



JL SEAGULL POWER PRODUCTS

Power Quality Improvement

Harmonic Analysis Report & Recommendation

Customer Name: XXXXXXXX



JL SEAGULL POWER PRODUCTS,

#5, P.R. Complex,
New No.38 (Old No.22)
Thambiah Road Extension,
West Mambalam,
Chennai – 600 033
Off: +91 44 2484 9797

Approved By,
S. Panneer Selvam, M.E., M.S., (Mgmt.,)
Proprietor

JL SEAGULL Power Products

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Prepared By,
JL SEAGULL Power Products

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1) Objective of this study:

M/S JL Seagull power products studied in M/s XXXXXXXXXXXX to assess the Harmonic level on PCC point, Transformer LT side and Individual load. Objective of this study is to assess the Harmonics level whether the same is within the level prescribed by CEA & IEEE 519 Standard at PCC point.

2) TNEB NOTIFICATION DETAILS:

- 1) Determination of Tariff for Generation and Distribution; Order No. 1 of 2012 dated 30-03- 2012 (Effective from 01-04-2012)
- 2) Ministry of Power (Central Electricity Authority) Notification No: 12/X/STD (CONN)/GM/CEA (21-Feb-07)

As per the above notification, Harmonics shall be within the limits given below:

3) CEA Standard –Voltage and Current Harmonics:

- (1) The total harmonic distortion for voltage at the connection point shall not exceed 5% with no individual harmonic higher than 3%.
- (2) The total harmonic distortion for current drawn from the transmission system at the Connection point shall not exceed 8%.

As specified in the Supply Code, when the consumer fails to provide adequate harmonic suppression equipment to avoid dumping of harmonics beyond the limits as specified by CEA regulations in to Licensee's distribution system, they are liable to pay compensation at **15%** of the respective tariff. As and when the consumer brings down the harmonics within the limit, compensation charges shall be withdrawn.

4) IEEE 519:

**Current Distortion Limits for General Distribution Systems
(120 V Through 69000 V)**

Maximum Harmonic Current Distortion in Percent of I_L						
Individual Harmonic Order (Odd Harmonics)						
I_{sc}/I_L	<11	$11 \leq h < 17$	$17 \leq h < 23$	$23 \leq h < 35$	$35 \leq h$	TDD
<20*	4.0	2.0	1.5	0.6	0.3	5.0
20<50	7.0	3.5	2.5	1.0	0.5	8.0
50<100	10.0	4.5	4.0	1.5	0.7	12.0
100<1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0
Even harmonics are limited to 25% of the odd harmonic limits above.						
Current distortions that result in a dc offset, e.g. half-wave converters, are not allowed.						
* All power generation equipment is limited to these values of current distortion, regardless of actual I_{sc}/I_L .						
Where						
I_{sc}	= maximum short-circuit current at PCC.					
I_L	= maximum demand load current (fundamental frequency component) at PCC.					
TDD	= Total demand distortion (RSS), harmonic current distortion in % of maximum demand load current (15 or 30 min demand).					
PCC	= Point of common coupling.					

5) Instrument Detail:

Instrument used for Harmonic Measurement is “**Fluke 435 – II, Class A Accuracy**”. We used instrument as prescribed by IEC 61000-4-30 Class A, IEEE519, CEA Standard. Instrument last Calibration carried out on 3rd April 2019 and next calibration on 3rd April 2020.

Tektronix® Tektronix India Pvt Ltd
Salarpuria Premia Survey No.16
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ACCREDITED CALIBRATION CERTIFICATE



ULR-CC21301900000870F

Certificate No: 1927045-1-435II-20093122-1

Customer:

JL SEAGULL POWER PRODUCTS
5.P.R.Complex, New No.38(Old N
Chennai, IN

Model: 435 Series II
Serial No: 20093122
Manufacturer: Fluke
Description: Power Quality and Energy Analyzer
Location of Calibration: Service Center
Calibration Interval Source: Customer requested
Cal Date: 03-Apr-2019
Due Date: 03-Apr-2020
Calibration Interval: 12 Months
Temperature(25±2°C): 24.4 °C
Humidity (40-70%RH): 53 %
Received Date: 03-Apr-2019

Tektronix certifies that the performance of the above instrument has been verified using test equipment of known accuracy and had been calibrated using measurement standards traceable to the International System of Units (SI) through the National and International Standards (such as NIST, NPL etc).

This certificate shall not be reproduced except in full, without the written approval of the calibration facility.

This calibration conforms to the requirements of ISO/IEC 17025:2005 and the Quality System is registered to ISO 9001:2015

Measurement results are valid at the time of and under stated conditions of measurement.

Measurement points are marked with “*” are not accredited to ISO/IEC 17025: 2005.

Entries in the Uncertainty column show the expanded measurement uncertainties evaluated and reported in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). The coverage factor (k) is 2, with coverage probability of approximately 95%.

The calibration data report of the measurements are shown on page 3 from 8

The Data Type found in this certificate must be interpreted as:

As- Found: Calibration data collected before the unit is adjusted and /or repaired.
As-left: Calibration data collected after the unit is adjusted and /or repaired.
Found-Left: Calibration data collected without any adjustment and /or repaired.

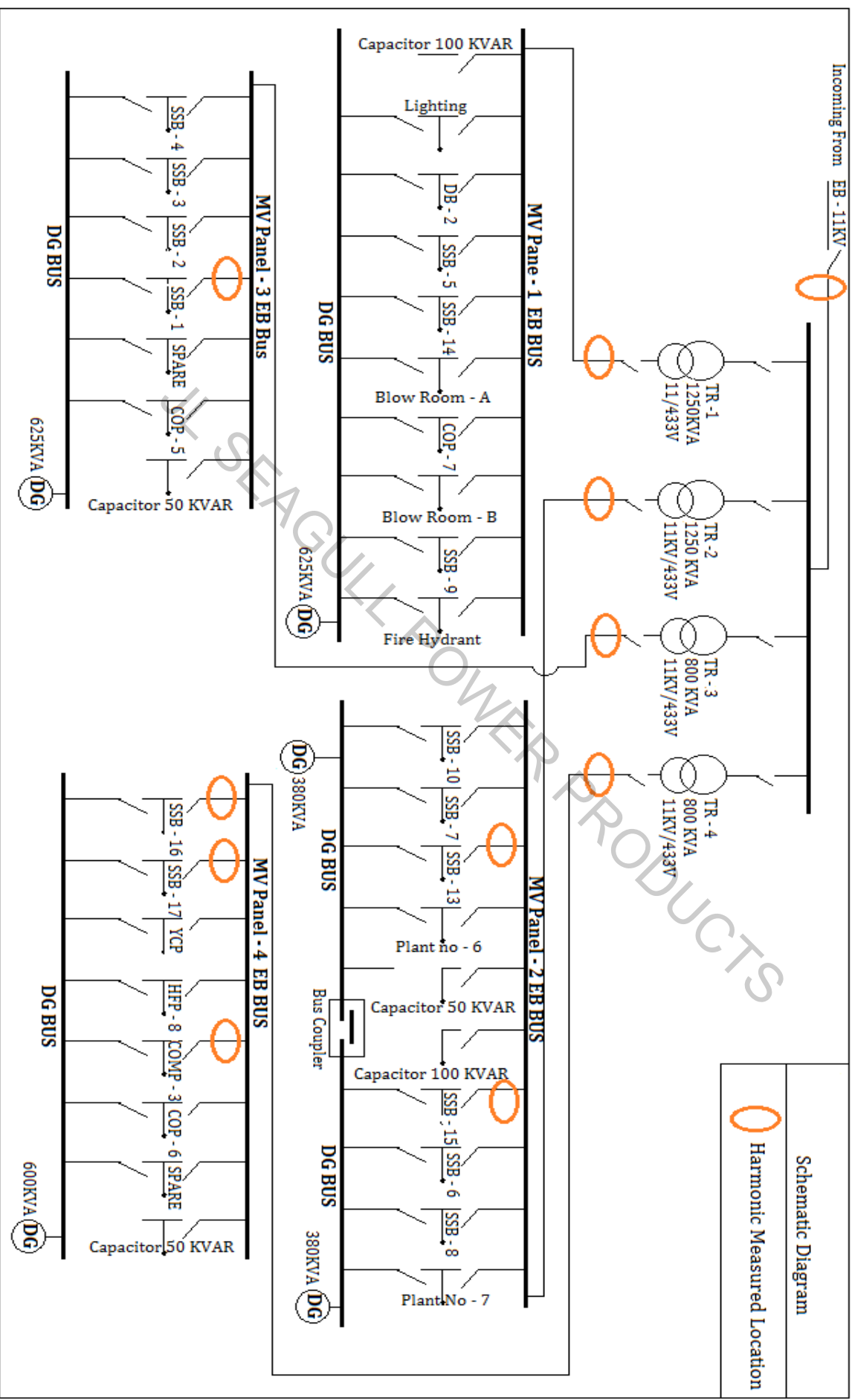
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These items are controlled by the U.S. Government and authorized for export only to the country of ultimate destination for use by the ultimate consignee or end-user(s) herein identified. They may not be resold, transferred, or otherwise disposed of, to any other country or to any person other than the authorized ultimate consignee or end-user(s), either in their original form or after being incorporated into other items, without first obtaining approval from the U.S. government or as otherwise authorized by U.S. law and regulations.



6) Site Details

Schematic Diagram:



No of Transformers: 4

- Transformer – 1: 1250KVA, 11 KV/433V
- Transformer – 2: 1250KVA, 11 KV/433V
- Transformer – 3: 800KVA, 11 KV/433V
- Transformer – 4: 800KVA, 11KV/433V

Name of the Industry/Location:	XXXXXXXXXX
Voltage level at PCC:	11 KV
Sanction Demand:	2290 KVA
Last 12 month Average Demand/ current:	1831 KVA / 96.105A (Apr-18 to Mar-19)
Average current During Measurement:	89.95 A (93.59% of 12 month Avg. current)

Harmonic Measurement Data as per EB Method:

Measured Values of Power Quality parameter			
S.No	Description	Values	
		Allowable Limit	Measured
1	Individual Voltage Harmonic Distortion(max)	3%	1.52% (5 th Harmonic order)
2	Total voltage Harmonic Distortion	5%	1.65%
3	Total Current Harmonic Distortion (TDDi)	8%	9.13%

7. Harmonic Analysis Data & Observation

S. No	Measured Location	Reference @	Load Current (A) (RMS)	Fundamental Current (A)	THD _v (%)	Apparent Power Total (KVA)	Reactive Power Total (KVAR)	Power Factor Total	THDi (%)	TDDi (%)
1)	PCC Side	Maximum TDDi with Capacitor	95.53	95.12	1.33	1651.95	65.40	0.99	09.22	09.13
2)	PCC Side	Maximum TDDi without Capacitor	108.89	108.60	1.14	1876.05	686.40	0.93	07.29	08.24

Transformer: Ref: Maximum Compensation Current - Required Harmonic Compensation Current

S. No	Measured Location	Load Current (A) (RMS)	Fundamental Current (A)	THD _v (%)	THDi (%)	Apparent Power Total (KVA)	Reactive Power Total (KVAR)	Power Factor Total	Harmonic Compensation Current	Harmonic Compensation Current 50% Cushion
1)	Transformer – 1 with Capacitor ON	584.50	581.60	1.98	14.63	406.80	23.25	0.99	85.09	127.63
2)	Transformer – 1 with Capacitor OFF	692.20	691.60	1.49	5.53	501.60	264.75	0.91	38.25	57.37
3)	Transformer – 2 with Capacitor ON	905.20	901.80	2.90	9.06	667.50	173.85	0.99	81.70	122.55
4)	Transformer – 2 with Capacitor OFF	958.00	956.60	2.64	5.81	688.20	323.25	0.91	55.58	83.37
5)	Transformer – 3 with Capacitor ON	613.40	611.20	2.20	10.64	420.60	98.25	0.99	65.03	97.54
6)	Transformer – 3 with Capacitor OFF	709.20	708.40	1.94	6.84	481.35	262.95	0.90	48.45	72.67
7)	Transformer – 4 with Capacitor ON	562.80	542.80	5.85	35.01	416.70	40.05	0.96	190.03	285.04
8)	Transformer – 4 with Capacitor OFF	552.40	538.80	4.10	29.05	403.50	159.00	0.93	156.52	234.78

Individual Loads:

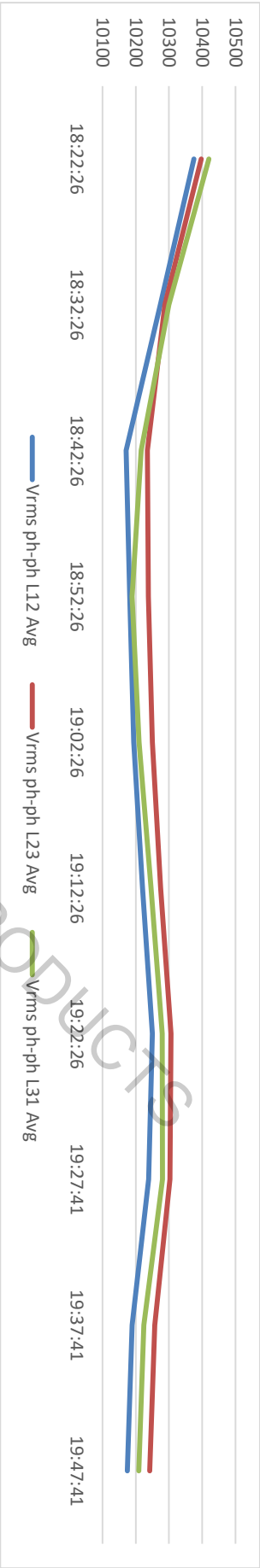
S. No	Measured Location	Reference @	Load Current (A) (RMS)			THDv (%)			THDi (%)			Apparent Power Total (KVA)	Reactive Power Total (KVAR)	Power Factor Total
			L1	L2	L3	L1	L2	L3	L1	L2	L3			
1)	SSB – 1	Maximum RMS	127.3	127.8	123.9	2.01	1.96	2.02	19.99	23.23	23.37	88.50	40.65	0.93
		Maximum THDi	64.4	65.2	66.2	1.95	1.86	1.81	31.78	36.43	32.9	46.65	-21.30	0.83
		Maximum RMS	84.1	83.4	87.1	2.55	2.42	2.19	24.63	24.83	23.08	62.04	23.84	0.92
2)	SSB – 13	Maximum THDi	83.3	82.5	86.1	2.36	2.25	2.03	25.86	26.60	24.61	61.37	23.58	0.91
		Maximum RMS	221.3	211.9	226.8	2.37	2.30	2.09	13.84	13.48	12.15	156.56	62.49	0.91
		Maximum THDi	226.1	216.4	231.2	2.42	2.34	2.11	18.30	18.53	16.35	159.80	63.50	0.85
3)	SSB – 15	Maximum RMS	188.4	178.4	179.4	4.30	4.43	4.50	36.87	37.67	42.74	133.95	57.30	0.91
		Maximum THDi	69.6	55.9	54.5	3.41	3.61	3.92	39.84	50.76	59.86	43.05	9.60	0.85
		Maximum RMS	174.8	171.5	164.8	4.58	4.67	4.78	27.58	27.14	30.24	123.30	27.45	0.94
4)	SSB – 16	Maximum THDi	104.1	100.3	91.4	3.29	3.22	3.34	37.79	36.12	40.79	71.10	18.75	0.90
		Maximum RMS	99	100.3	86	5.37	5.39	5.40	36.77	33.22	41.44	68.49	17.10	0.91
		Maximum THDi	41.2	39.4	31.1	5.00	4.93	5.13	66.49	60.43	73.67	26.76	4.77	0.82
5)	SSB – 17	Maximum RMS	79.1	80.6	78.7	2.37	2.51	2.43	36.22	38.90	38.78	55.35	7.68	0.93
		Maximum THDi	18.6	22.9	20.4	2.04	2.14	2.02	79.86	79.84	86.74	14.58	2.47	0.76
		Maximum THDi												
6)	COMP	Maximum RMS												
		Maximum THDi												
		Maximum THDi												
7)	LR – 11	Maximum RMS												
		Maximum THDi												
		Maximum THDi												

Observation:

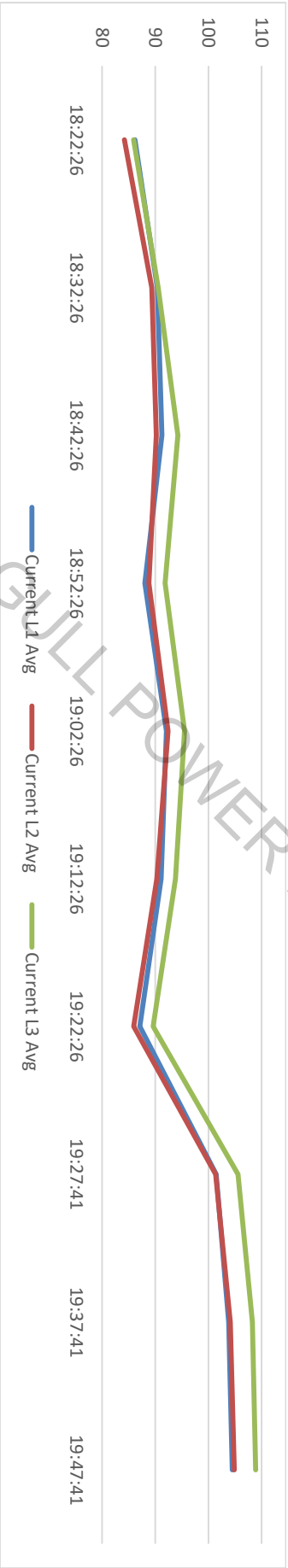
- As Per PCC Point Data, THD_v is within the limit of CEA but TDDi is around 9.13%, when capacitor OFF condition TDDi is 8.24% which is above the limit of CEA. When capacitor OFF condition Total Harmonics Distortion (THDi) is reducing from 9.22% to 7.29% at PCC point
- In Transformer – 1, Total Harmonic Distortion (THDi) is **14.63%**, when capacitor in the system OFF condition THDi is **5.53%**, so Capacitors are amplifying the harmonics in the system, so we recommend to detune all the existing capacitors to avoid harmonic amplification in the system,
- In Transformer – 2, Total Harmonic Distortion (THDi) is **9.06%**, when capacitor in the system OFF condition THDi is **5.81%**, so Capacitors are amplifying the harmonics in the system, so we recommend to detune all the existing capacitors to avoid harmonic amplification in the system
- In Transformer – 3, Total Harmonic Distortion (THDi) is **10.64%**, when capacitor in the system OFF condition THDi is **6.84%**, so Capacitors are amplifying the harmonics in the system, so we recommend to detune all the existing capacitors to avoid harmonic amplification in the system
- In Transformer – 4, Total Harmonic Distortion (THDi) is **35.01%**, when capacitor in the system OFF condition THDi is **29.05%**, so Capacitors are amplifying the harmonics in the system, so we recommend to detune all the existing capacitors to avoid harmonic amplification in the system, then have to measure the harmonic level in the system to size the harmonic filter.
- In Transformer – 4, Power factor is around 0.96 only, so add some more capacitor to maintain power factor around 0.99 or unity

8. PCC Point Data:

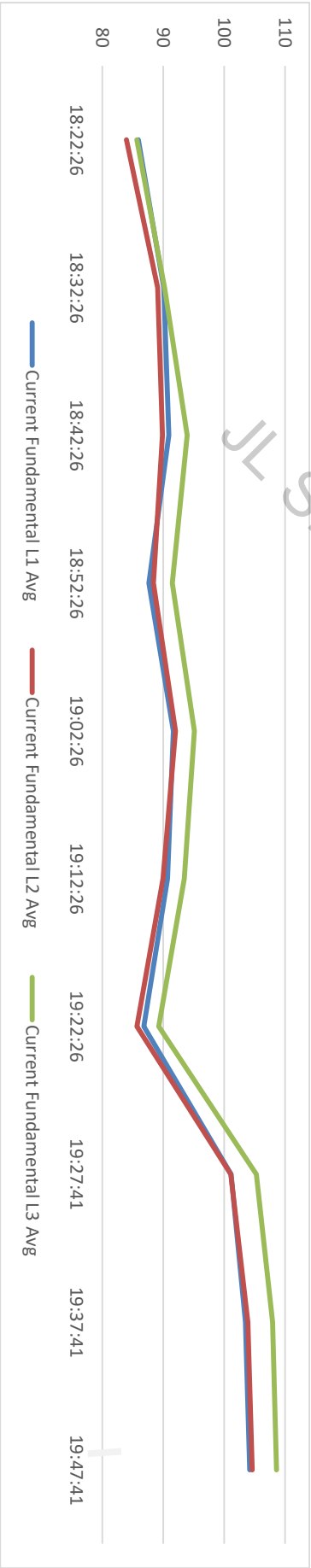
Line to Line Voltage



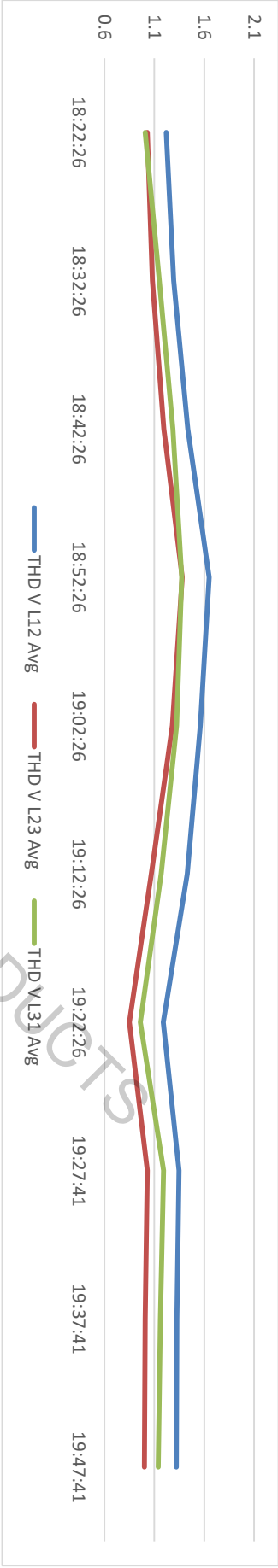
Load Current (RMS) (A)



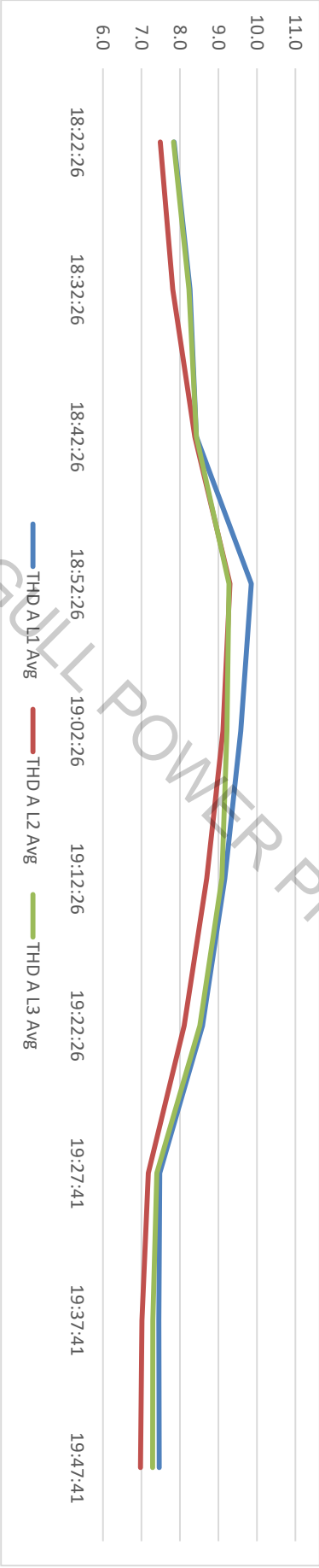
Fundamental Current (Trend)



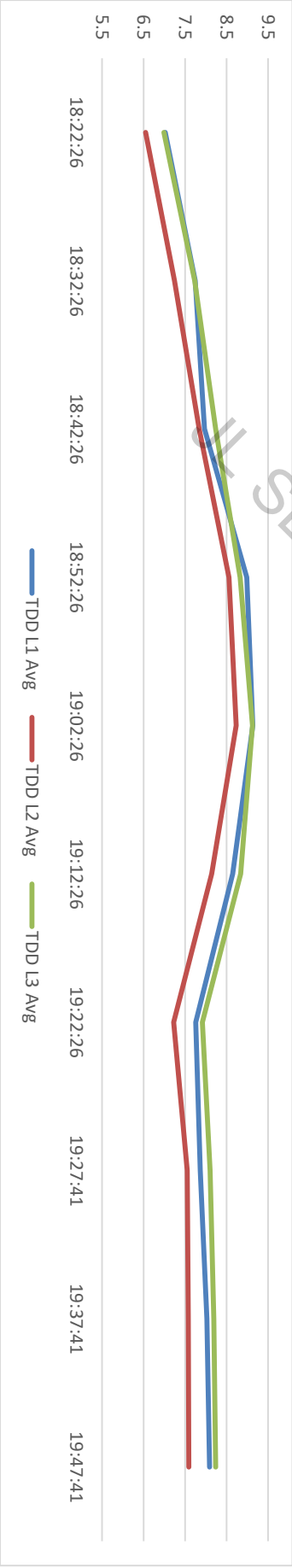
THDv % (Total Voltage Harmonics Distortion)



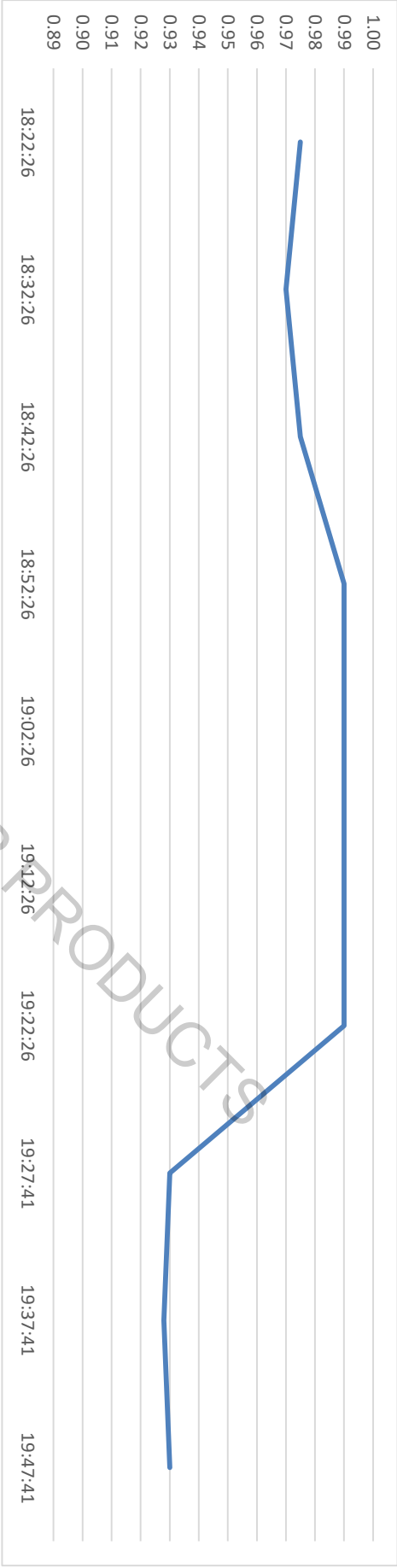
THDi % (Total Current Harmonics Distortion)



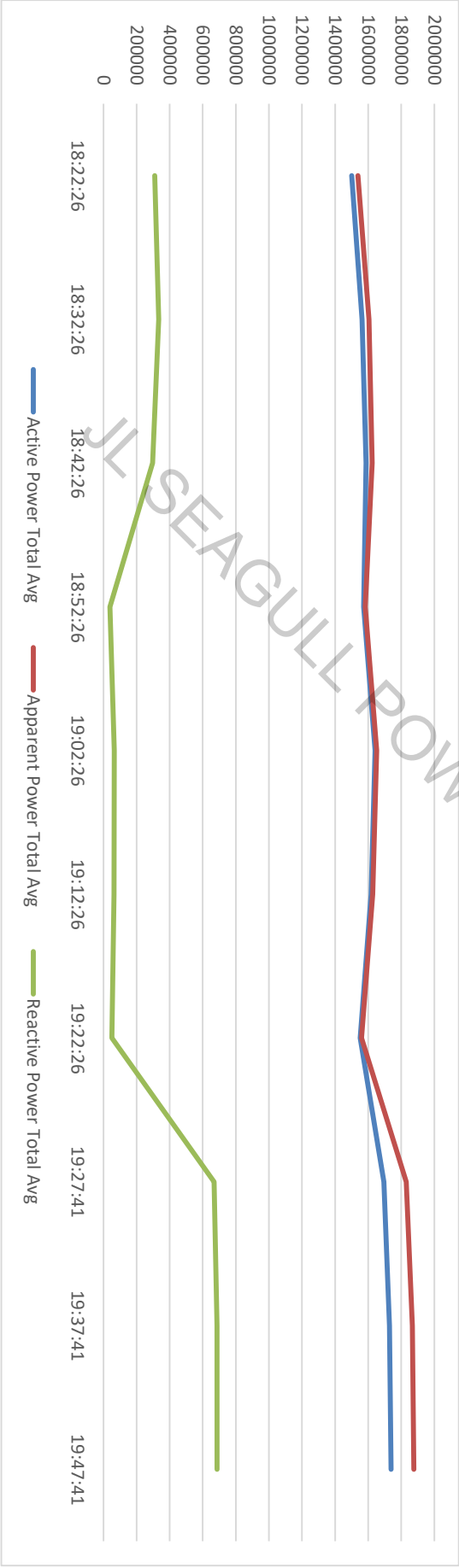
TDDi % (Total Demand Distortion)



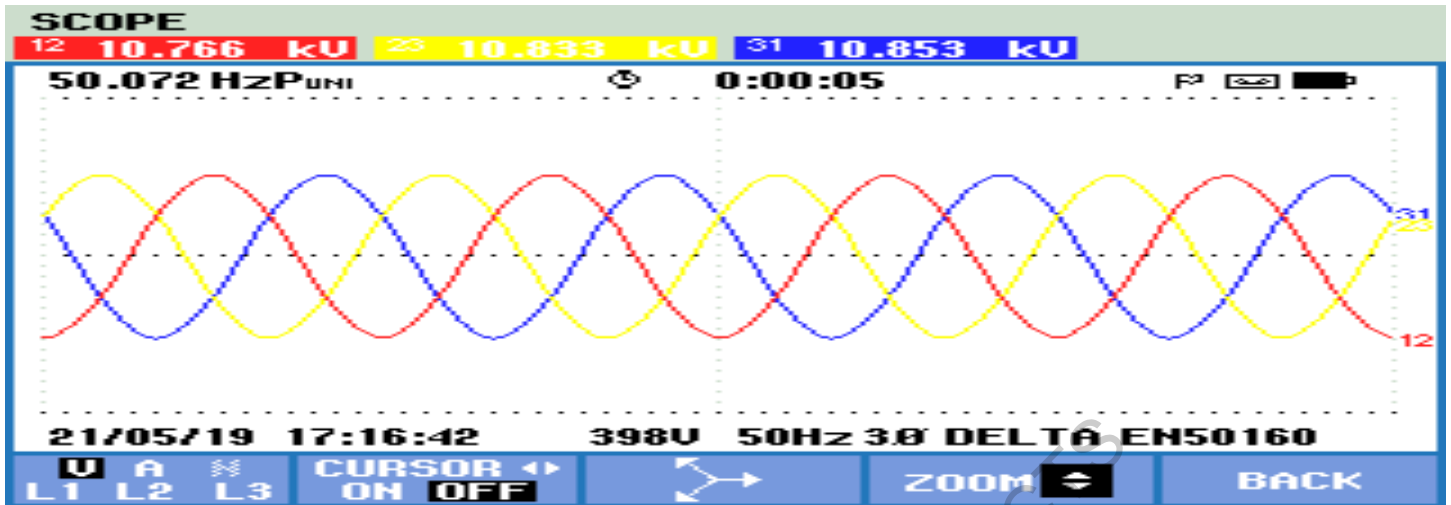
Power Factor total fig



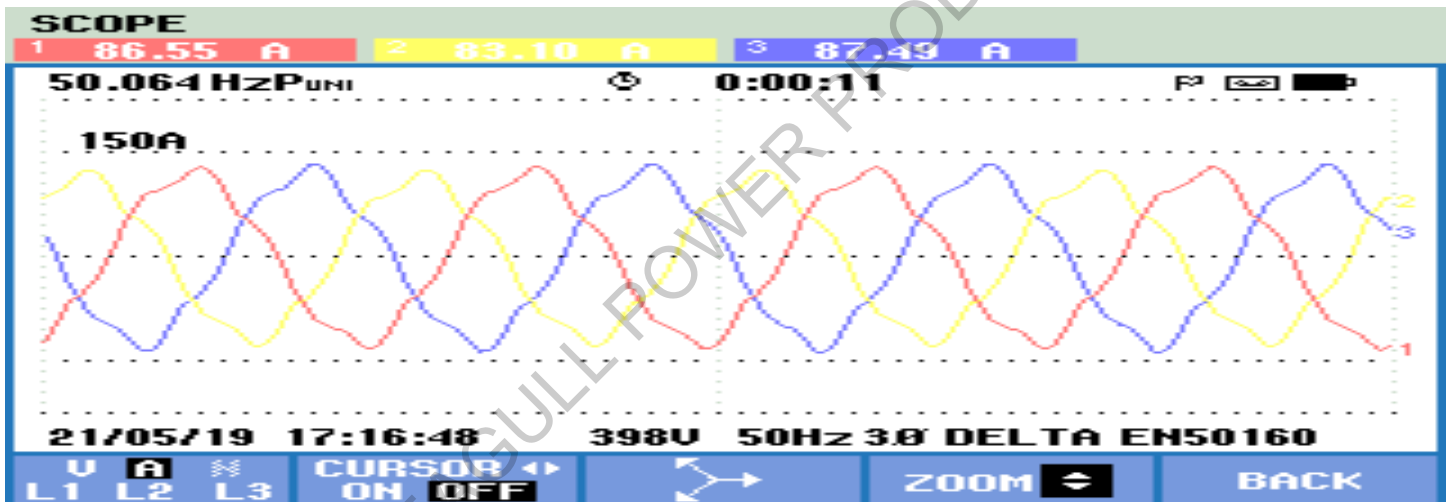
Active, Apparent & Reactive power total



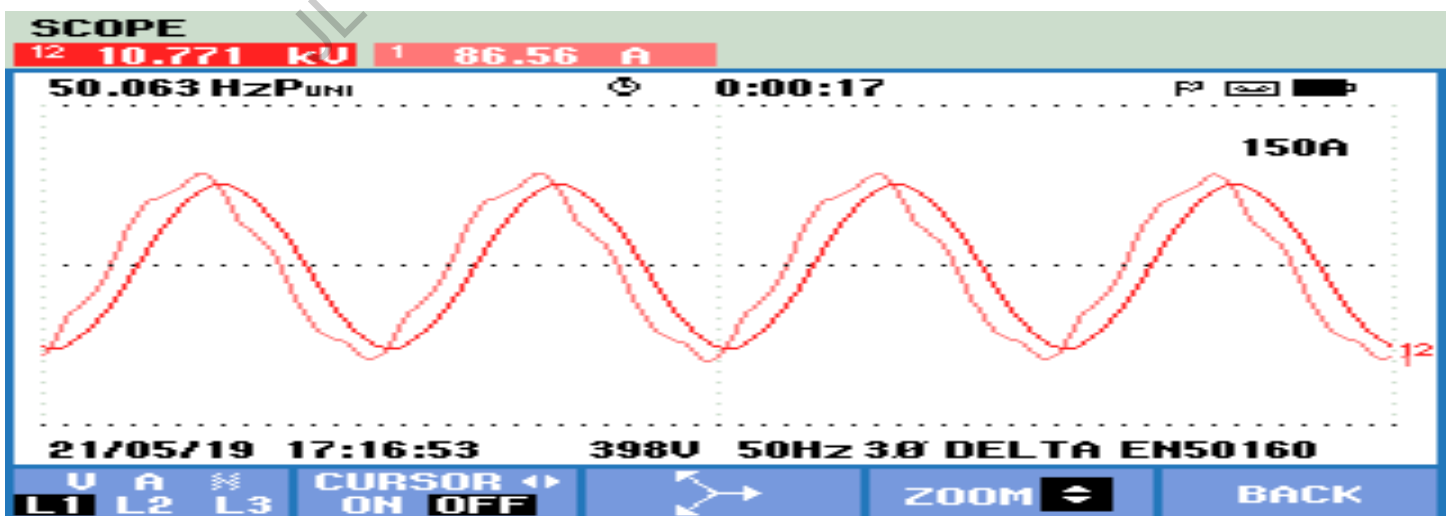
3 ϕ - Voltage Waveform (instantaneous)



3 ϕ - Distorted Current Waveforms (instantaneous)



R ϕ - Distorted Current Waveform (instantaneous)

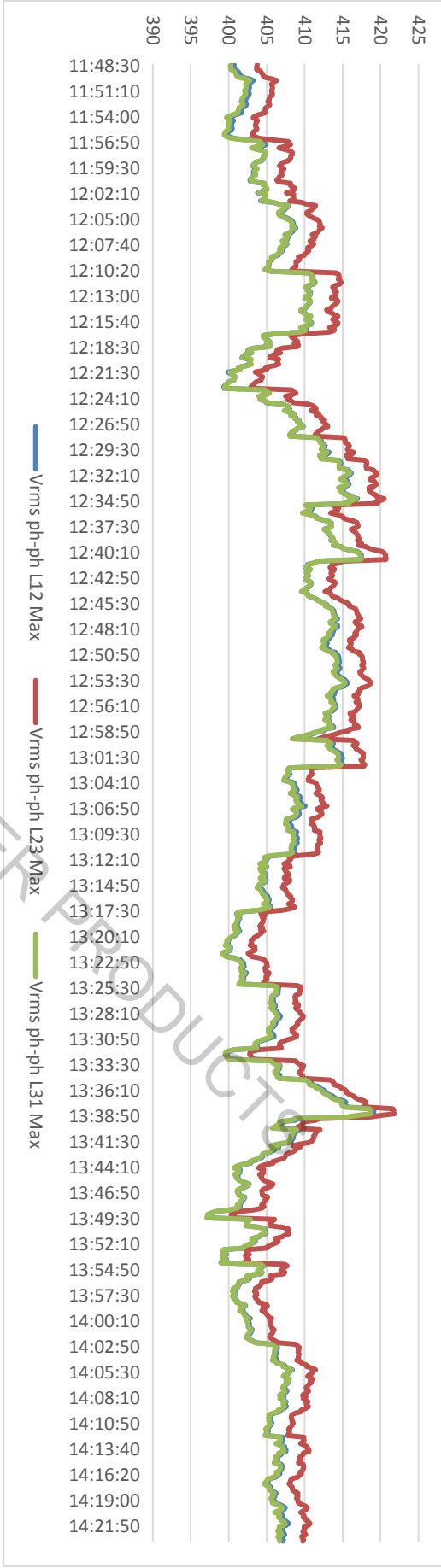


9) Harmonic measurement data – Transformer – 1 1250 KVA:

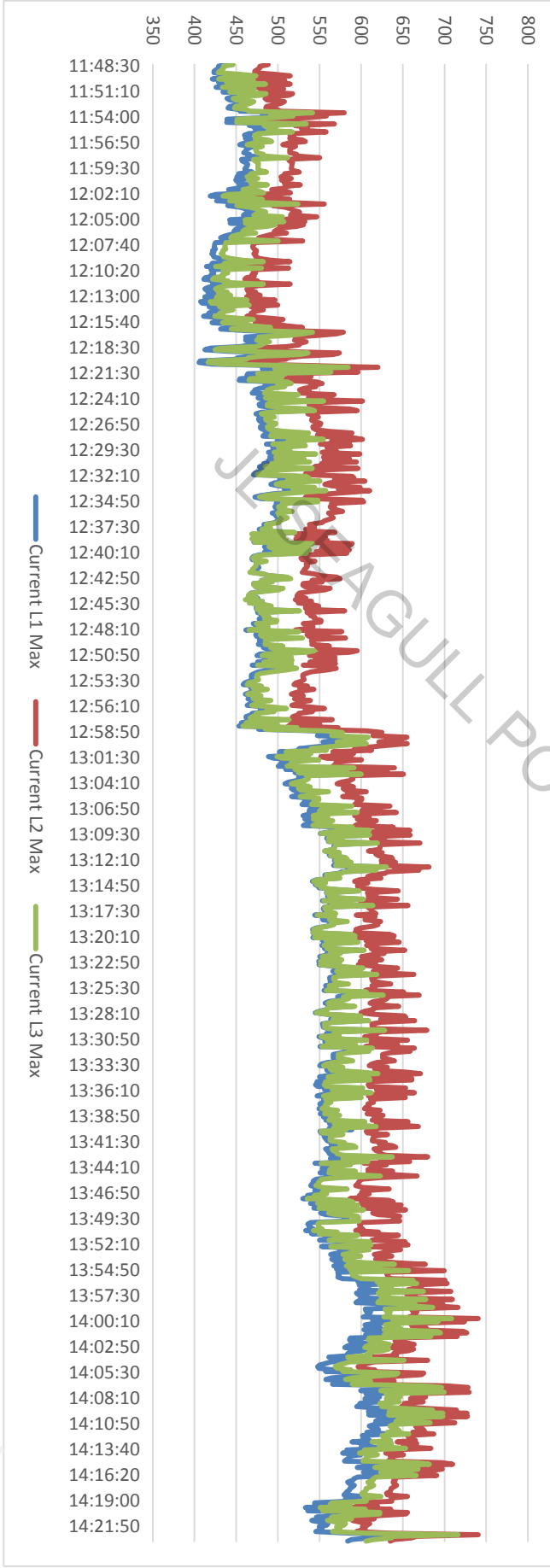
Transformer -1 1250KVA LT Side						
DATE: 22-05-2019	Measured Location			1250KVA Transformer - 1 LT Side		
	Measured Date & Duration			22 nd May'19 & 2 hrs 30 mins		
	Maximum Load Current Rms (Measured)			740.60 A		
Load Details	1250KVA Distribution Transformer:					
	S.	Feeder	Important Machine	KW	Invertor Load	KVAR
	1	SSB – 18	lighting, ST-Plant	51.4	-	-
	2	DB – 2	DK800(13-17), LK(1-5) & LH10	123.8	11	25
	3	SSB – 5	CDG(1-6), SB2, Drawing(1-6)	175.1	2.3x1, 11x2	50
	4	SSB – 14	CDG(7-12), LK250(1-5), RSB(7-8), HF Plant-5, LK642	227.1	3.7x5	50
	5	Blow Room A	CP-1	88.1	1.5x5	-
	6	COP – 7	HF Plant(1-4), SSB-11&12)	221	-	89
	7	Blow Room B	CP-2	66.6	1.5x2	25
	8	SSB – 9	VXL(1&2)	164.5	-	75
	9	Fire Hydrant	Fire Pump	62.5	-	-
	10	Capacitors		-	-	100
	Capacitor Bank details	Total Power factor control panel			414 KVAR (Detuning Choke Not Provided)	
Note: Existing Capacitor should be Detuned						

Logger Data & trend:

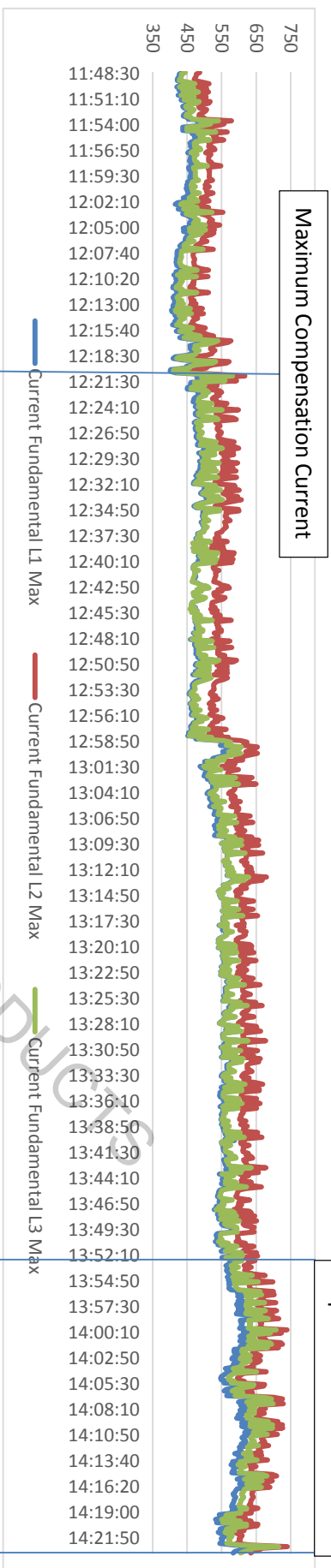
Line to Line Voltage:



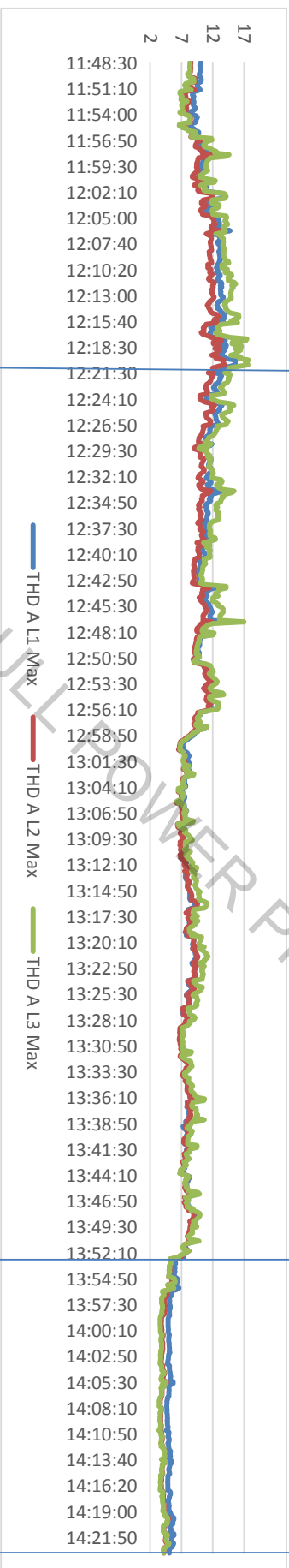
Load Current (rms) (A):



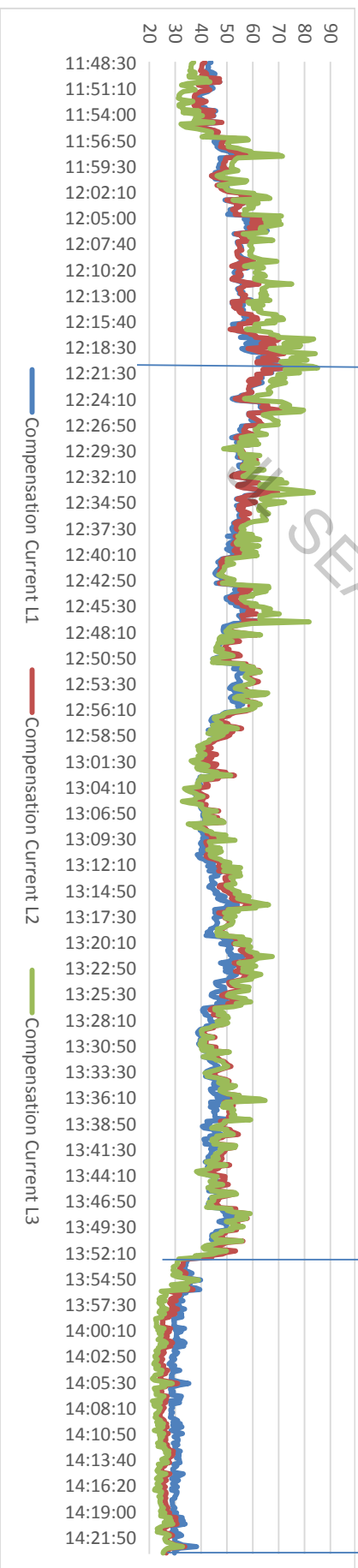
Fundamental Current (Trend):



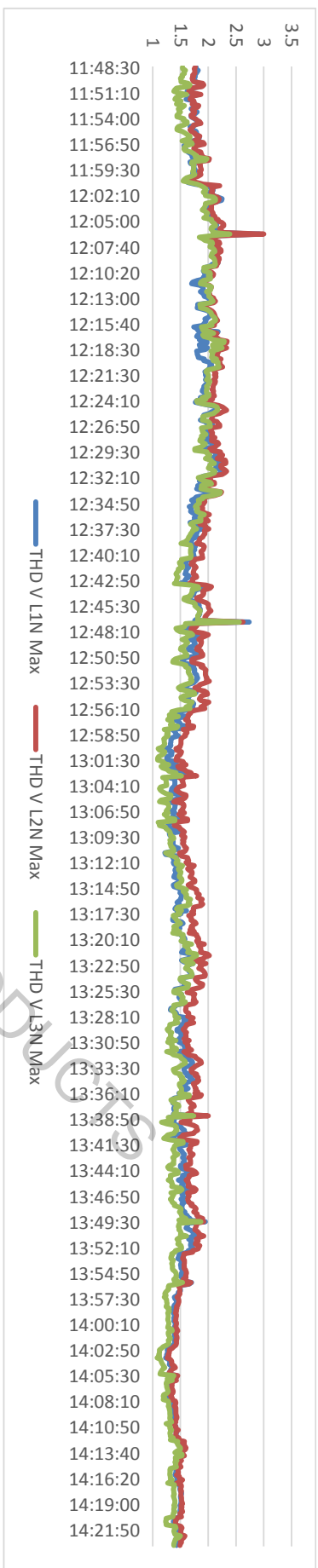
THDI % (Total Current Harmonics Distortion):



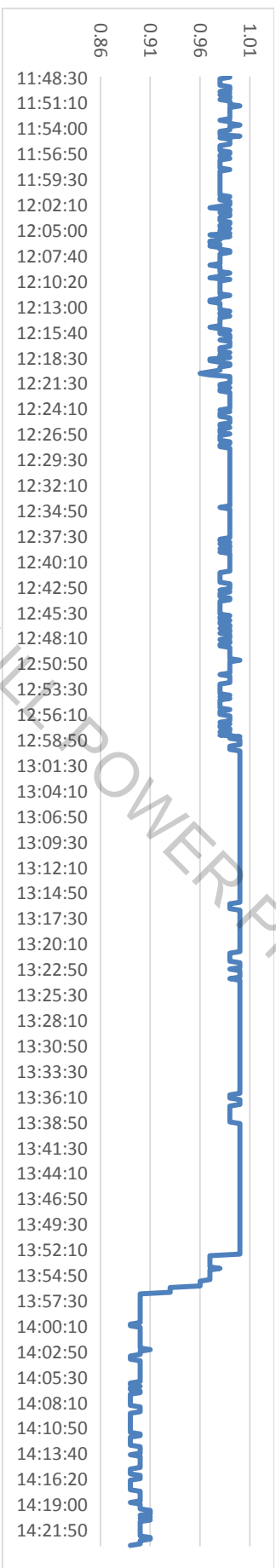
Harmonic Compensation Current:



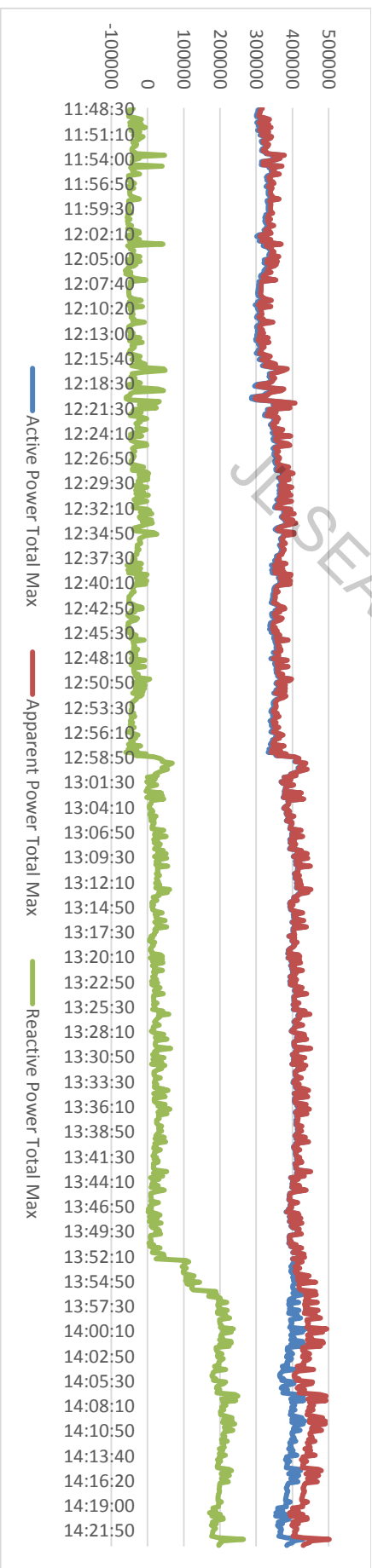
THDv % (Total Voltage Harmonics Distortion):



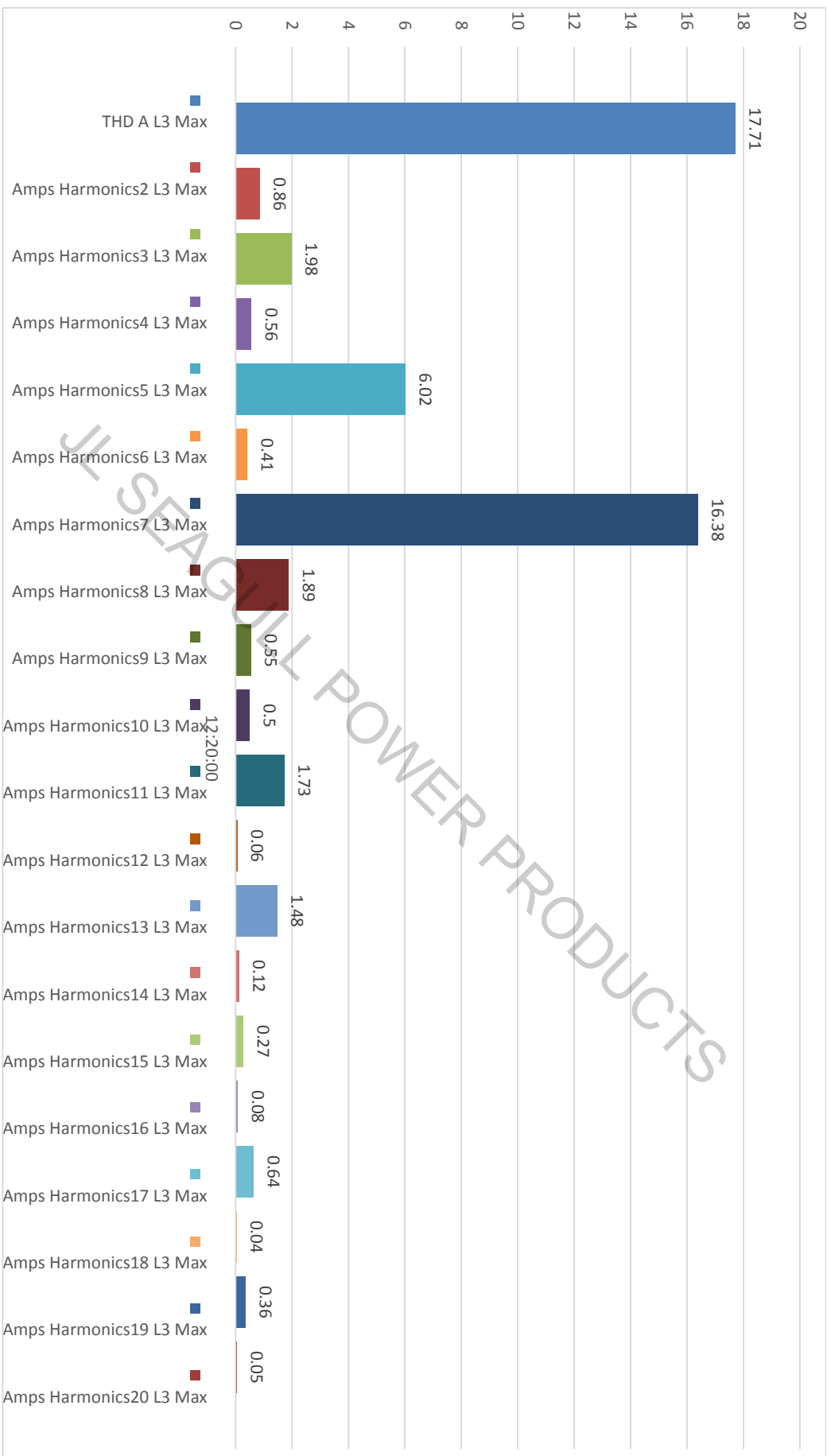
Power Factor total max:



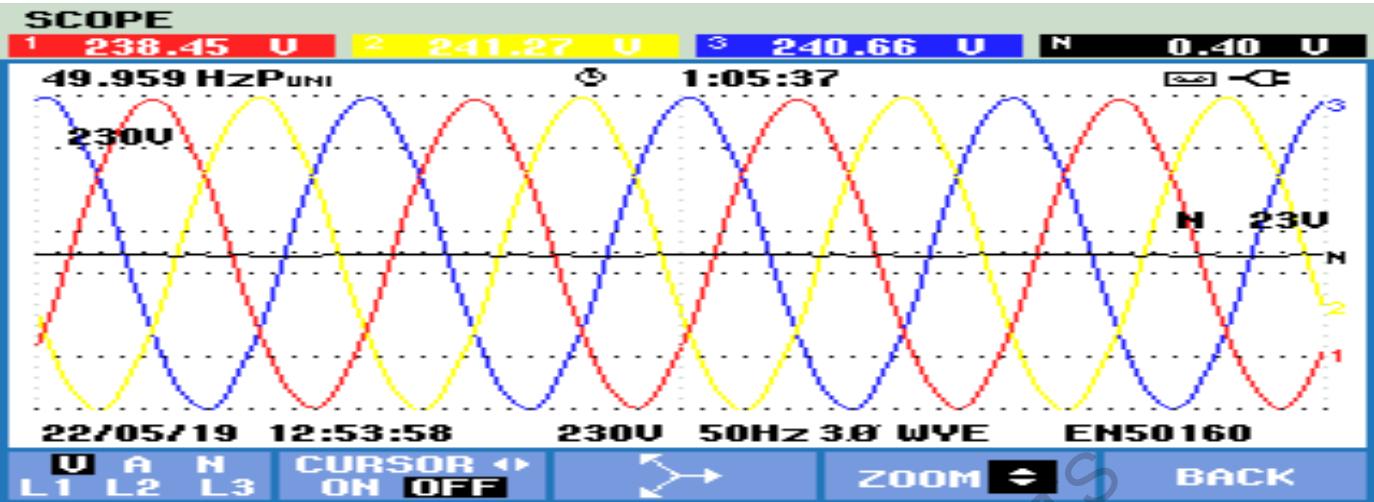
Active, Apparent & Reactive power total max:



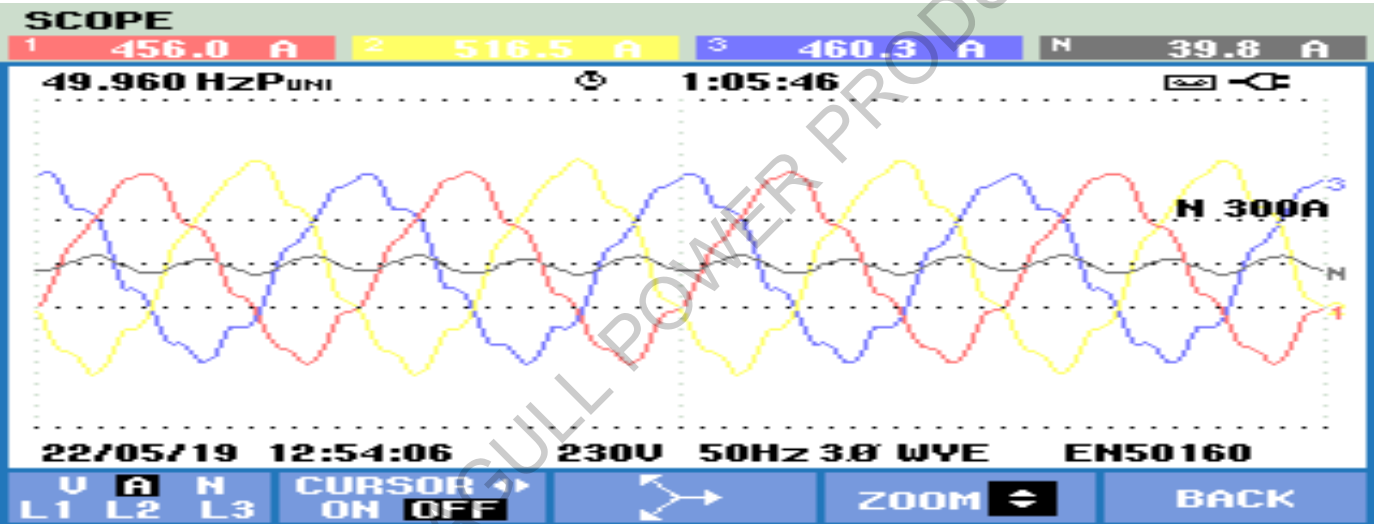
Individual Order Current Harmonic (Ref: Max THDi):



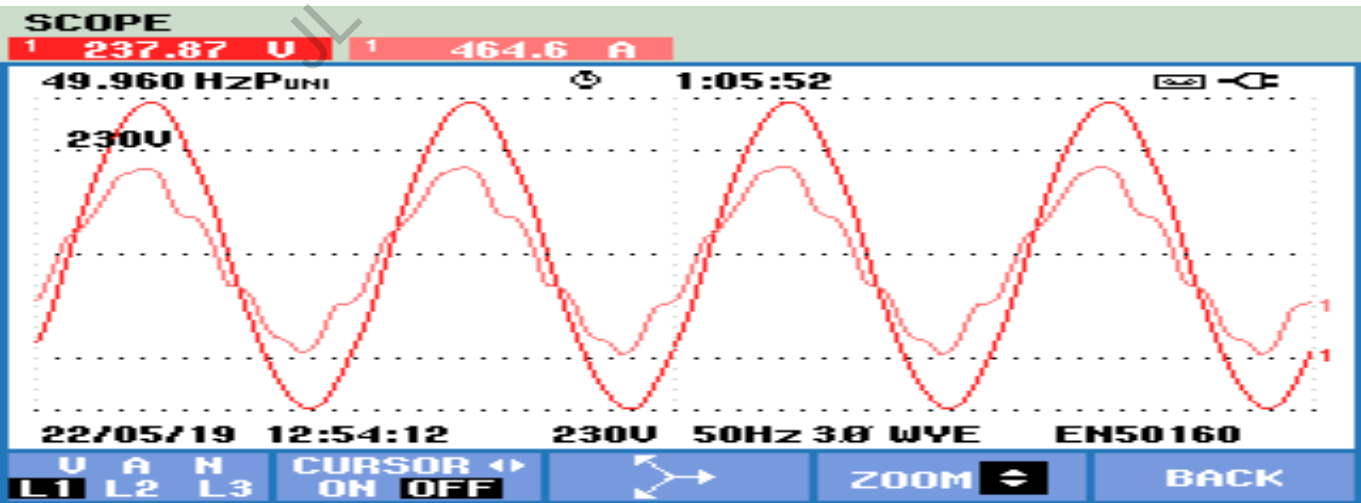
3 ϕ - Voltage Waveform (instantaneous)



3 ϕ - Distorted Current Waveforms (instantaneous)



R ϕ - Distorted Current Waveform (instantaneous)

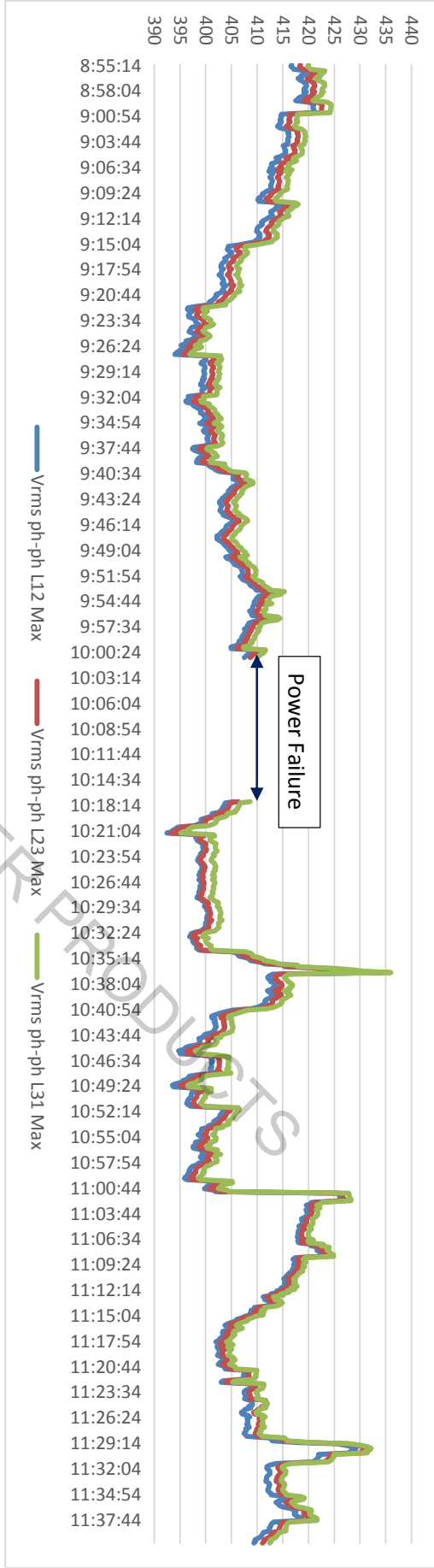


10) Harmonic measurement data: Transformer – 2 1250KVA

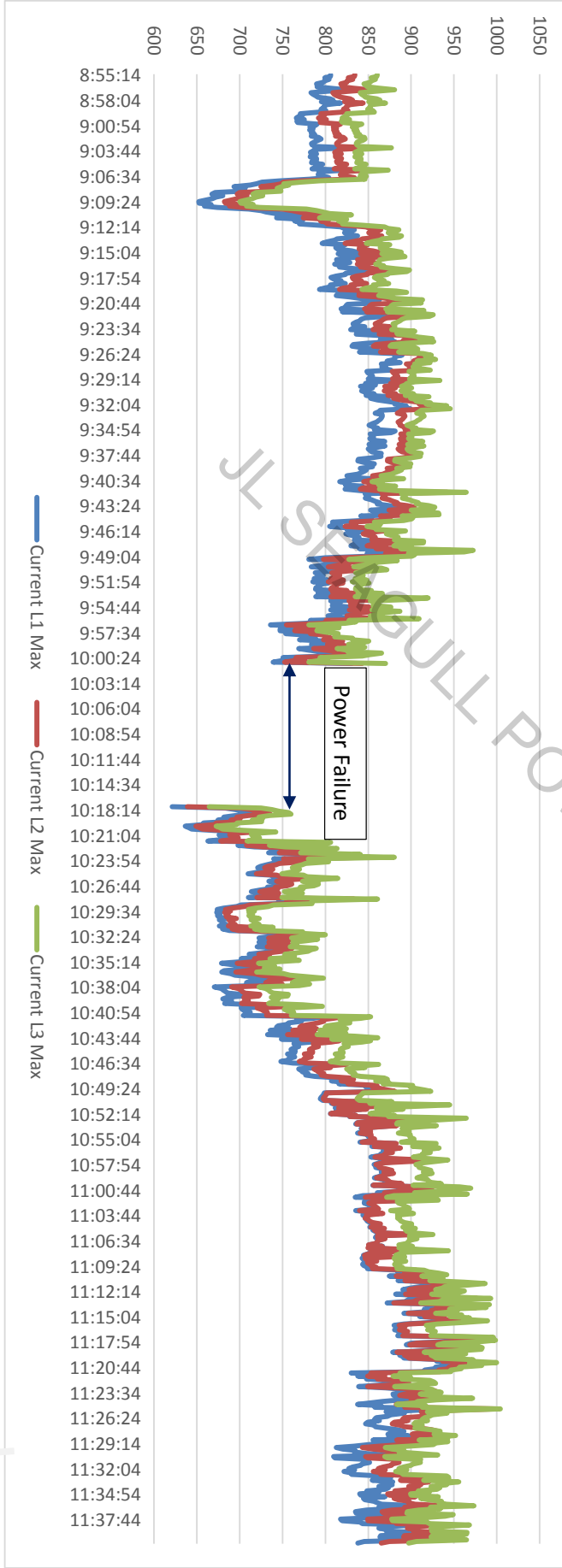
Transformer -2 1250KVA LT Side						
DATE: 22-05-2019	Measured Location			1250KVA Transformer - 2 LT Side		
	Measured Date & Duration			22 nd May'19 & 2 hrs 45 mins		
	Maximum Load Current Rms (Measured)			1004.20 A		
Load Details	1250KVA Distribution Transformer:					
	S.	Feeder	Important Machine	KW	Invertor Load	KVAR
	1	SSB – 10	Fly Frame (1-8)	119.1	-	25
	2	SSB – 7	R/F-(15-18), Cheesh Winding	162.4	3.5x7+5x4+.75x24+ 2.3x1+15KVA UPS	50
	3	SSB – 13	Autoconer (6-9)	60.2	15x4	-
	4	Plant no – 6	H.F Plant no: 6, Humifogg, RO Plant	32.5	-	6
	5	SSB – 15	Autoconer (1-5), Compressor 1 & 2	203.9	15 x 5	-
	6	SSB – 6	R/F (19-22)	192.2	5x4 & Solar inverter 48.8KW	50
	7	SSB – 8	R/F- (12-14)	176.5	5x3	50
	8	Plant no – 7	Plant no 7(MCC-3)	45.4	-	25
	9	Capacitors		-	-	150
Capacitor Bank details	Total Power factor control panel			356 KVAR (Detuning Choke Not Provided)		
Note: Existing Capacitor should be Detuned						

Logger Data & trend:

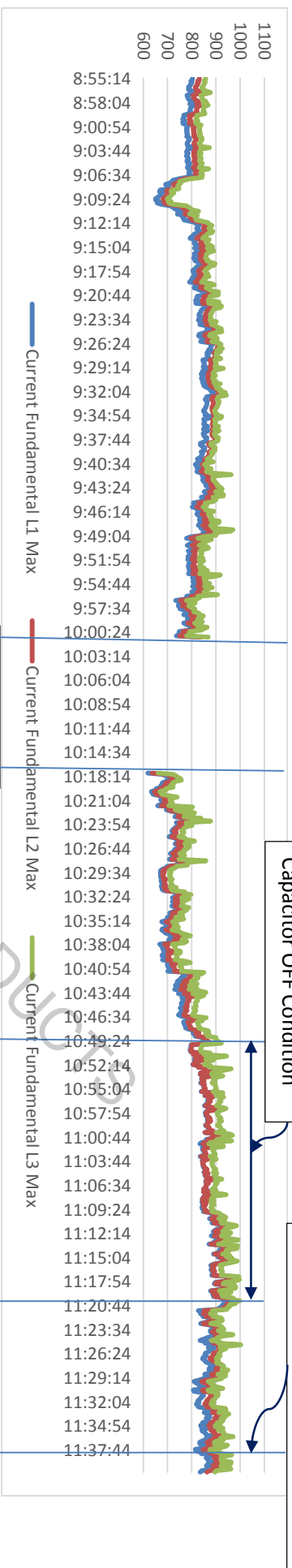
Line to Line Voltage:



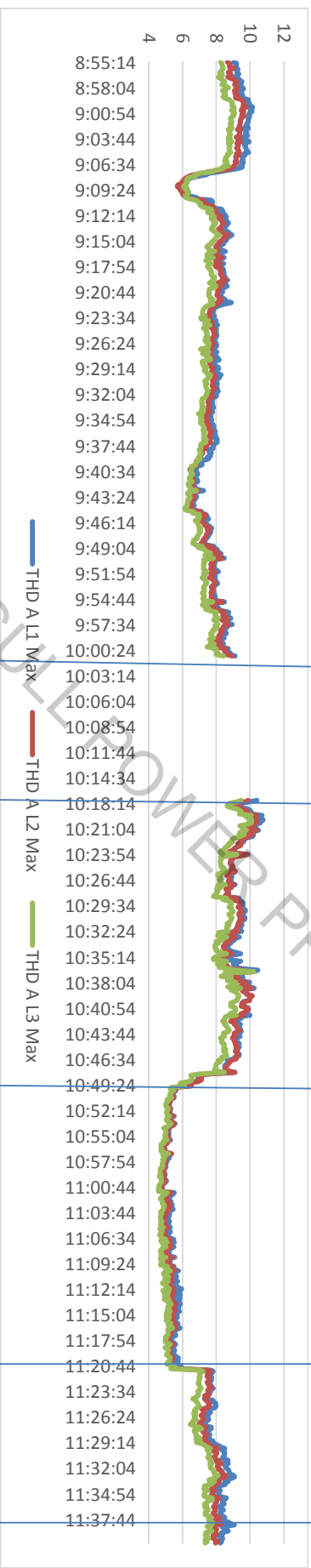
Load Current (rms) (A):



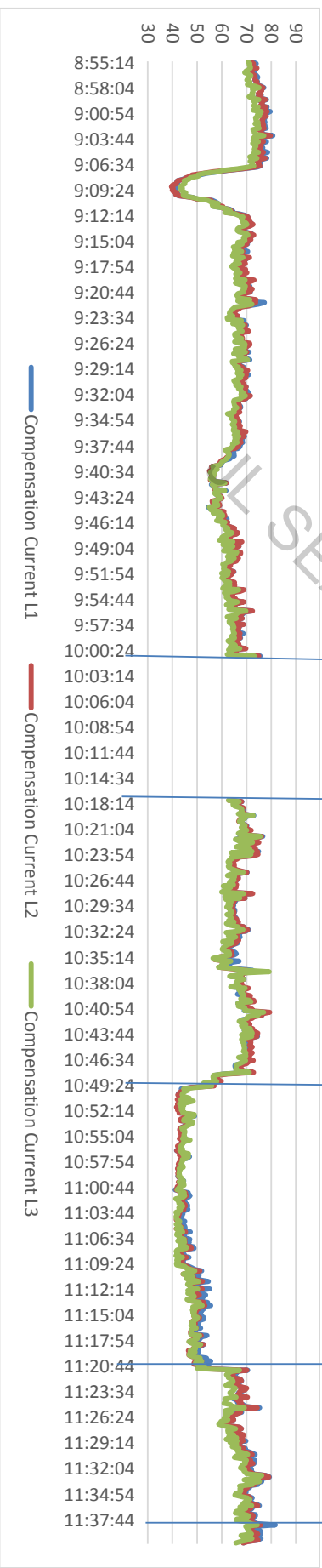
Fundamental Current (Trend):



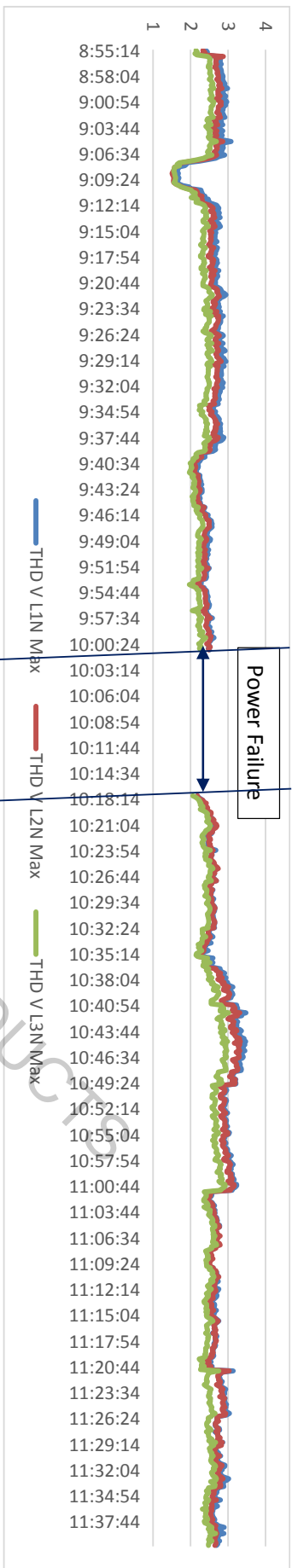
THDi % (Total Current Harmonics Distortion):



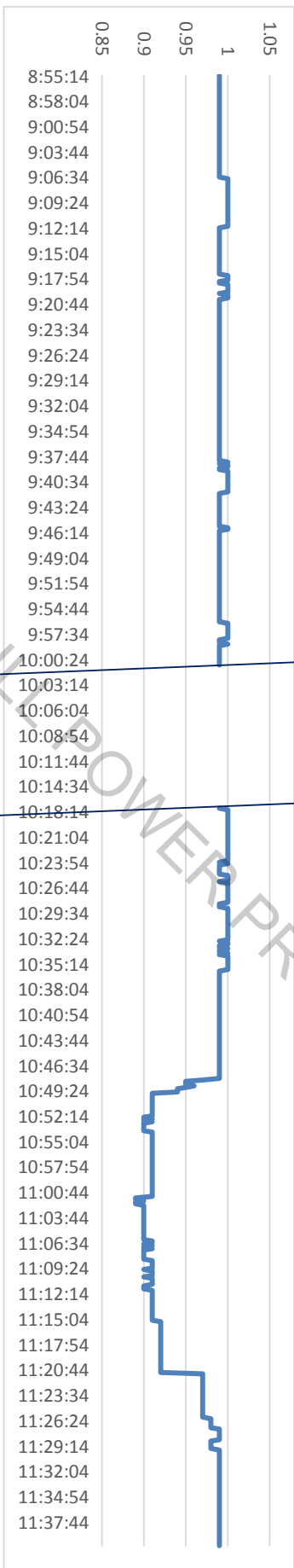
Harmonic Compensation Current:



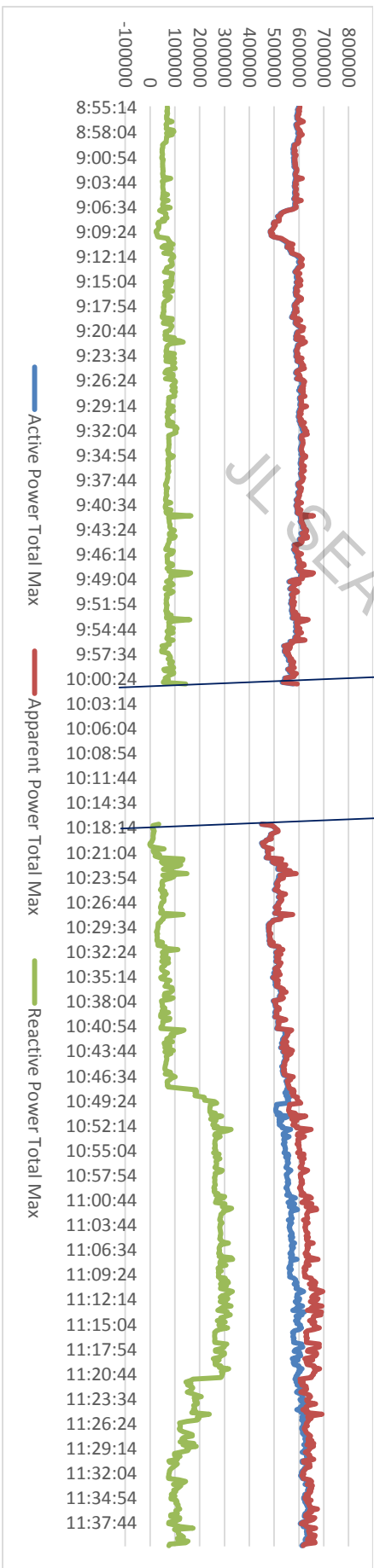
THDv % (Total Voltage Harmonics Distortion):



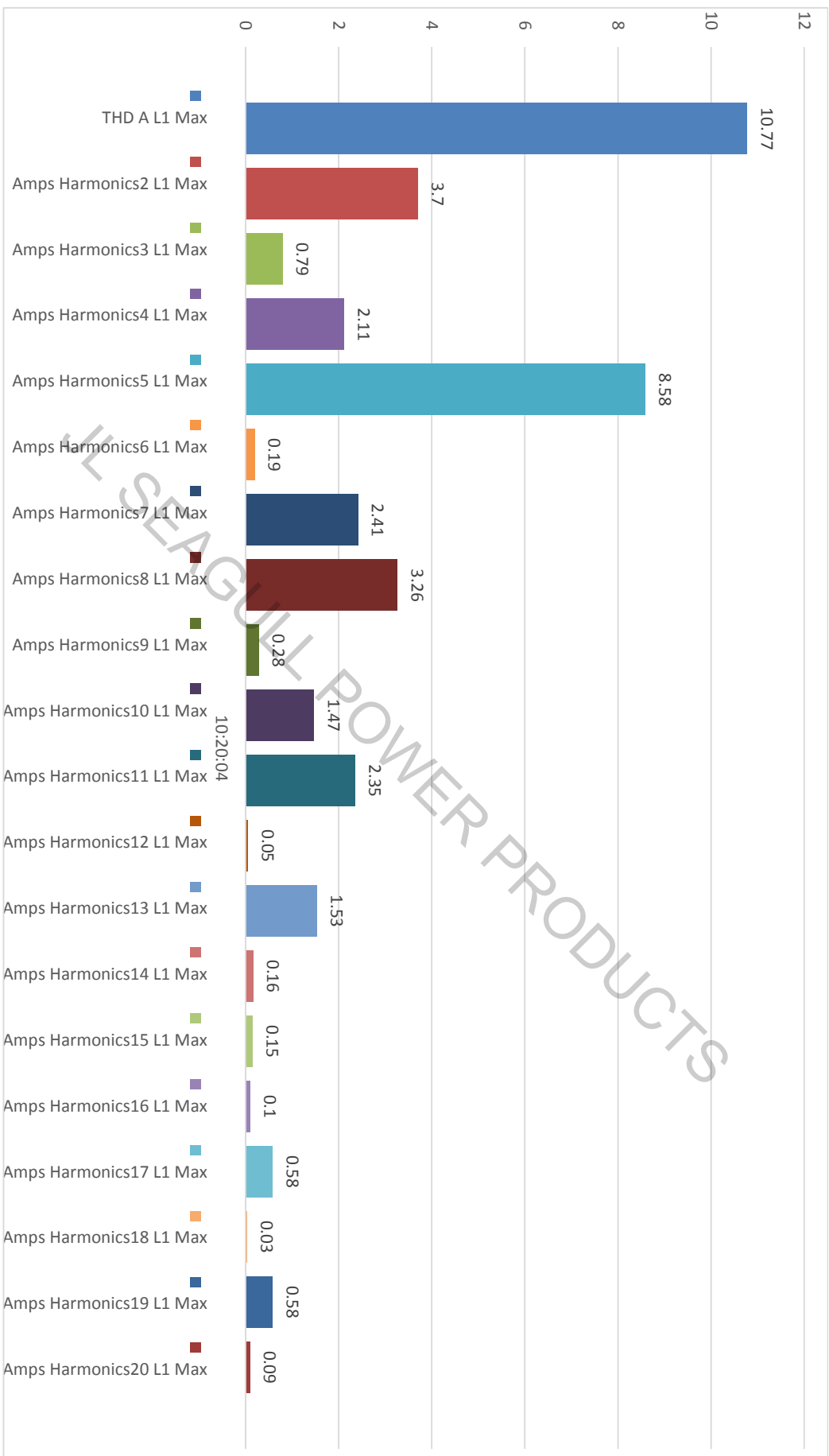
Power Factor total max:



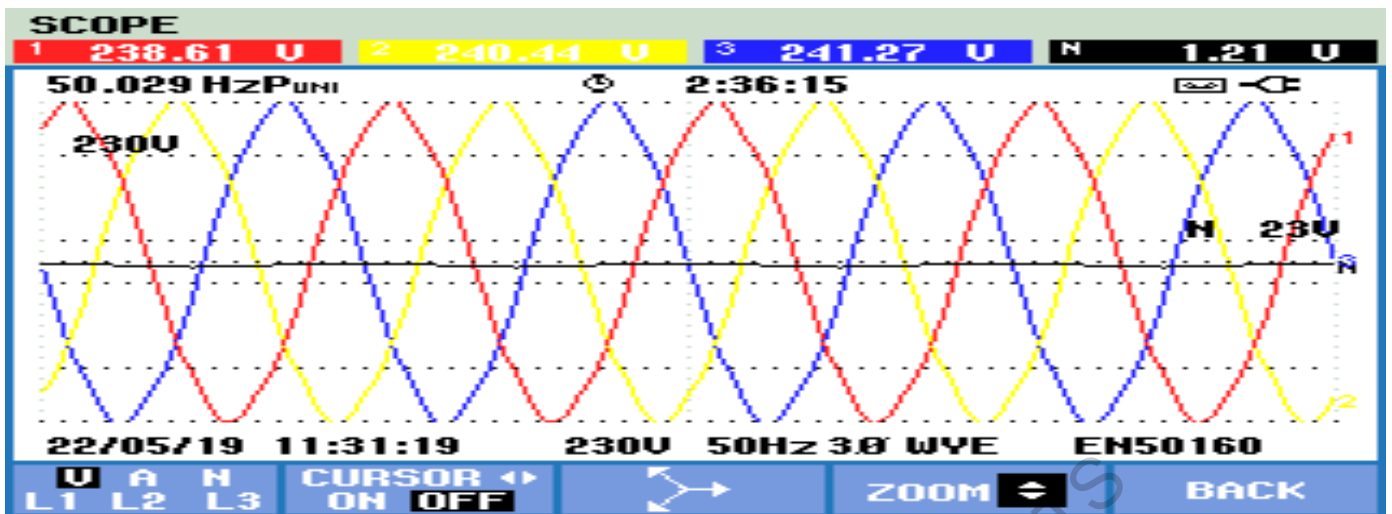
Active, Apparent & Reactive power total max:



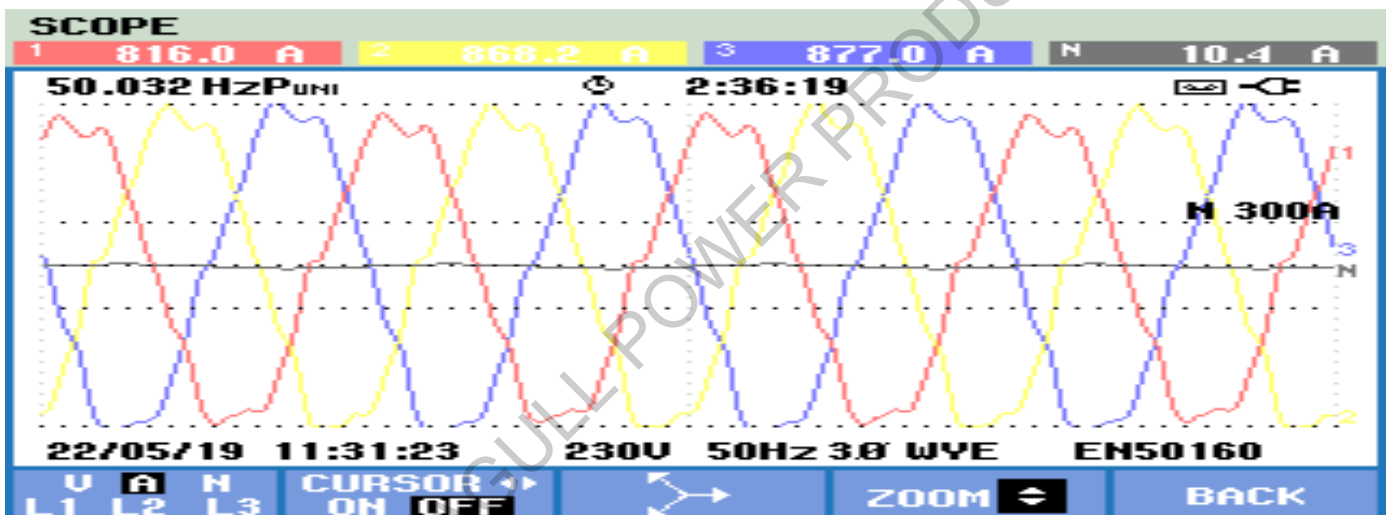
Individual Order Current Harmonic (Ref: Max THDi):



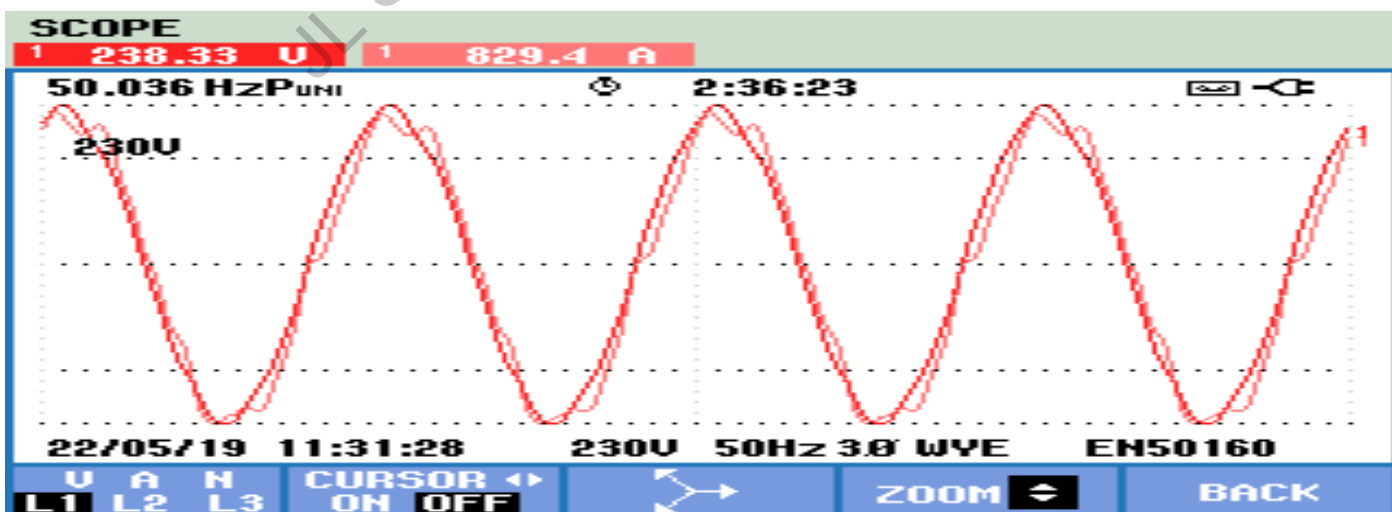
3 ϕ - Voltage Waveform (instantaneous)



3 ϕ - Distorted Current Waveforms (instantaneous)



R ϕ - Distorted Current Waveform (instantaneous)

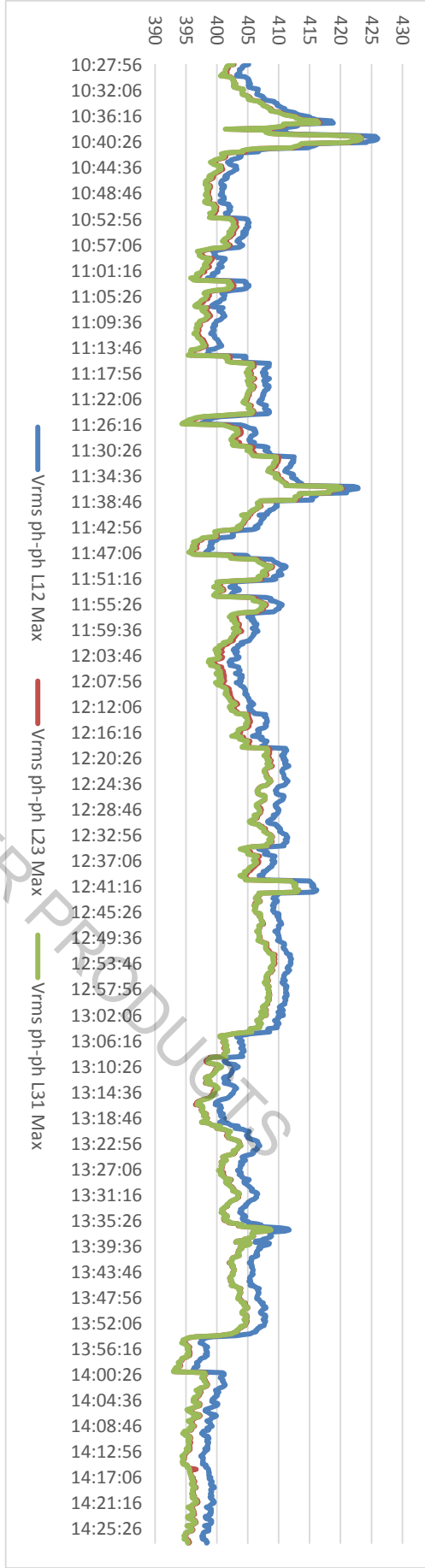


11) Harmonic measurement data – Transformer – 3: 800KVA

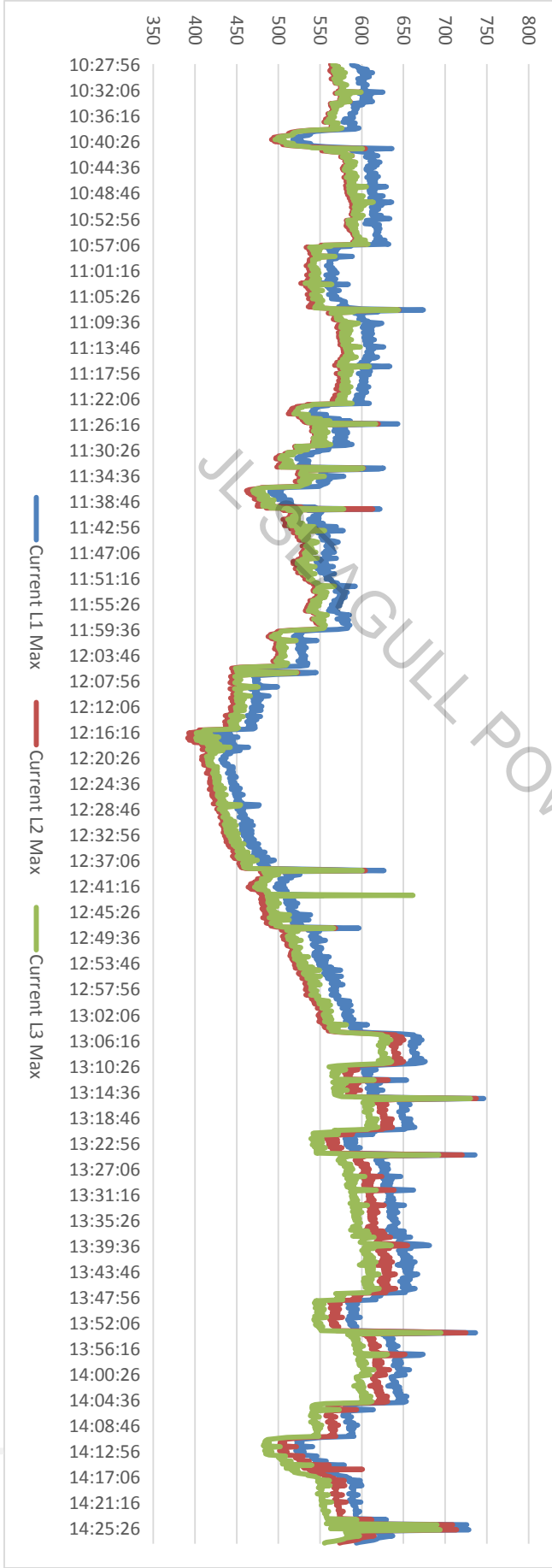
Transformer -3 800KVA LT Side						
DATE: 21-05-2019	Measured Location			800KVA Transformer - 3 LT Side		
	Measured Date & Duration			21 st May'19 & 4 hrs		
	Maximum Load Current Rms (Measured)			746.40 A		
Load Details	800KVA Distribution Transformer:					
	S,	Feeder	Important Machine	KW	Invertor Load	KVAR
	1	SSB – 4	R/F no – (1-3)	181.4	5x3	50
	2	SSB – 3	R/F no – (4-6)	181.4	5x3	50
	3	SSB – 2	R/F no – (7-9)	142	5x3	50
	4	SSB – 1	R/F no – 10 & 11	45.4	55x1 + 7.5x1 + 5x1	50
	5	COP – 5	Compressor no: 2	47.9	-	-
	9	Capacitors		-	-	50
	Total Power factor control panel			250 KVAR (Detuning Choke Not Provided)		
	Capacitor Bank details					
Note: Existing Capacitor should be Detuned						

Logger Data & trend:

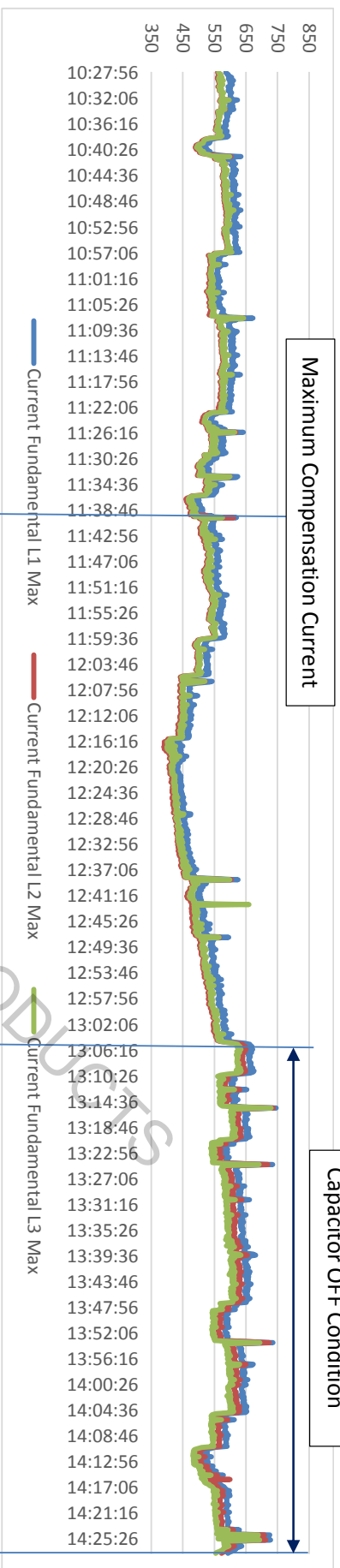
Line to Line Voltage:



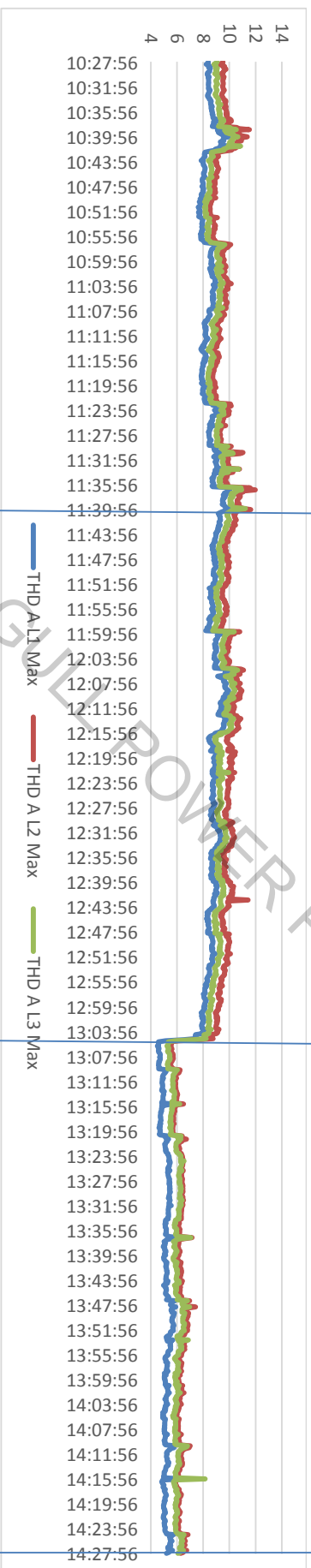
Load Current (rms) (A):



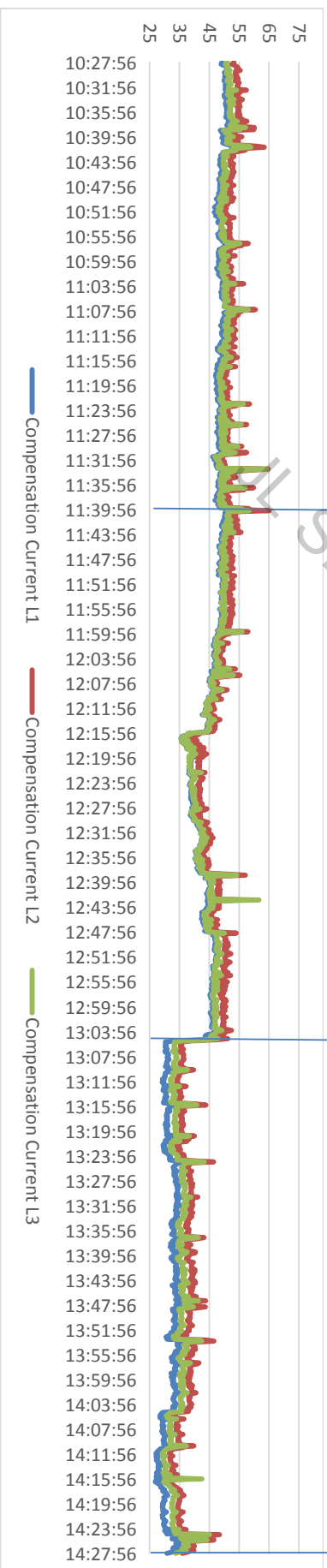
Fundamental Current (Trend):



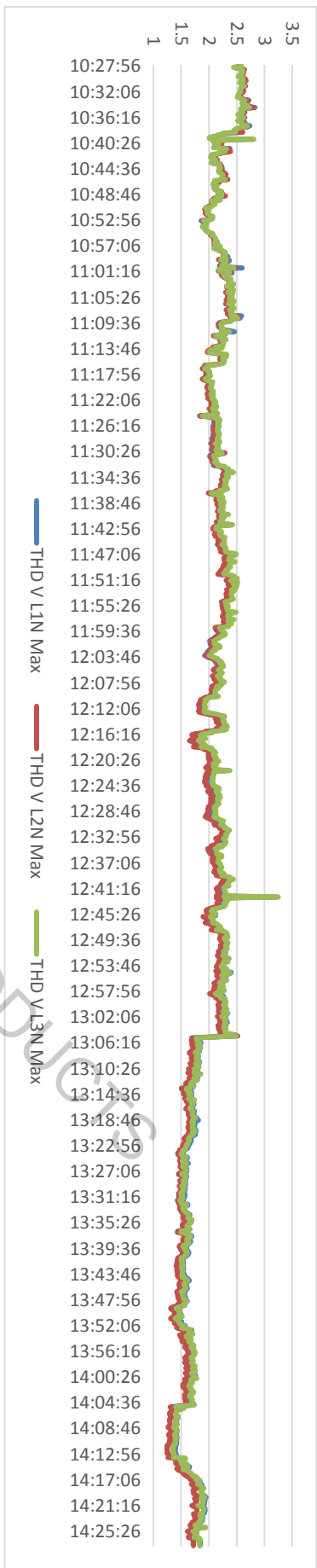
THDi % (Total Current Harmonics Distortion):



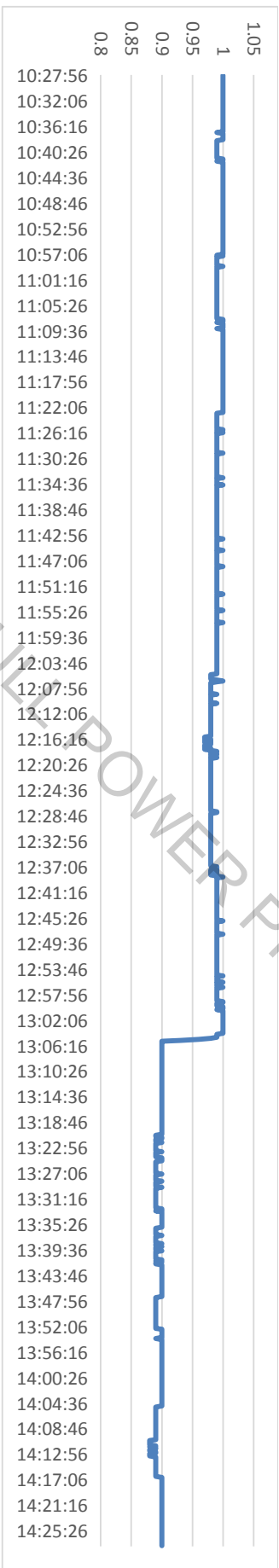
Harmonic Compensation Current:



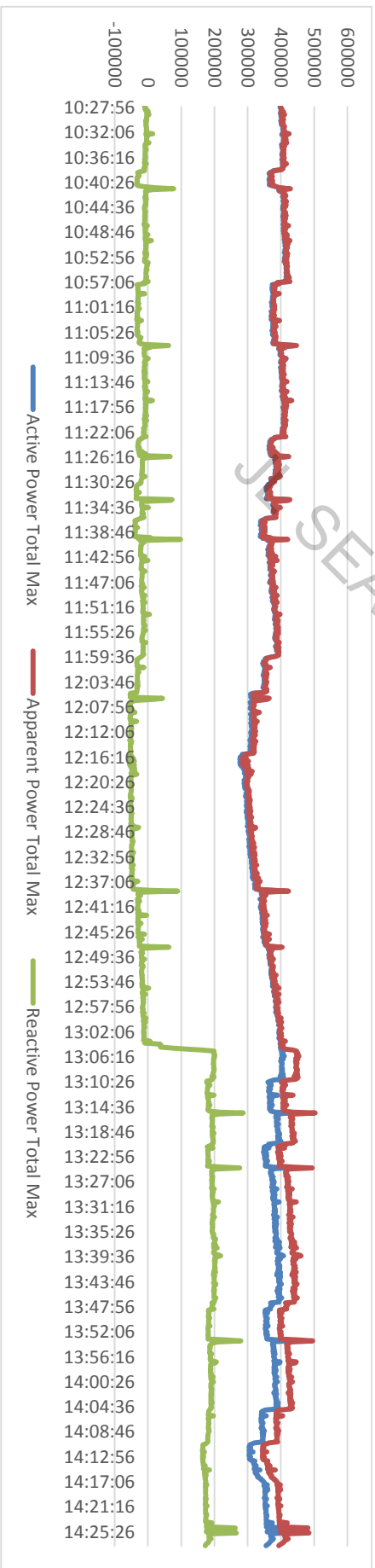
THDv % (Total Voltage Harmonics Distortion):



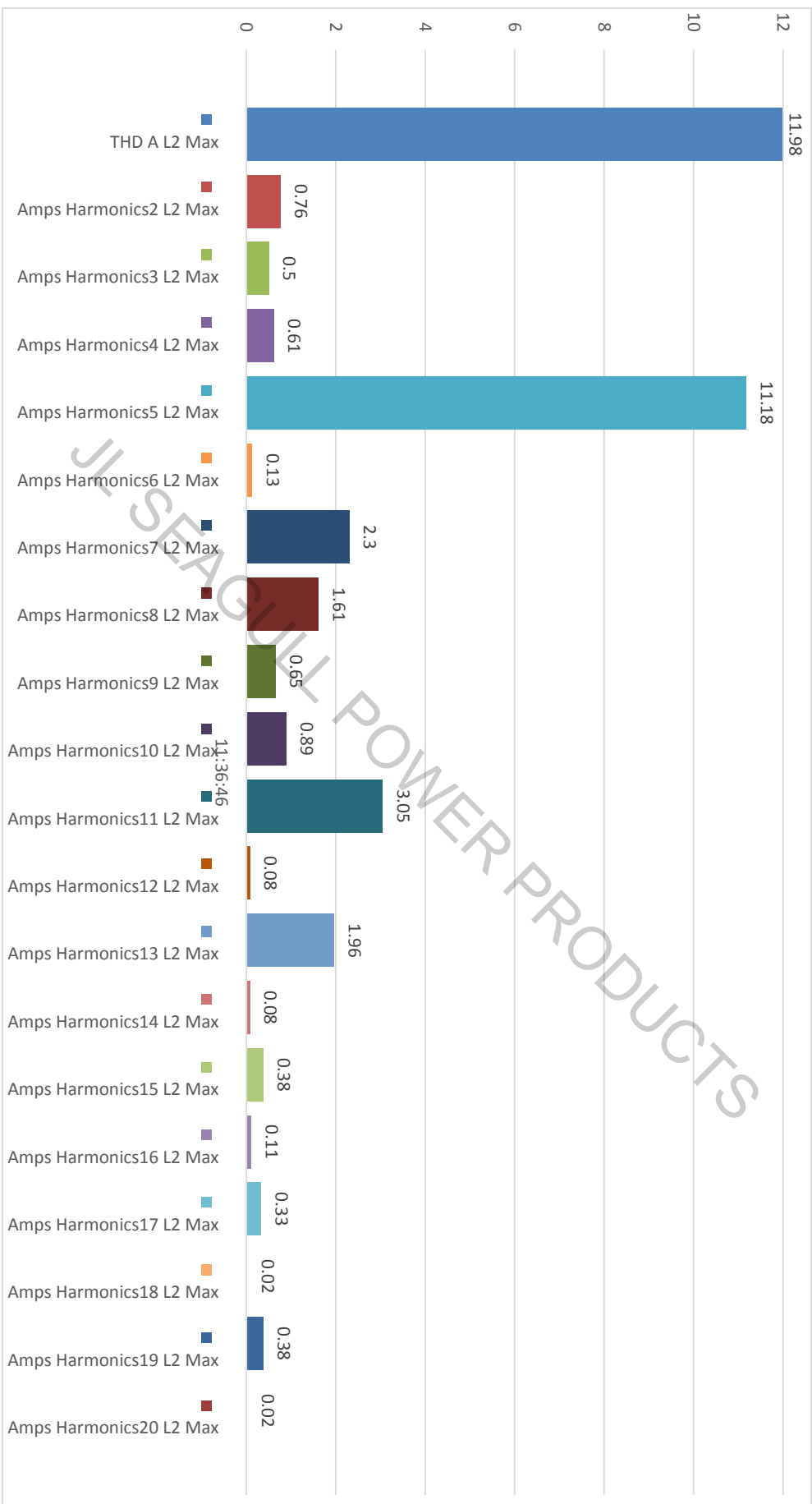
Power Factor total max:



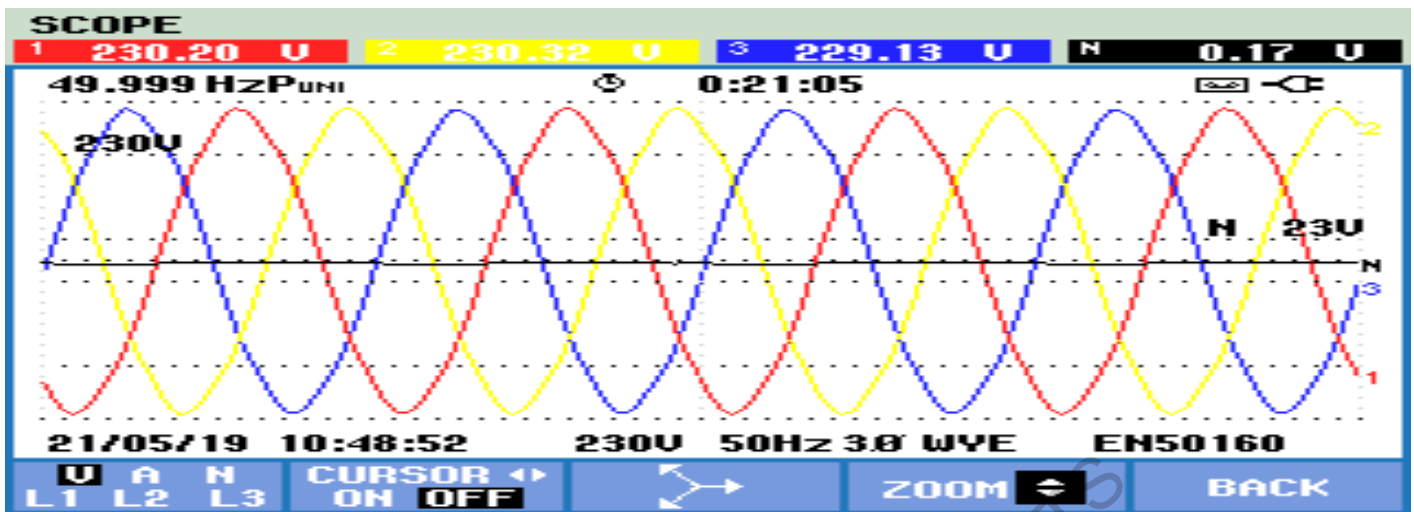
Active, Apparent & Reactive power total max:



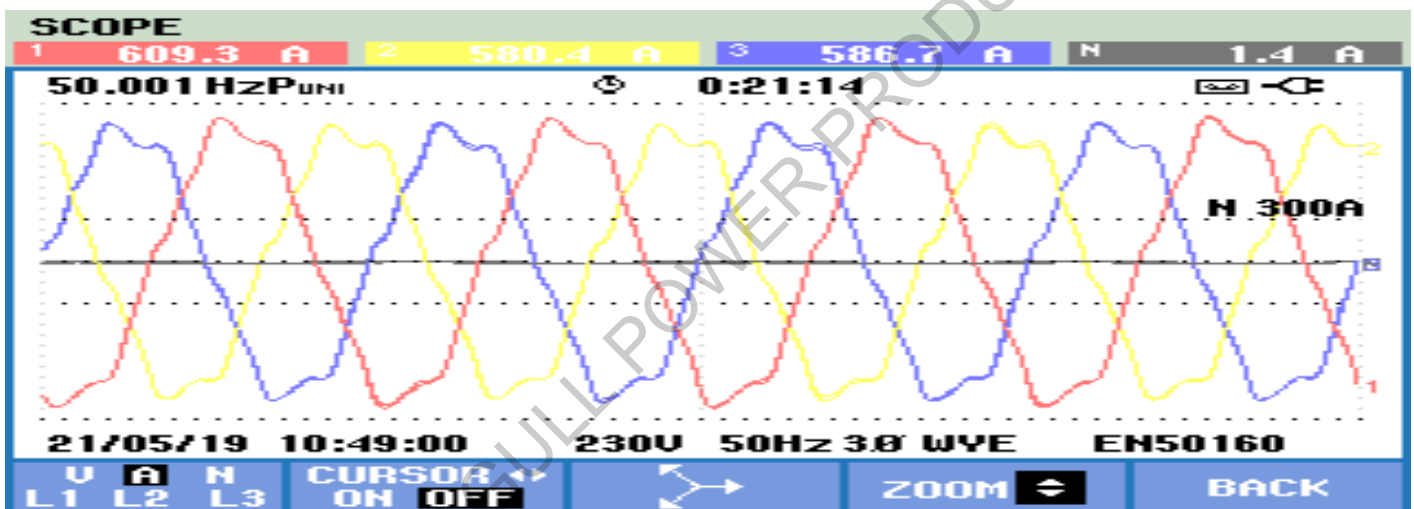
Individual Order Current Harmonic (Ref: Max THDi):



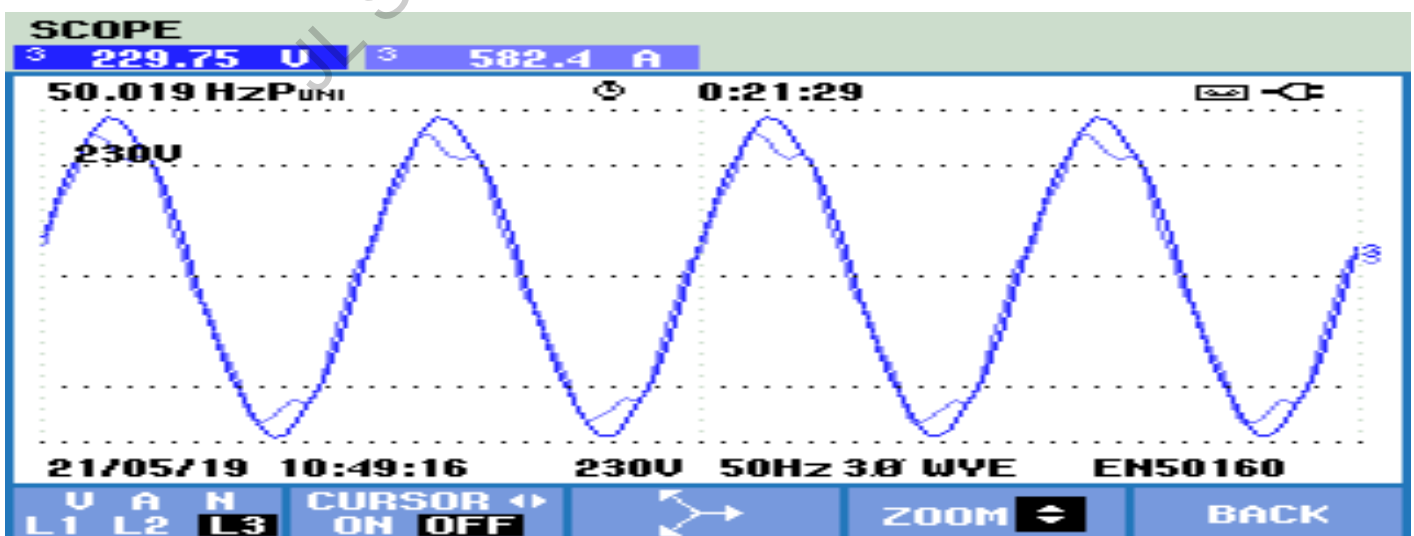
3 ϕ - Voltage Waveform (instantaneous)



3 ϕ - Distorted Current Waveforms (instantaneous)



B ϕ - Distorted Current Waveform (instantaneous)

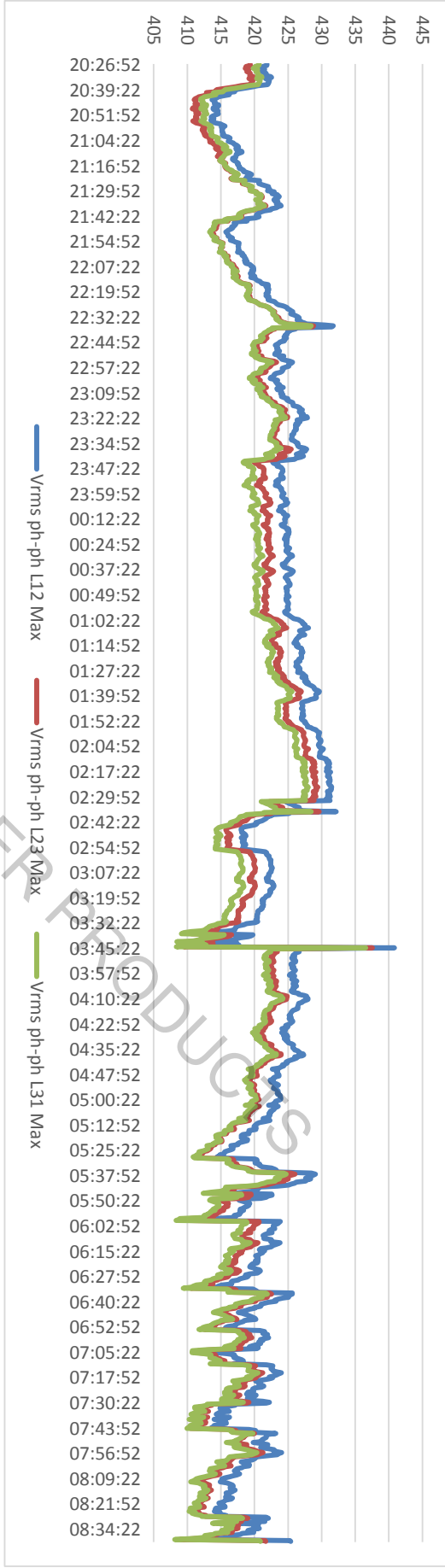


12) Harmonic measurement data – Transformer – 4: 800KVA

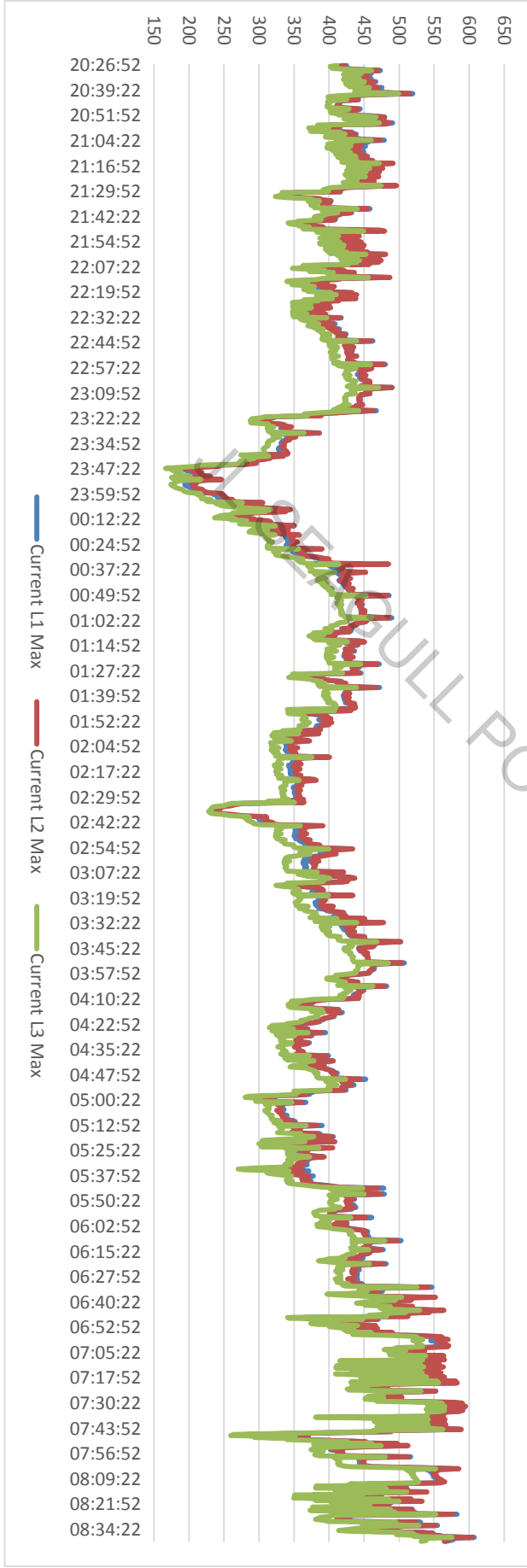
Transformer -4 800KVA LT Side						
DATE: 21-05-2019	Measured Location		800KVA Transformer - 4 LT Side			
	Measured Date & Duration		21 st to 22 nd May'19 & 12 hrs 15 mins			
	Maximum Load Current Rms (Measured)		607.30 A			
Load Details	800KVA Distribution Transformer:					
	S.	Feeder	Important Machine	KW	Invertor Load	KVAR
	1	SSB – 16	R/F – (23-25), TFO (1&2)	45.8	55x3 + 7.5x3	-
	2	SSB – 17	R/F 26 &27, Autoconer 10&11, TFO – 3	69.5	55x2 + 15x2 + 7.5x2 +10 KVA UPS	-
	3	YCP	Yarn Condition Plant	85.9	-	-
	4	Plant no – 8	HFP – 8 (MCC – 8)	86.4	-	-
	5	COMP – 3	Compressor – 3	48	55 x 1	-
	6	COP – 6	-	-	-	-
	9	Capacitors		-	-	50
	Capactor Bank details	Total Power factor control panel			50 KVAR (Detuning Choke Not Provided)	
Note: Existing Capacitor should be Detuned						

Logger Data & trend:

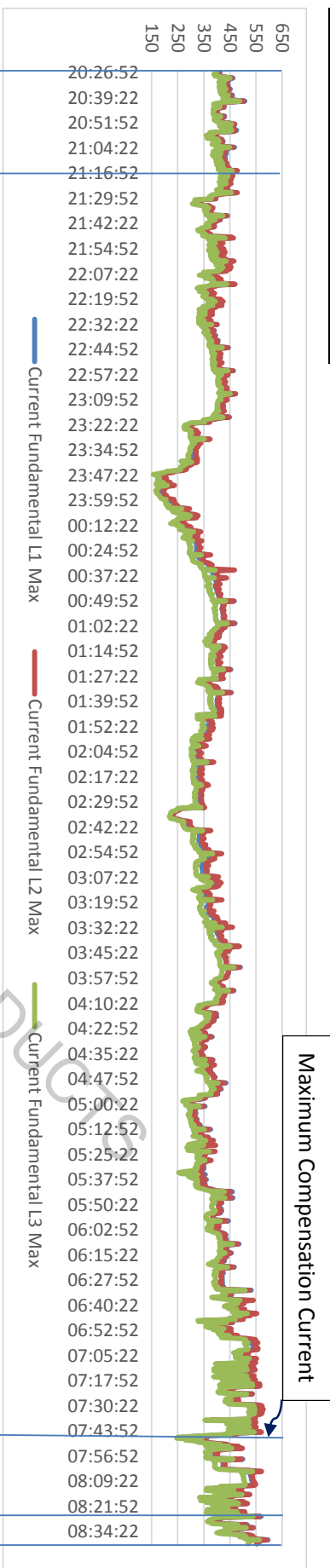
Line to Line Voltage:



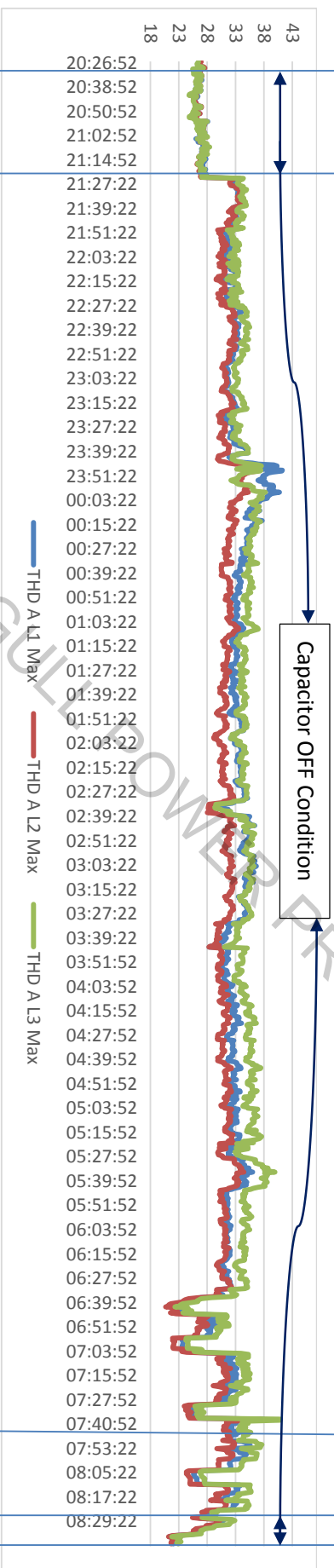
Load Current (rms) (A):



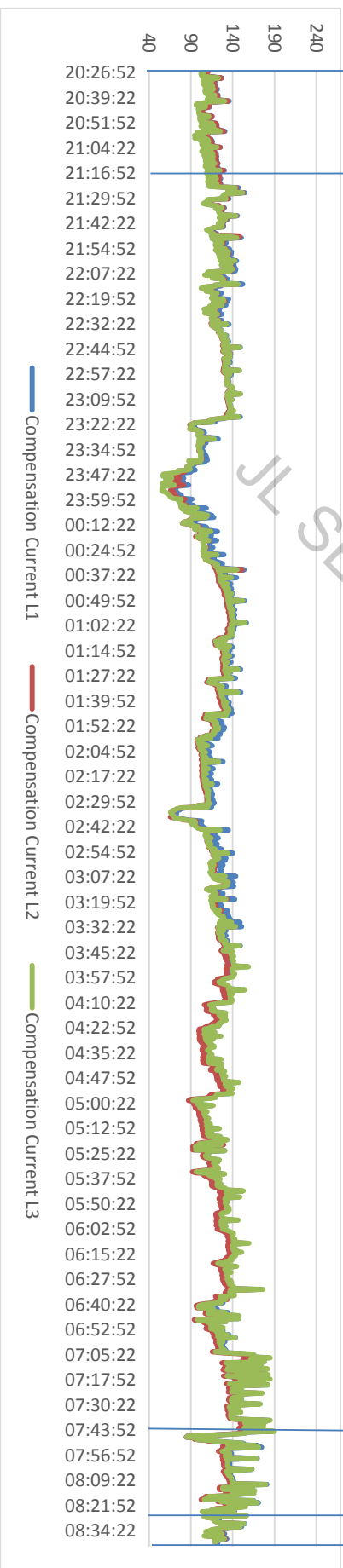
Fundamental Current (Trend):



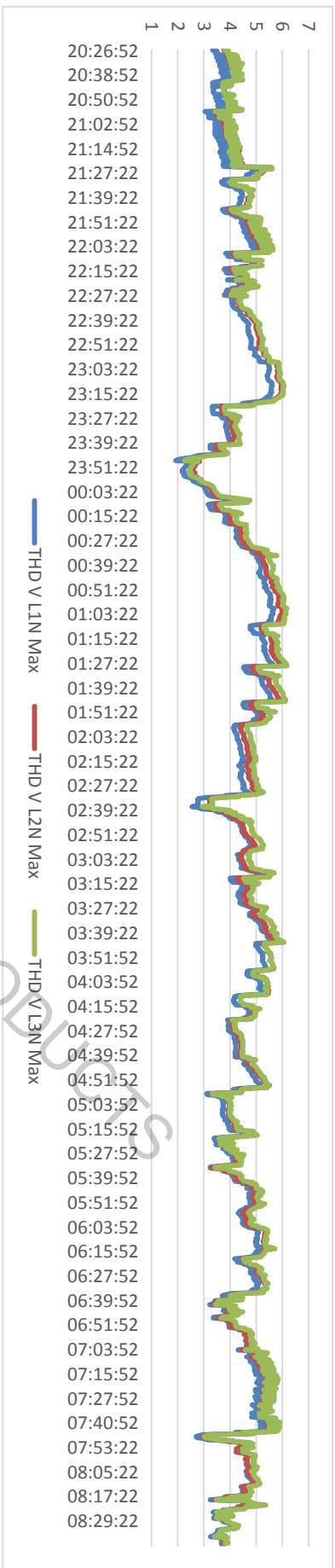
THDi % (Total Current Harmonics Distortion):



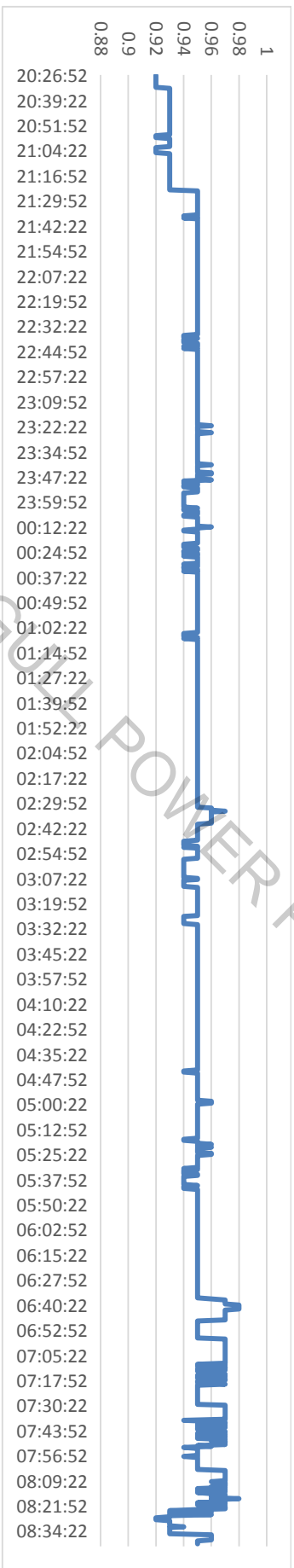
Harmonic Compensation Current:



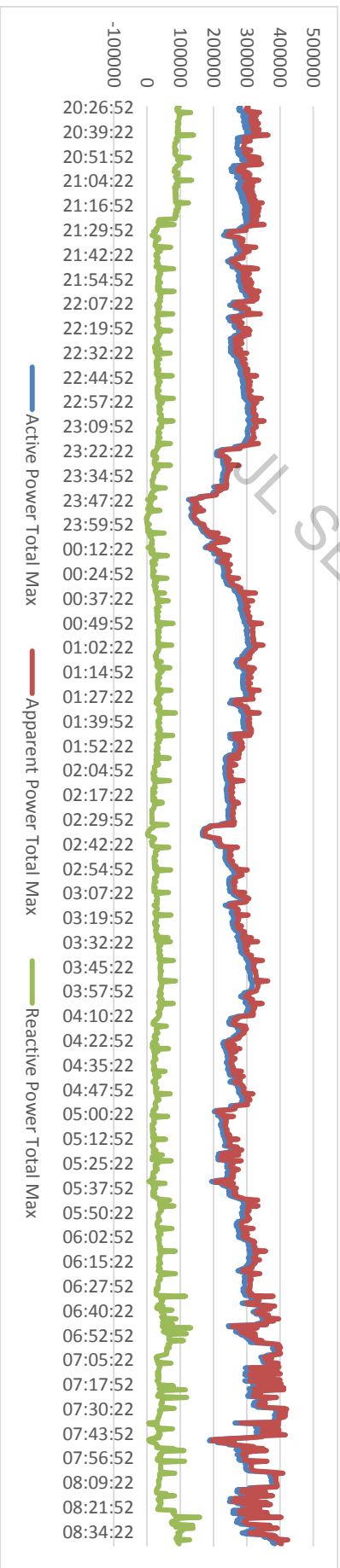
THDv % (Total Voltage Harmonics Distortion):



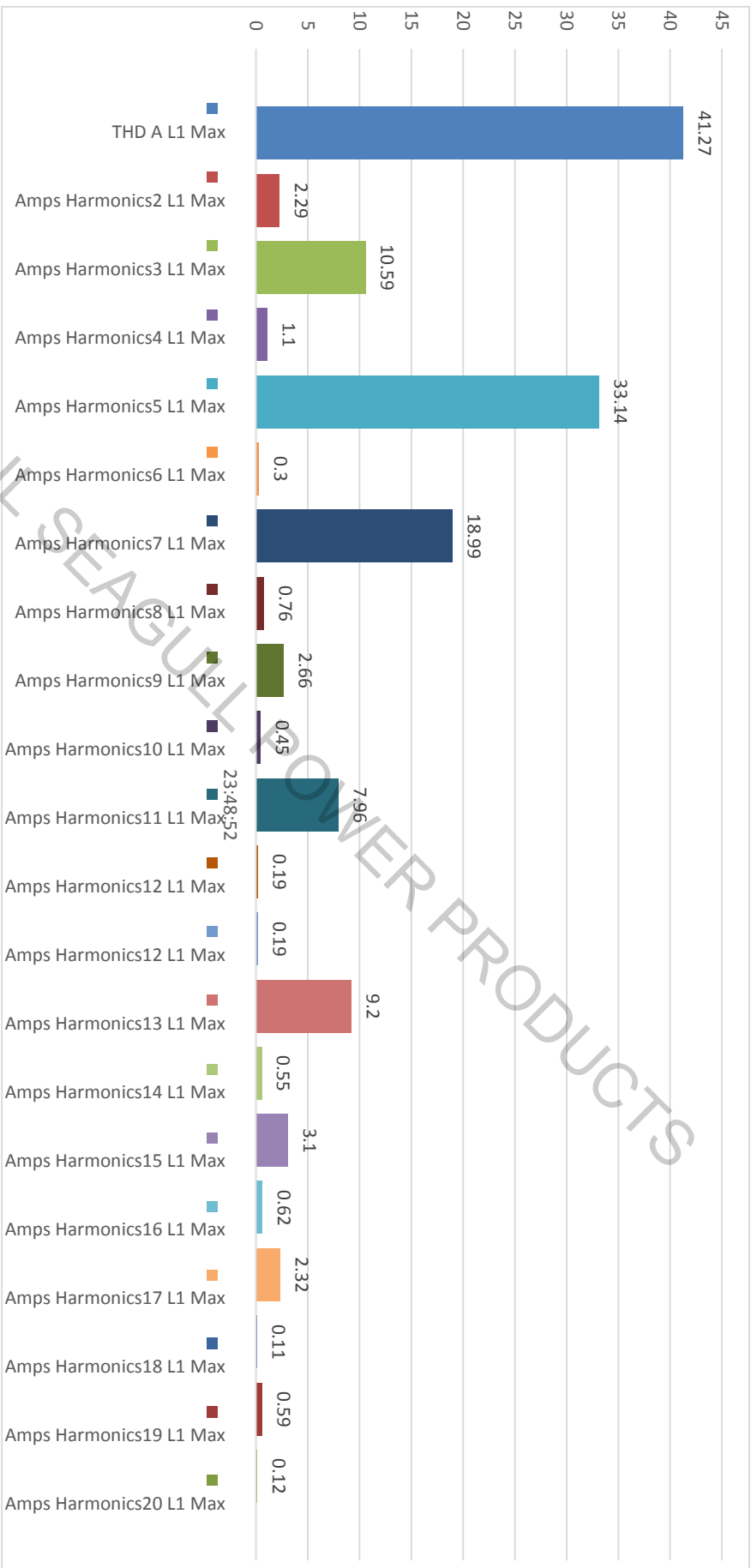
Power Factor total max:



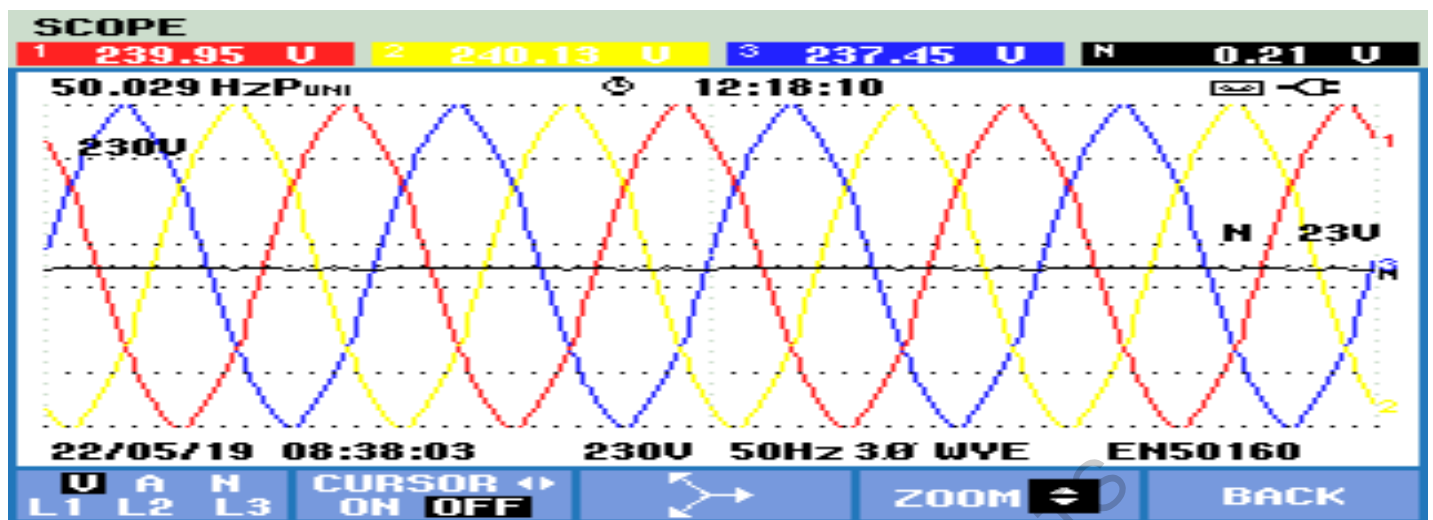
Active, Apparent & Reactive power total max:



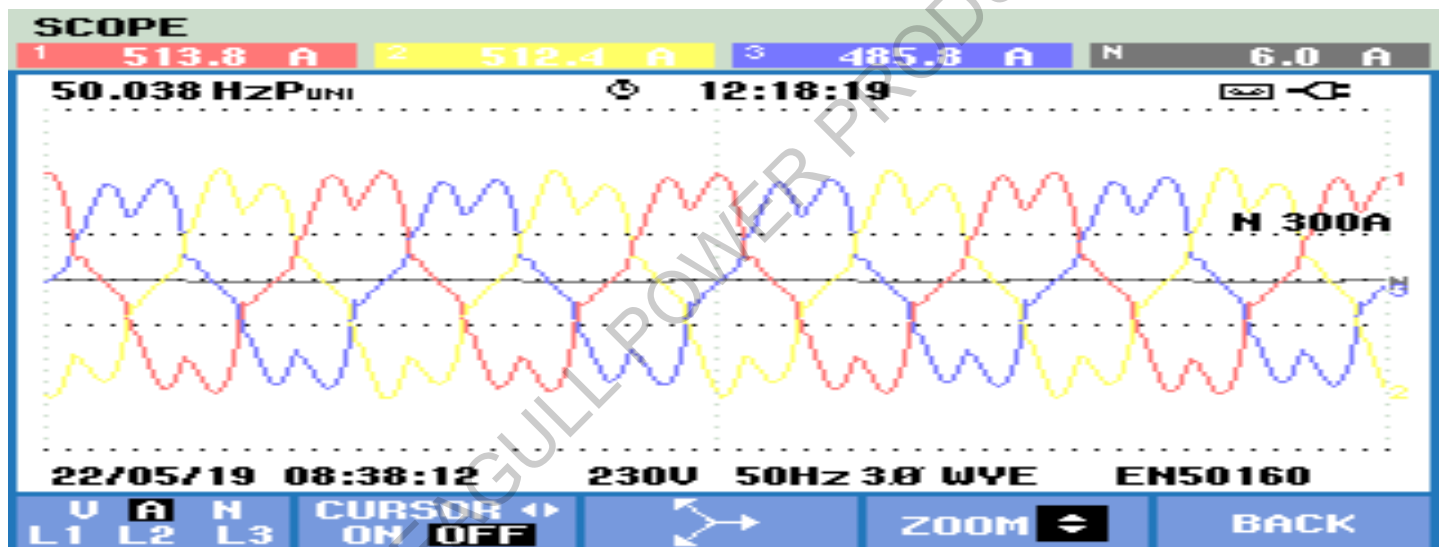
Individual Order Current Harmonic (Ref: Max THDi):



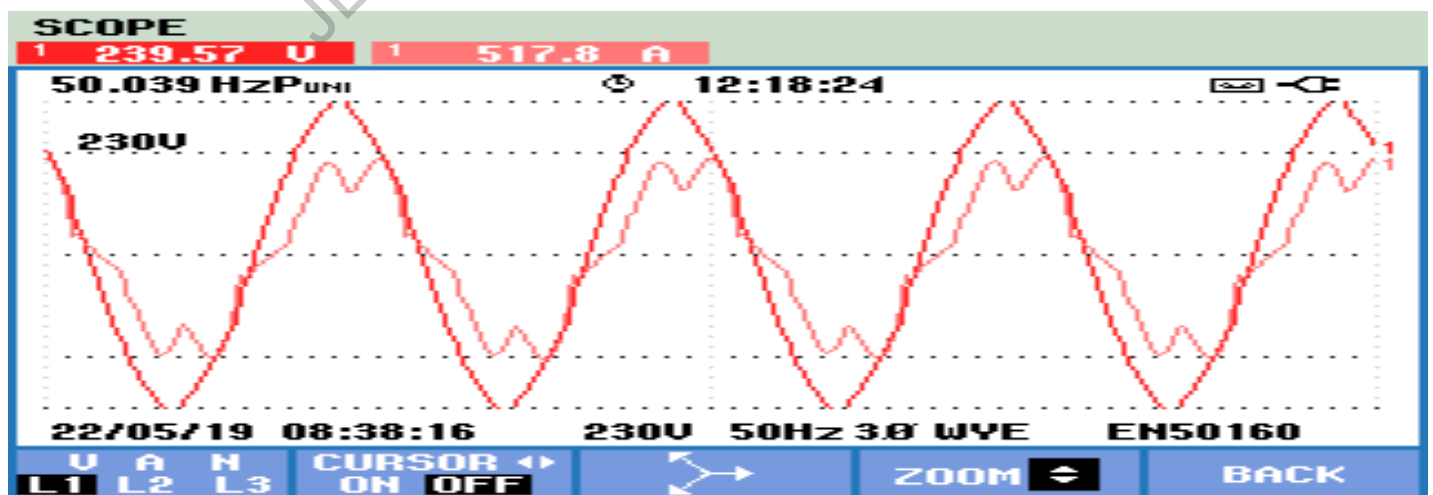
3 ϕ - Voltage Waveform (instantaneous)



3 ϕ - Distorted Current Waveforms (instantaneous)



R ϕ - Distorted Current Waveform (instantaneous)



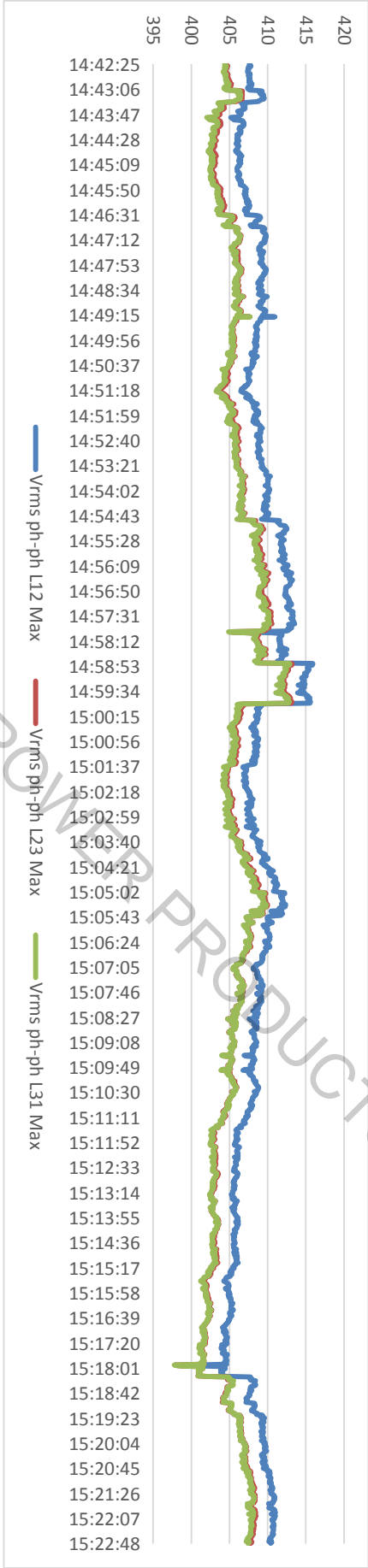
13) Harmonic measurement data – SSB – 1

Harmonic Study Duration: 40 mins, 1 sec Sampling

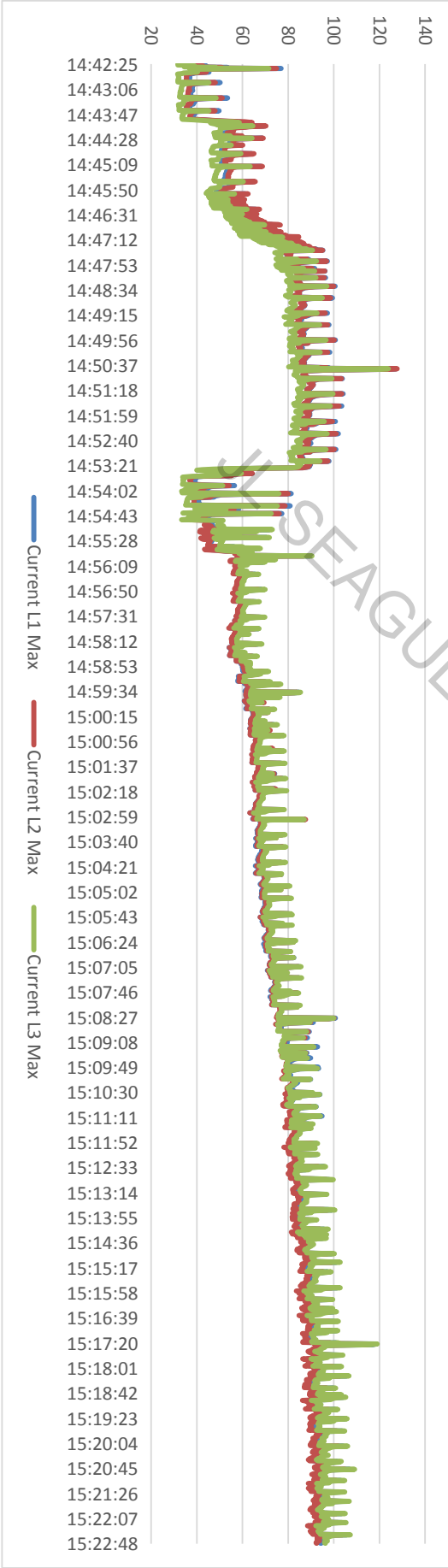
Load Details: R/F no – 10 & 11 – 45.4 KW (Linear Load) + 67.5KW (Inverter Load) + 50KVAR

Logger Data & trend:

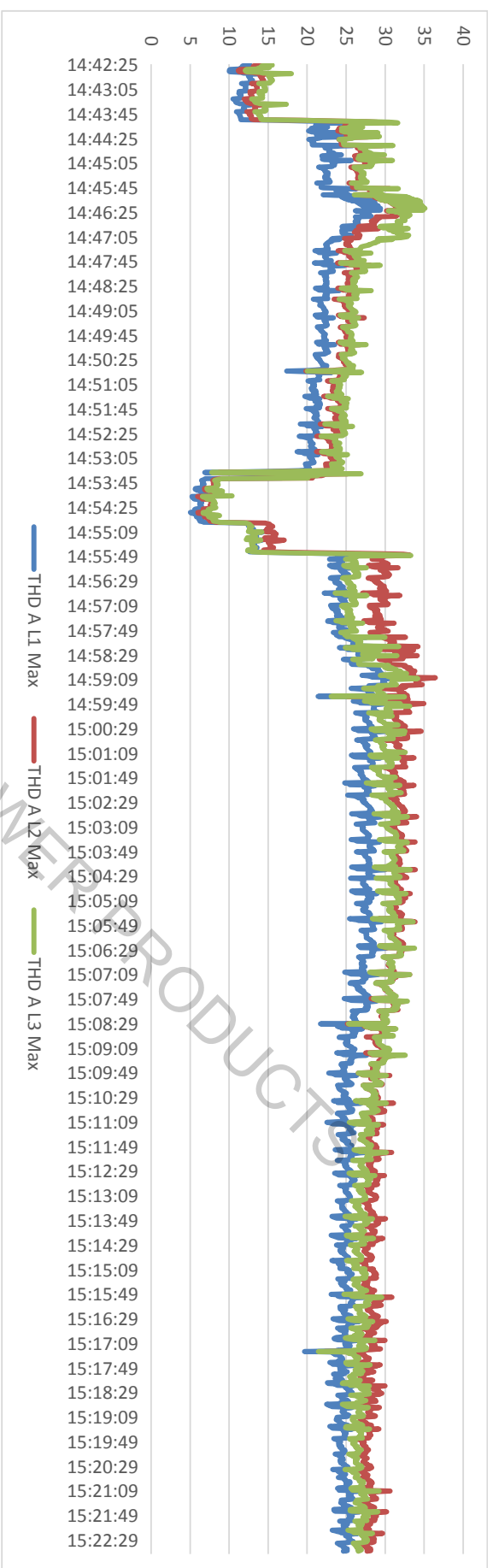
Line to Line Voltage:



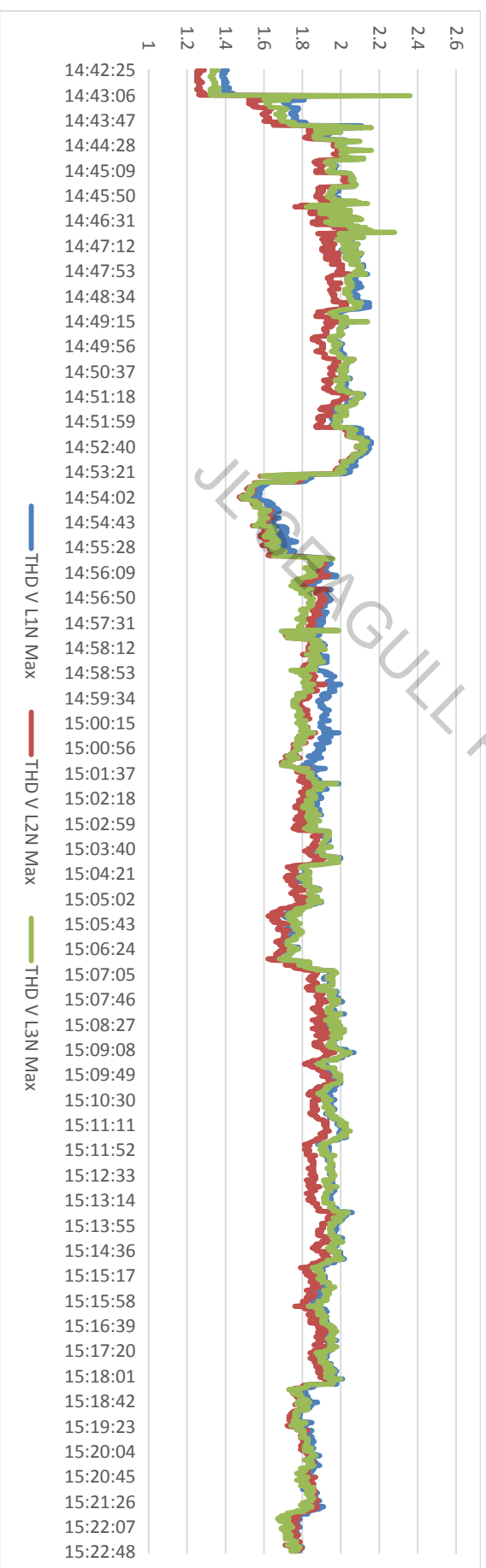
Load Current (rms) (A):



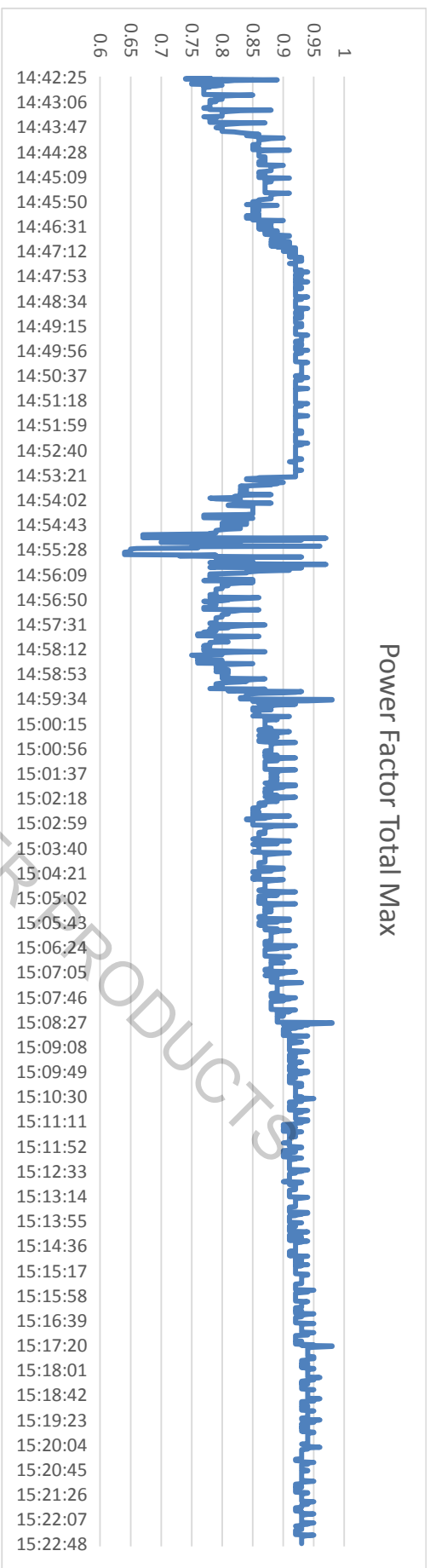
THDi % (Total Current Harmonics Distortion):



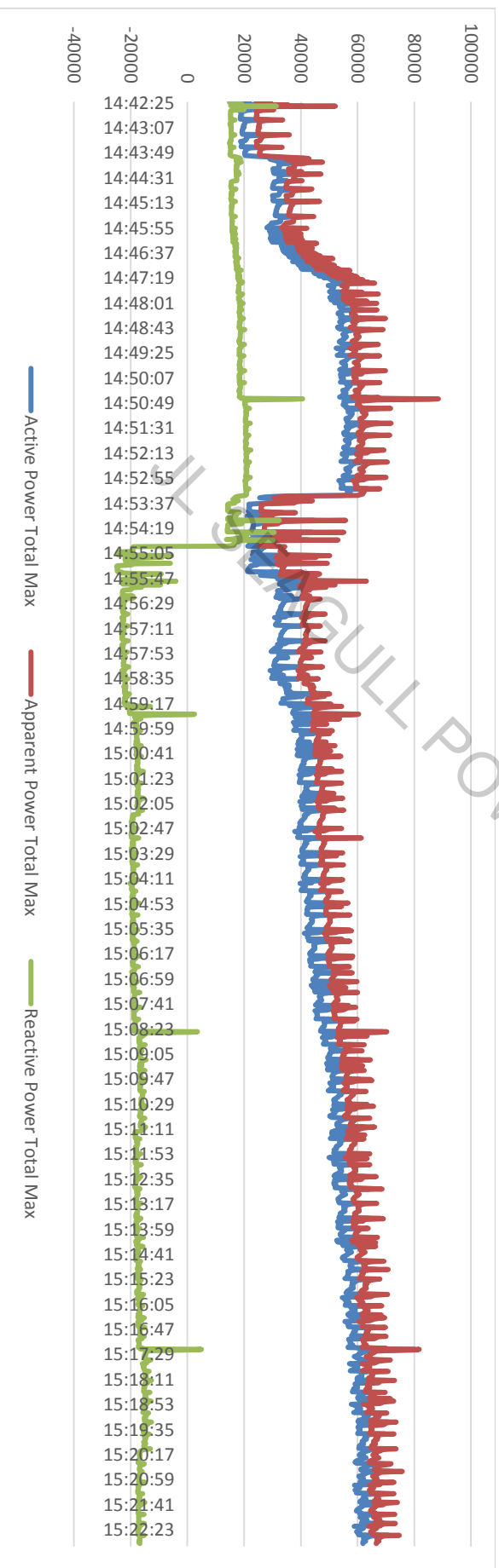
THDv % (Total Voltage Harmonics Distortion):



Power Factor total max:



Active, Apparent & Reactive power total max:



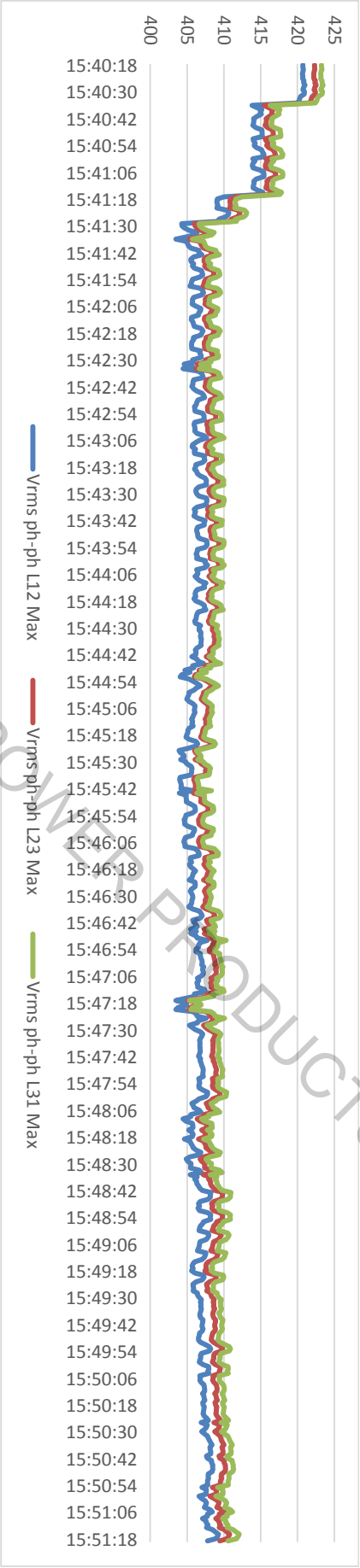
14) Harmonic measurement data – SSB – 13

Harmonic Study Duration: 11 mins, 1 sec Sampling

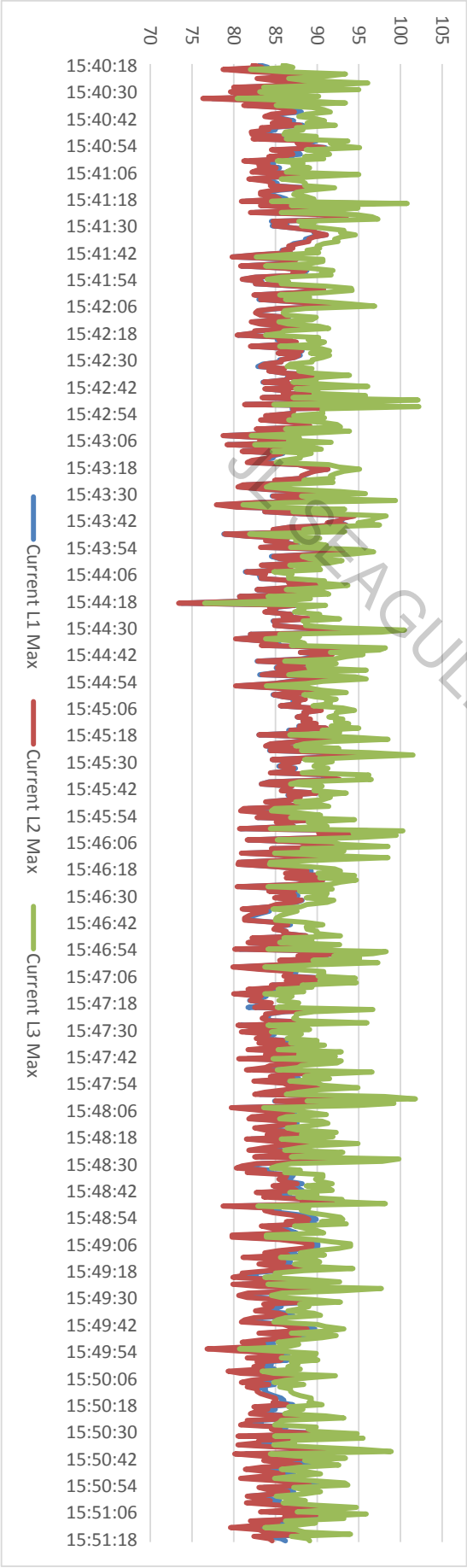
Load Details: Autoconer – 6 to 9 – 60.2KW (Linear Load) + 60KW (Inverter Load)

Logger Data & trend:

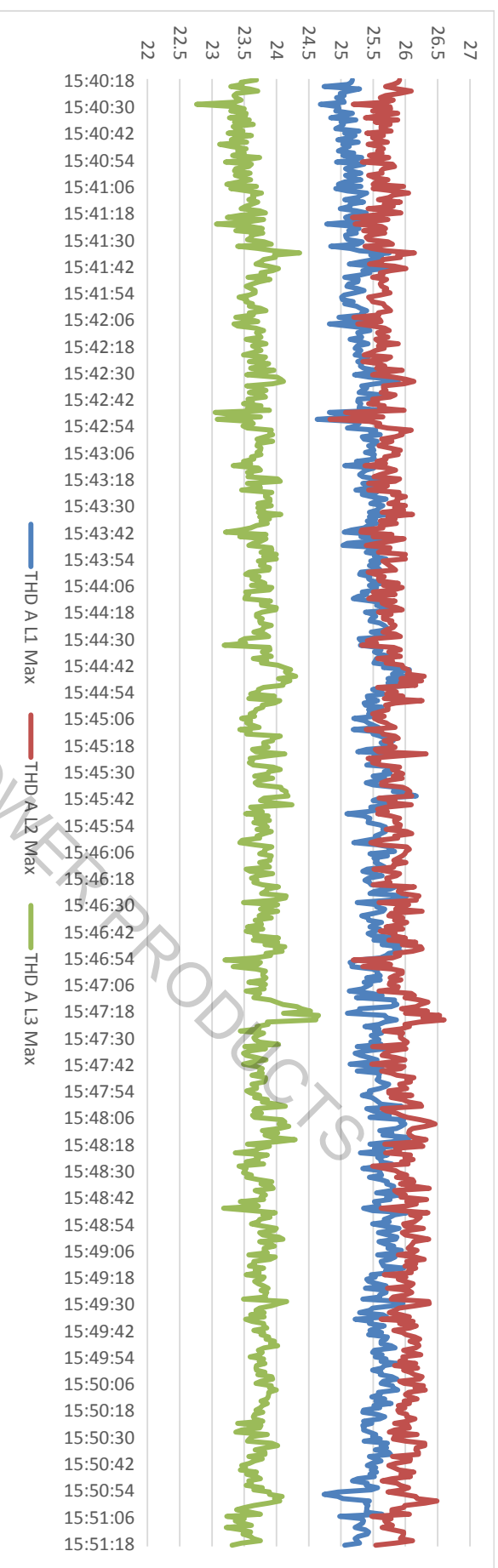
Line to Line Voltage:



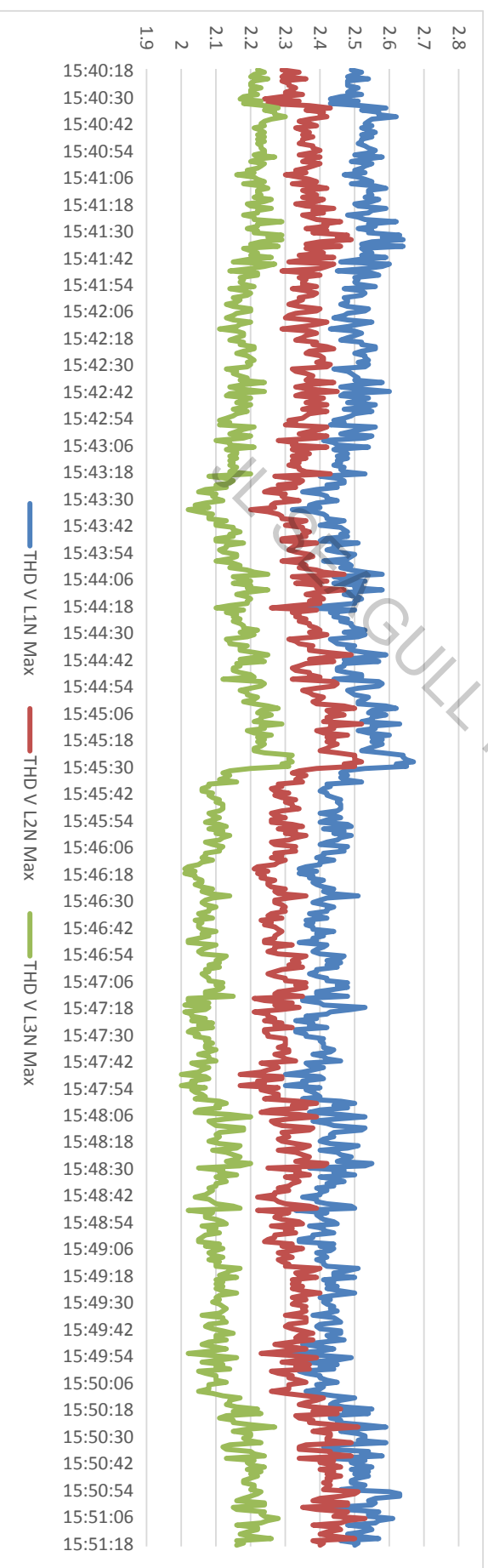
Load Current (rms) (A):



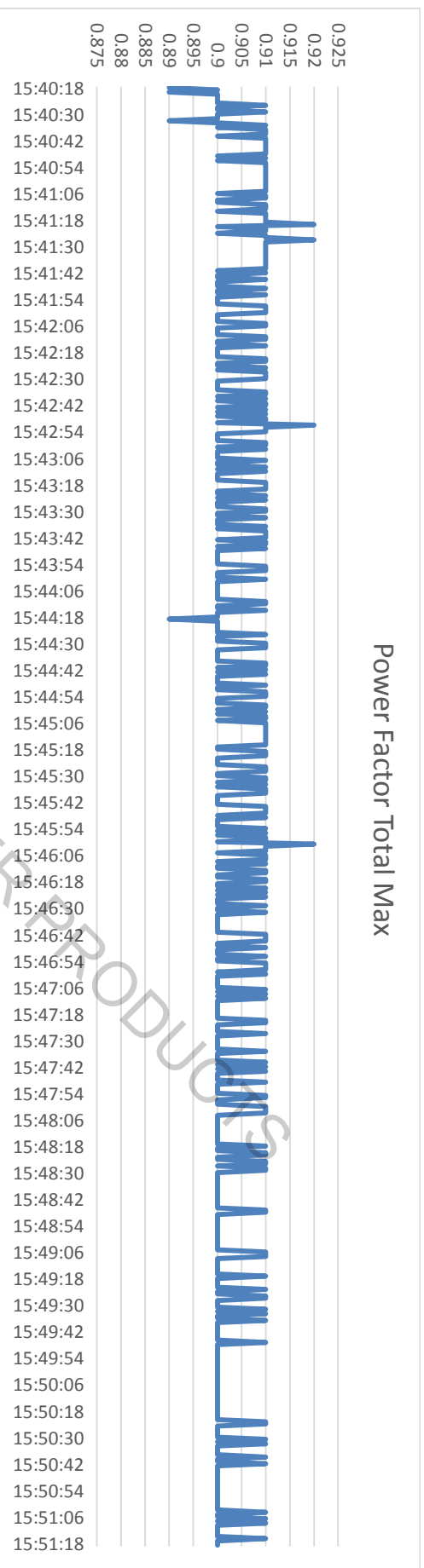
THDi % (Total Current Harmonics Distortion):



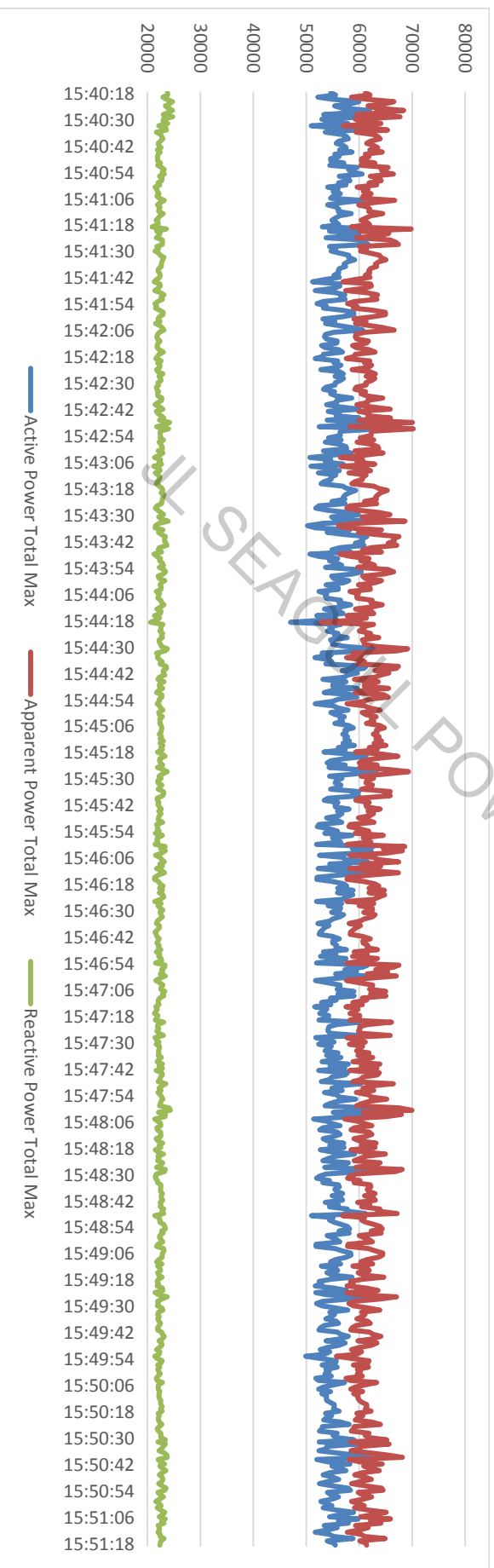
THDv % (Total Voltage Harmonics Distortion):



Power Factor total max:



Active, Apparent & Reactive power total max:



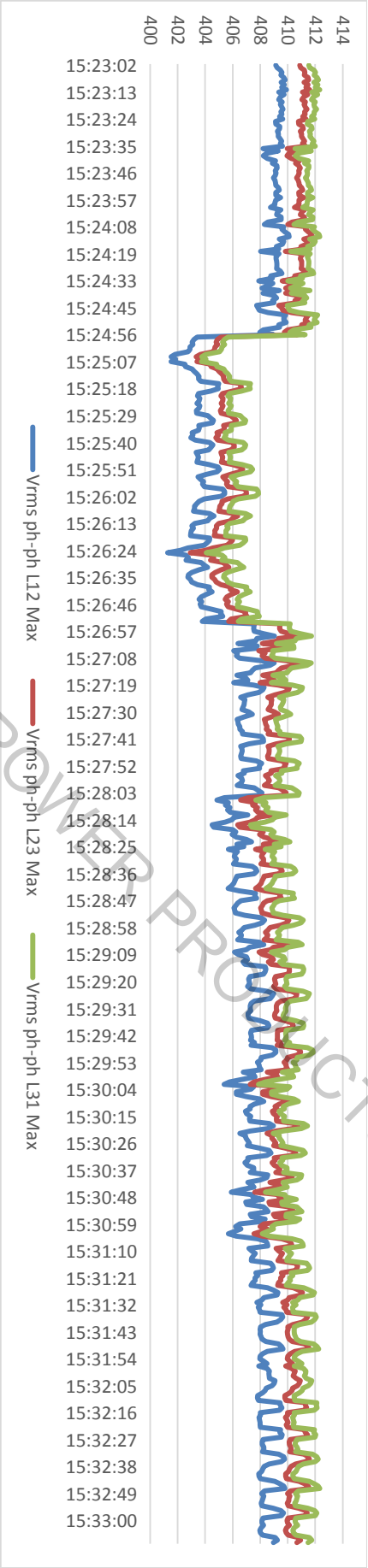
15) Harmonic measurement data – SSB – 15

Harmonic Study Duration: 15 mins, 0.5 sec Sampling

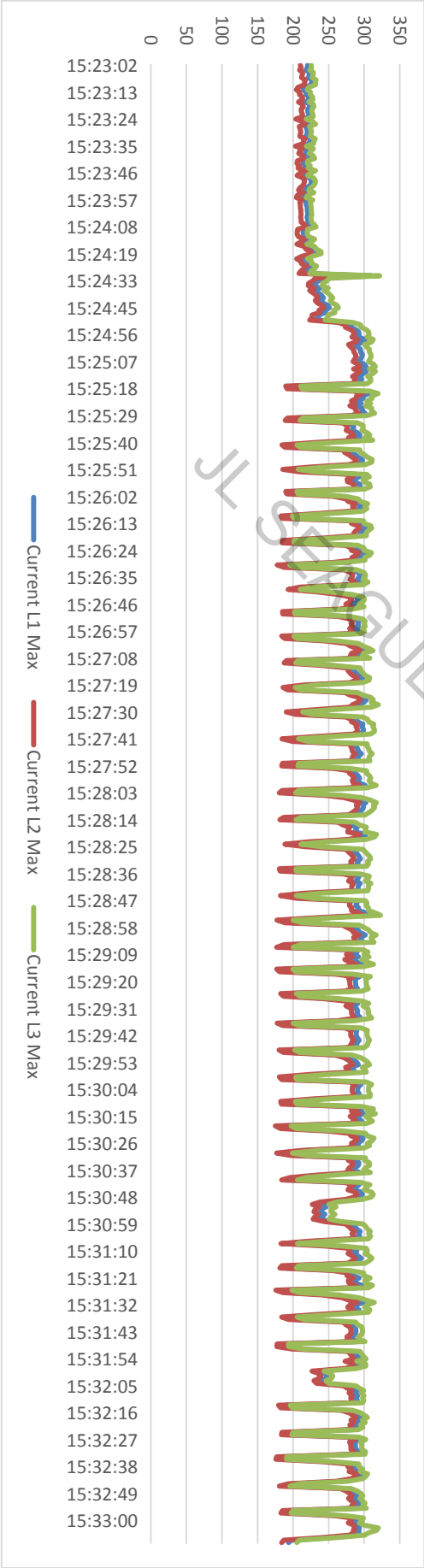
Load Details: Autoconer – 1 to 5 and Compressor 1 & 2:- 203.9KW (Linear Load) + 75 KW inverter load

Logger Data & trend:

Line to Line Voltage:



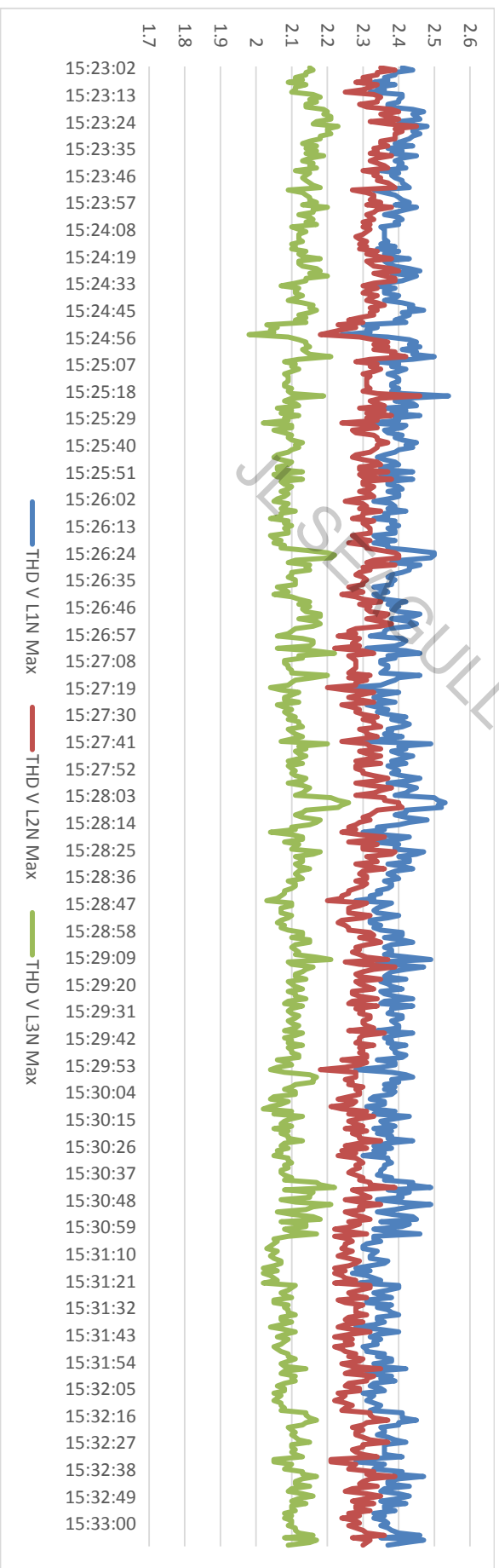
Load Current (rms) (A):



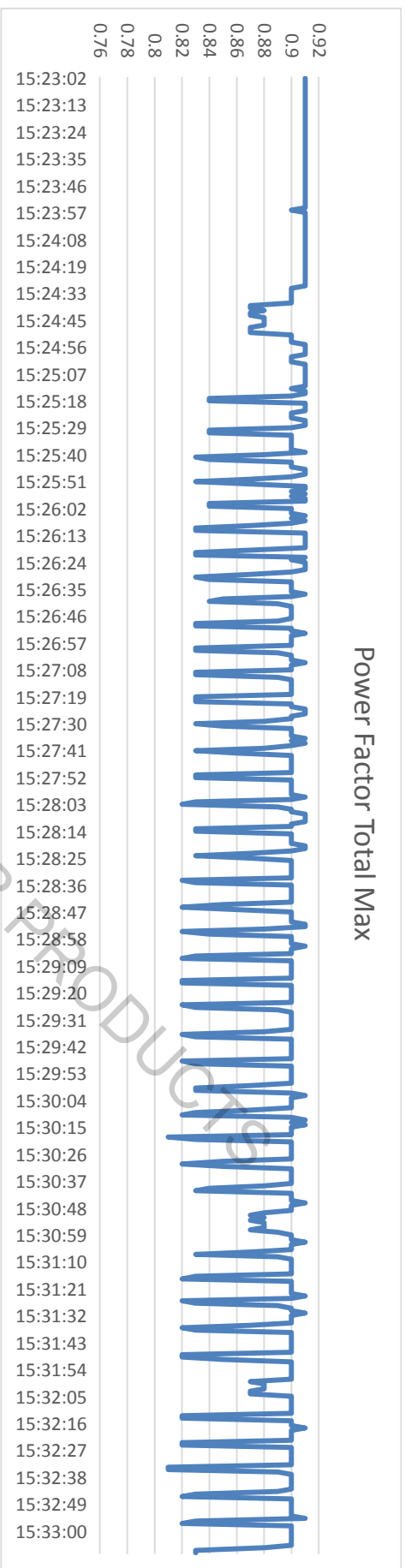
THDi % (Total Current Harmonics Distortion):



THDv % (Total Voltage Harmonics Distortion):



Power Factor total max:



Active, Apparent & Reactive power total max:



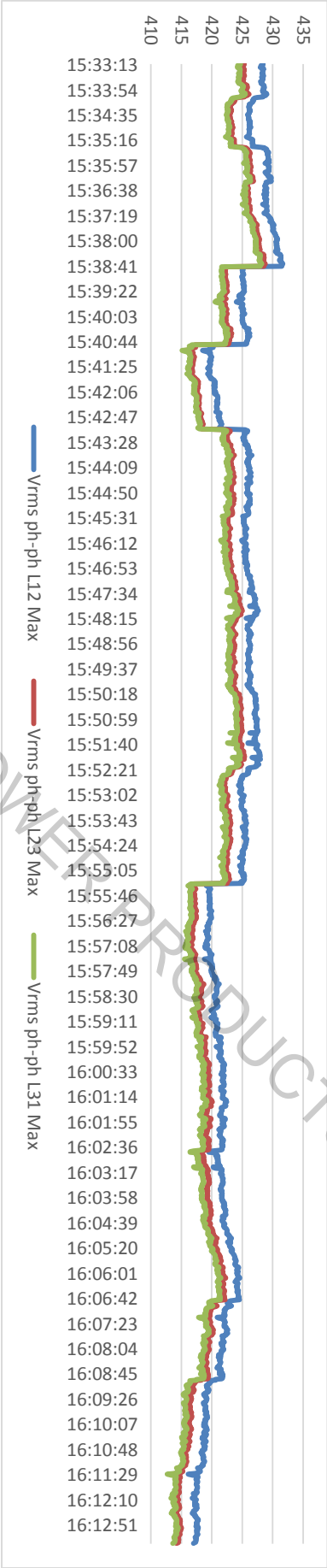
16) Harmonic measurement data – SSB – 16

Harmonic Study Duration: 40 mins, 1sec Sampling

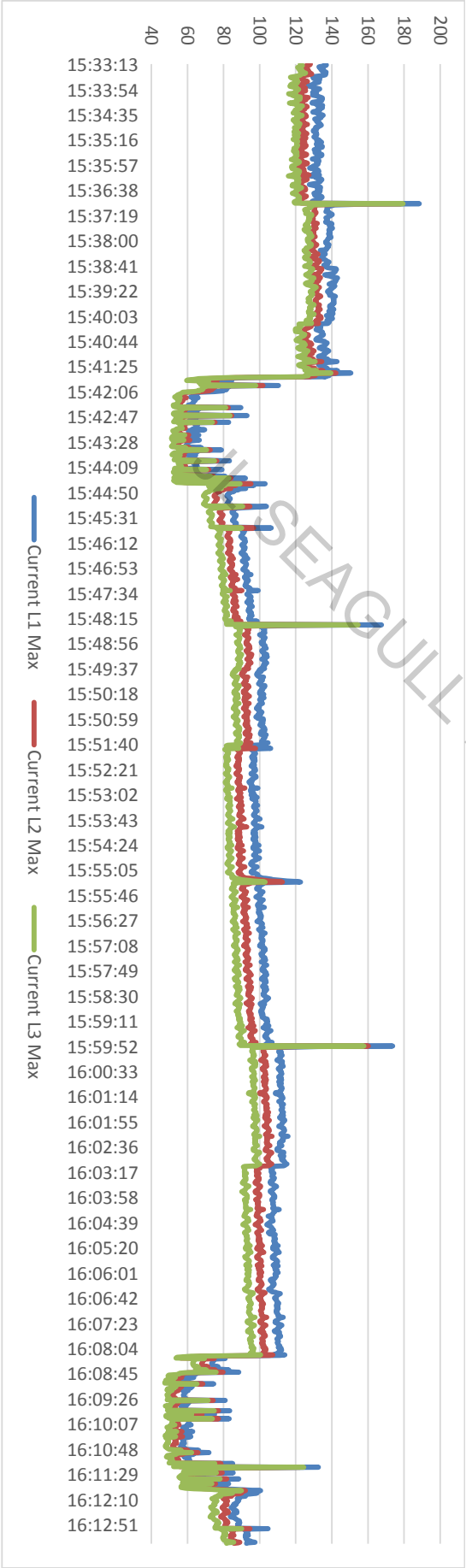
Load Details: R/F – 23 to 25 and TFO – 1 & 2 : 45.8KW (Linear Load) + 187.5KW (Inverter Load)

Logger Data & trend:

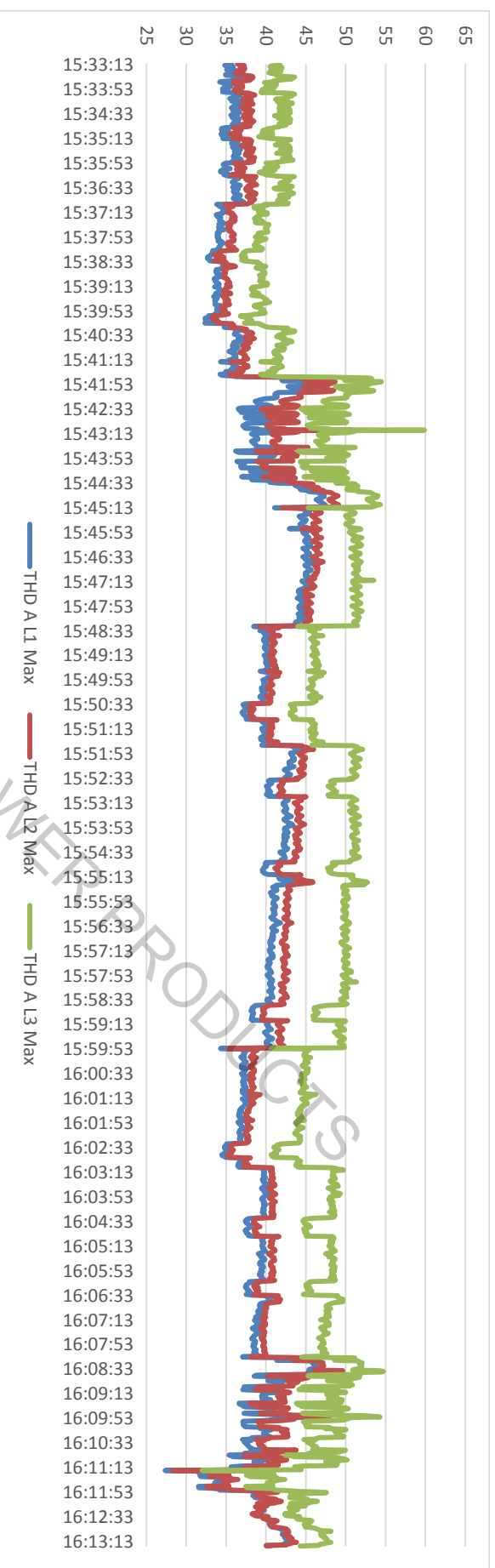
Line to Line Voltage:



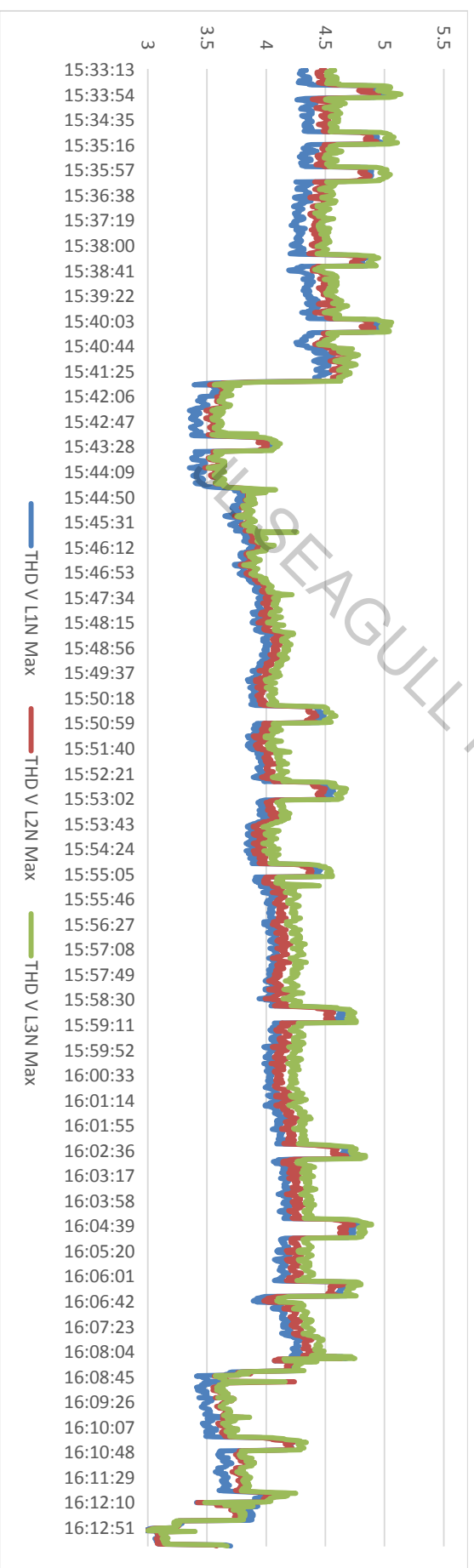
Load Current (rms) (A):



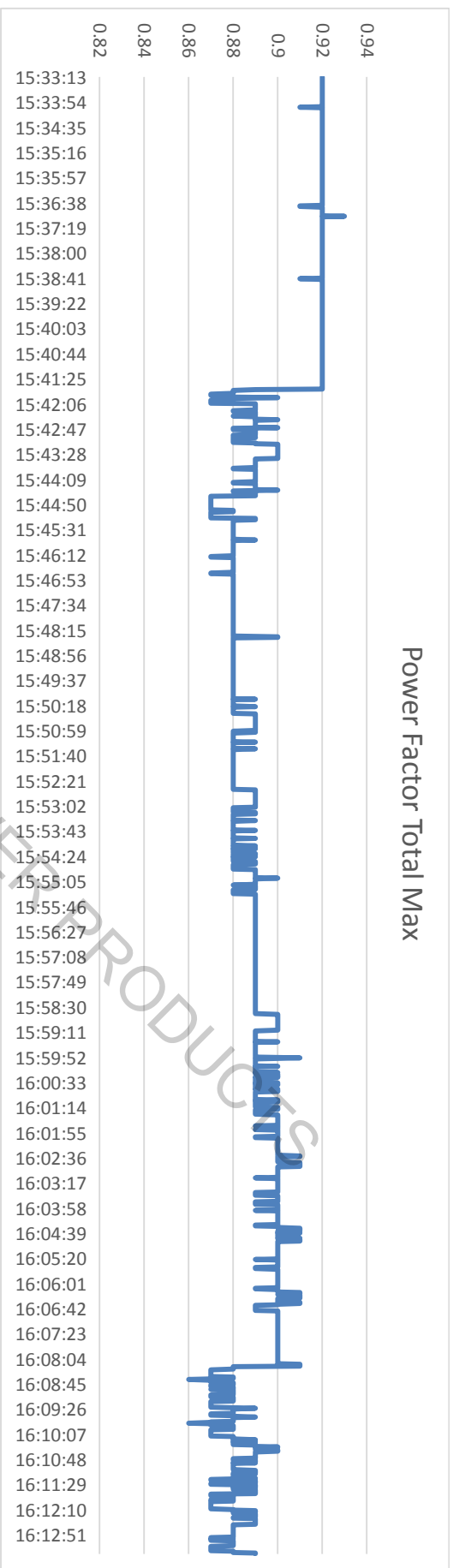
THDi % (Total Current Harmonics Distortion):



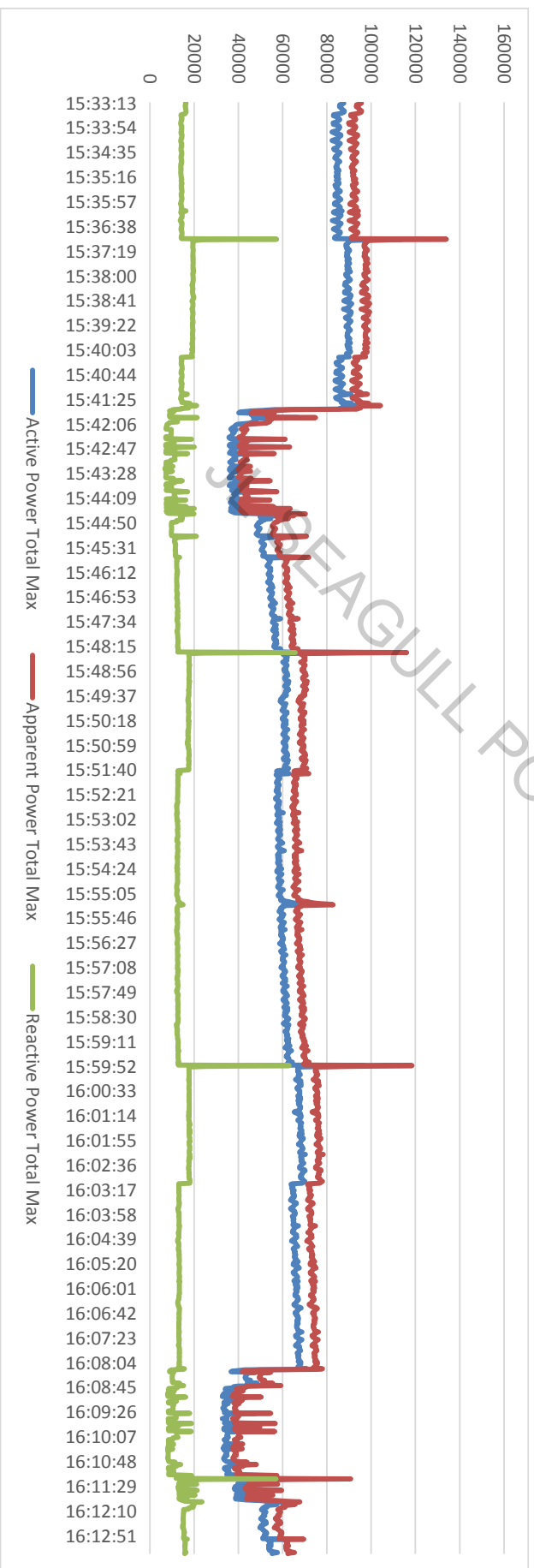
THDv % (Total Voltage Harmonics Distortion):



Power Factor total max:



Active, Apparent & Reactive power total max:



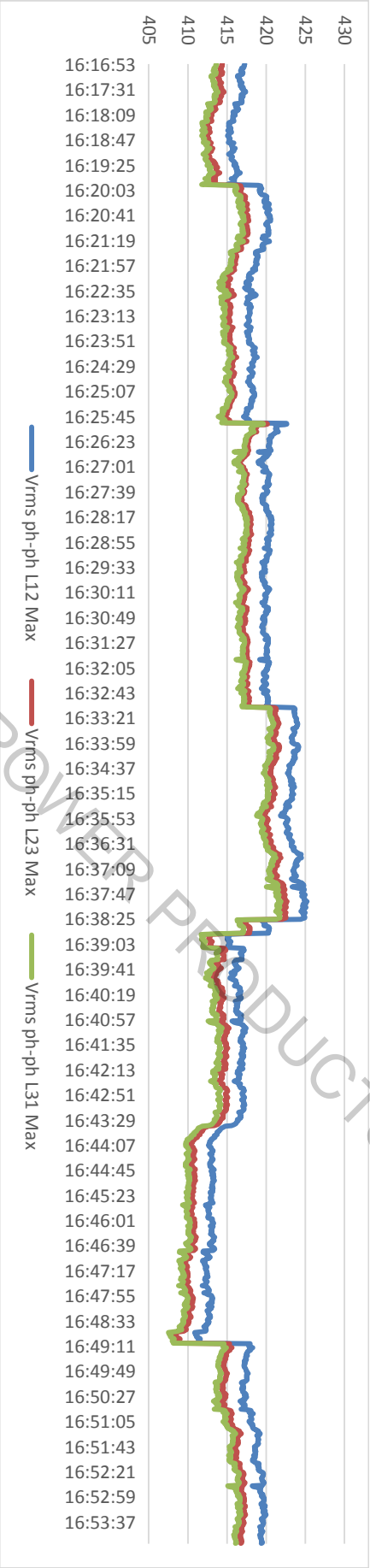
17) Harmonic measurement data – SSB – 17

Harmonic Study Duration: 37 mins, 1 sec Sampling

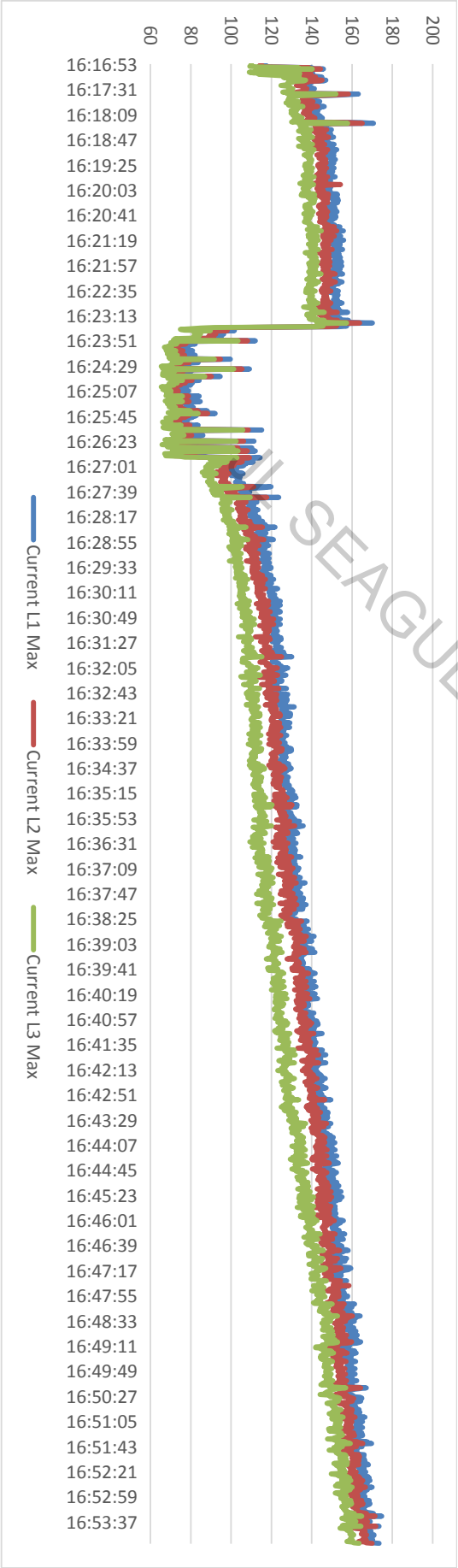
Load Details: R/F – 26 & 27, Autoconer – 10 & 11 and TFO – 3 : 69.5KW (Linear Load) + 155KW (Inverter Load) + 10KVA UPS

Logger Data & trend:

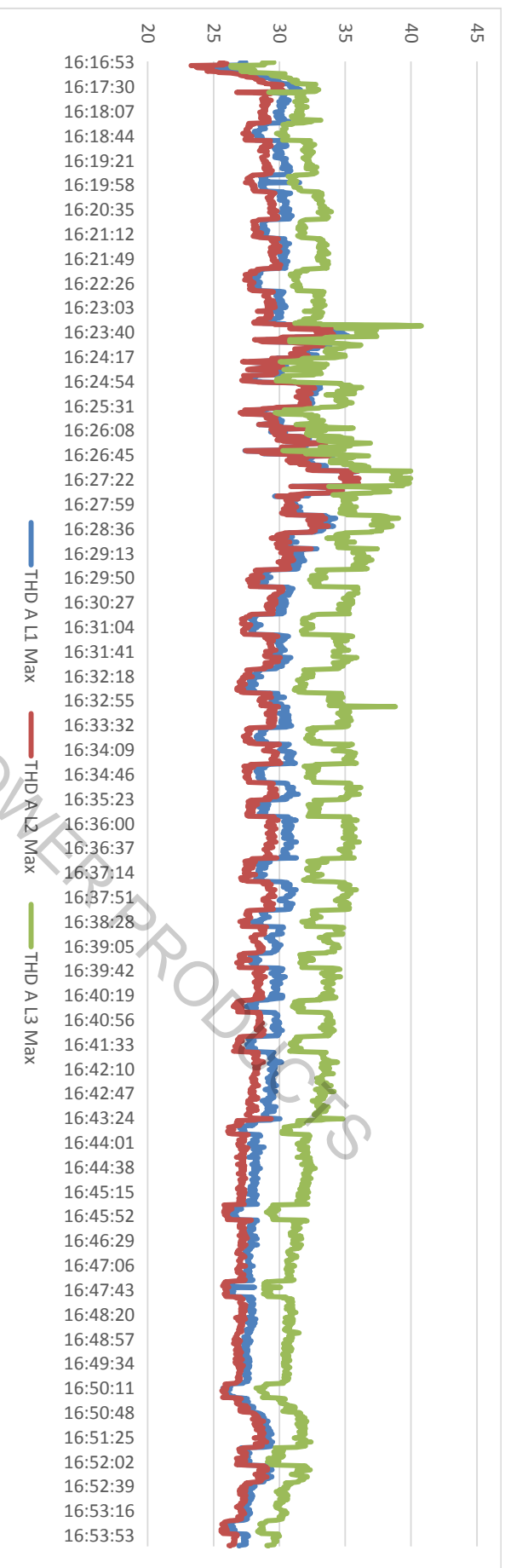
Line to Line Voltage:



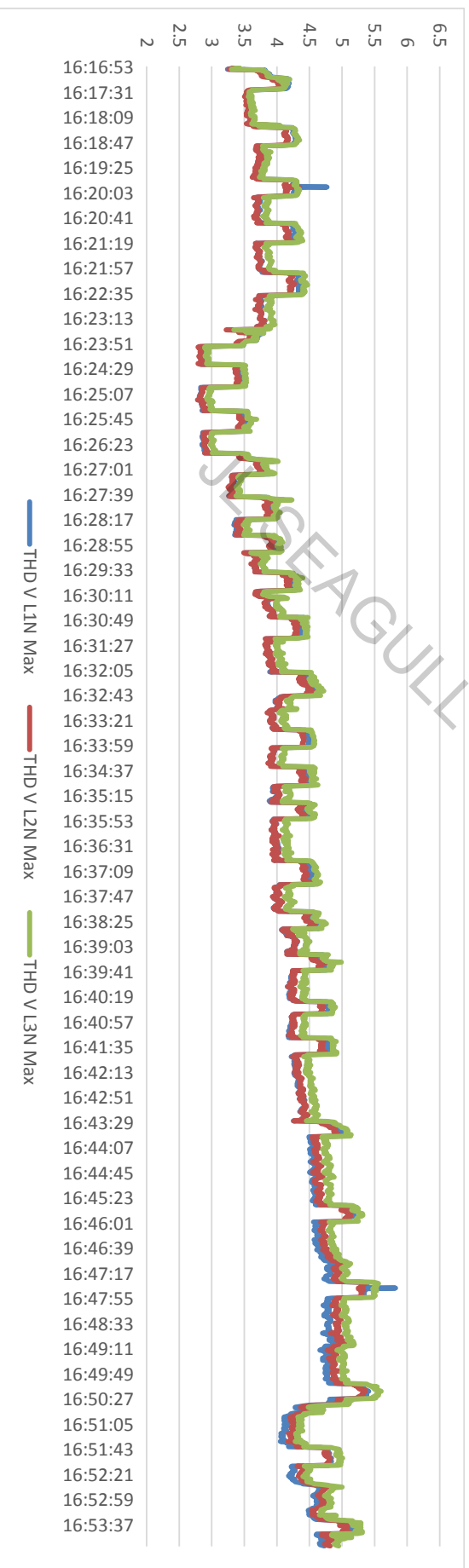
Load Current (rms) (A):



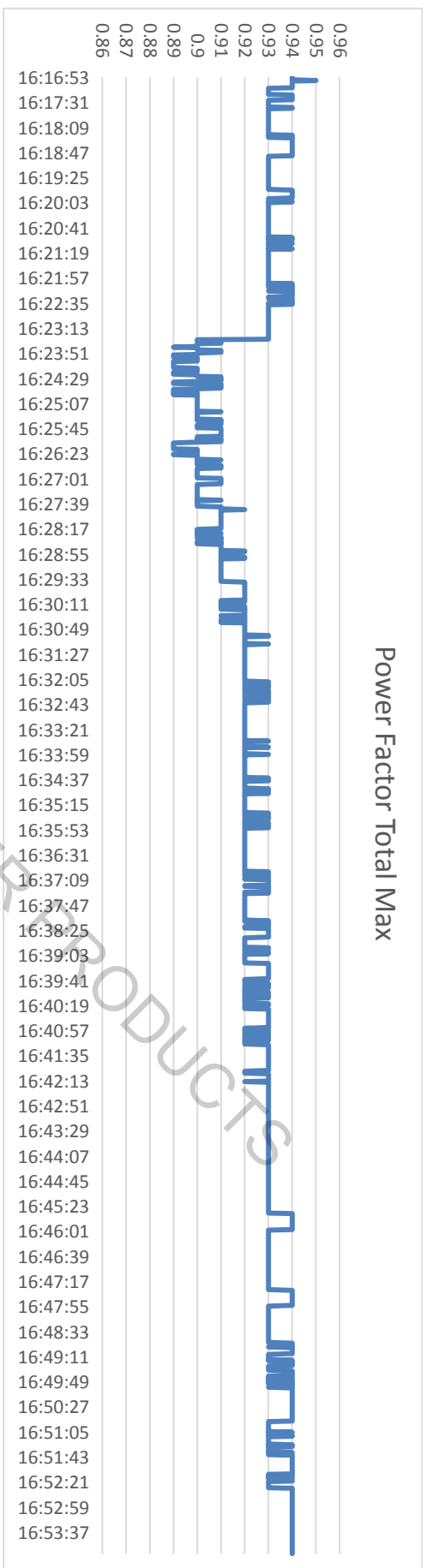
THDi % (Total Current Harmonics Distortion):



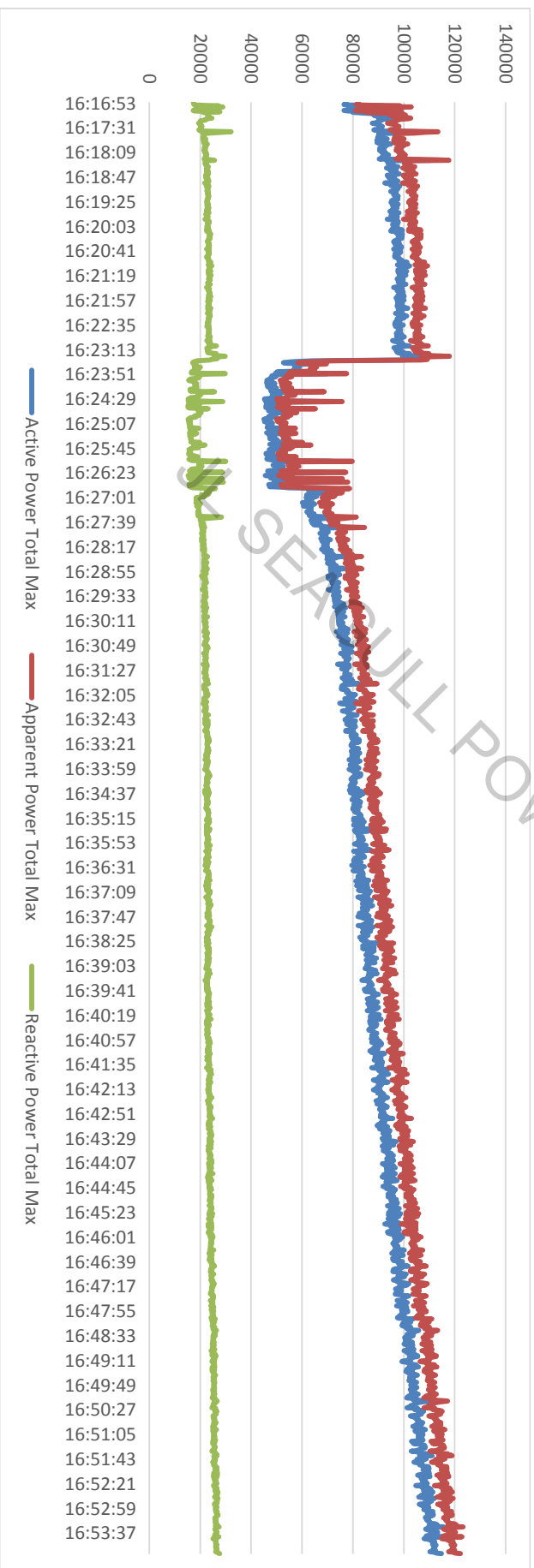
THDv % (Total Voltage Harmonics Distortion):



Power Factor total max:



Active, Apparent & Reactive power total max:



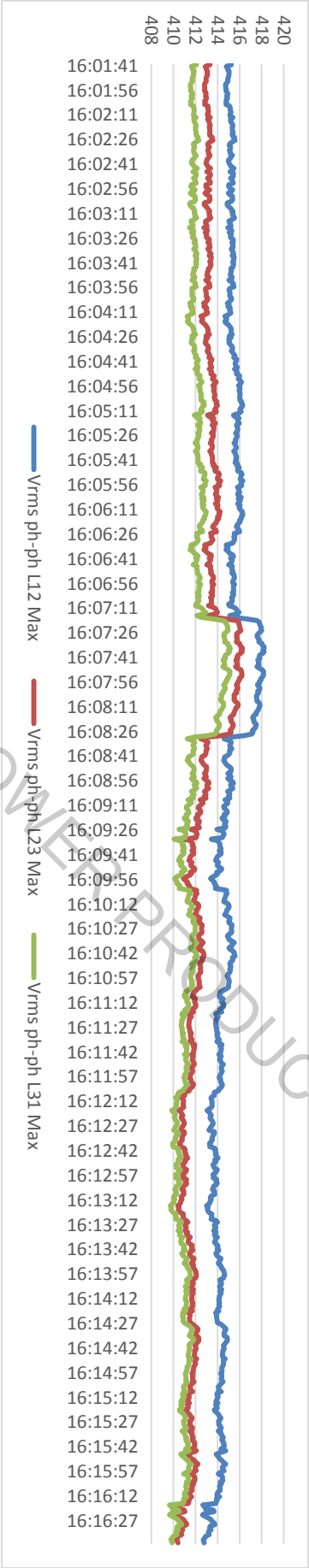
18) Harmonic measurement data – COMP

Harmonic Study Duration: 10 mins, 1 sec Sampling

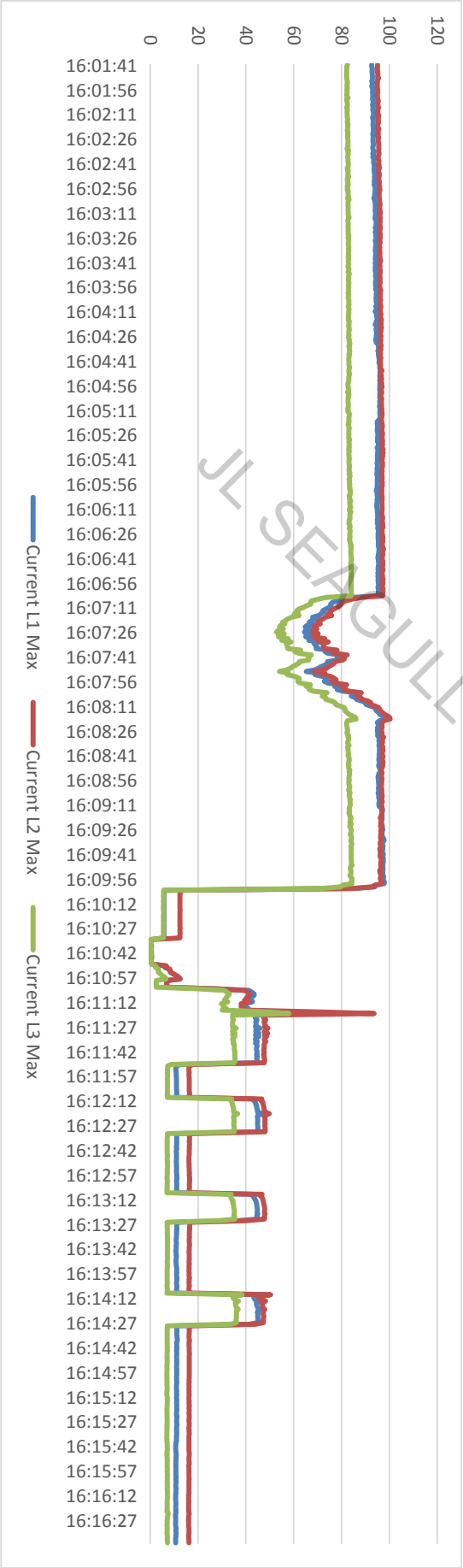
Load Details: Compressor – 55KW Drive

Logger Data & trend:

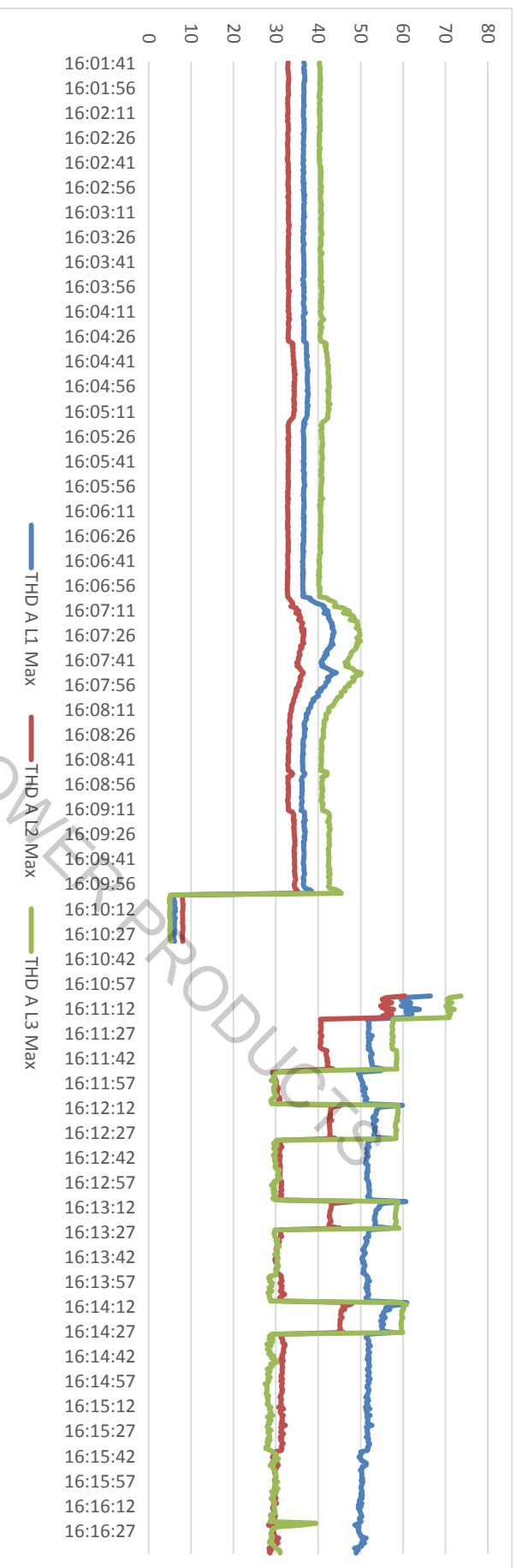
Line to Line Voltage:



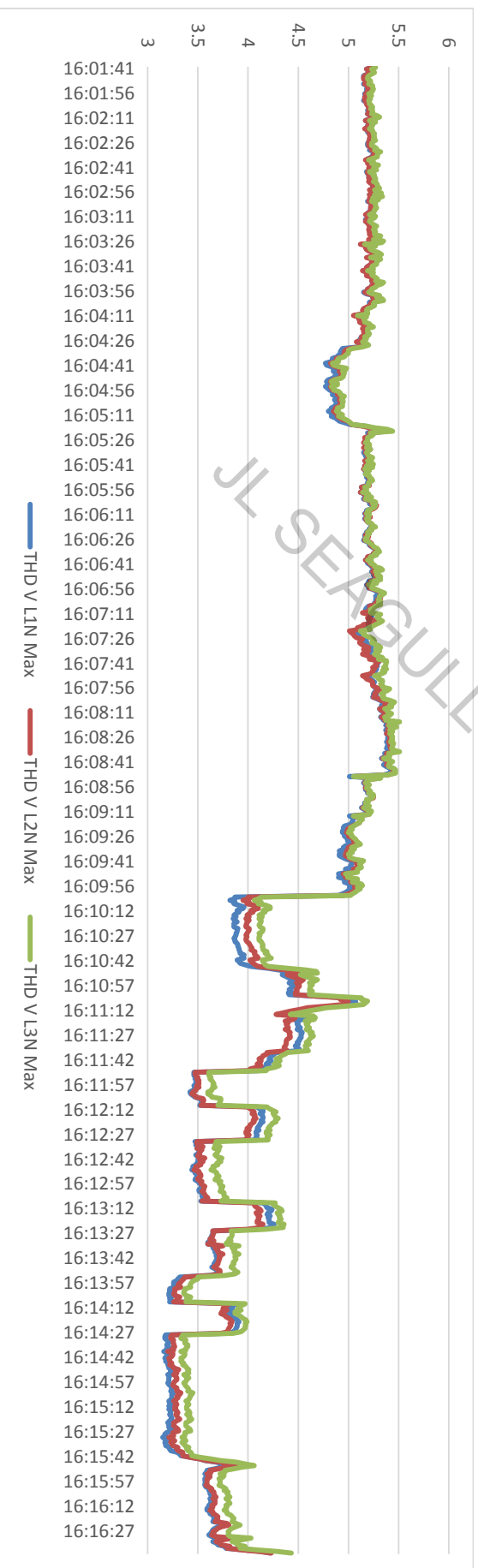
Load Current (rms) (A):



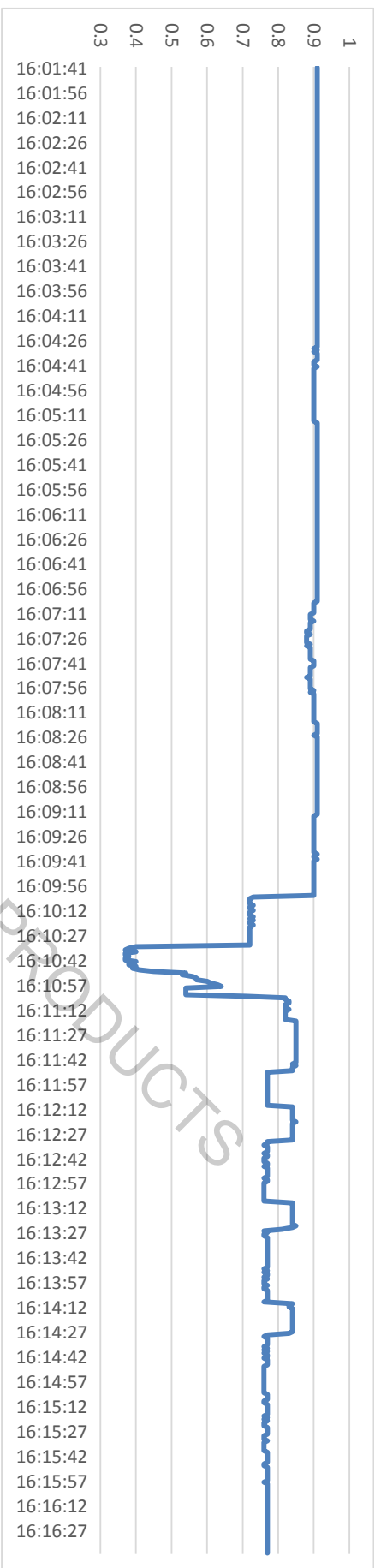
THDi % (Total Current Harmonics Distortion):



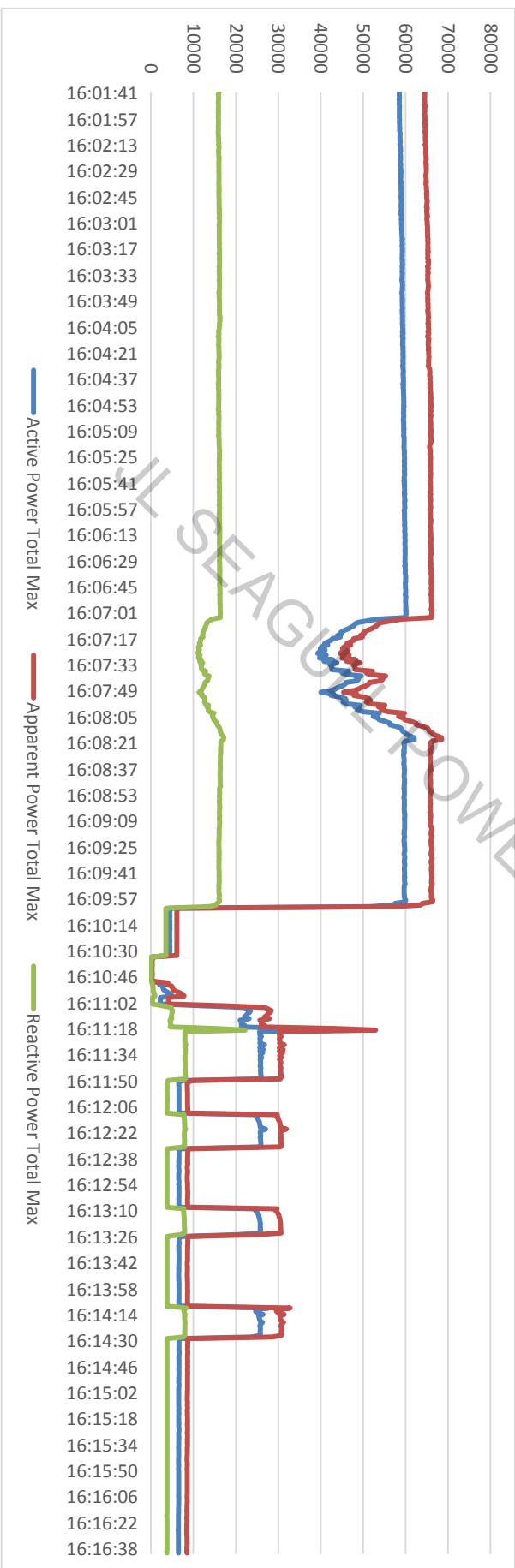
THDv % (Total Voltage Harmonics Distortion):



Power Factor total max:



Active, Apparent & Reactive power total max:



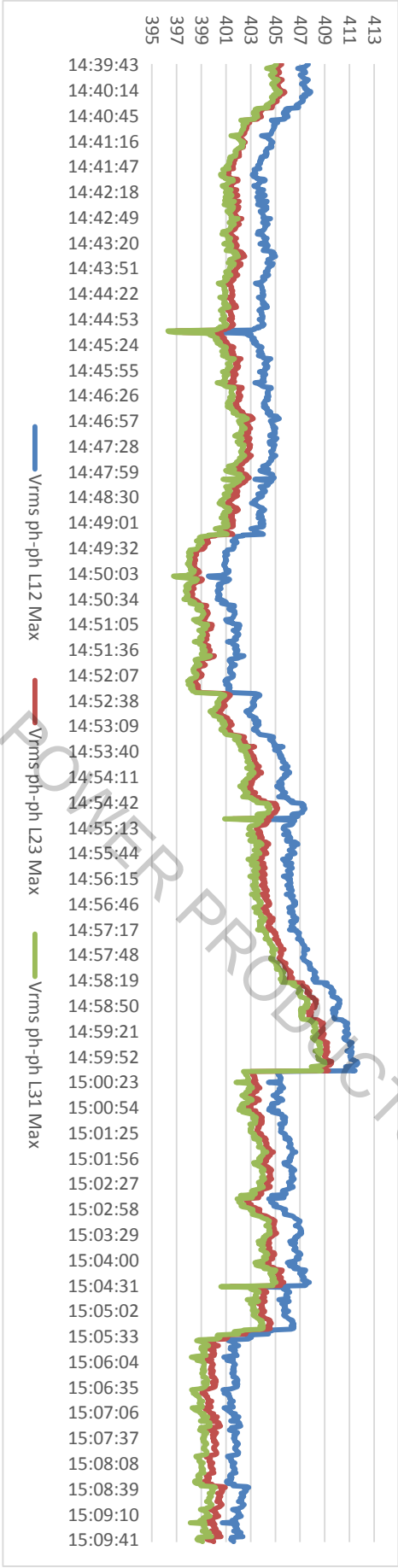
19) Harmonic measurement data – LR-11

Harmonic Study Duration: 30 mins, 0.5 sec Sampling

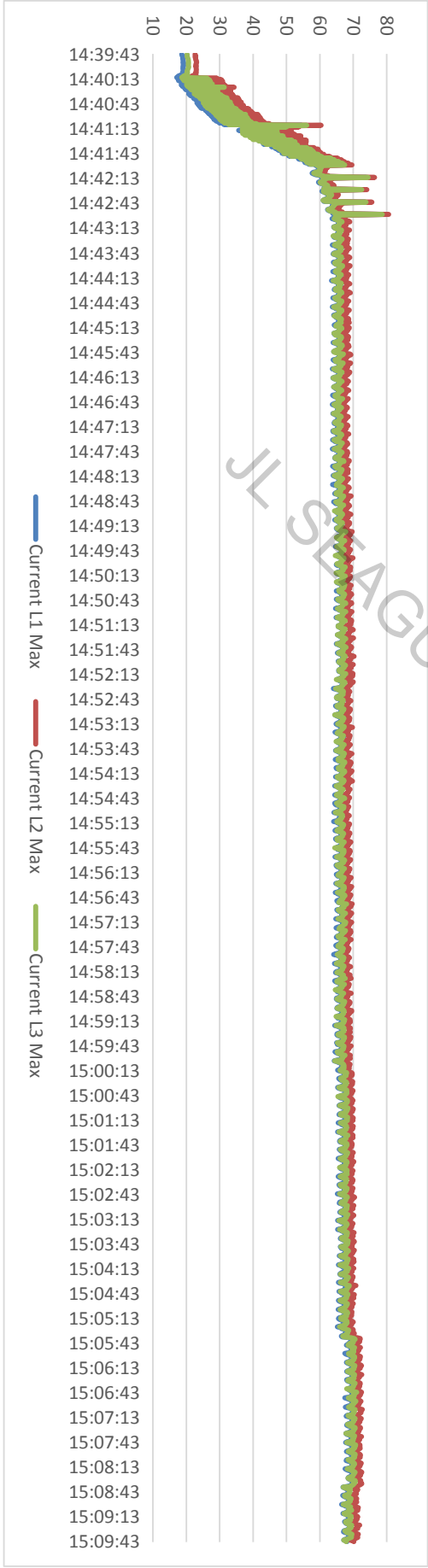
Load Details : R/F – 11 – 67.5 KW Inverter load

Logger Data & trend:

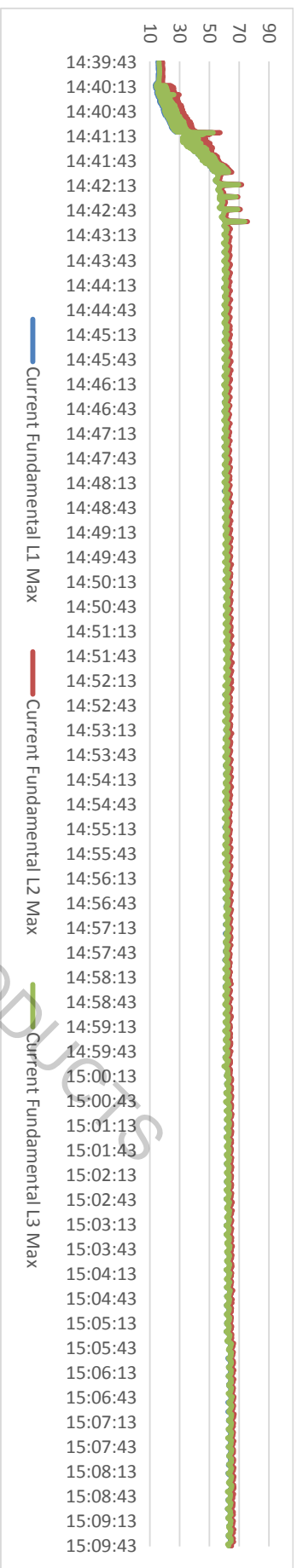
Line to Line Voltage:



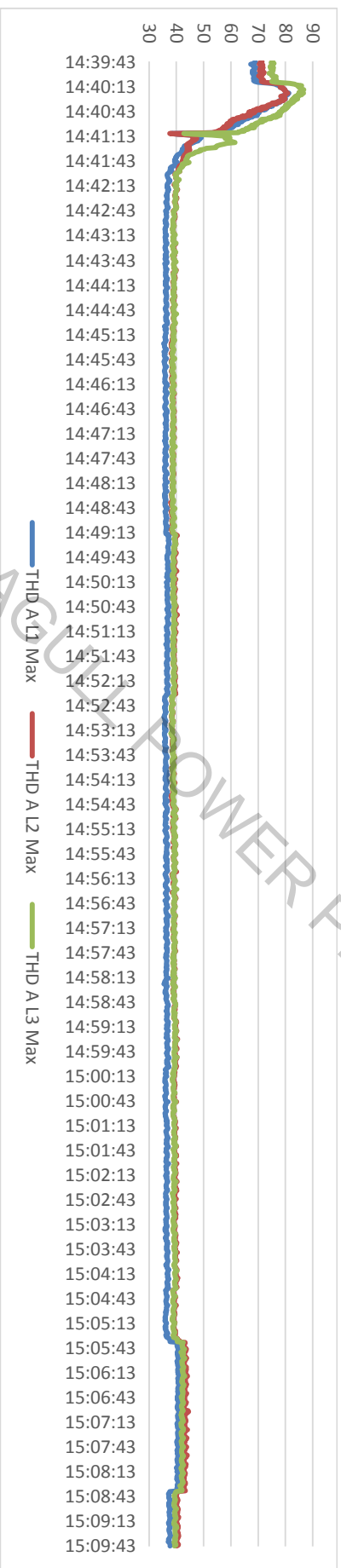
Load Current (rms) (A):



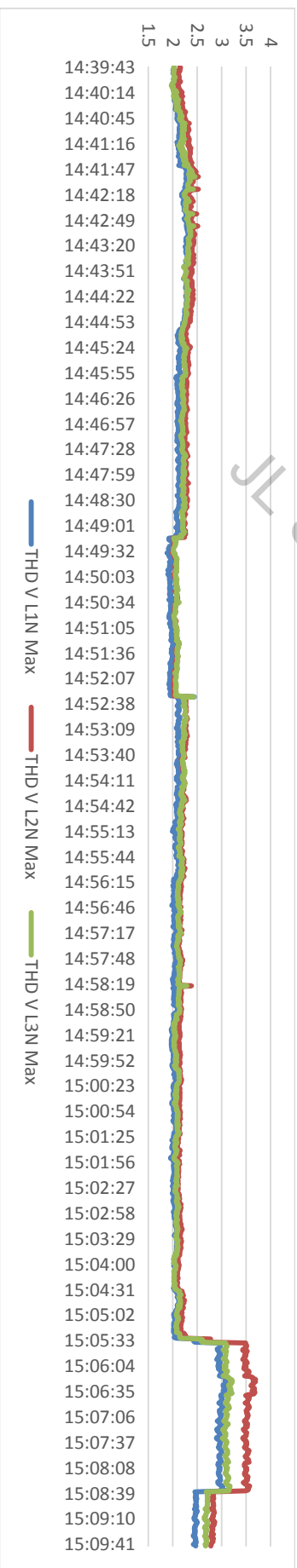
Fundamental Current (Trend):



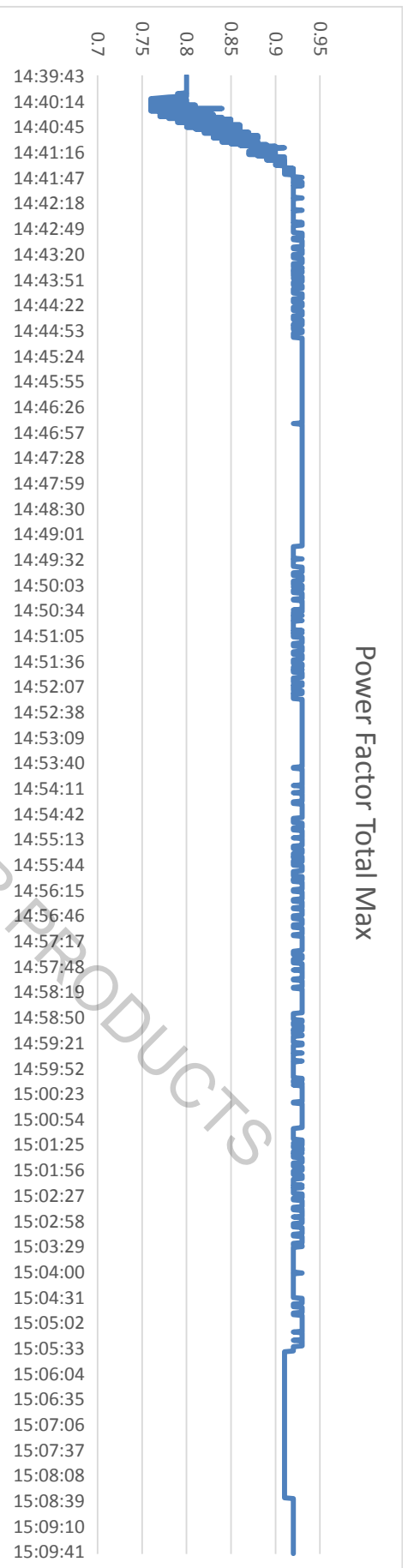
THDi % (Total Current Harmonics Distortion):



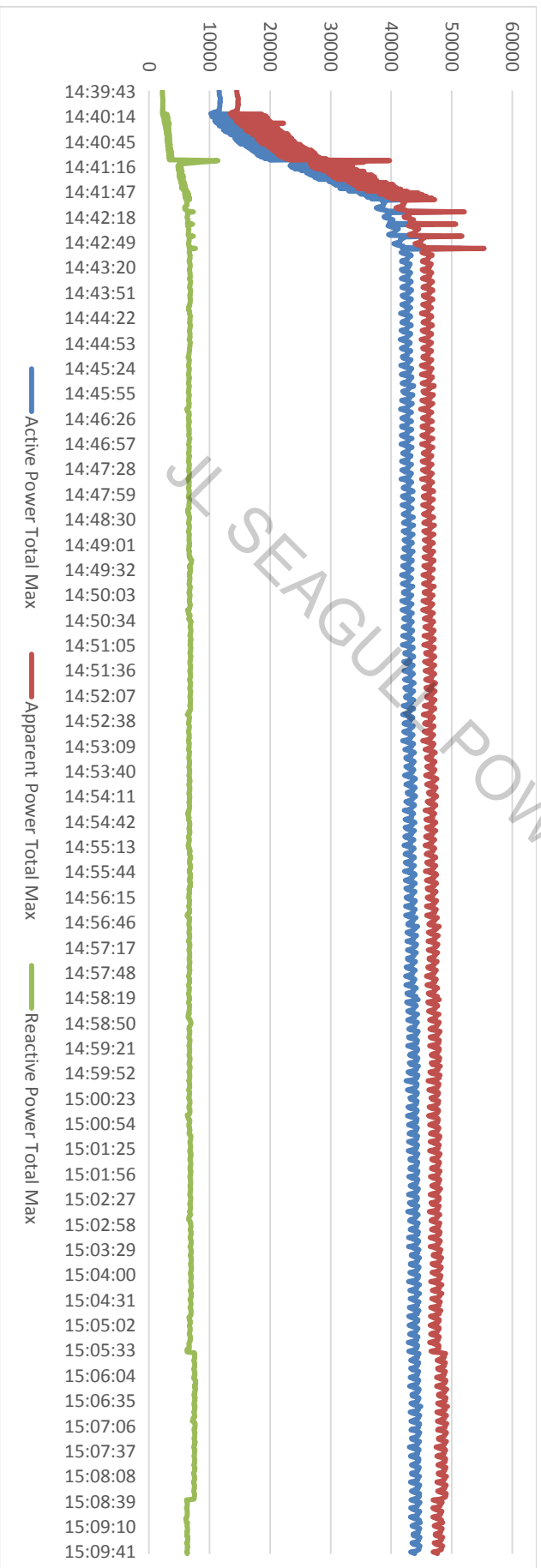
THDv % (Total Voltage Harmonics Distortion):



Power Factor total max:



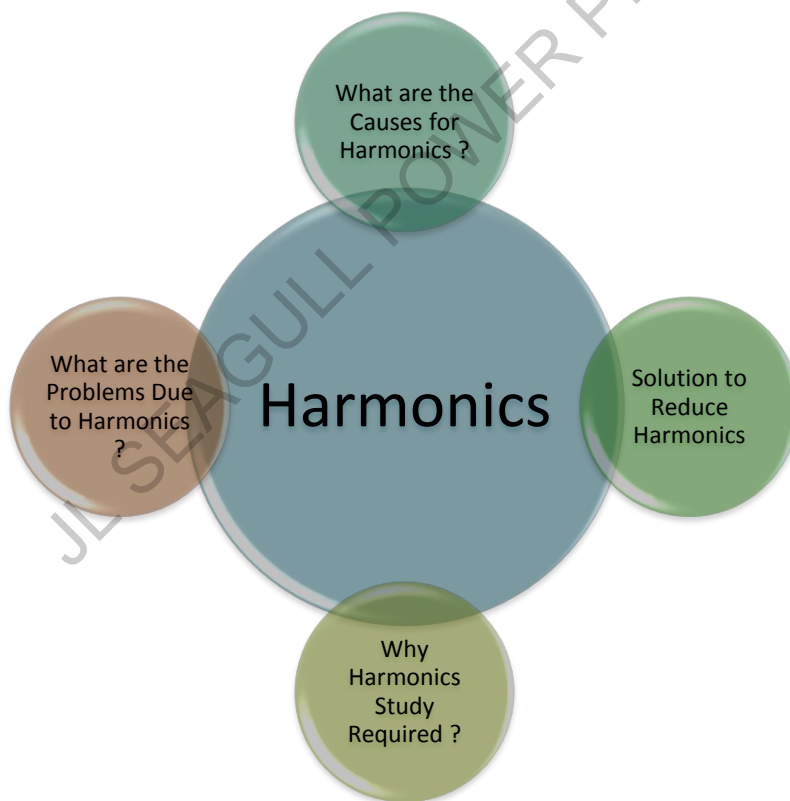
Active, Apparent & Reactive power total max:



20. APPENDIX:

Harmonics:

Harmonics by definition are distortion of the fundamental frequency (50 Hz). Harmonic distortion of current occurs when sinusoidal voltage is applied to a non-linear load (ex. electronic ballast, PLC, adjustable-speed drive, arc furnace, any ac/dc converter UPS, VFD's). The result is a distortion of the fundamental current waveform. This distortion occurs in integer multiples of the fundamental frequency (50 Hz). Hence, the 2nd Harmonic has a frequency = $2 \times 50 = 100$ Hz, the 3rd Harmonic = 150 Hz and so on. Voltage distortion, on the other hand, is generated indirectly as result of harmonic currents flowing through a distribution system.



Causes for Harmonics:

Harmonic currents are generated by all non-linear loads both in single & three phase.

- **Single phase loads, e.g.**
 - ✓ Switched mode power supplies (SMPS)
 - ✓ Electronic fluorescent lighting ballasts
 - ✓ Small uninterruptible power supplies (UPS) units
- **Three phase loads, e.g.**
 - ✓ Variable frequency drives (VFD's) (HVAC or Chiller Plants)
 - ✓ Large UPS Systems
 - ✓ Welding
 - ✓ Arc/Induction Furnace



Problems due to Harmonics:

- ✓ **Heating**—Cable insulation breakdown, Random thermal breaker tripping, Fuse blowing, Transformer failure
- ✓ **Power factor capacitor** incompatibility - Resonating power factor capacitors—Failed capacitor banks
- ✓ Increased **Hysteresis losses**
- ✓ Decreased **kVA** capacity
- ✓ **Neutral** overloading
- ✓ Unacceptable **neutral-to-ground** voltages
- ✓ **Distorted** voltage and current **waveforms**
- ✓ Breakers and fuses **tripping**
- ✓ **Interference** on phone and communications systems
- ✓ Unreliable operation of **electronic equipment**

