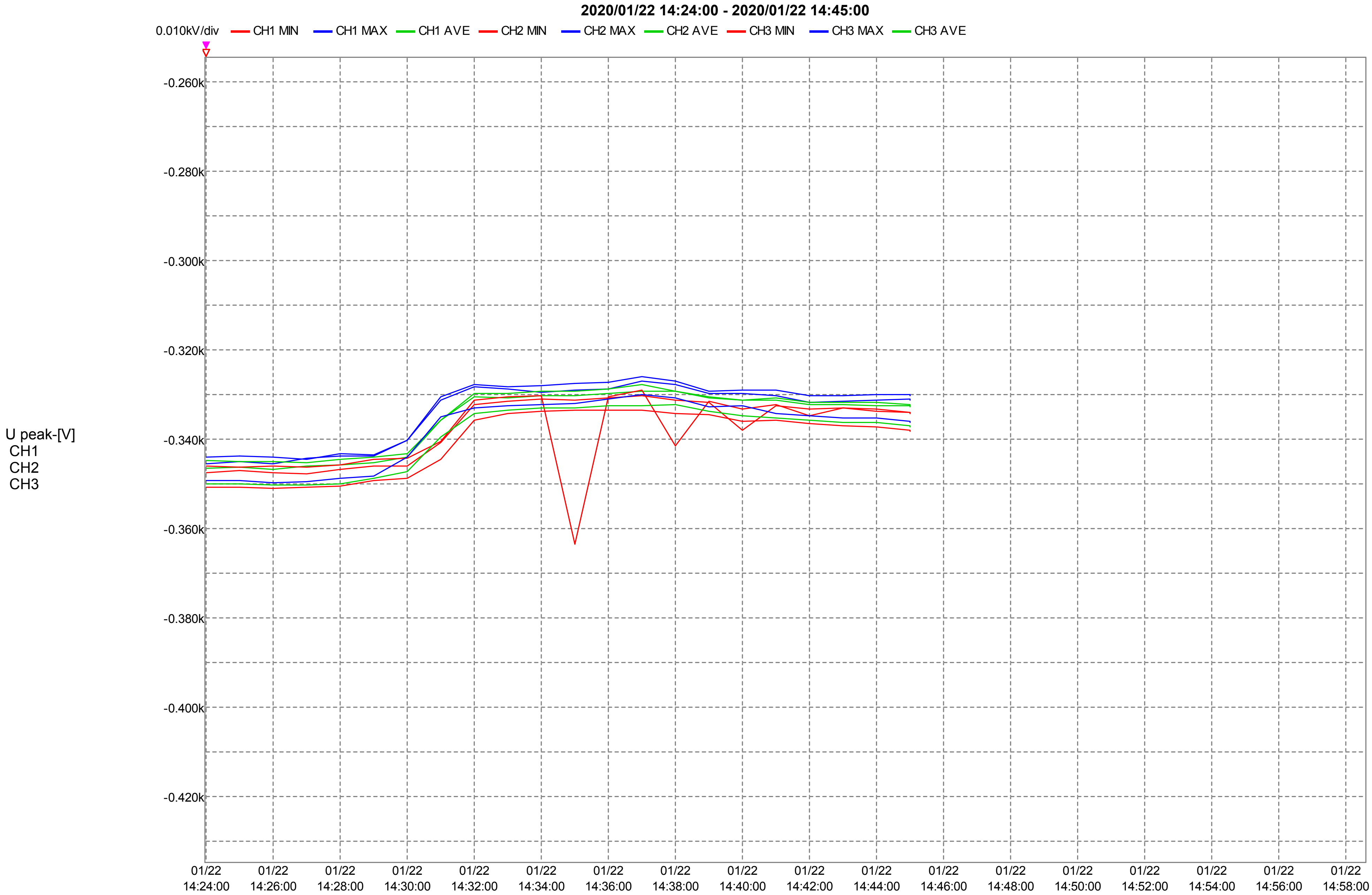
| OTTOTRACTIONS | Time Plot Graph<br><br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br><br>KWA Piravom |
|---|---|---|



| | | |
|---|---|---|
| OTTOTRACTIONS | Time Plot Graph<br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |

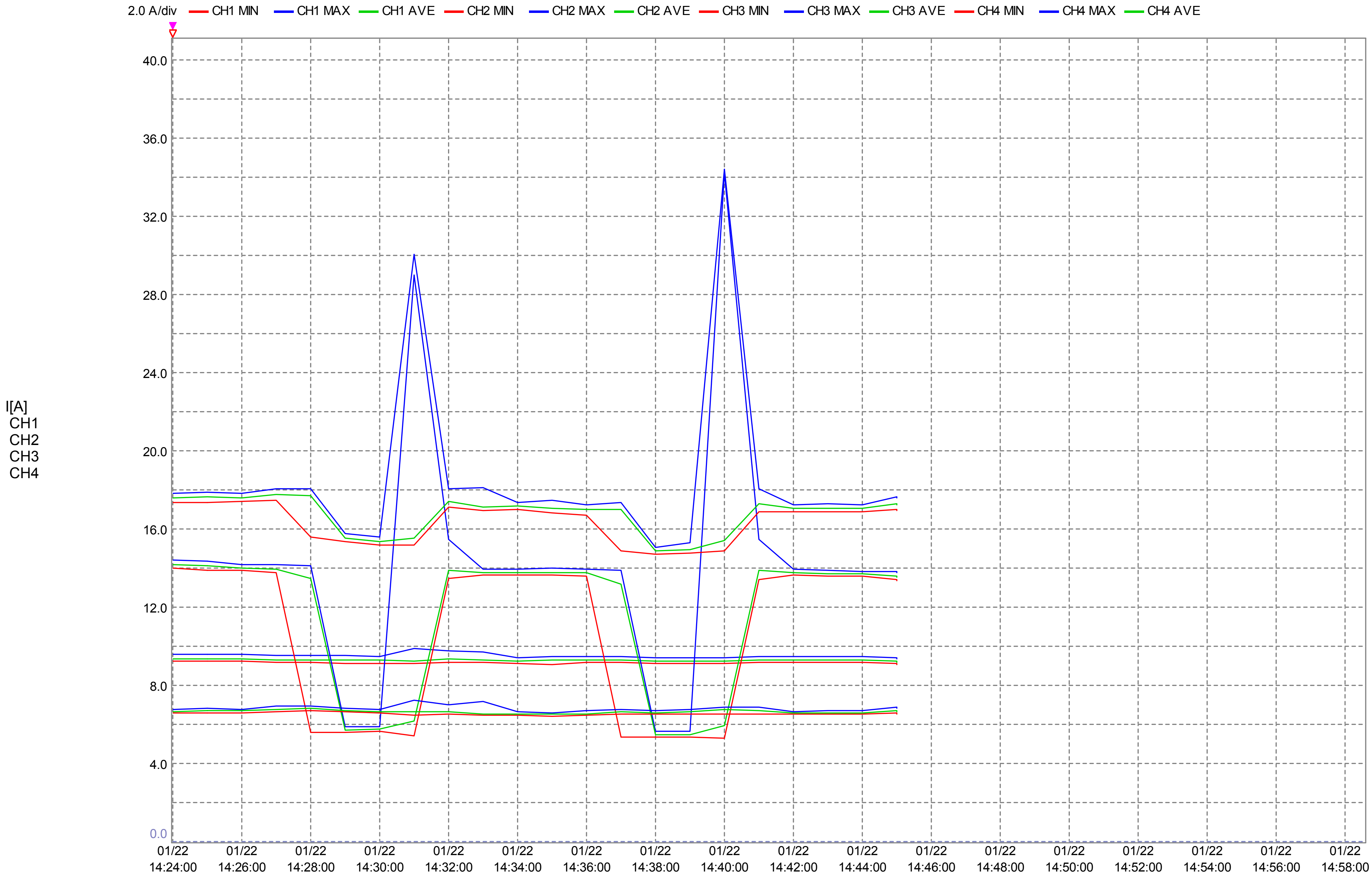


| | | |
|---|---|---|
| OTTOTRACTIONS | Time Plot Graph<br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |



| | | |
|---|---|---|
| OTTOTRACTIONS | Time Plot Graph<br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |

**2020/01/22 14:24:00 - 2020/01/22 14:45:00**



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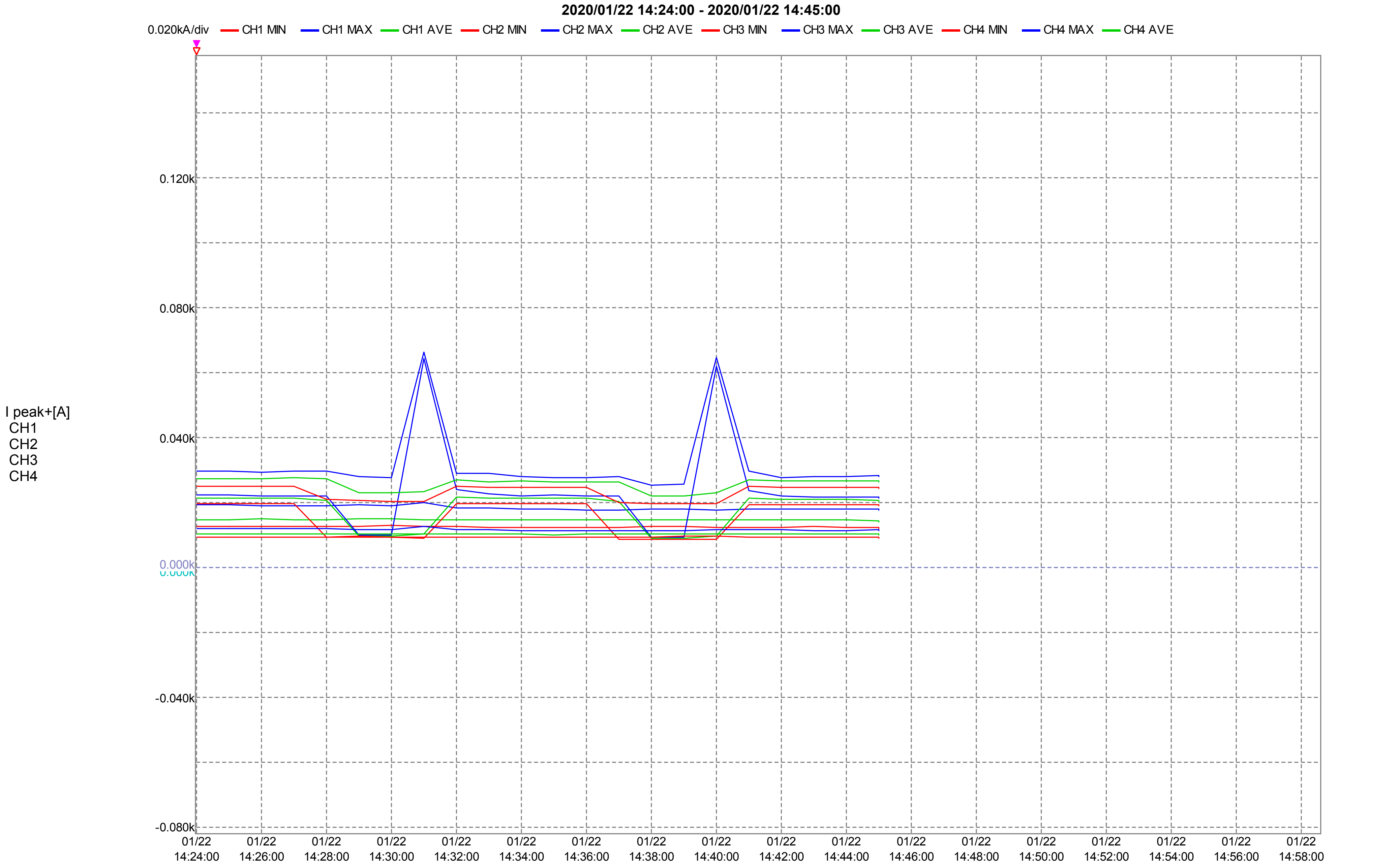
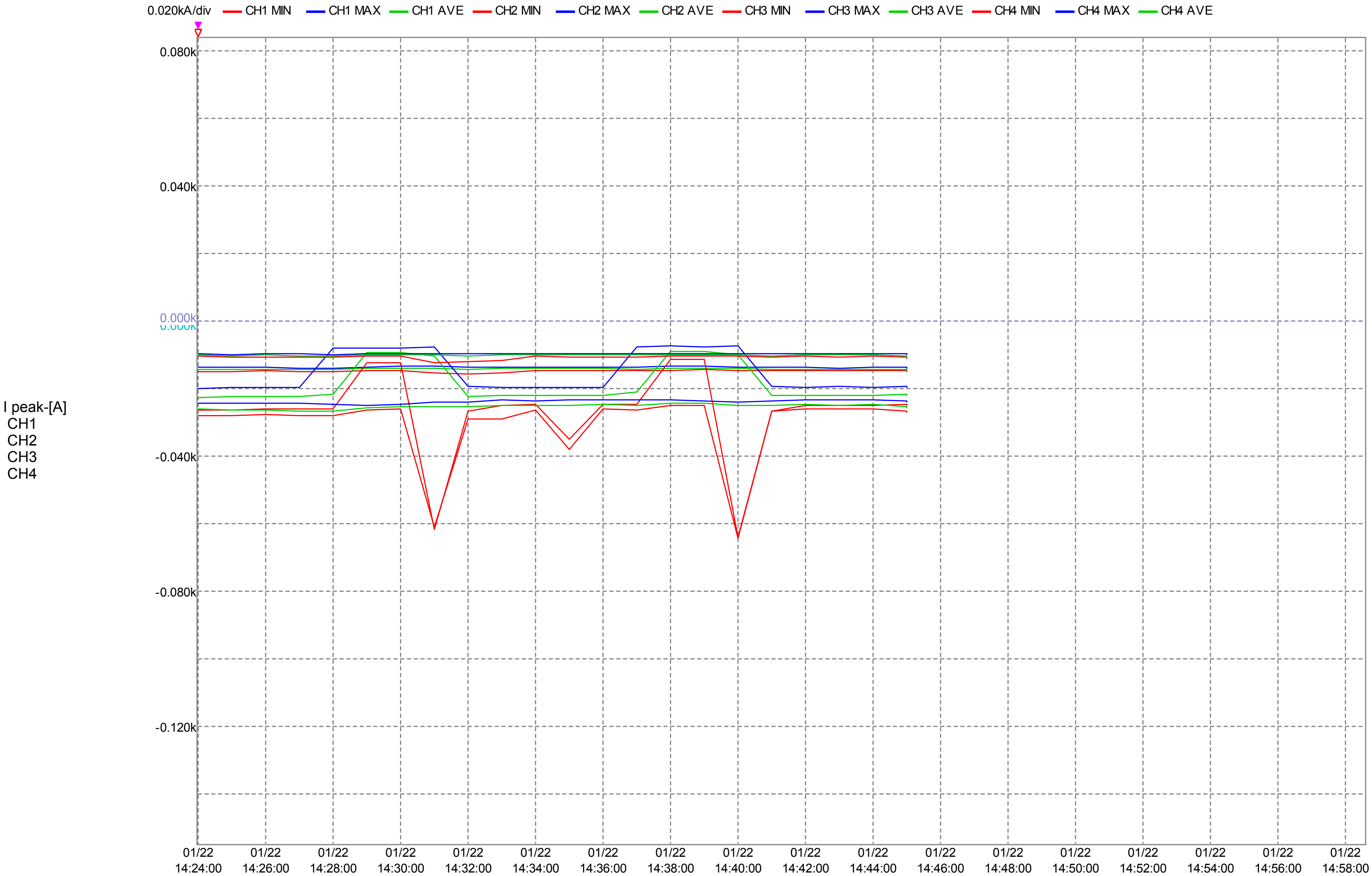
|---|---|---|
| OTTOTRACTIONS | Time Plot Graph<br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |



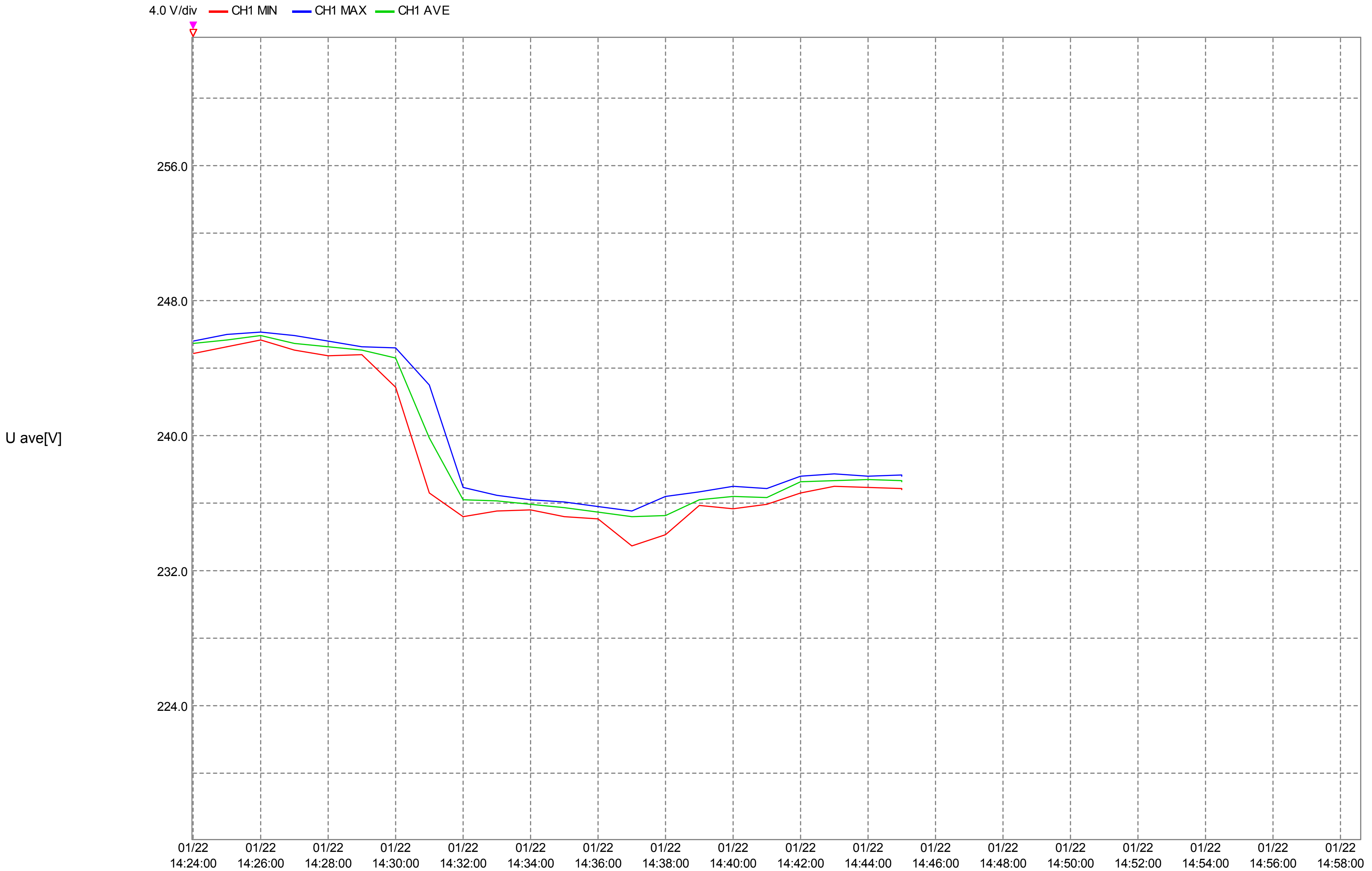
| OTTOTRACTIONS | Time Plot Graph<br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |
|---|---|---|

**2020/01/22 14:24:00 - 2020/01/22 14:45:00**



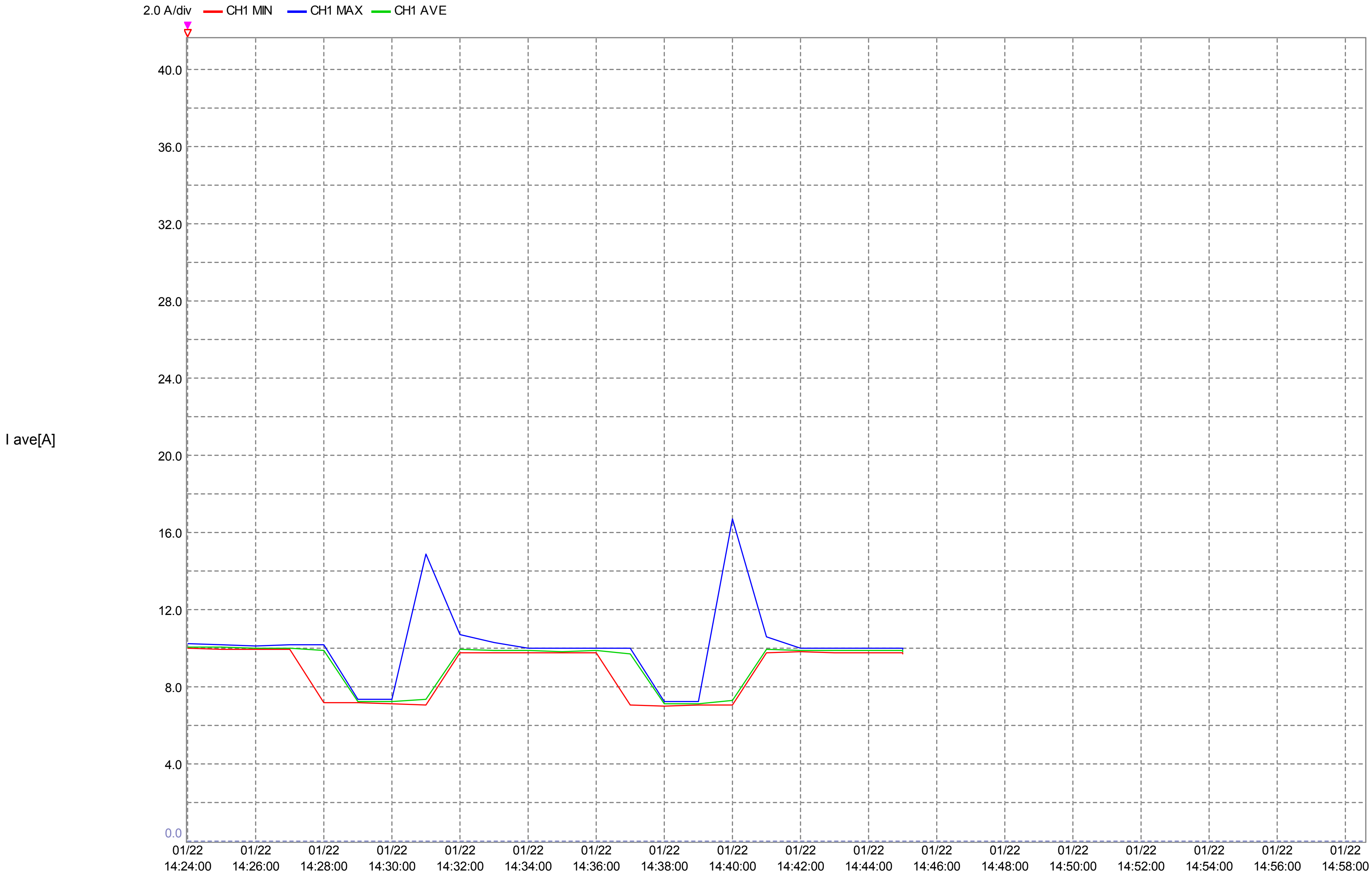
| OTTOTRACTIONS | Time Plot Graph<br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |
|---|---|---|

**2020/01/22 14:24:00 - 2020/01/22 14:45:00**



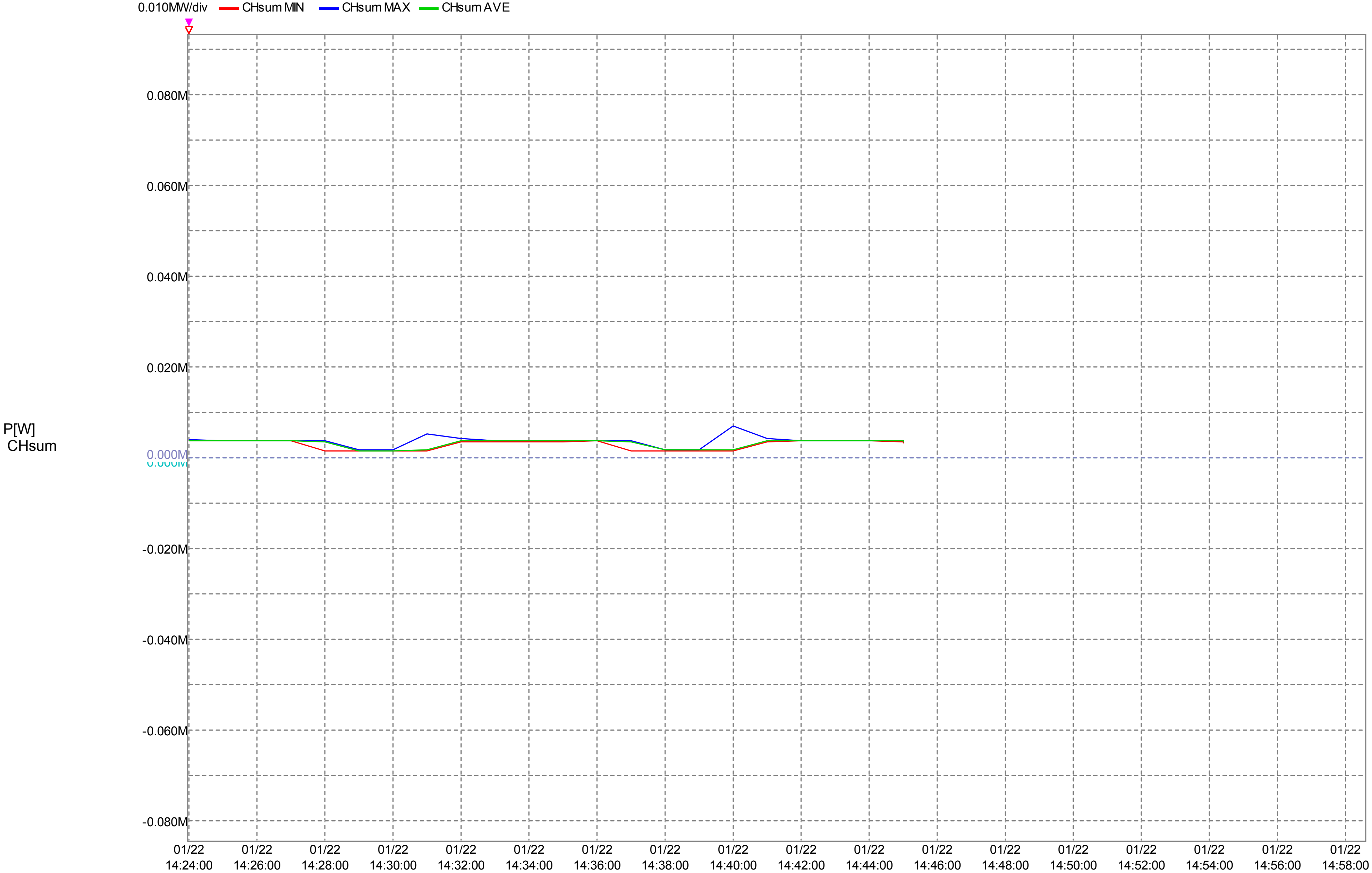
| OTTOTRACTIONS | Time Plot Graph<br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |
|---|---|---|

**2020/01/22 14:24:00 - 2020/01/22 14:45:00**



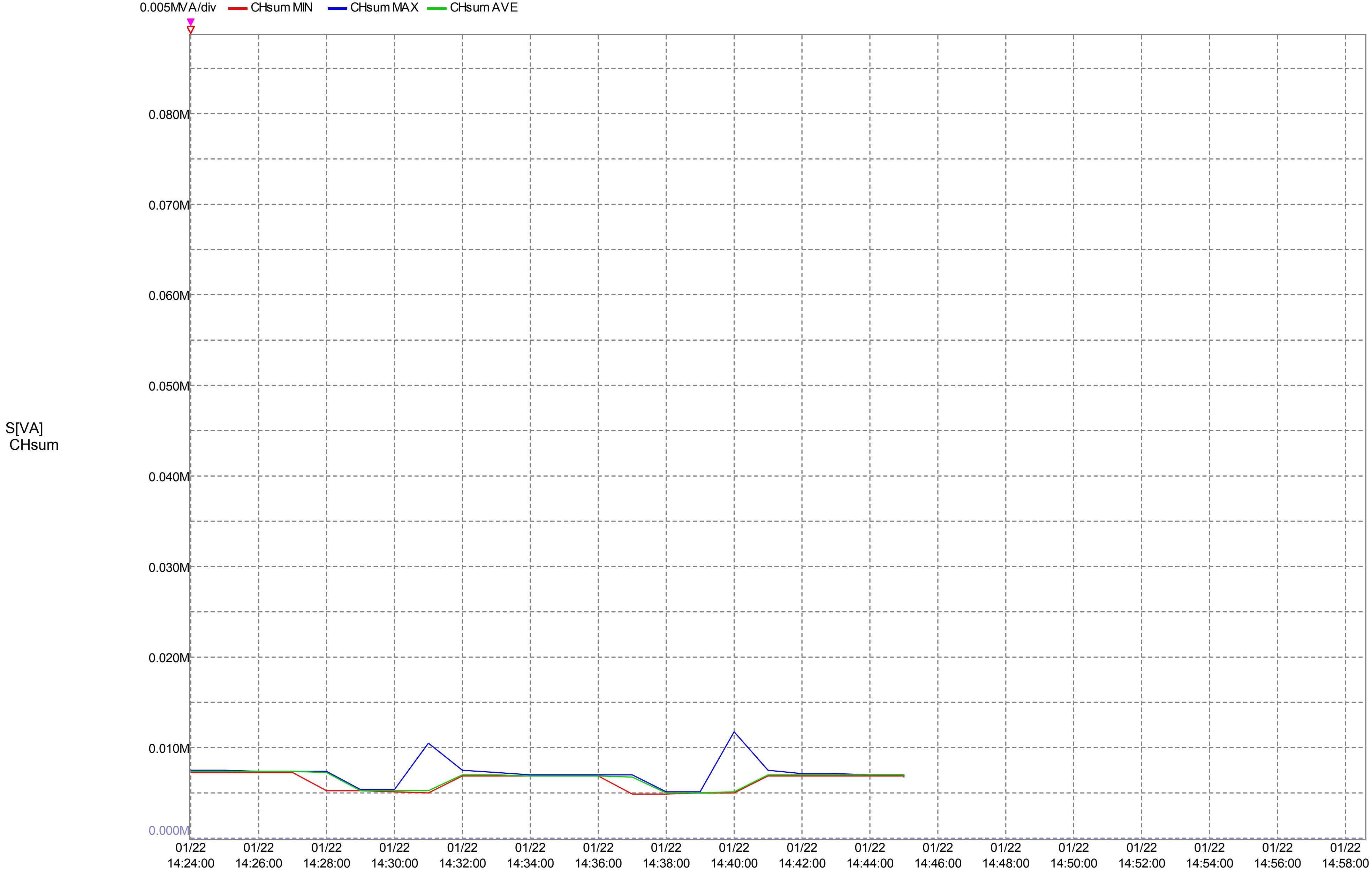
| OTTOTRACTIONS | Time Plot Graph<br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |
|---|---|---|

**2020/01/22 14:24:00 - 2020/01/22 14:45:00**



| OTTOTRACTIONS | Time Plot Graph<br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |
|---|---|---|

**2020/01/22 14:24:00 - 2020/01/22 14:45:00**



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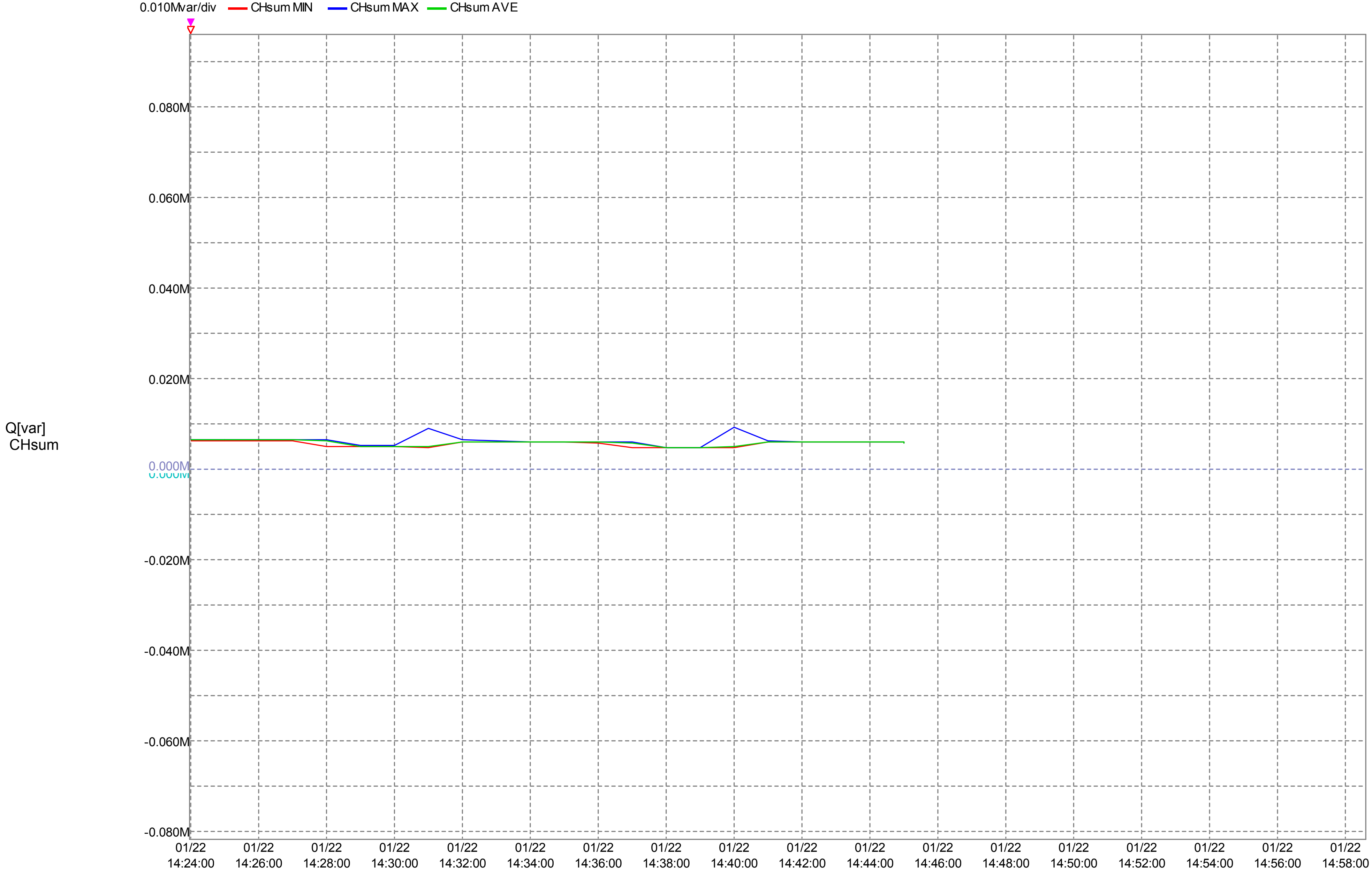
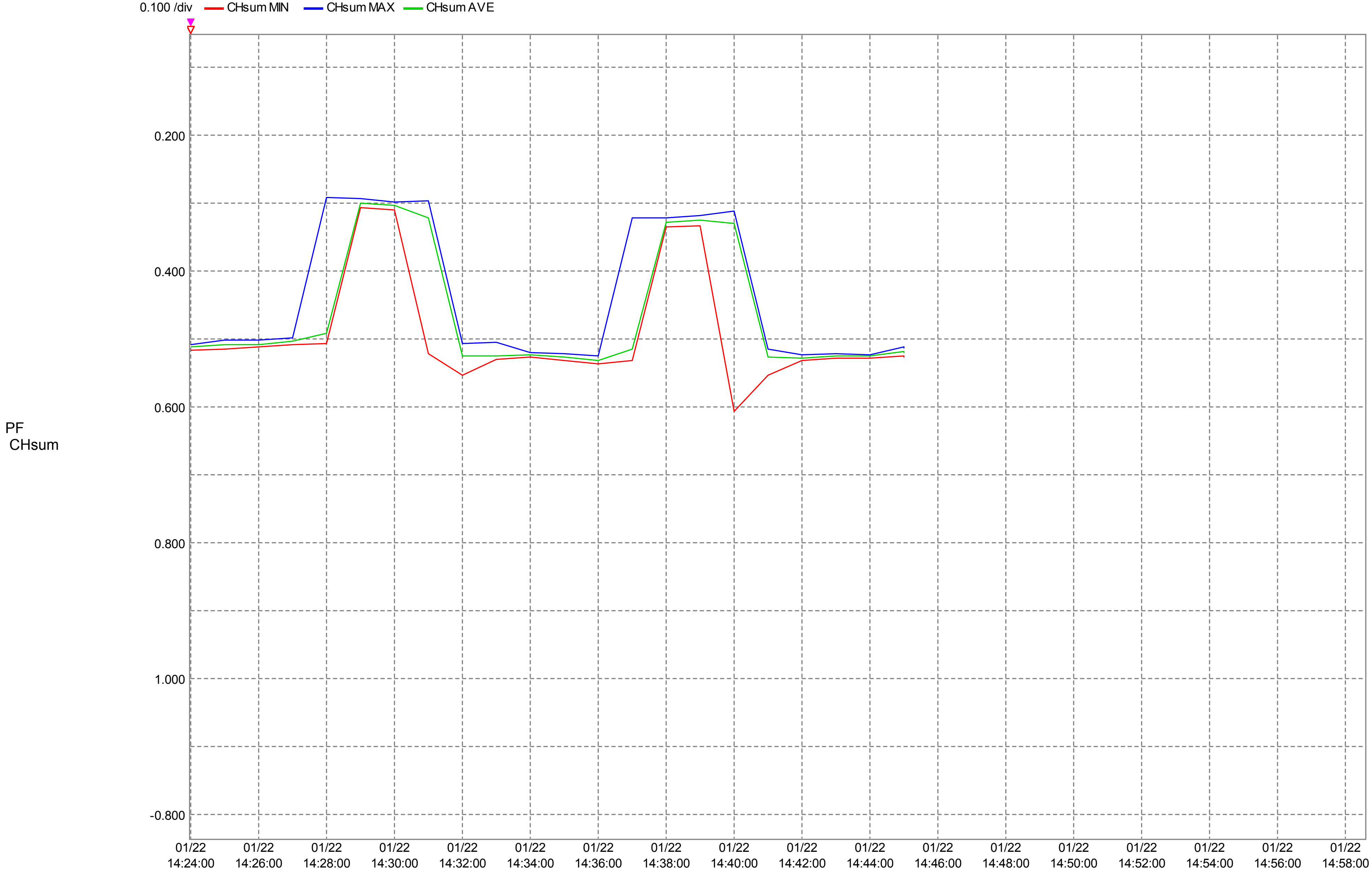
|---|---|---|
| OTTOTRACTIONS | Time Plot Graph<br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |

**2020/01/22 14:24:00 - 2020/01/22 14:45:00**



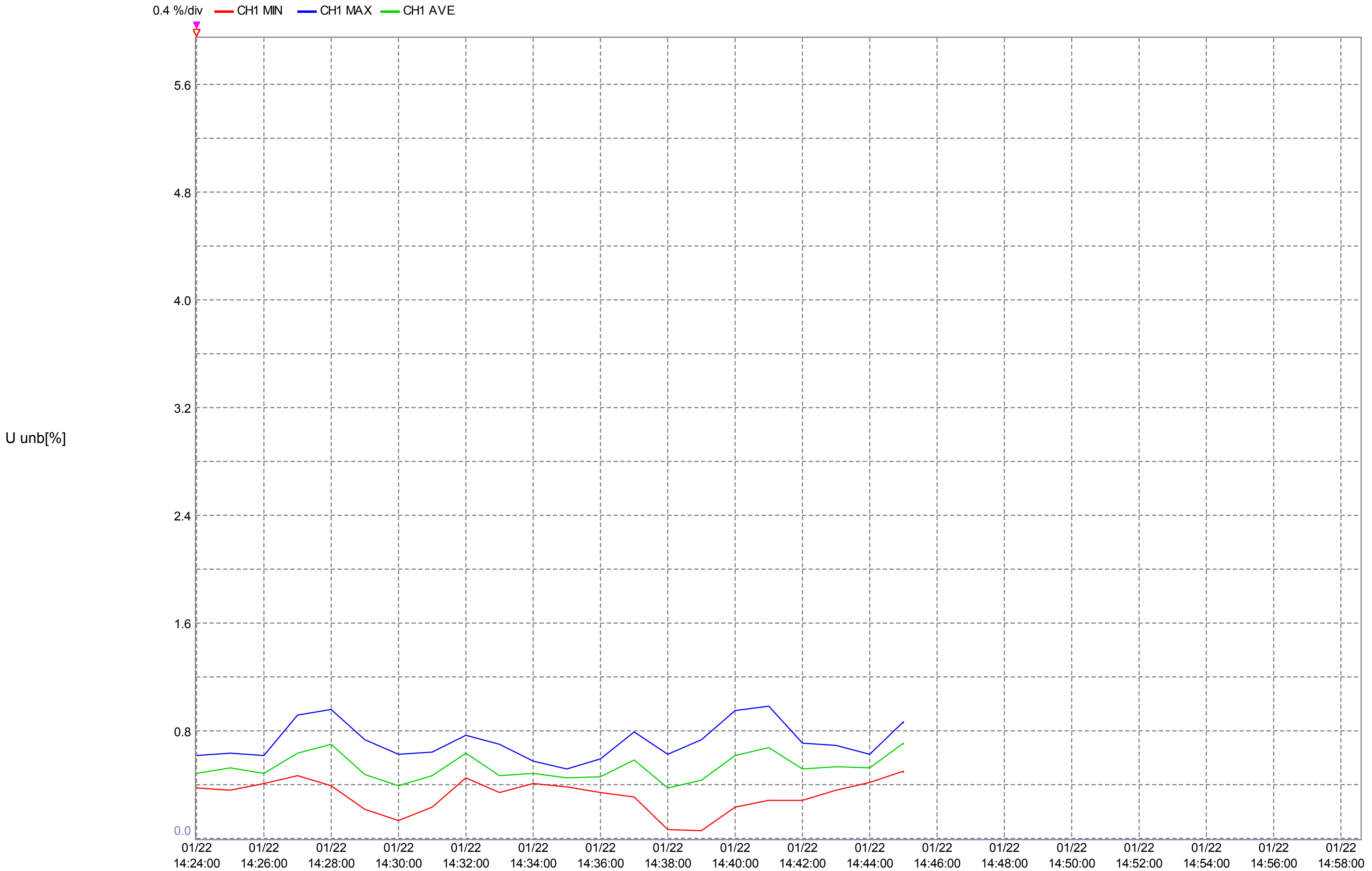
| OTTOTRACTIONS | Time Plot Graph<br><br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |
|---|---|---|

**2020/01/22 14:24:00 - 2020/01/22 14:45:00**



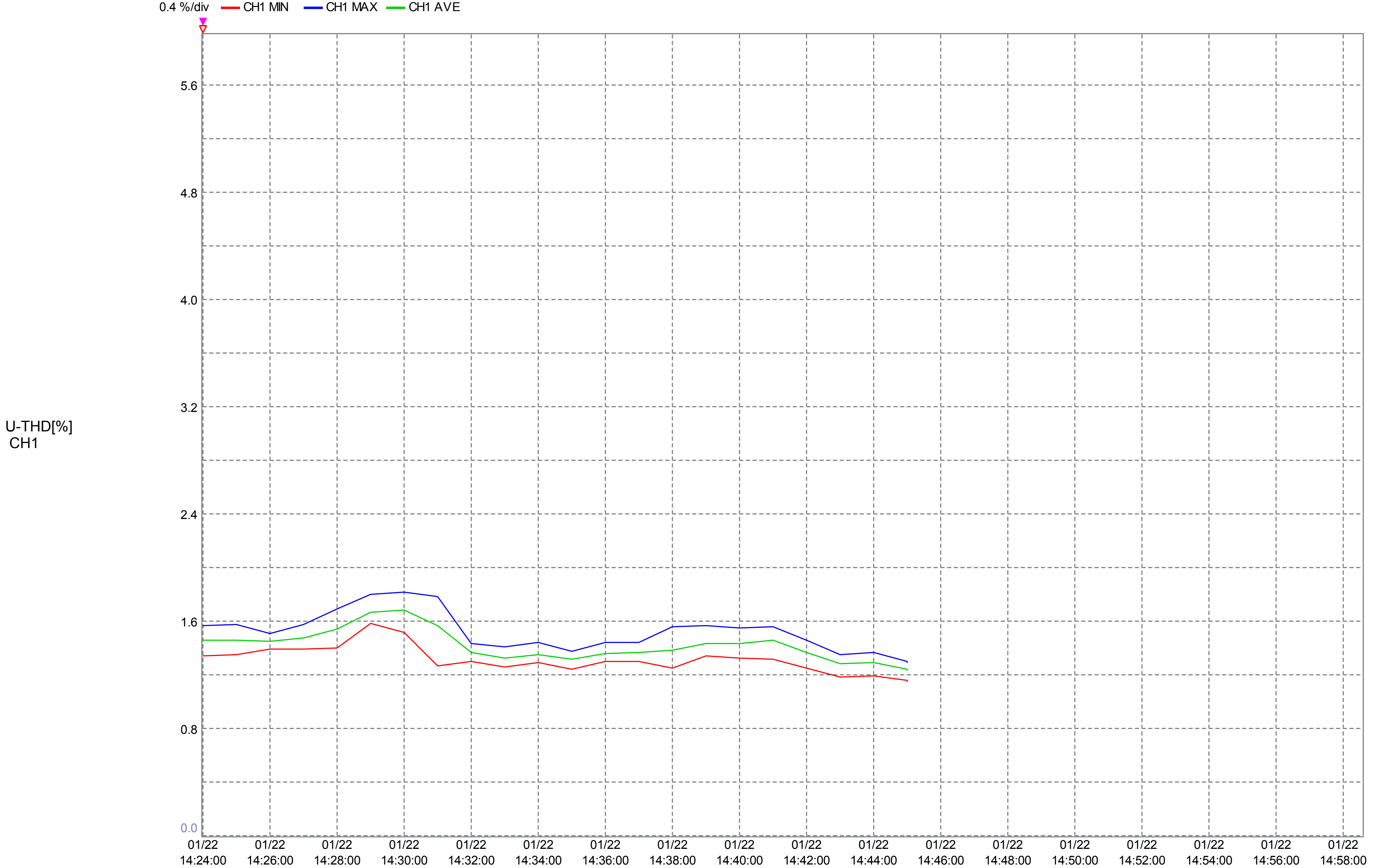
| OTTOTRACTIONS | Time Plot Graph<br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |
|---|---|---|

**2020/01/22 14:24:00 - 2020/01/22 14:45:00**



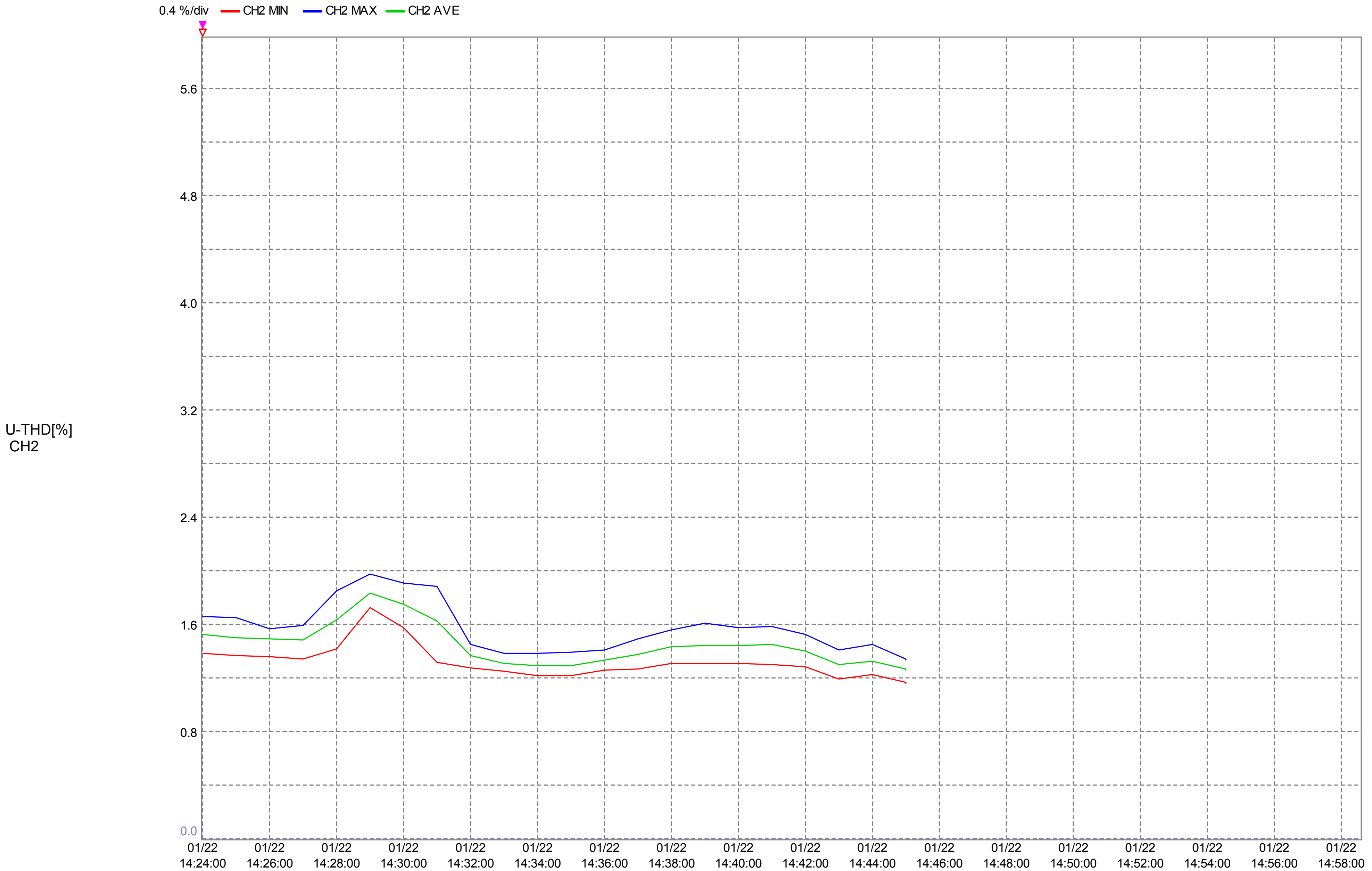
| OTTOTRACTIONS | Time Plot Graph<br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |
|---|---|---|

**2020/01/22 14:24:00 - 2020/01/22 14:45:00**



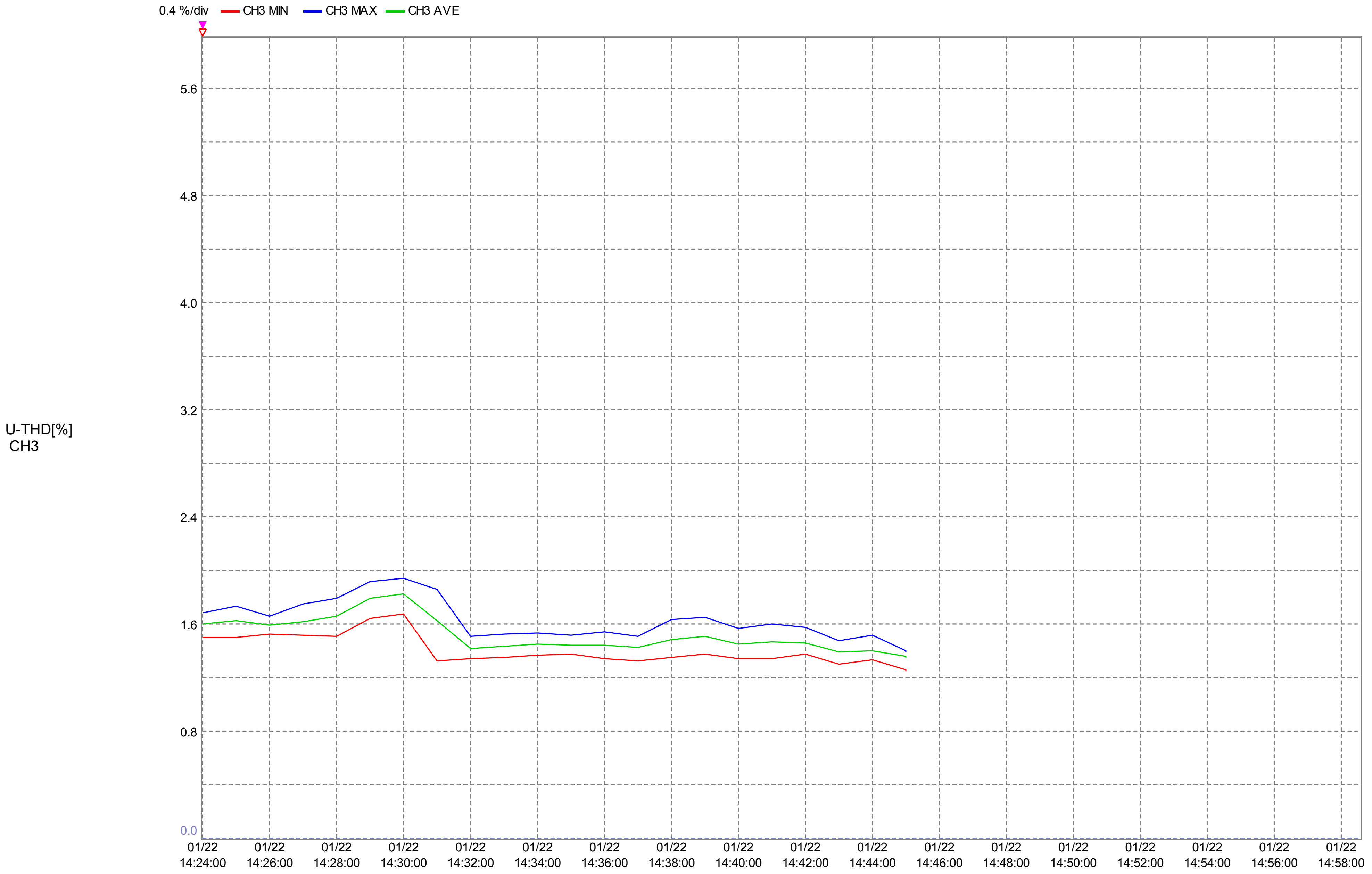
| OTTOTRACTIONS | Time Plot Graph<br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |
|---|---|---|

**2020/01/22 14:24:00 - 2020/01/22 14:45:00**



| OTTOTRACTIONS | Time Plot Graph<br><br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |
|---|---|---|

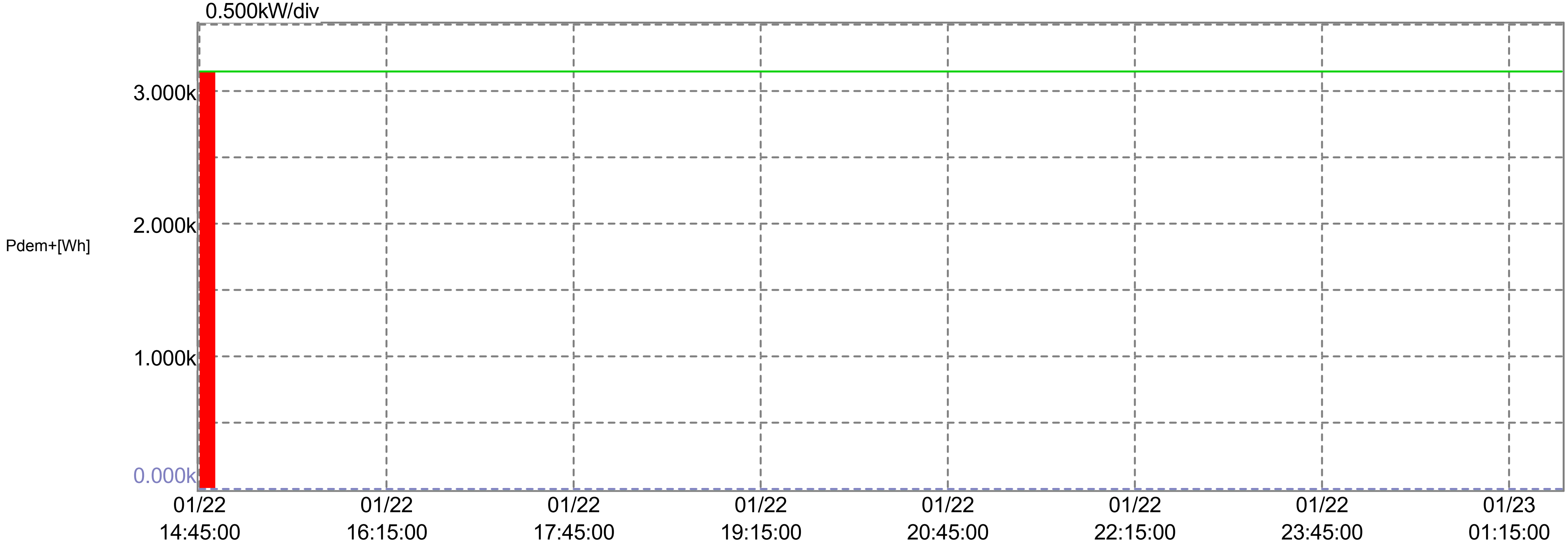
**2020/01/22 14:24:00 - 2020/01/22 14:45:00**



| OTTOTRACTIONS | Demand Analysis<br><br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |
|---|---|---|

**2020/01/22 14:45:00 - 2020/01/22 15:00:00 Demand Interval:15Minute**

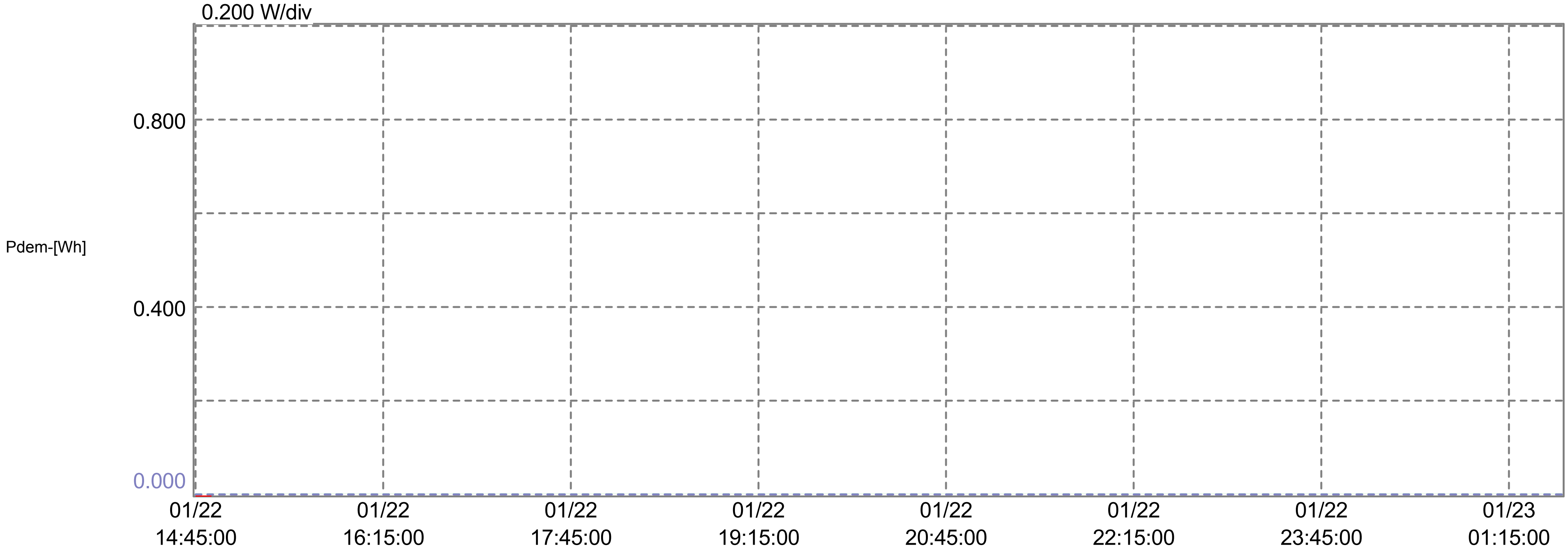
MAX demand value: 3.147kW 01/22 14:45:00 AVE demand value: 3.147kW
Load factor: 100.0%



| OTTOTRACTIONS | Demand Analysis<br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |
|---|---|---|

**2020/01/22 14:45:00 - 2020/01/22 15:00:00 Demand Interval:15Minute**

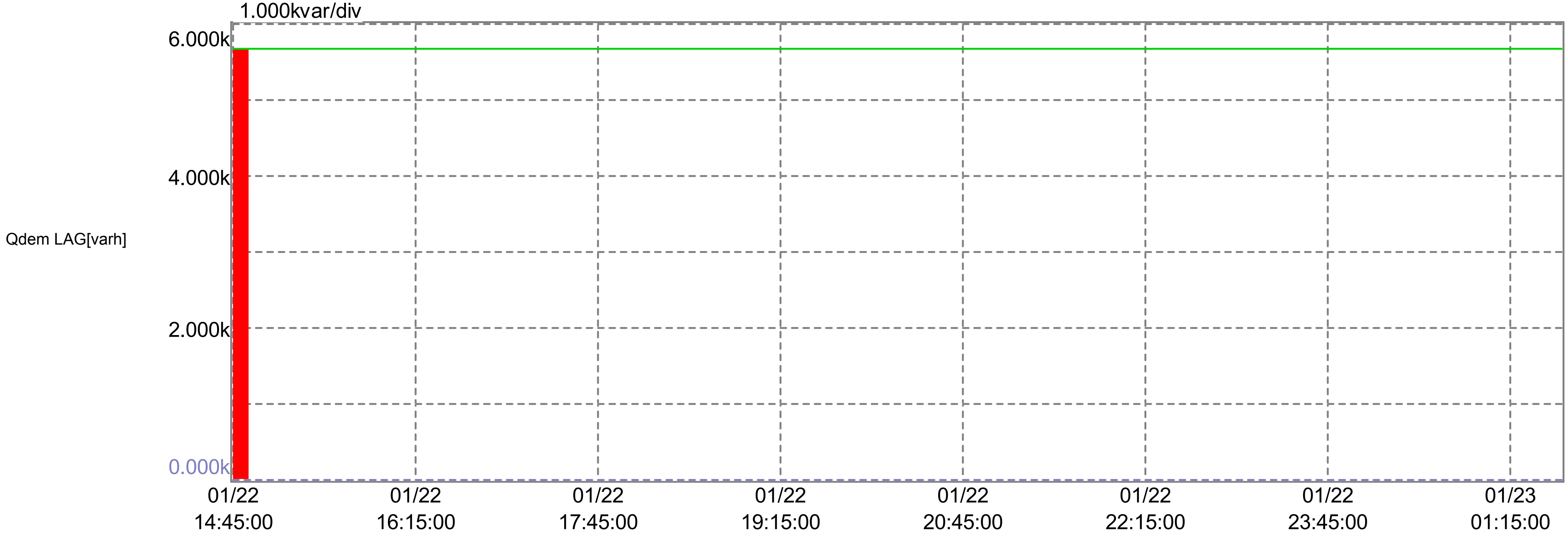
MAX demand value: 000.0mW 01/22 14:45:00 AVE demand value: 000.0mW
Load factor: ----- %



| OTTOTRACTIONS | Demand Analysis<br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |
|---|---|---|

**2020/01/22 14:45:00 - 2020/01/22 15:00:00 Demand Interval:15Minute**

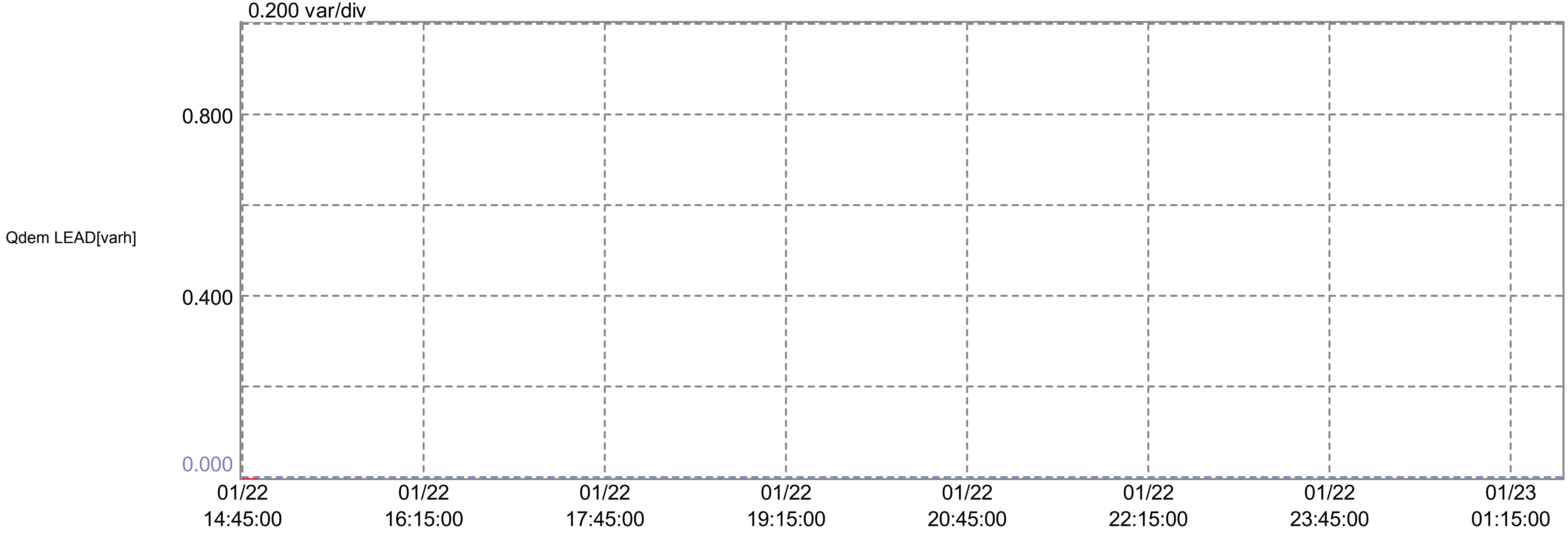
MAX demand value: 5.674kvar 01/22 14:45:00 AVE demand value: 5.674kvar
Load factor: ----- %



| | | |
|---|---|---|
| OTTOTRACTIONS | Demand Analysis<br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |

**2020/01/22 14:45:00 - 2020/01/22 15:00:00 Demand Interval:15Minute**

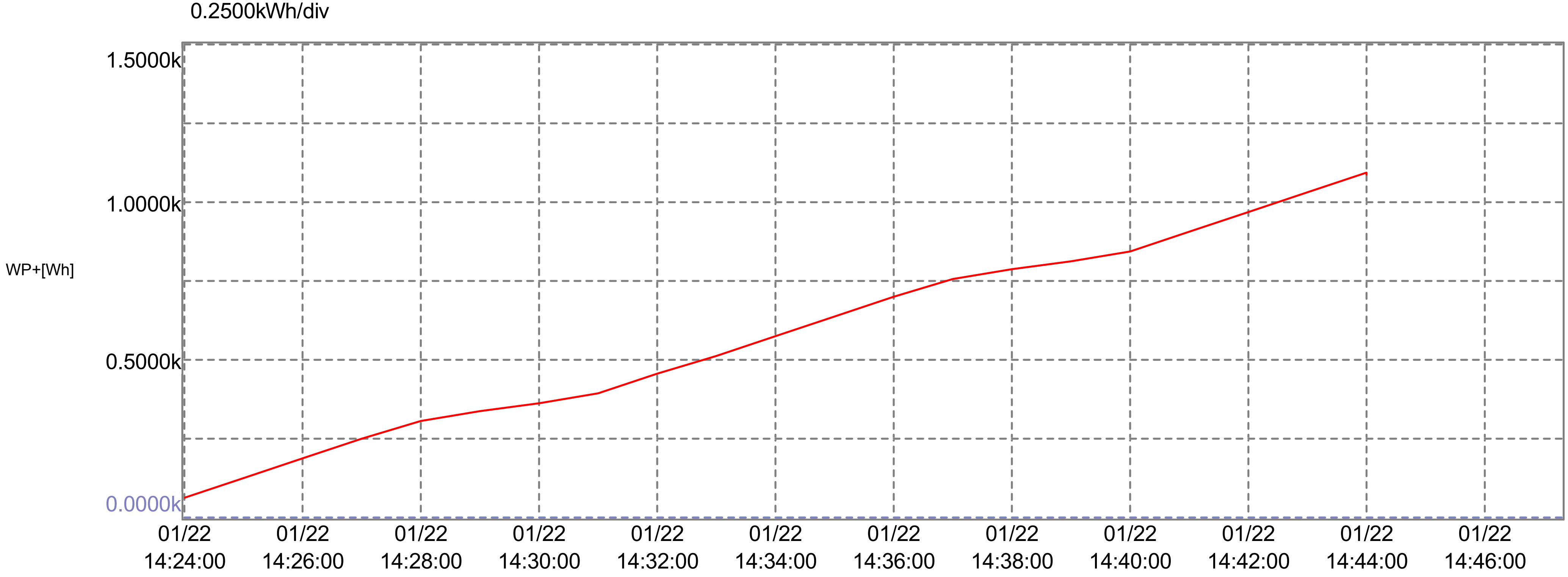
MAX demand value: 000.0mvar 01/22 14:45:00 AVE demand value: 000.0mvar
Load factor: ----- %



| | | |
|---|---|---|
| OTTOTRACTIONS | Integrated Power Analysis<br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |

**2020/01/22 14:24:00 - 2020/01/22 14:45:00**

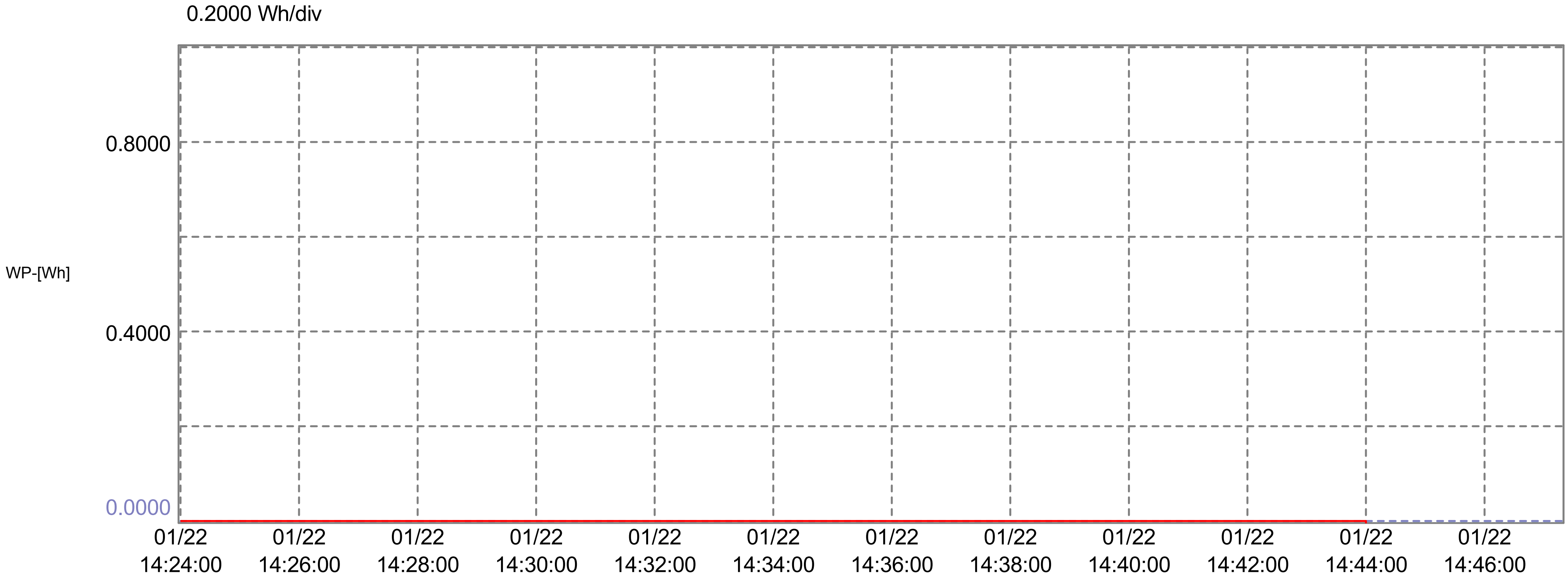
Maximum integrated power value: 1.0899kWh



| OTTOTRACTIONS | Integrated Power Analysis<br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |
|---|---|---|

**2020/01/22 14:24:00 - 2020/01/22 14:45:00**

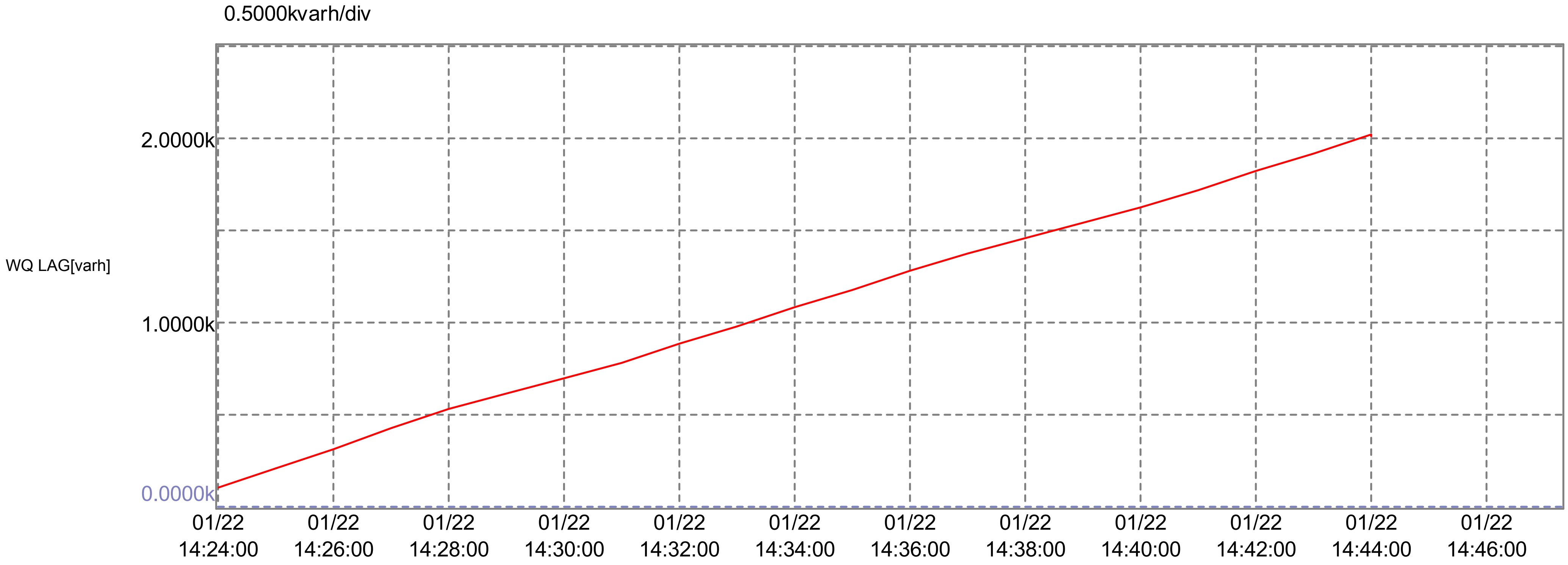
Maximum integrated pow er value: 0.0000 Wh



| OTTOTRACTIONS | Integrated Power Analysis<br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |
|---|---|---|

**2020/01/22 14:24:00 - 2020/01/22 14:45:00**

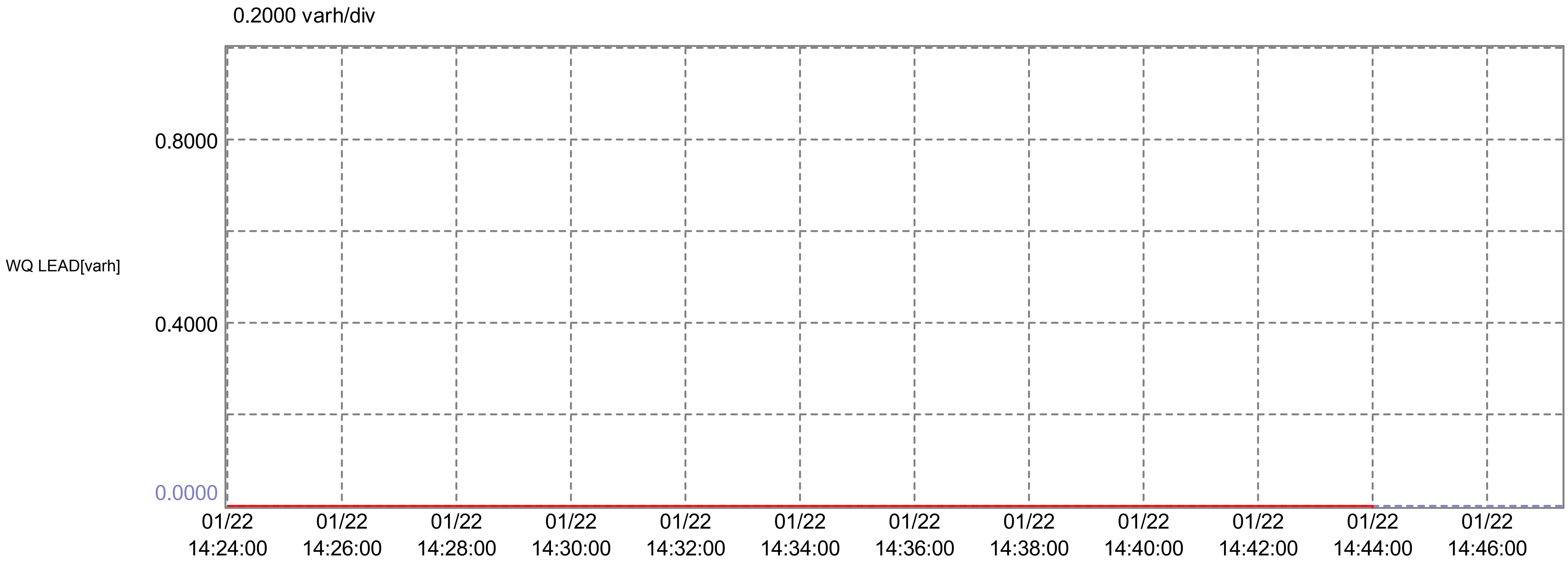
Maximum integrated pow er value: 2.0181kvarh



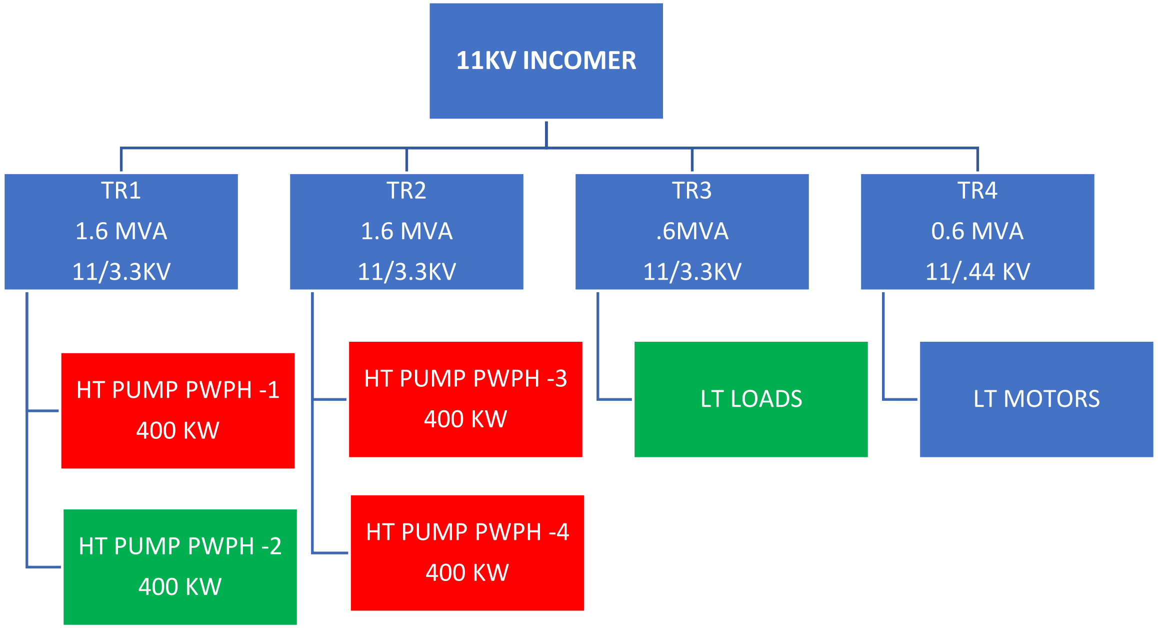
| | | |
|---|---|---|
| OTTOTRACTIONS | Integrated Power Analysis<br>Measurement from a HIOKI 3197 PQA | 02-11-2020 D:\OT ABIN AUG 2019\Ongoing\EA\KWA HT\EA 584 PH PIRAVAM\B0012300<br>KWA Piravom |

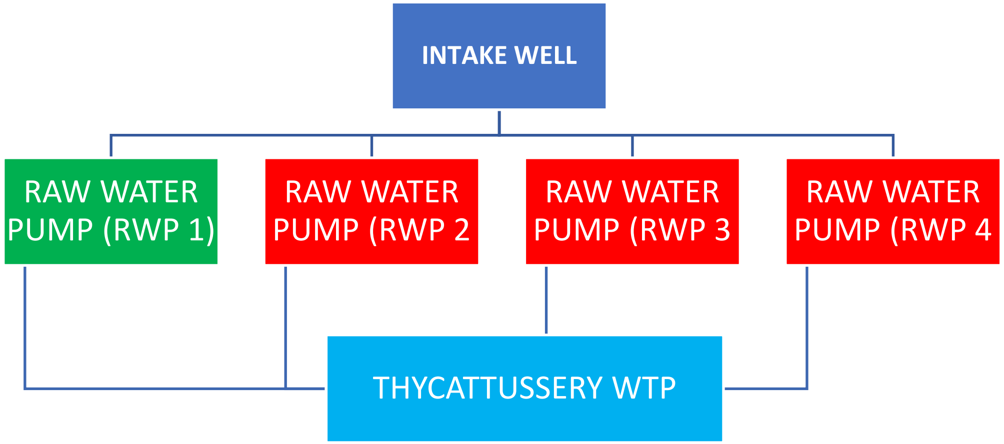
**2020/01/22 14:24:00 - 2020/01/22 14:45:00**

Maximum integrated pow er value: 0.0000 varh



# SINGLE LINE DIAGRAM




INTAKE WELL
RAW WATER PUMP (RWP 1)
RAW WATER PUMP (RWP 2
RAW WATER PUMP (RWP 3
RAW WATER PUMP (RWP 4
THYCATTUSSERY WTP

Enriching Lives

# VERTICAL PUMPS

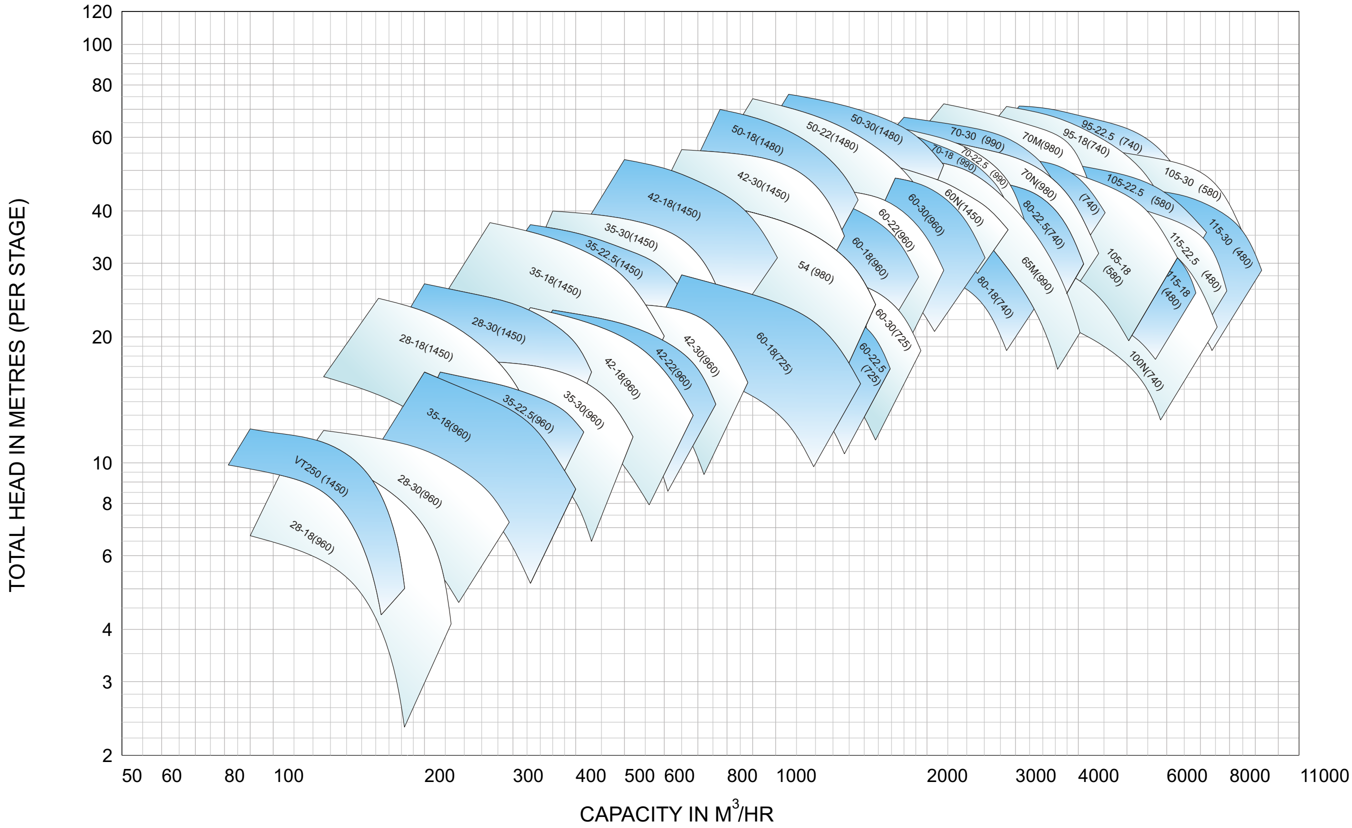
## TYPE - BHR / BHQ / BHM / BHK / BHMa / BHA

CE Ex

**KIRLOSKAR BROTHERS LIMITED**

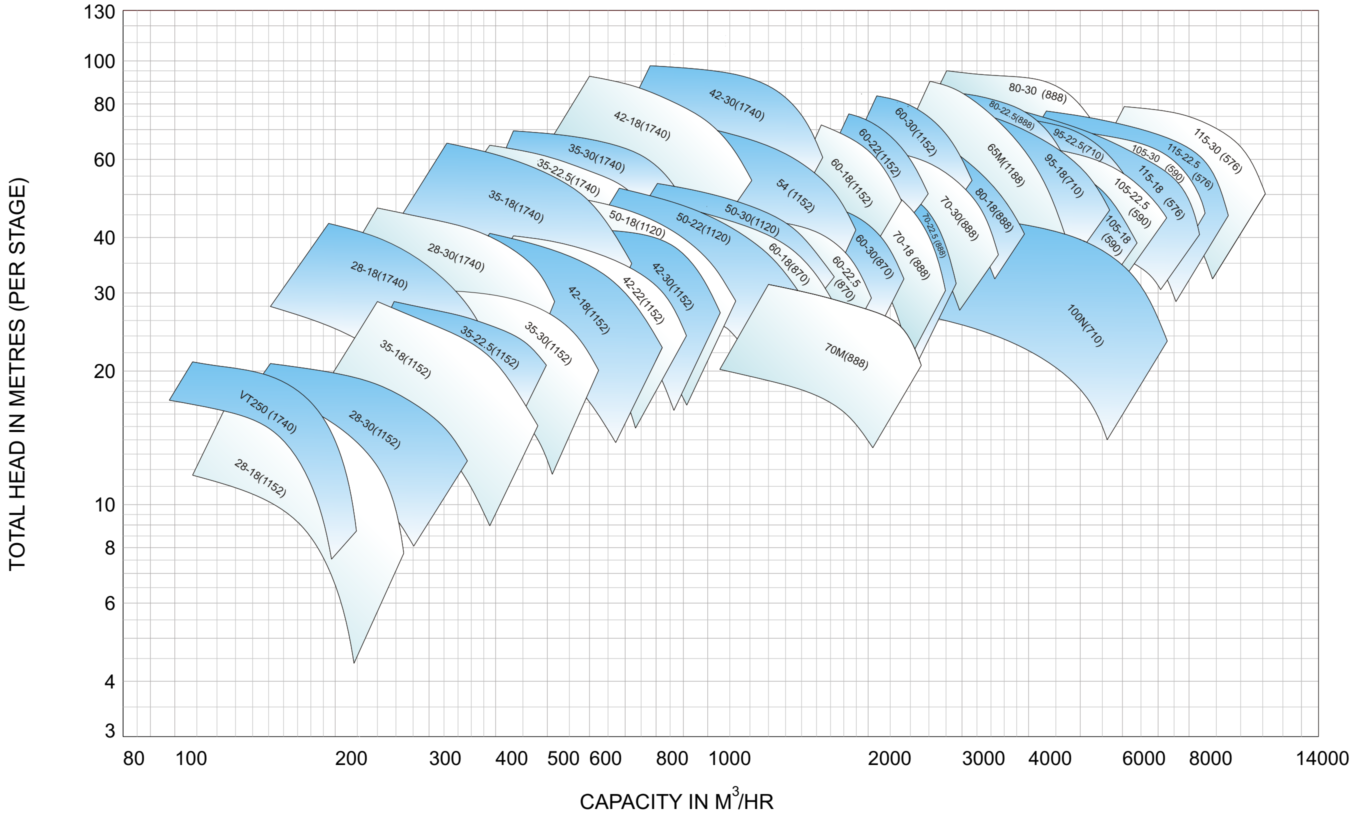
A Kirloskar Group Company

## FAMILY CURVES FOR BHR PUMPS (50HZ)



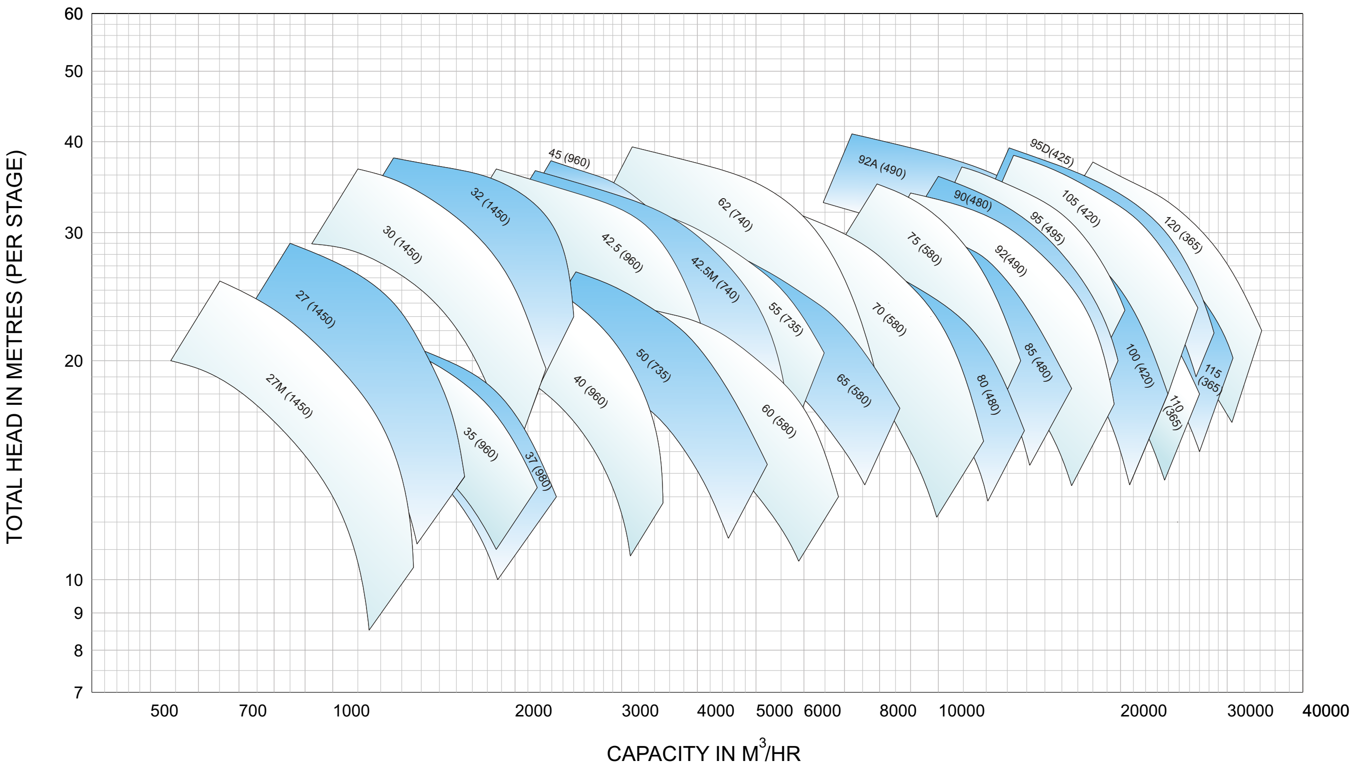

NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

## FAMILY CURVES FOR BHR PUMPS (60HZ)



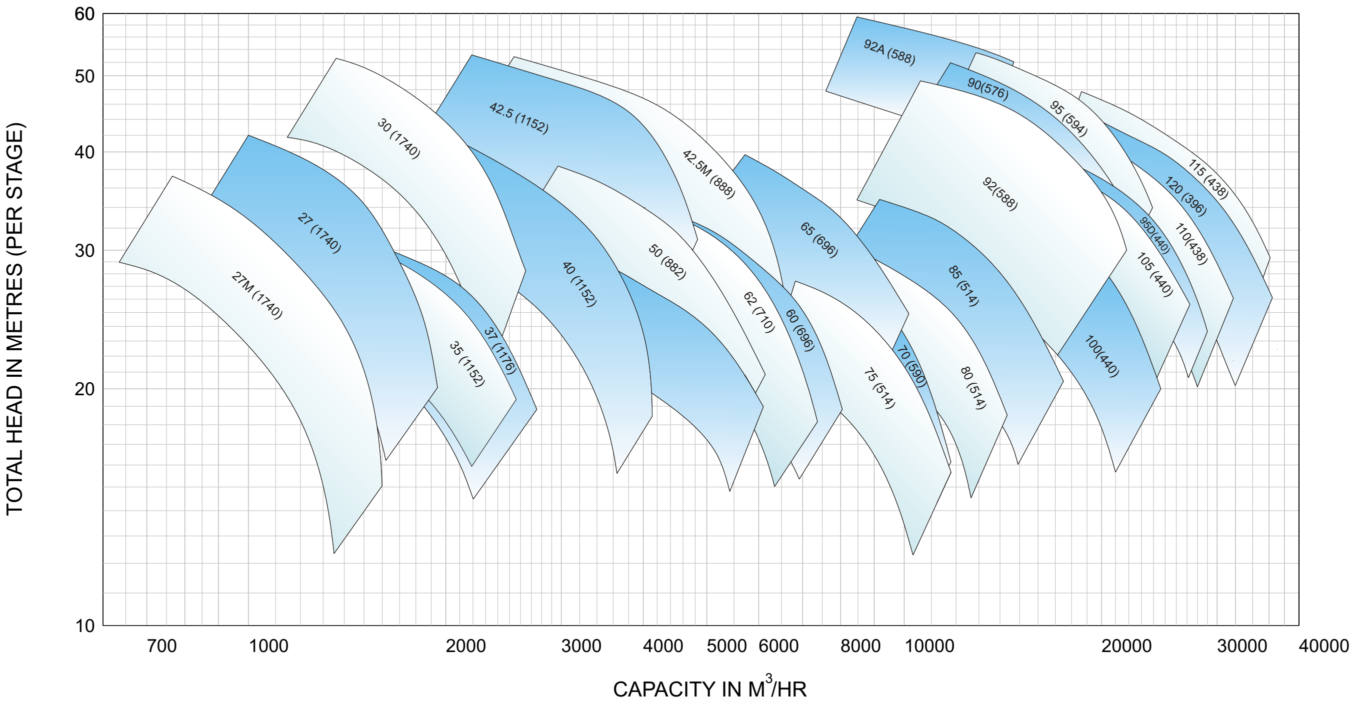

NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

## FAMILY CURVES FOR BHQ PUMPS (50HZ)



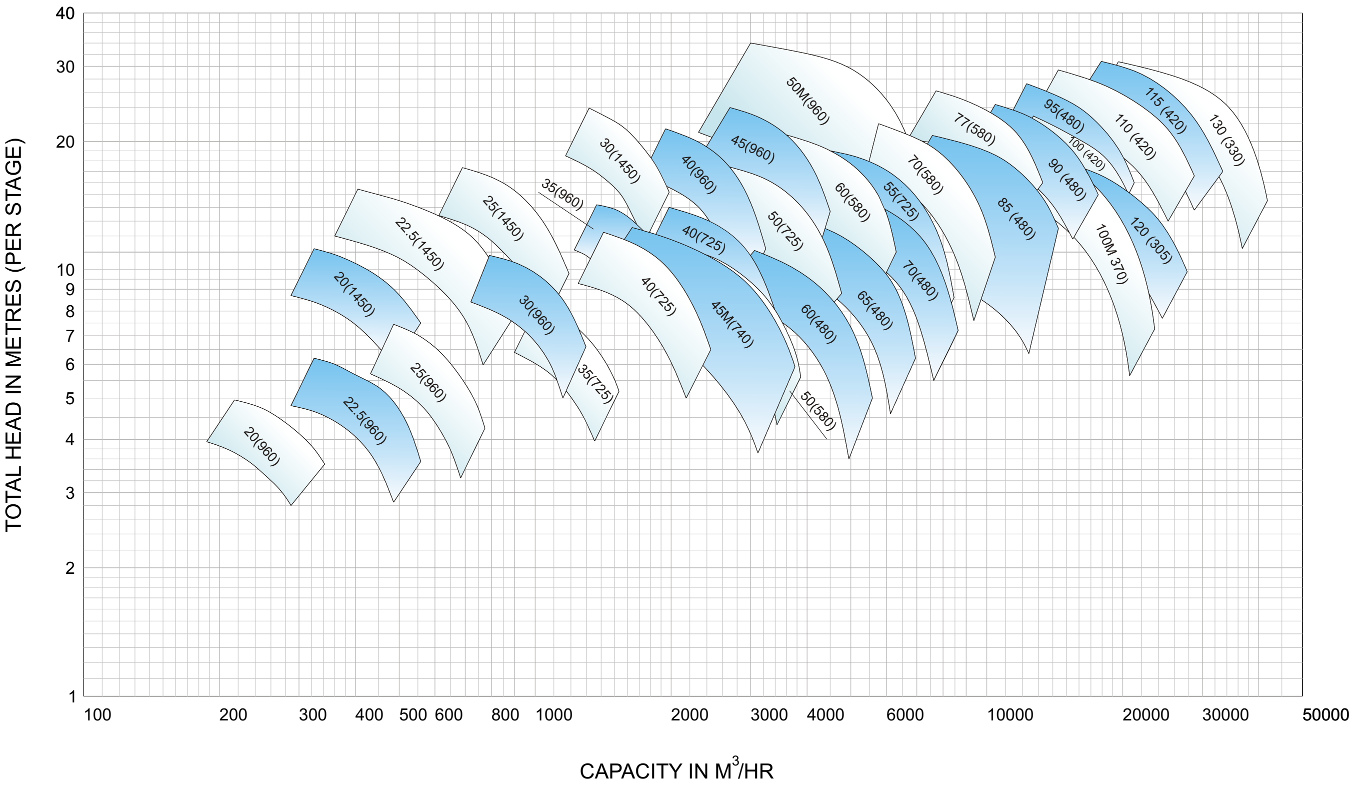

NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

## FAMILY CURVES FOR BHQ PUMPS (60HZ)



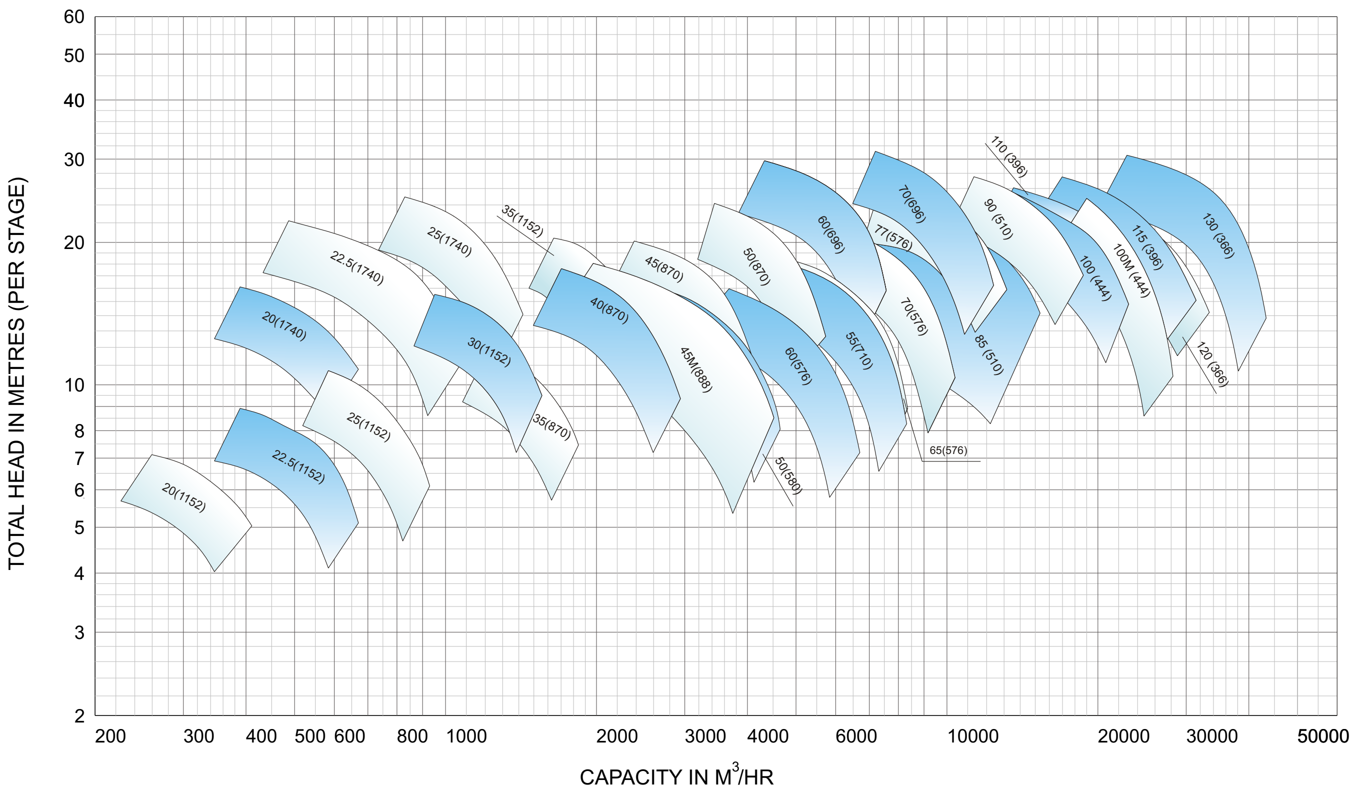

NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

## FAMILY CURVES FOR BHM PUMPS (50HZ)



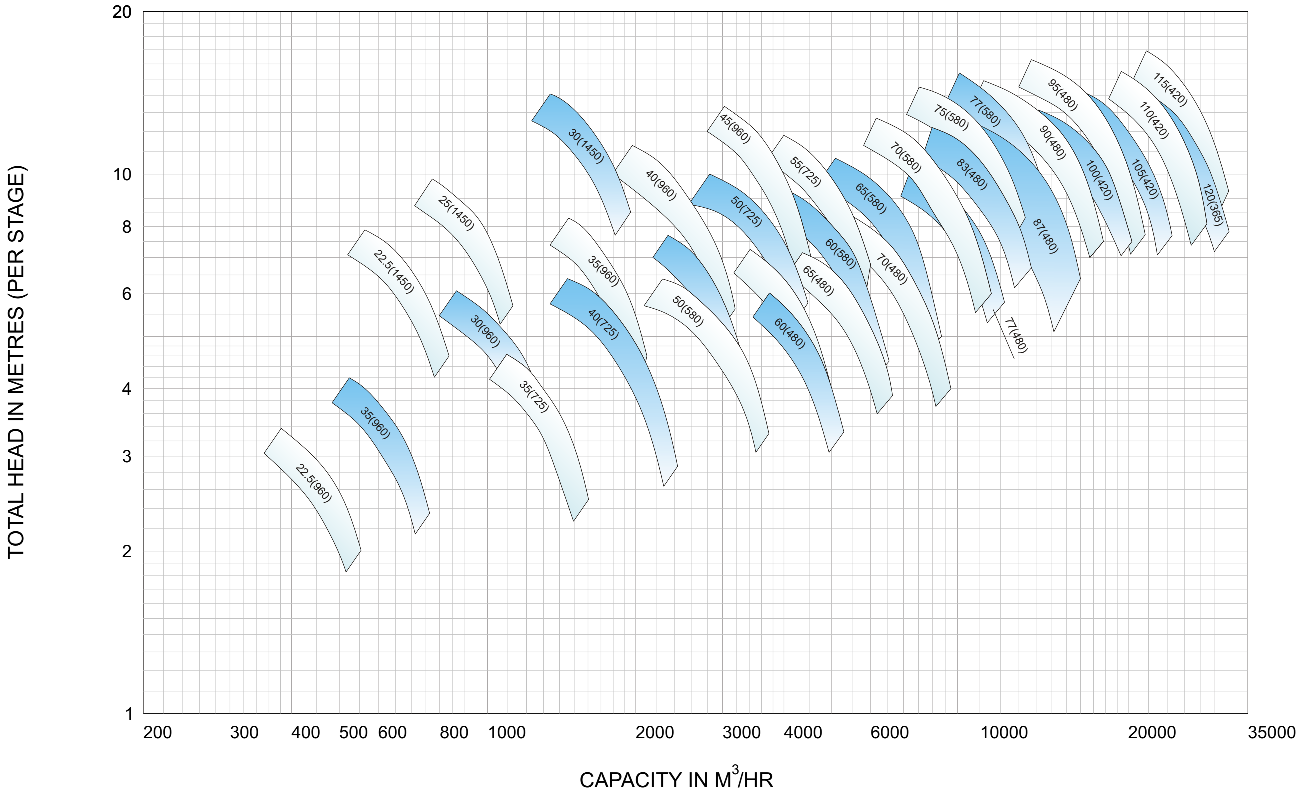

NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

## FAMILY CURVES FOR BHM PUMPS (60HZ)



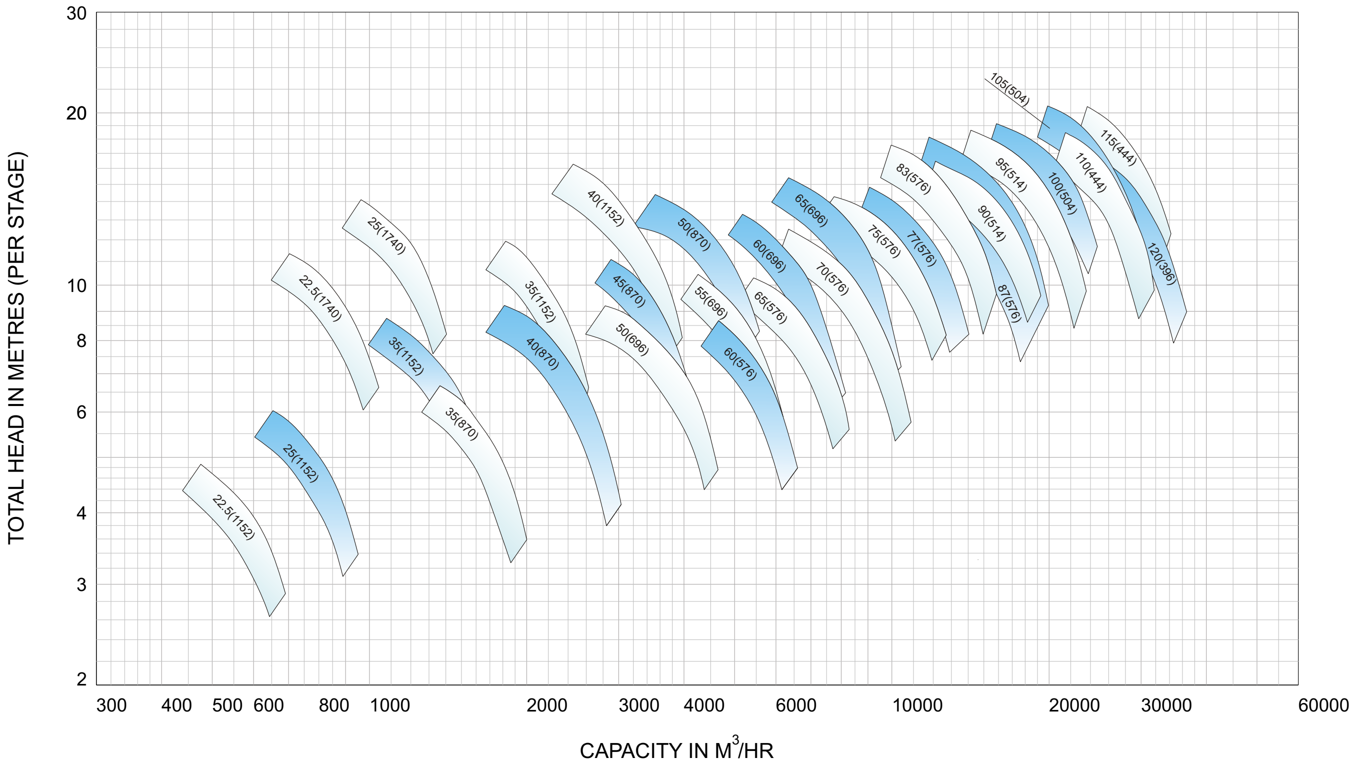

NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

## FAMILY CURVES FOR BHMa PUMPS (50HZ)




NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

## FAMILY CURVES FOR BHMa PUMPS (60HZ)




NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

# ABOUT KBL

Kirloskar Brothers Limited (KBL) is a world class pump manufacturing company with expertise in engineering and manufacture of systems for fluid management. Established in 1888 and incorporated in 1920, KBL is the flagship company of the $ 2.1 billion Kirloskar Group. KBL, a market leader, provides complete fluid management solutions for large infrastructure projects in the areas of water supply, power plants, irrigation, oil & gas and marine & defence. We engineer and manufacture industrial, agriculture and domestic pumps, valves and hydro turbines.

In 2003, KBL acquired SPP Pumps, United Kingdom and established SPP INC, Atlanta, USA, as a wholly owned subsidiary of SPP, UK to expand its international presence. In 2007, Kirloskar Brothers International B.V., The Netherlands and Kirloskar Brothers (Thailand) Ltd., a wholly owned subsidiary in Thailand, were incorporated. In 2008, KBL incorporated Kirloskar Brothers Europe B.V. (Kirloskar Pompen B.V. since June 2014), a joint venture between Kirloskar International B.V. and Industrial Pump Group, The Netherlands. In 2010, KBL further consolidated its global position by acquiring Braybar Pumps, South Africa. SPP MENA was established in Egypt in 2012. In 2014, KBL acquired SyncroFlo Inc., the largest independent fabricator of commercial and municipal domestic water booster pumps.

To further strengthen its global position, in 2015, Kirloskar Pompen B.V. acquired Rodelta Pumps International, The Netherlands.

KBL has joint venture cooperation with Ebara, Japan since 1988 for the manufacture of API 610 standard pumps. Kirloskar Corrocoat Private Limited is a joint venture cooperation with Corrocoat, UK since 2006. KBL acquired The Kolhapur Steel Limited in 2007 and Hematic Motors in 2010.

KBL has eight manufacturing facilities in India at Kirloskarvadi, Dewas, Kondhapuri, Shirwal, Sanand, Kaniyur, Kolhapur and Karad. In addition, KBL has global manufacturing and packaging facilities in Egypt, South Africa, Thailand, The Netherlands, United Arab Emirates, United Kingdom and United States of America. KBL has 12,700 channel partners in India and 80 overseas and is supported by best-in-class network of Authorised Centres and Authorised Refurbishment Centres across the country.

All the manufacturing facilities at KBL are certified for ISO 9001, ISO 14001, ISO 50001, BS OHSAS 18001 and SA8000. In addition, the Kirloskarvadi plant is also certified for N & NPT Stamp. KBL's corporate office in Pune is certified for ISO 9001 & Sa8000.

The factories deploy Total Quality Management tools using European Foundation for Quality Management (EFQM) model.
The Kirloskarvadi plant of KBL is a state-of-the-art integrated manufacturing facility having Asia's largest hydraulic research centre with testing facility upto 5000 kW and 50,000 $m^3$/hr.

KBL is the ninth pump manufacturing company in the world to be accredited with the N and NPT certification by American Society of Mechanical Engineers (ASME).

**Pumps | Valves | Hydro Turbines | Turnkey Projects**

Water Resource Management | Irrigation | Power | Industry | Oil & Gas | Marine & Defence | Building & Construction | | Distribution (Small Pumps) | Valves | Customer Service & Spares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A Kirloskar Group Company

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OUR COMPANIES

SPP PUMPS — United Kingdom | SyncroFlo — U.S.A. | BP — South Africa | KOPL — India | RODELTA PUMPS INTERNATIONAL — The Netherlands




VT-BHR-BHQ - 06-2016

Jyoti Ltd.

Water • Power • Progress

# JYOTI
# Vertical Turbine Pumps
## (oil & water-lubricated)

Manufactured, designed
and made the First Vertical Turbine
(VT) Pump in India, way back in 1942

ISO 9001:2015 || TUV INDIA

TÜV INDIA
TÜV NORD GROUP

70 YEARS OF ENGINEERING EXCELLENCE

## APPLICATION

**Pumps for**

- irrigation
- urban & rural water supply
- Cooling tower
- Fire fighting
- Flood control
- Mine dewatering
- Thermal power stations
- Condensate extraction
- General & process water in industries
- Oil field water services and a hoast of other needs.

## RANGE

| | |
|---|---|
| Bowl sizes | 150 mm to 600 mm |
| Capacity | 200 lpm to 33200 lpm |
| Head | upto 225 mts |

For higher capacities refer to us.

## SPECIAL DESIGN FEATURES

- Heavy wall cast iron bowls & cast iron / Stainless Steel impellers provided for maximum operating life, under ardous Indian conditions.
- Impeller shafts of stainless steel
- Column pipes and line shafts are machined and threaded on double ended special purpose machines in single setting ensuring concentricity.
- All shaft couplings in water lubricated pumps are made of stainless steel for extra-long life.

## CONSTRUCTIONAL FEATURES

'JYOTI' VT pumps are offered in non-pull out construction as a standard design. The pump can be supplied for coupling with vertical hollow shaft motors or vertical solid shaft motors. Also for surface discharge or underground discharge.

## BOWLS

Standard bowls are made of close grained cast iron. The diffuser vanes are cast integrally.

## IMPELLERS

Impellers are closed or semi-open type, statically and dynamically balanced for vibration-free operation. They are secured to the impeller shaft with tapered lock collects or keys & split rings. The impeller position can be adjusted vertically by means of impeller-adjusting nut provided in the drive.

## IMPELLER SHAFT

Impeller shaft is of stainless steel, accurately ground to close tolerances. The shaft is supported by bearings above and below each impeller.

## COLUMN PIPES

Column pipes are normally supplied in nominal lengths of 3.0m, 1.5m and 0.75m pipes of non-standard lengths also can be supplied on request.

## LINE SHAFTS

Line shafts are of high grade carbon steel, ground to close tolerances and threaded concentrically at the ends. Available in nominal lengths of 3.0m, 1.5m and 0.75m and in non-standard lengths to suit specific site conditions. Line shaft in stainless steel and suitable for muff couplings also can be supplied, if required.

## LINE SHAFT BEARINGS

Made of bronze for oil lubricated pumps and Nitrile Rubber for water lubricated pumps.

## SHAFT ENCLOSING TUBES

**(for oil-lubricated pump)**

These heavy duty steel tubes protect the line shafts from corrosion and foreign materials and support the line shaft bearings. The tubes are threaded concentrically in one setting at both ends. Available in different lengths, as line shafts.

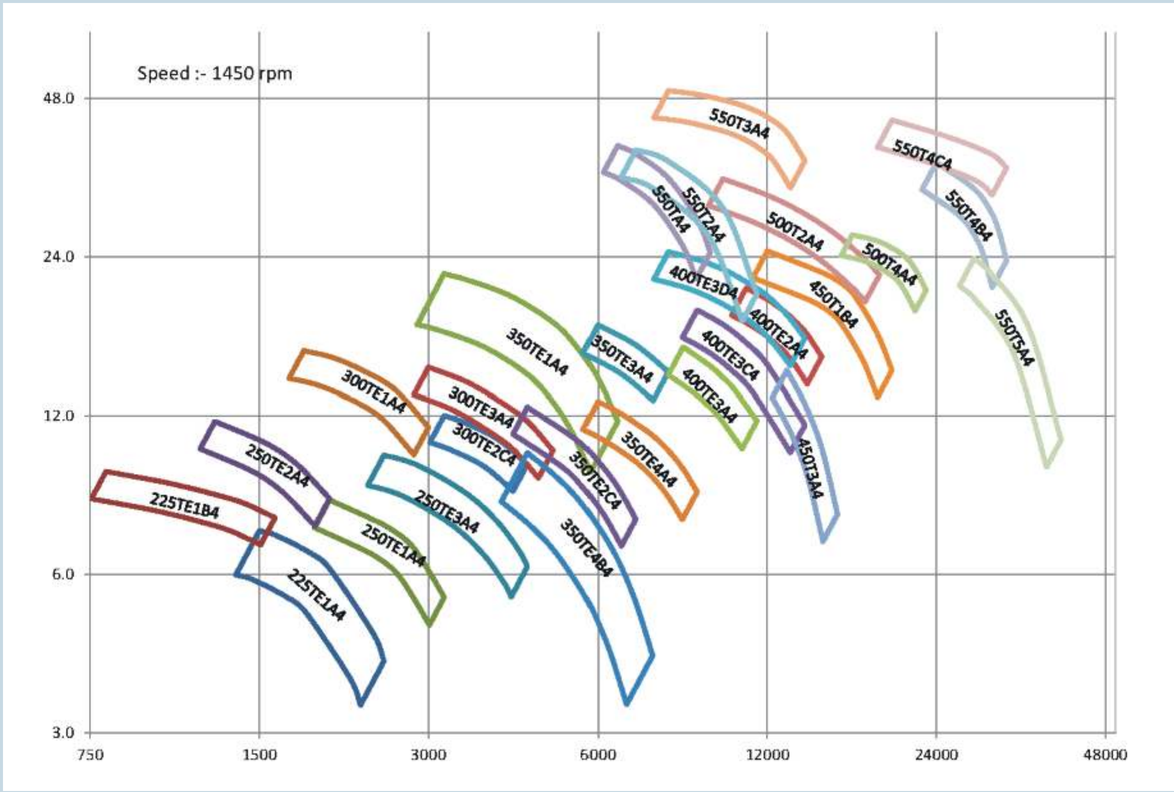
## DISCHARGE HEAD

Standard construction in cast iron. Fabricated ones also can be supplied on request. Pump can be supplied with surface or underground discharge to suit specific site conditions.

## DRIVES

Electrical motors with vertical hollow shaft or vertical solid shaft are normally used. Alternatively right angle gear head with diesel engine also can be used.

# FAMILY CURVE FOR STANDARD VT PUMPS (225 to 550 mm)




# STANDARD MATERIAL OF CONSTRUCTION

OIL LUBRICATED / WATER LUBRICATED / FORCE LUBRICATED PUMP

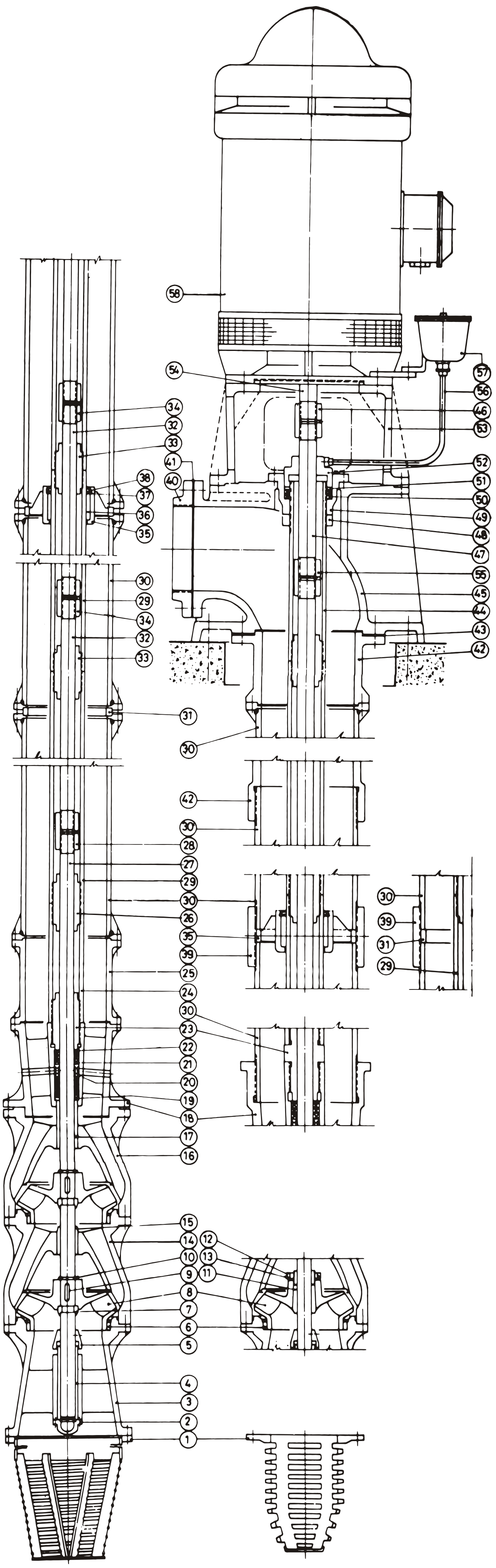
| S.NO. | PART DESCRIPTION | MATERIAL | SPECIFICATION |
|---|---|---|---|
| 1 | STAINER | M.S. | IS : 2062 St.42-S |
| 2 | SUCTION CASE | CAST IRON | IS : 210 Gr FG-200 |
| 3 | SUCTION CASE BEARING | BRONZE | IS : 318 Gr LTB2 |
| 4 | IMPELLER SEAL RING | CAST IRON | IS : 210 Gr FG-200 |
| | | BRONZE | IS : 318 Gr LTB2 |
| 5 | IMPELLER | CAST IRON | IS : 210 Gr FG-200/260 |
| | | BRONZE | IS : 318 Gr LTB2 |
| 6 | BOWL | CAST | IRON IS : 210 Gr FG-260 |
| 7 | IMPELLER SHAFT | ST. STEEL | ASTM A276 SS 410 |
| 8 | DISCHARGE CASE | CAST IRON | IS : 210 Gr FG-200/260 |
| 9 | COLUMN PIPE ADOPTOR | CAST IRON | IS : 210 Gr FG-200/260 |
| 10 | GUIDE SPIDER/BEARING HOLDER | CAST IRON | IS : 210 Gr FG-200/260 |
| 11 | COLUMN PIPE | ERW STEEL | IS : 1239 Class C / IS : 1978 |
| | | M.S. FABRICATED | IS : 2062 St.42-S |
| 12 | SHAFT ENCLOSING TUBE (OL) | STEEL | IS : 1239 Class C / IS : 1978 |
| 13 | LINE SHAFT CARBON | STEEL | IS: 1570 C40 / ASTM A276 SS 410 |
| 14 | LINE SHAFT COUPLING (OL) CARBON | STEEL | IS: 1570 C40 / ASTM A276 SS 410 |
| 15 | LINE SHAFT COUPLING (WL) ST. | STEEL | ASTM A276 SS 410 |
| 16 | LINE SHAFT BEARING (OL) | BRONZE | IS : 318 Gr LTB2 |
| 17 | LINE SHAFT BEARING (WL) | NITRILE RUBBER | SHORE HARDNESS 60-65 |
| 18 | TOP COLUMN FLANGE | CAST IRON | IS : 210 Gr FG-200/260 |
| 19 | DISCHARGE HEAD BODY | CAST IRON | IS : 210 Gr FG-200/260 |
| | | M.S. FABRICATED | IS : 2062 St.42-S |
| 20 | HEAD SHAFT CARBON | STEEL | IS: 1570 C40 / ASTM A276 SS 410 |
| 21 | STUFFING BOX | CAST IRON | IS : 210 Gr FG-200/260 |
| 22 | GLAND | CAST IRON | IS : 210 Gr FG-200/260 |
| 23 | MOTOR SKIRT | CAST IRON | IS : 210 Gr FG-200/260 |
| | | M.S. FABRICATED | IS : 2062 St.42-S |
| 24 | MOTOR | VERTICAL HOLLOW OR | IS: 325 |
| | | SOLID SHAFT | |

**NOTE :** Material of Construction mentioned above are our standard ones, other materials to suit specific site conditions can be supplied on request.

**OPTIONAL ACCESSORIES**

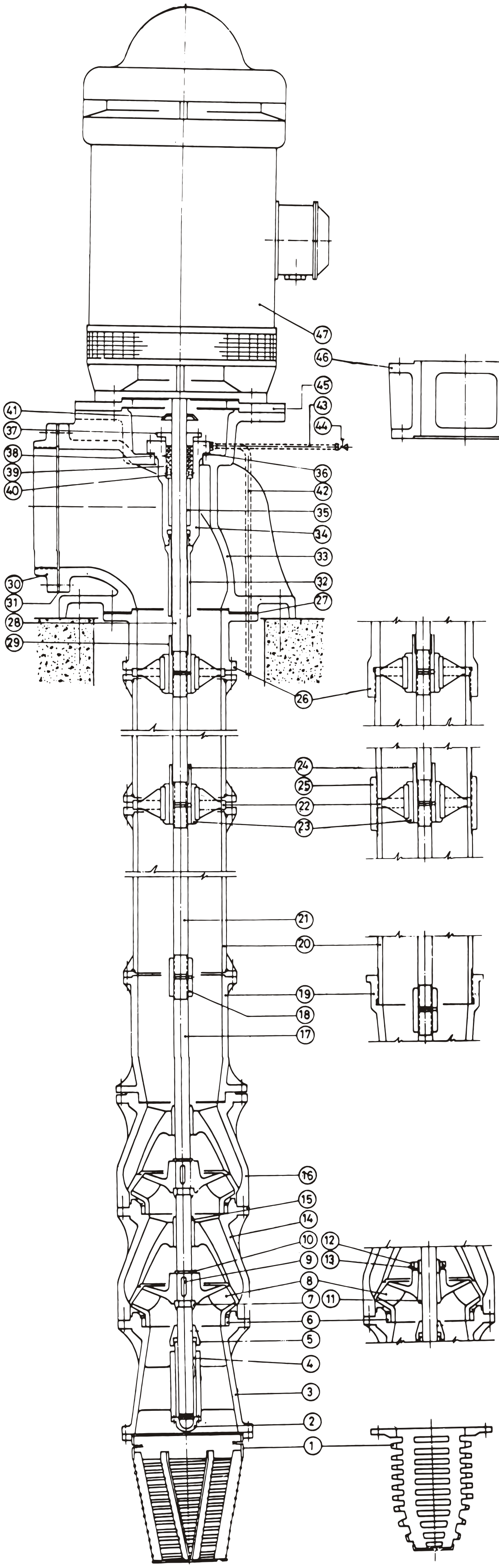
- Foundation bolts
- Sole plate
- Companion flanges.

# 'JYOTI' VERTICAL TURBINE PUMP
## (OIL-LUBRICATED)

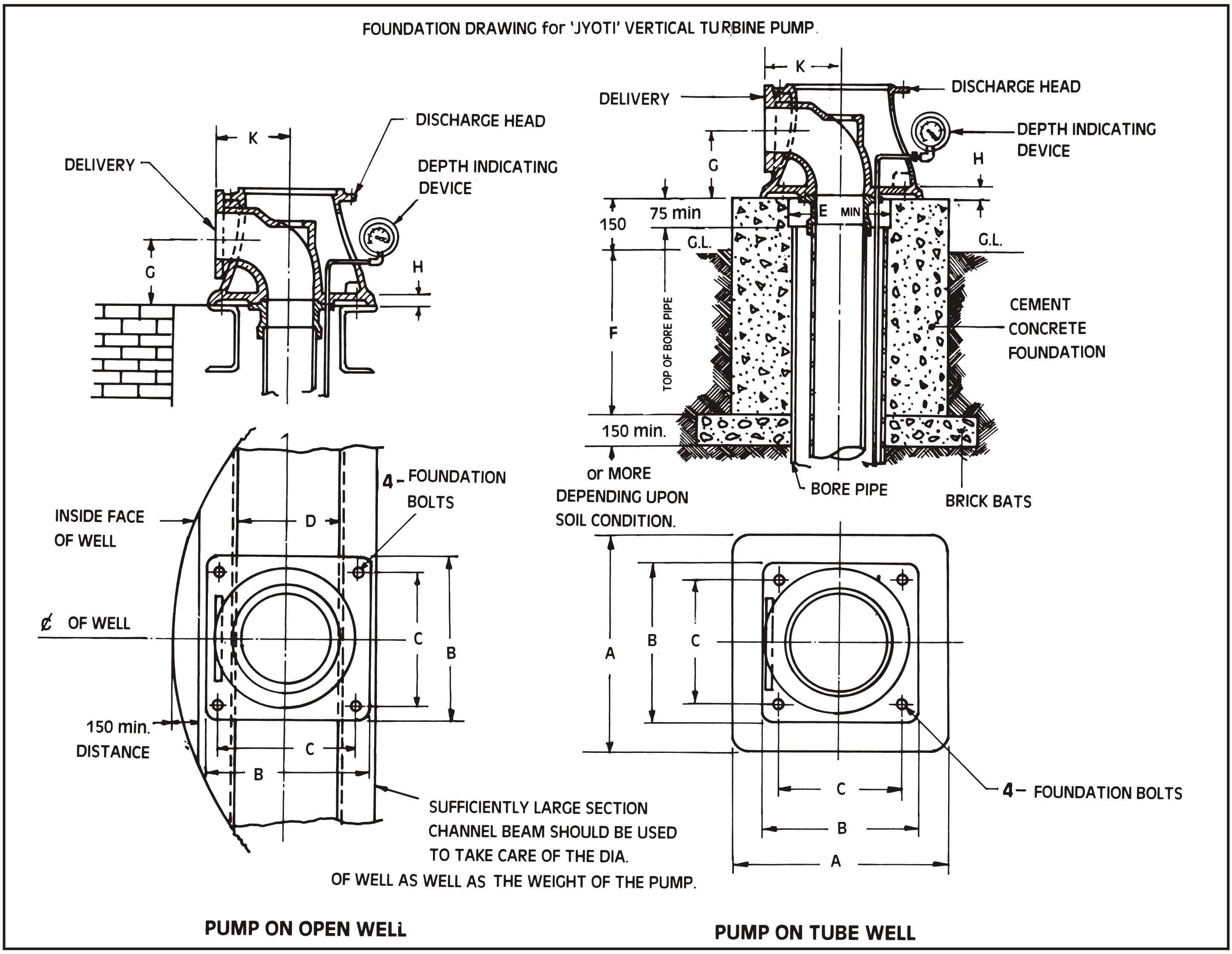


| Sr. No. | PART NAME |
|---|---|
| 58 | Vertical Hollow Shaft Motor |
| 57 | Automatic Lubricator Assly |
| 56 | Oiling Pipe |
| 55 | Head Shaft Coupling |
| 54 | Head Shaft |
| 53 | Motor Skirt or Adapting Plate |
| 52 | Gland |
| 51 | Gland Packing Ring |
| 50 | Gland Packing |
| 49 | Tube Tension Plate |
| 48 | Check Nut |
| 47 | Head Shaft Extension |
| 46 | Head Shaft Extension Coupling |
| 45 | Discharge Head Body |
| 44 | Tube Tension Nipple |
| 43 | Top Column Flange Gasket |
| 40 | Delivery Flange (Up to D-150 Dis-Head) |
| 39 | Column Pipe Coupling |
| 38 | Circlip |
| 37 | Rubber Guide Ring Washer |
| 36 | Rubber Guide Ring |
| 35 | Guide Spider |
| 34 | Line Shaft Coupling |
| 33 | Line Shaft Bearing |
| 32 | Line Shaft |
| 31 | Column pipe spacer |
| 30 | Column Pipe Flanged or Threaded |
| 29 | Shaft Enclosing Tube |
| 28 | Impeller Shaft Coupling |
| 27 | Impeller Shaft |
| 26 | Impeller Shaft Bearing |
| 25 | Column Pipe Adoptor |
| 24 | Tubing Adaptor |
| 23 | Discharge Case Bearing |
| 22 | Impeller Shaft Packing Ring |
| 21 | Impeller Shaft Packing |
| 20 | Lantern Ring |
| 19 | Distance Piece |
| 18 | Discharge Case Flange or Threaded |
| 17 | Top Bowl Bearing |
| 16 | Top Bowl |
| 15 | Bowl Bearing |
| 14 | Bowl |
| 13 | Impeller Collect Nut Washer |
| 12 | Impeller Collet Nut |
| 11 | Impeller Collet |
| 10 | Circlip |
| 9 | Impeller Key |
| 8 | Impeller |
| 7 | Impeller Holding Split Ring |
| 6 | Impeller Seal Ring |
| 5 | Suction Case Sand Collar |
| 4 | Suction Case Bearing |
| 3 | Suction Case |
| 2 | Suction Case Plug |
| 1 | Suction Pipe Strainer |

# 'JYOTI' VERTICAL TURBINE PUMP
(WATER-LUBRICATED)




| Sr. No. | PART NAME |
|---|---|
| 46 | Vertical Hollow Shaft Motor |
| 45 | Adapting Plate or Distance Piece |
| 44 | Valve |
| 43 | Water Lubricating Tube |
| 42 | Water Leakage Tube |
| 41 | Water Deflector |
| 40 | Lantern Ring |
| 39 | Gland Packing |
| 38 | Gland Packing Ring |
| 37 | Gland |
| 36 | Stuffing Box Gasket |
| 35 | Stuffing Box Bush |
| 34 | Stuffing Box |
| 33 | Discharge Head Body |
| 32 | Stilling Pipe |
| 31 | Delivery Flange Gasket |
| 30 | Delivery Flange (Up to D-150 Dis-Head) |
| 29 | Head Shaft Coupling |
| 28 | Head Shaft |
| 27 | Top Column Flange Gasket |
| 26 | Top Column Flange - Flanged or Threaded |
| 25 | Column Pipe Coupling Threaded |
| 24 | Line Shaft Coupling |
| 23 | Rubber Bearing |
| 22 | Brg. Holder Flanged or Threaded |
| 21 | Line Shaft |
| 20 | Column Pipe flanged or Threaded |
| 19 | Col. Pipe flanged or Threaded or Threaded |
| 18 | Impeller Shaft Coupling |
| 17 | Impeller Shaft |
| 16 | Top Bowl |
| 15 | Bowl Bearing |
| 14 | Bowl |
| 13 | Impeller Collet Nut washer |
| 12 | Impeller Collet Nut |
| 11 | Impeller Collet |
| 10 | Circlip |
| 9 | Impeller Key |
| 8 | Impeller |
| 7 | Impeller Holding Split Ring |
| 6 | Impeller Seal Ring |
| 5 | Suction Case Sand Collar |
| 4 | Suction Case Bearing |
| 3 | Suction Case |
| 2 | Suction Case Plug |
| 1 | Suction pipe Strainer |




| Discharge Head | A | B | C | D | E | F | G | H | K | L | M | N | Foundation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | Dia | No. | Length |
| D/DS 100 | 600 | 400 | 335 | 260 | 295 | 460 | 156 | 30 | 190 | 4 | 18 | 178 | M 16 | 4 | 250 |
| D/DS 150 | 640 | 440 | 375 | 295 | 330 | 460 | 203 | 35 | 215 | 8 | 18 | 235 | M 20 | 4 | 300 |
| D/DS 200 | 775 | 565 | 485 | 410 | 410 | 610 | 235 | 45 | 285 | 8 | 18 | 292 | M 24 | 4 | 500 |
| D/DS 250 | 900 | 690 | 600 | 500 | 520 | 610 | 270 | 60 | 350 | 8 | 22 | 356 | M 24 | 4 | 500 |
| D/DS 300 | 900 | 700 | 600 | 500 | 520 | 610 | 320 | 60 | 355 | 12 | 22 | 406 | M 24 | 4 | 500 |
| D/DS 350 | 1050 | 850 | 740 | 625 | 590 | 700 | 365 | 60 | 430 | 12 | 24 | 470 | M 24 | 4 | 500 |
| D/DS 400 | 1050 | 850 | 740 | 625 | 590 | 700 | 380 | 60 | 430 | 12 | 24 | 521 | M 24 | 4 | 500 |

All dimensions are in mm except otherwise stated.

**Note :** Delivery flanges are acording to BS : 10, Table "E"

**Jyoti Ltd.** VADODARA (INDIA)

Water • Power • Progress

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*In keeping with the technological strides the world is making in the engineering field, we introduce changes in the design of our products. Hence, the products as actually supplied might have features varying here from.*



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