

<i>Customer</i> ENW		<i>ABB Ref.</i>	
<i>Project</i> Howard Street Report Filter Load Balance & PFC		<i>Cust. Ref.</i>	
<i>Dealt with by</i> MR	<i>Date</i> 20/06/2013	<i>Issue</i> 0	<i>Page</i> 1 of 34

## Harmonic Measurement Survey Report

at

# Howard Street Filter Load Balance & PFC

Report prepared by:

Manjunath R  
Senior Applications Engineer  
ABB Ltd  
Rossmore Road East  
Ellesmere Port  
CH65 3DD  
Tel 0151 357 8400

<i>Customer</i> ENW		<i>ABB Ref.</i>	
<i>Project</i> Howard Street Report Filter Load Balance & PFC		<i>Cust. Ref.</i>	
<i>Dealt with by</i> MR	<i>Date</i> 20/06/2013	<i>Issue</i> 0	<i>Page</i> 2 of 34

---

## Contents

---

Terminology	3
Harmonic Theory	4
Introduction	7
Basic Data	8
Analyser Configuration	9
Timeplot - Voltage	10
Timeplot - Current	11
Timeplot - Voltage	12
Timeplot - Active Power kW	13
Timeplot - Apparent Power kVA	14
Timeplot - Reactive Power kVAr	15
Timeplot - Power Factor	16
Timeplot - Voltage Spectra 150hz	17
Timeplot - Voltage Spectra 250hz	18
Timeplot - Voltage Spectra 350hz	19
Timeplot - Voltage Spectra 450hz	20
Timeplot - Current Spectra 150hz	21
Timeplot - Current Spectra 250hz	22
Timeplot - Current Spectra 350hz	23
Timeplot - Current Spectra 450hz	24
Timeplot - ThdV	25
Min/Max/Avg Power Report	26
Load Profile - Voltage	27
Load Profile - Current	28
Load Profile - kW	29
Load Profile - kVA	30
Load Profile - kVAr	31
Load Profile - pF	32
Harmonic Against Limits	33

<i>Customer</i> ENW		<i>ABB Ref.</i>	
<i>Project</i> Howard Street Report Filter Load Balance & PFC		<i>Cust. Ref.</i>	
<i>Dealt with by</i>	MR	<i>Date</i>	20/06/2013
		<i>Issue</i>	0
		<i>Page</i>	3 of 34

## Terminology

A number of standards, terms and abbreviations are used to compile this report; the full descriptions are detailed below.

Term/abbreviation	Description
BS-EN 50160:2000	Voltage Characteristics of Electricity Supplied by Public Distribution Systems.
BS-EN 61000-4-7: 2002	Electromagnetic Compatibility (EMC) General Guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto
IEC 61000-4-30:2003	Electromagnetic Compatibility (EMC) Testing and measurement techniques – Power quality measurement methods
G5/4-1	Energy Networks Association Engineering Recommendation G5/4-1 Dated October 2005“Planning Levels for Harmonic Voltage Distortion and the Connection of Non-Linear Equipment to Transmission Systems and Distribution Networks in the United Kingdom.”
ETR 122	Energy Networks Association Engineering Technical Report ETR122 Dated February 2003 “Guide to the Application of Engineering Recommendation G5/4 in the Assessment of Harmonic Voltage Distortion and Connection of Non-Linear Equipment to the Electricity Supply System in the UK.
EMC	Electromagnetic Compatibility – harmonics are low frequency conducted emissions.
Fault Level	The power that will flow in a short circuit condition in a network, this gives a guide to the network impedance.
Harmonic	The harmonic components in a line voltage or current when subjected to a fourier analysis. Principle harmonics in the public supply network are odd integers and are measured up to the 50 <sup>th</sup> .
NOC	Network Operating Company (the electricity supply company who provide the connection to the network, not necessarily the clients electricity vendor)
MCC	Motor Control Centre
PCC	Point of Common Coupling – the point at which other consumers are connected to the public electricity supply

<i>Customer</i> ENW		<i>ABB Ref.</i>	
<i>Project</i> Howard Street Report Filter Load Balance & PFC		<i>Cust. Ref.</i>	
<i>Dealt with by</i> MR	<i>Date</i> 20/06/2013	<i>Issue</i> 0	<i>Page</i> 4 of 34

## Harmonic Theory

### Basics

Many modern electrical and electronic products incorporate rectifiers, which take a non-linear current from the power supply.

There are a number of different methods of rectification that can be considered, the most common are uncontrolled (a number of diodes connected in a bridge), controlled (a number of thyristors connected in a bridge), and active (a number of IGBTs connected in a bridge).

These currents take the form of repetitive waveforms that can be subject to a fourier analysis to determine the magnitude and angle of each harmonic component. Each type of device will produce a characteristic harmonic spectrum, which will vary with bridge design, levels of filtering and source impedance. As the current will be drawn through the impedance of the supply network it will generate a complementary voltage distortion spectrum.

Typical effects of harmonics are detailed in the table below:-

#### Effects of high harmonic currents

- Overheating of conductors
- Insulation failure
- Nuisance tripping of circuit breakers
- Nuisance rupturing of fuses
- Additional significant voltage distortion of networks run from generators
- Overheating and possible resonance on networks using capacitors
- Overloaded neutral
- Neutral earth potential  
(generally due to single phase harmonic loads)
- PC/TV monitor stroboscopic effects
- Malfunction of microprocessor based equipment

#### Effects of high harmonic voltage distortion

- Causes linear devices to draw non linear current (ie- motors)
- Torque pulsations in motors
- Flicker in lighting
- Capacitor di-electric failure
- Insulation breakdown
- PC/TV monitor and power supply failure
- Electronic lighting failure

Customer ENW		ABB Ref.	
Project Howard Street Report Filter Load Balance & PFC		Cust. Ref.	
Dealt with by MR	Date 20/06/2013	Issue 0	Page 5 of 34

## Current Distortion

Both single and three phase non-linear loads draw harmonic currents. For both controlled and uncontrolled rectifiers the dominant harmonic is generally denoted by  $n-1$ , where  $n$  is the number of rectifying devices, ie a single phase 4 diode rectifier gives a dominant 3<sup>rd</sup> harmonic, and a three phase 6 diode rectifier gives a dominant 5<sup>th</sup> harmonic.

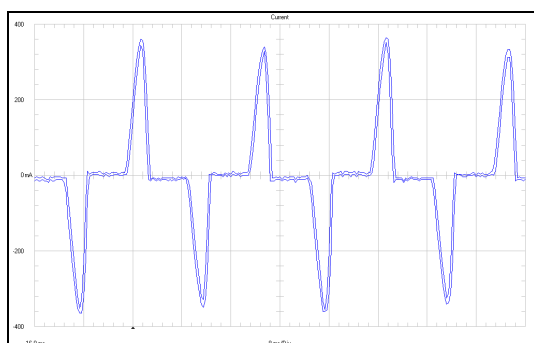


Figure 1

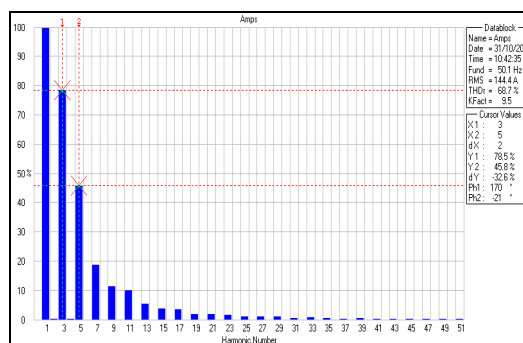


Figure 2

*Typical measured current waveform for single phase uncontrolled rectifier*

*Typical measured harmonic current spectrum for single phase uncontrolled rectifier*

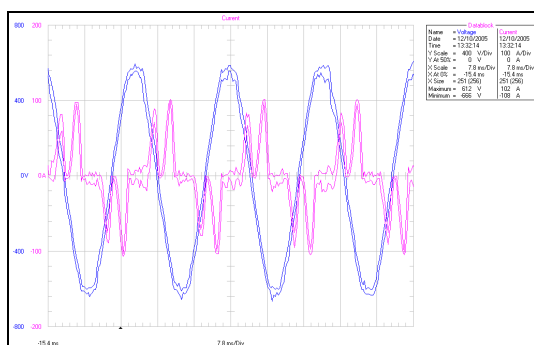


Figure 3

*Typical current and voltage waveform for 6 pulse uncontrolled rectifier*

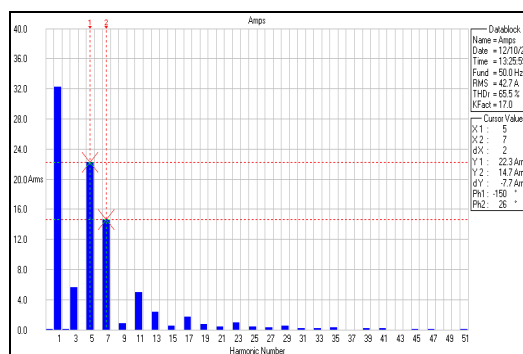


Figure 4

*Typical current spectrum analysis for 6 pulse uncontrolled rectifier*

## Voltage Distortion

Voltage distortion propagates throughout the entire distribution network, and must be regulated by the distributor to avoid the damaging effects.

The magnitude of the distortion is dependent on the current and the network impedance, and the lower the network impedance (higher fault level), the lower the resultant voltage distortion.

<i>Customer</i> ENW		<i>ABB Ref.</i>	
<i>Project</i> Howard Street Report Filter Load Balance & PFC		<i>Cust. Ref.</i>	
<i>Dealt with by</i> MR	<i>Date</i> 20/06/2013	<i>Issue</i> 0	<i>Page</i> 6 of 34

The levels of acceptable distortion are laid down in a number of standards including EN 50160, and IEC 61000 series.

## Harmonic flow

In theory a current will flow to the lowest impedance, hence it would be expected that harmonic current flow would be up through the increasing voltage levels of the network, however, if there are any resonant components in a network at lower voltage level, such as power factor correction, there can be a flow in this direction.

## Limits for Harmonic Voltage & Current

In the UK the network operators are governed by statutory instruments which specify the levels of service and network power quality and forms part of their license agreement.

Part of the power quality requirements are incorporated in an installation standard known as the Energy Networks Association Engineering Recommendation G5/4-1 – Planning levels for harmonic voltage distortion and connection of non-linear equipment to transmission systems and distribution networks in the UK.

This gives a number of Stages that can be applied to connections for consumers, and a guide to its application is available from [www.gambica.org.uk](http://www.gambica.org.uk).

<i>Customer</i> ENW		<i>ABB Ref.</i>	
<i>Project</i> Howard Street Report Filter Load Balance & PFC		<i>Cust. Ref.</i>	
<i>Dealt with by</i> MR	<i>Date</i> 20/06/2013	<i>Issue</i> 0	<i>Page</i> 7 of 34

## Introduction

The objective of the survey is to carry out a power quality survey at Howard Street.

Measurements were made for 7 days from 04/06/2013 14:41:58 to 10/06/2013 10:35:00

## Site Data

The site is located at main incomer.

<i>Customer</i> ENW		<i>ABB Ref.</i>	
<i>Project</i> Howard Street Report Filter Load Balance & PFC		<i>Cust. Ref.</i>	
<i>Dealt with by</i> MR	<i>Date</i> 20/06/2013	<i>Issue</i> 0	<i>Page</i> 8 of 34

## Basic Data

1.	<b>Company (submitting the report)</b>	ENW
2.	<b>Contact Name and Address</b>	John Simpson 07715 428043
3.	<b>Site address</b>	Howard Street
4.	<b>Metering Point Account Number</b>	N/A
5.	<b>Network connection (where known)</b>	N/A
6.	<b>Transformer details (where relevant)</b>	N/A
7.	<b>Reason for the survey</b>	Power Quality Survey
8.	<b>Existing non linear load</b>	Non-Linear Load
9.	<b>Details of new non linear load</b>	N/A
10.	<b>Point of measurement</b>	415V Main Incomer
11.	<b>Measurements</b>	Power Quality
12.	<b>Connection Arrangements</b>	4 WIRE / 3 PROBE (WYE)
13.	<b>Measuring instrument</b>	Dranetz PX5
14.	<b>Start time for measurements</b>	04/06/2013 14:41:58
15.	<b>Finish time for measurements</b>	10/06/2013 10:35:00

<i>Customer</i> ENW		<i>ABB Ref.</i>	
<i>Project</i> Howard Street Report Filter Load Balance & PFC		<i>Cust. Ref.</i>	
<i>Dealt with by</i> MR	<i>Date</i> 20/06/2013	<i>Issue</i> 0	<i>Page</i> 9 of 34

## Instrument Configuration

### Dranetz Power Xplorer Configuration

Firmware	Power Xplorer (c) 2009 Dranetz-BMI Jan 10 2011 @ 09:46:34 Ver.: V 4.2, Build: 9, DB ver.: 0
Serial Number	PX50ZA063
Site/Filename	howd st filt load bal and pfc
Measured from	04/06/2013 14:41:58
Measured to	10/06/2013 10:35:00
File ending	OK
Synchronization	Standard A
Configuration	4 WIRE / 3 PROBE (WYE)
Monitoring type	STANDARD PQ
Nominal voltage	240.0 V
Nominal current	29.3 A
Nominal frequency	50.0 Hz
Use inverse sequence	No
Using currents	Yes
Characterizer mode	IEEE 1159

### Current probes

Chan A	6000XL, RR6035A (Range2), 600A (Scale=400.00)
Chan B	6000XL, RR6035A (Range2), 600A (Scale=400.00)
Chan C	6000XL, RR6035A (Range2), 600A (Scale=400.00)
Chan D	6000XL, RR6035A (Range2), 600A (Scale=400.00)

### Voltage scale factors

Chan A	1.000
Chan B	1.000
Chan C	1.000
Chan D	1.000

### Current scale factors

Chan A	1.000
Chan B	1.000
Chan C	1.000
Chan D	1.000

### Trigger Response Setups

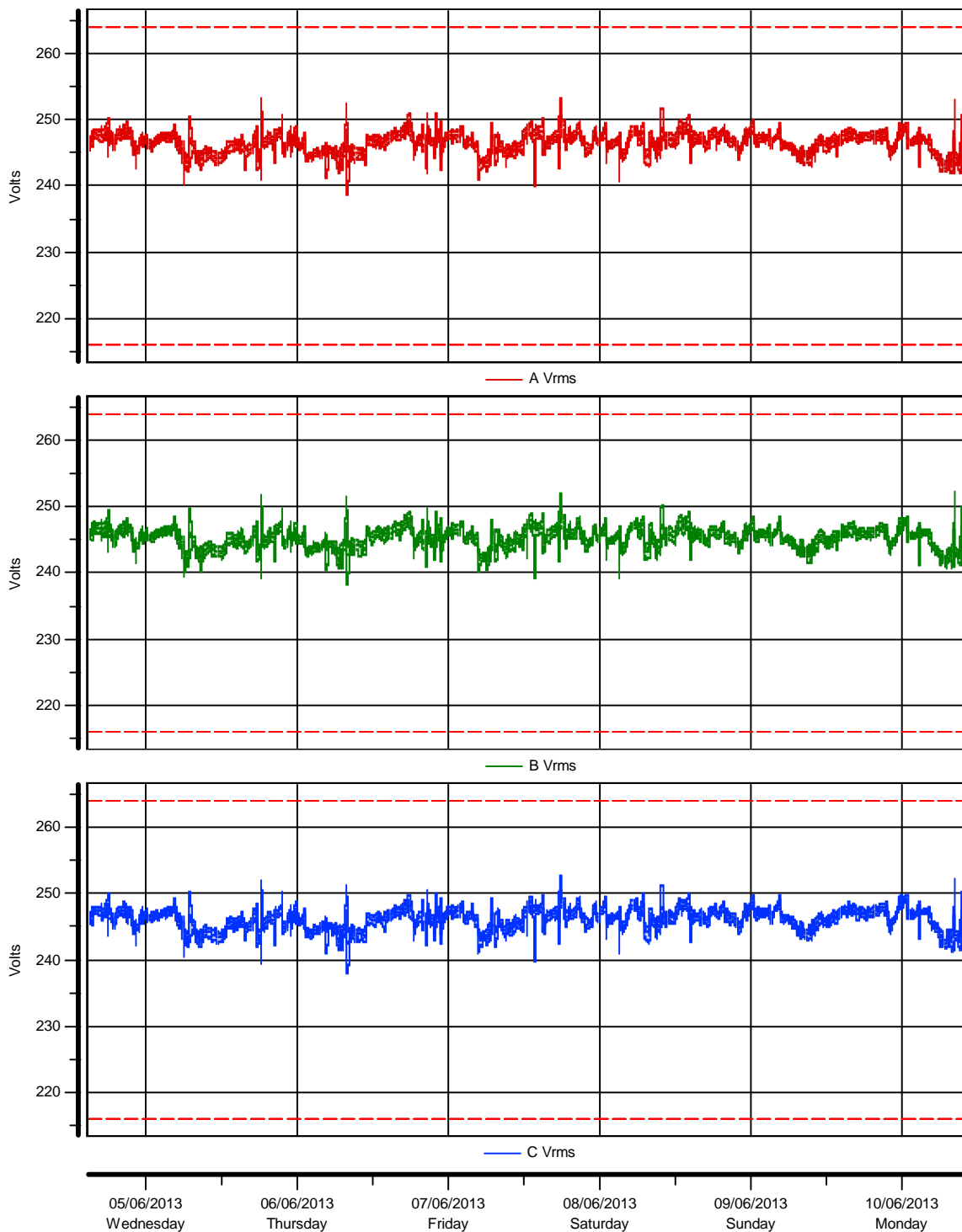
Summary Pre-trigger cycles	6 cycles
Summary Post-trigger cycles IN-TO-OUT	6 cycles
Summary Post-trigger cycles OUT-TO-IN	6 cycles
Waveform Pre-trigger cycles	2 cycles
Waveform Post-trigger cycles	2 cycles

<i>Customer</i> ENW		<i>ABB Ref.</i>	
<i>Project</i> Howard Street Report Filter Load Balance & PFC		<i>Cust. Ref.</i>	
<i>Dealt with by</i> MR	<i>Date</i> 20/06/2013	<i>Issue</i> 0	<i>Page</i> 10 of 34

## VOLTAGE TIMEPLOTS

Site: howd st filt load bal and pfc

Measured from 04/06/2013 14:50:00.0 to 10/06/2013 10:35:00.0

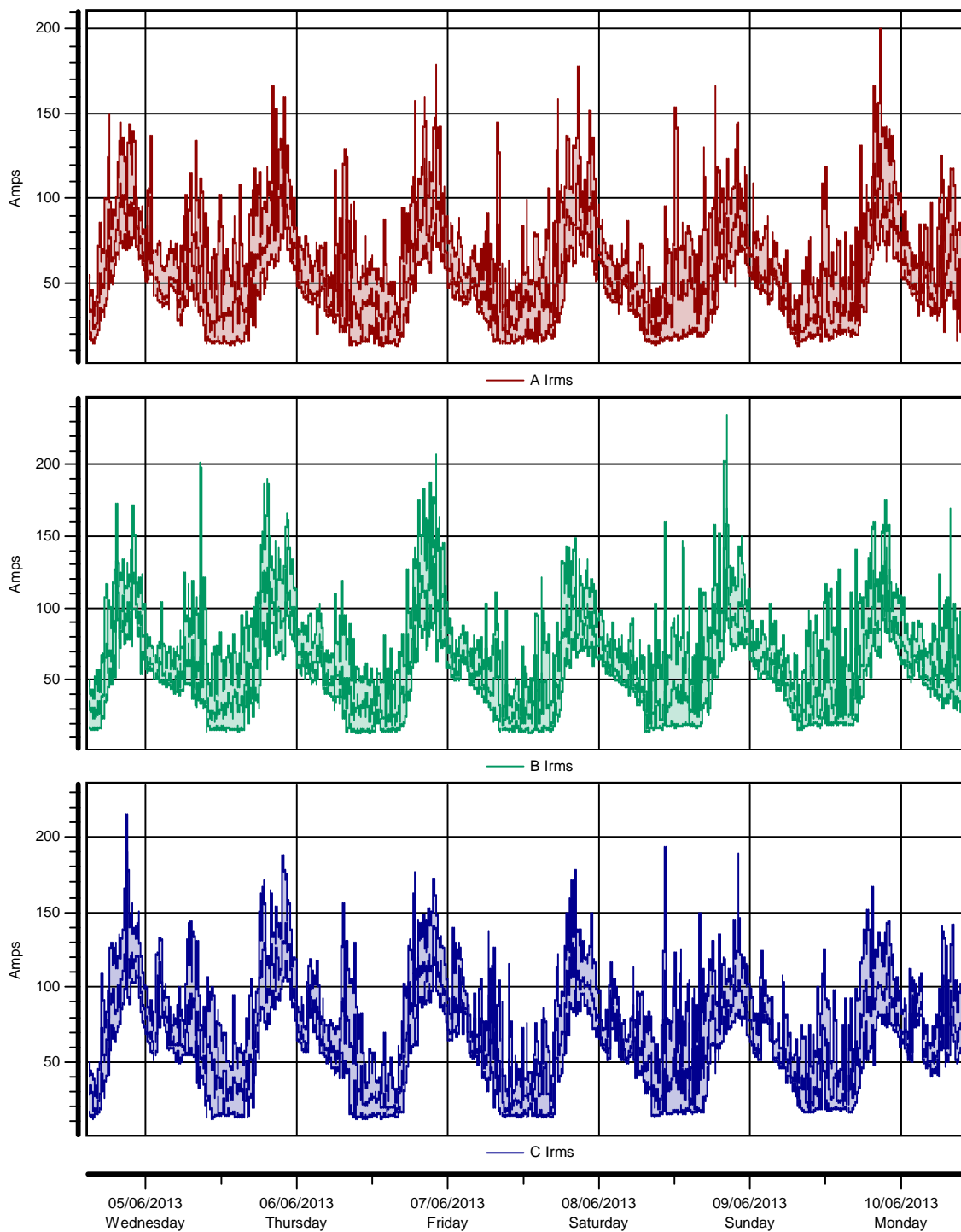


<i>Customer</i> ENW		<i>ABB Ref.</i>	
<i>Project</i> Howard Street Report Filter Load Balance & PFC		<i>Cust. Ref.</i>	
<i>Dealt with by</i> MR	<i>Date</i> 20/06/2013	<i>Issue</i> 0	<i>Page</i> 11 of 34

**CURRENT TIMEPLOTS**

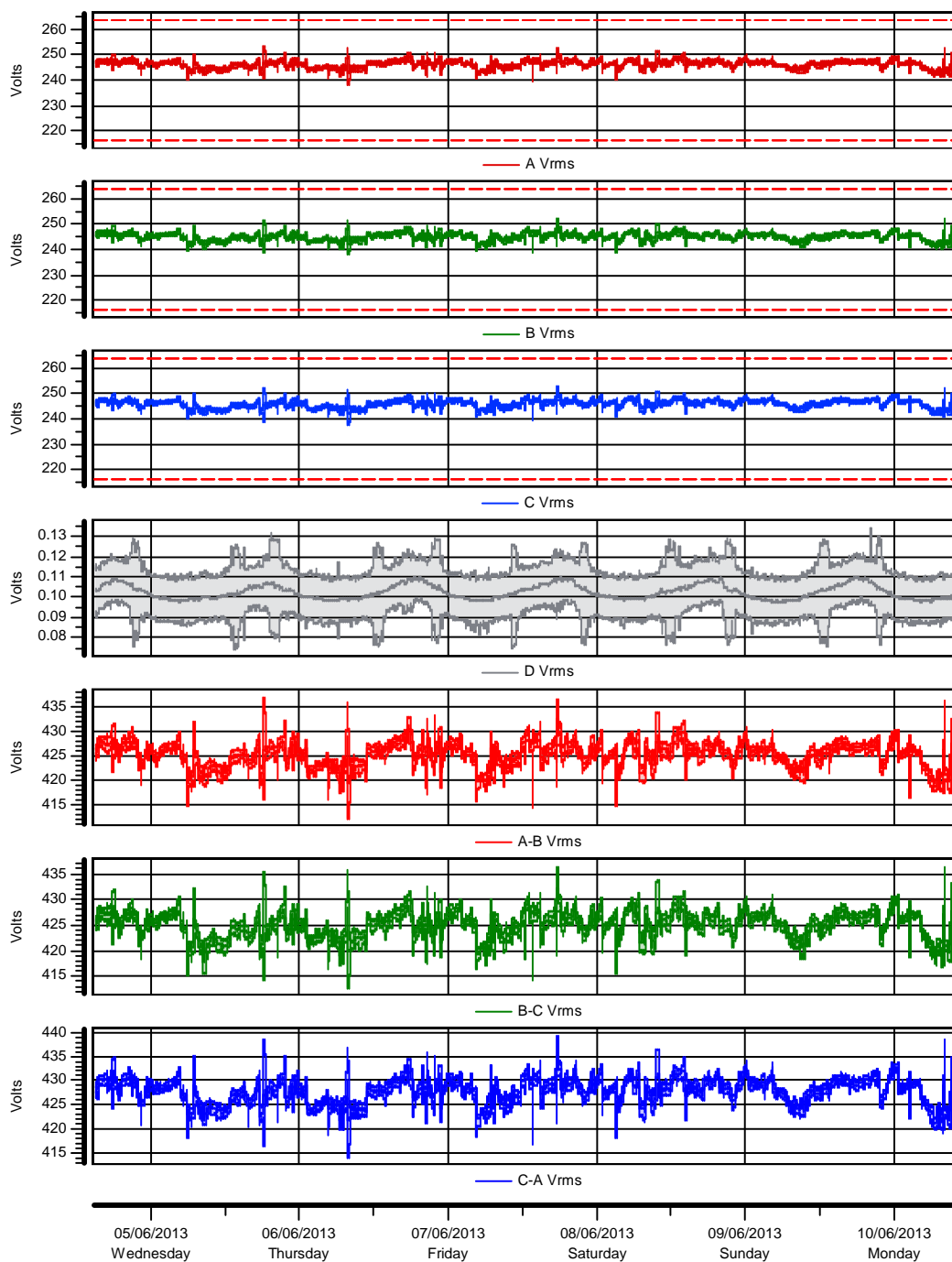
Site: howd st filt load bal and pfc

Measured from 04/06/2013 14:50:00.0 to 10/06/2013 10:35:00.0



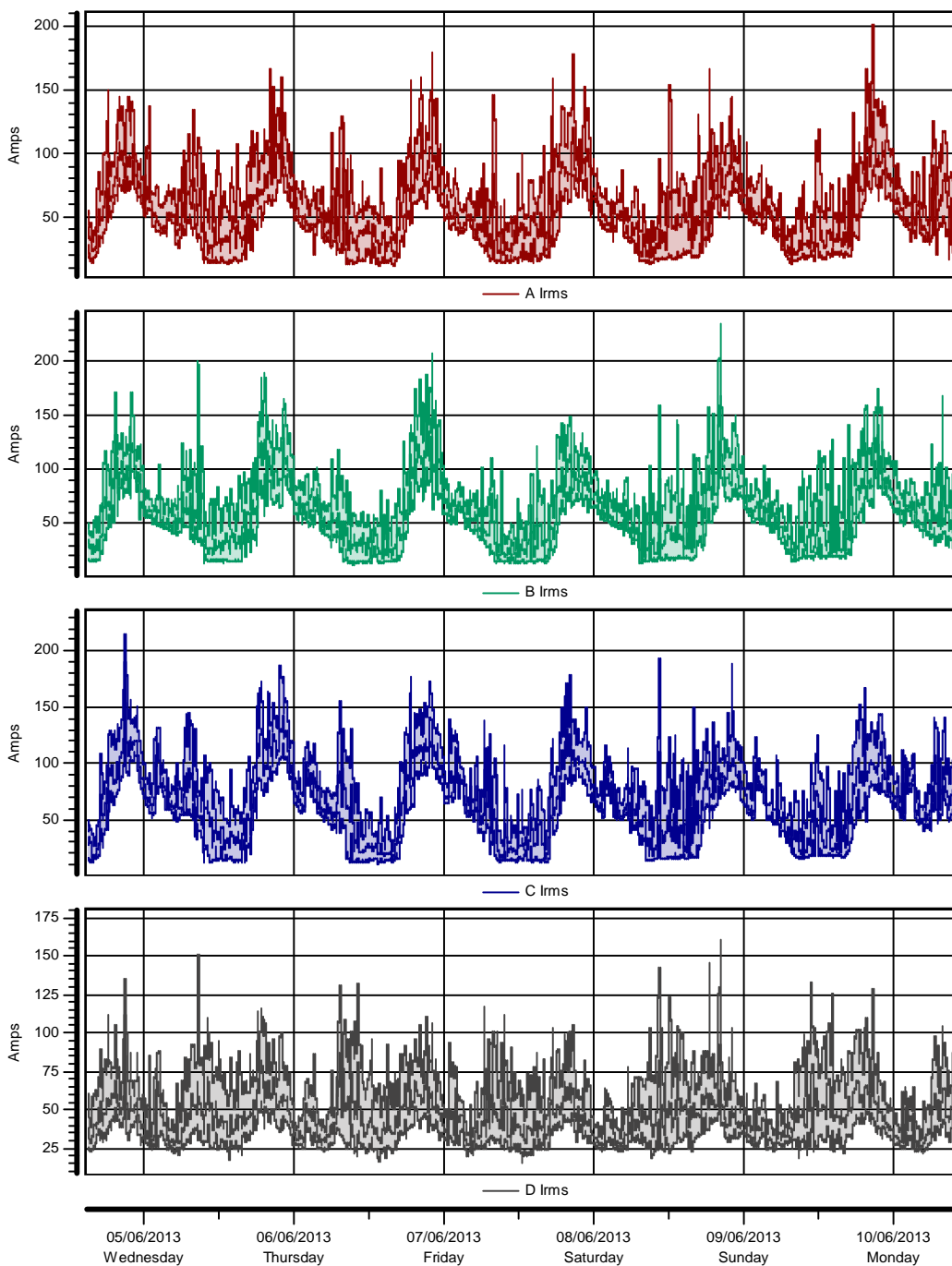
Customer ENW		ABB Ref.	
Project Howard Street Report Filter Load Balance & PFC		Cust. Ref.	
Dealt with by MR	Date 20/06/2013	Issue 0	Page 12 of 34

### Timeplot Voltage RMS value



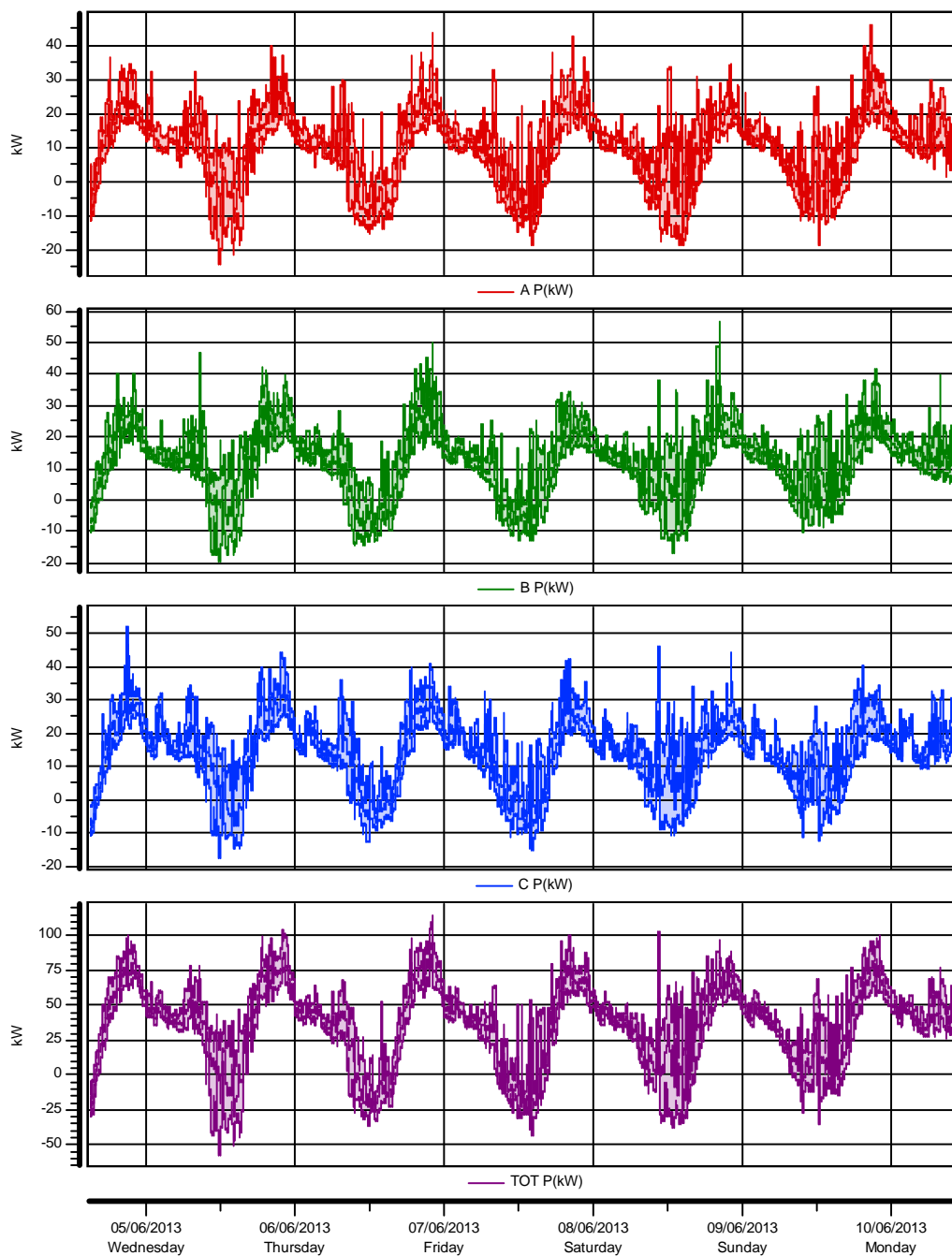
Customer ENW		ABB Ref.	
Project Howard Street Report Filter Load Balance & PFC		Cust. Ref.	
Dealt with by MR	Date 20/06/2013	Issue 0	Page 13 of 34

**Timeplot**  
**Current RMS value**



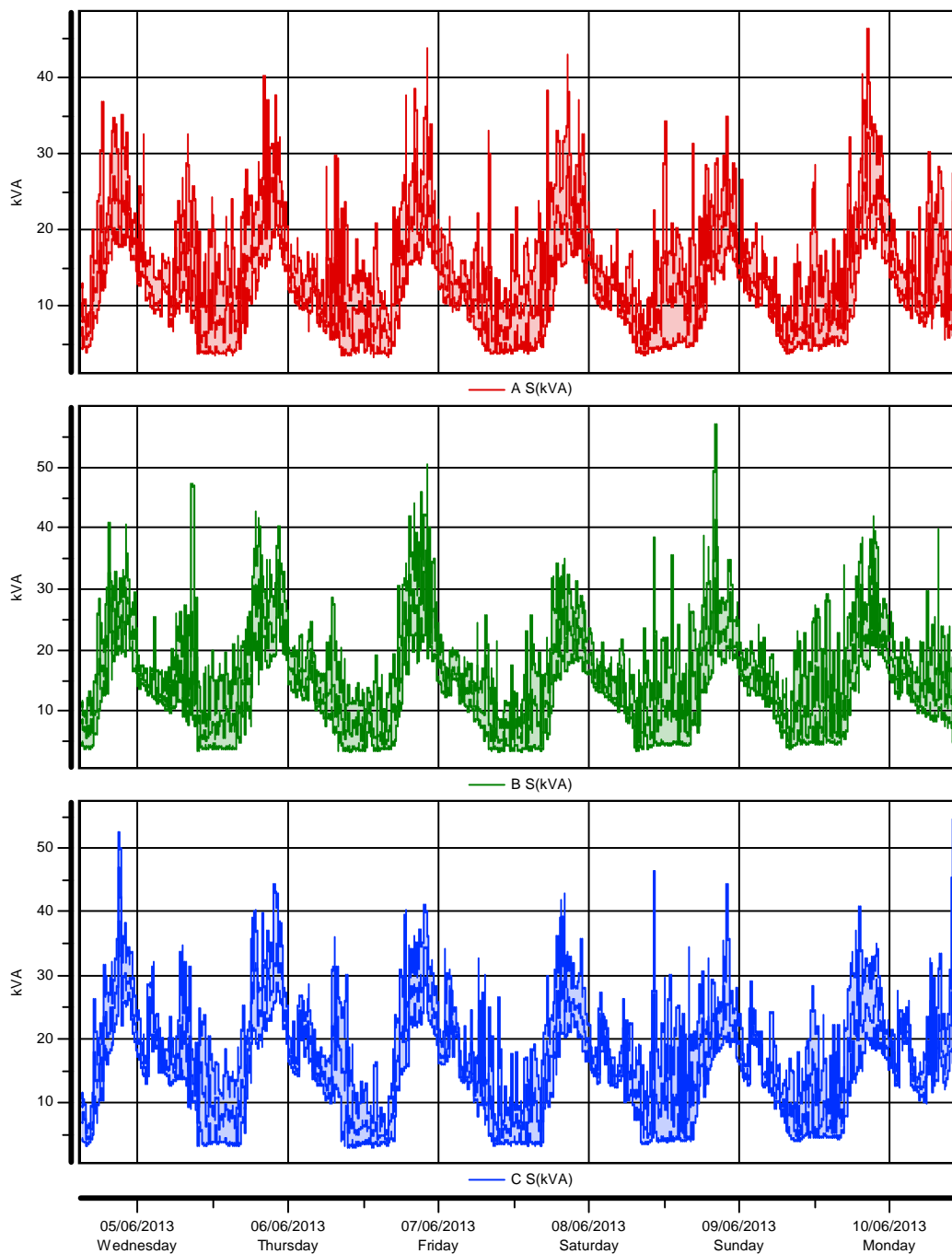
Customer ENW		ABB Ref.	
Project Howard Street Report Filter Load Balance & PFC		Cust. Ref.	
Dealt with by MR	Date 20/06/2013	Issue 0	Page 14 of 34

**Timeplot**  
**Active power, P (W)**



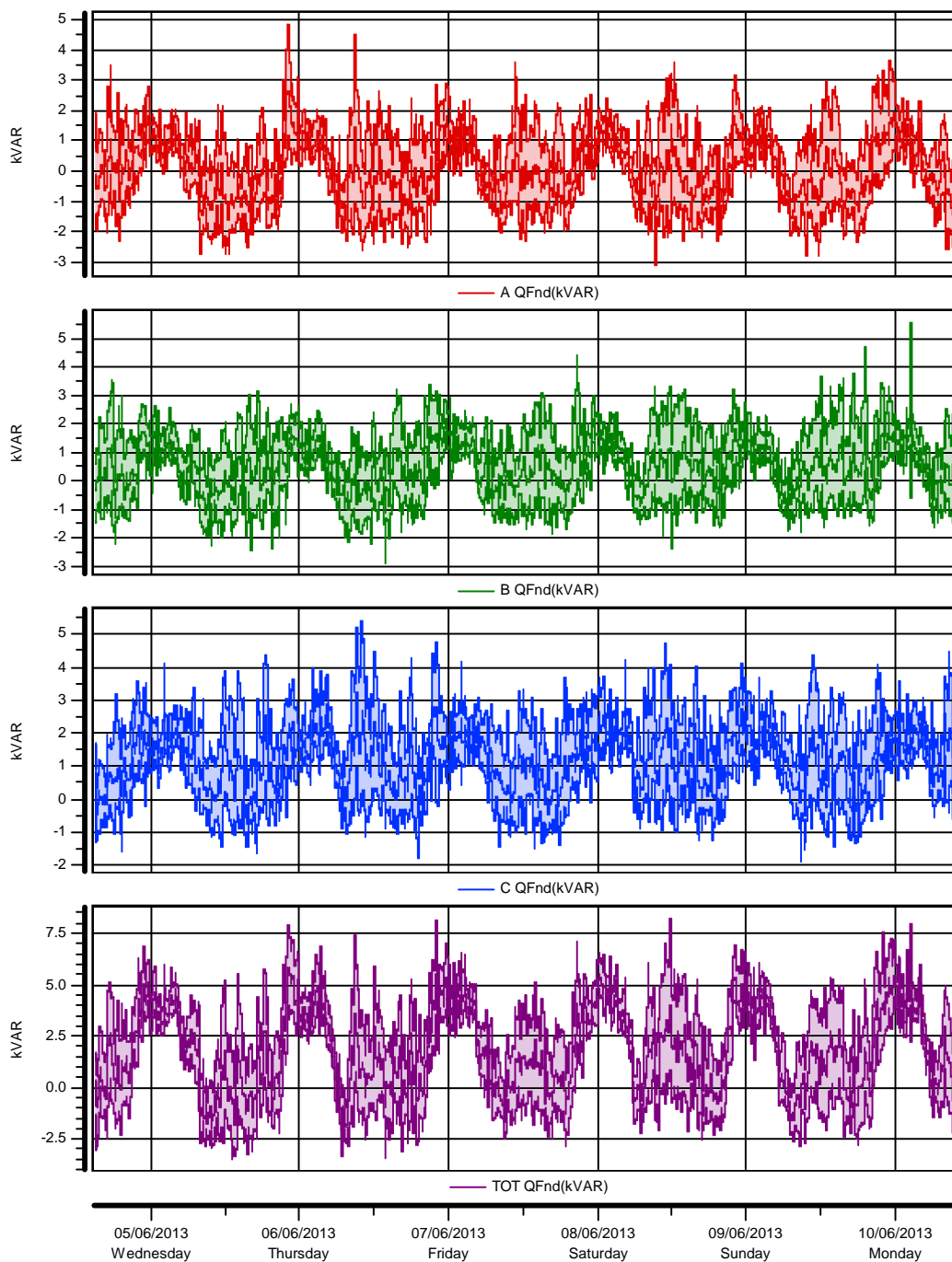
<i>Customer</i> ENW		<i>ABB Ref.</i>	
<i>Project</i> Howard Street Report Filter Load Balance & PFC		<i>Cust. Ref.</i>	
<i>Dealt with by</i> MR	<i>Date</i> 20/06/2013	<i>Issue</i> 0	<i>Page</i> 15 of 34

**Timeplot**  
**Apparent power, S (VA)**



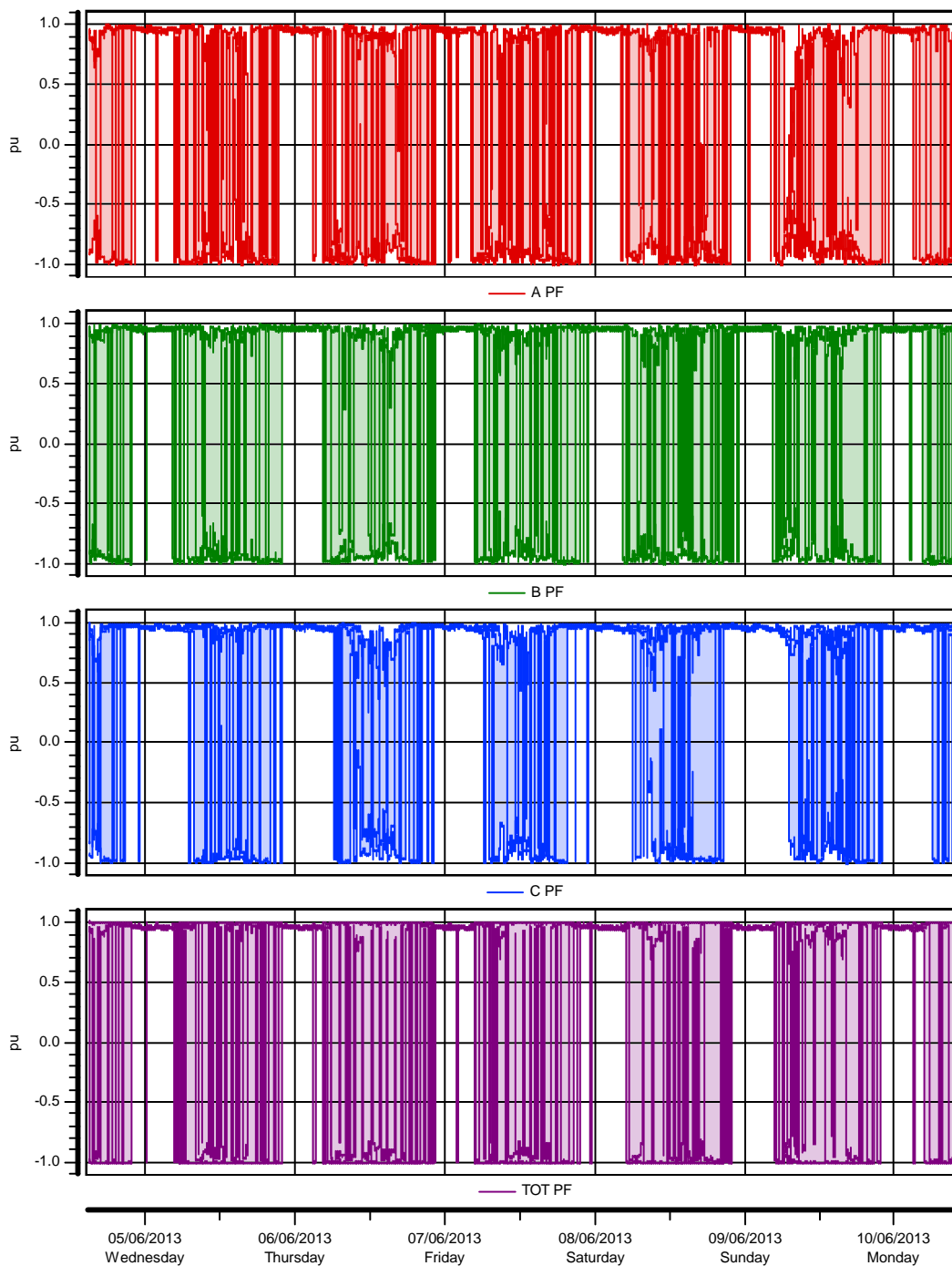
Customer ENW		ABB Ref.	
Project Howard Street Report Filter Load Balance & PFC		Cust. Ref.	
Dealt with by MR	Date 20/06/2013	Issue 0	Page 16 of 34

**Timeplot**  
**Reactive power Q, at fund. freq. (VAR)**



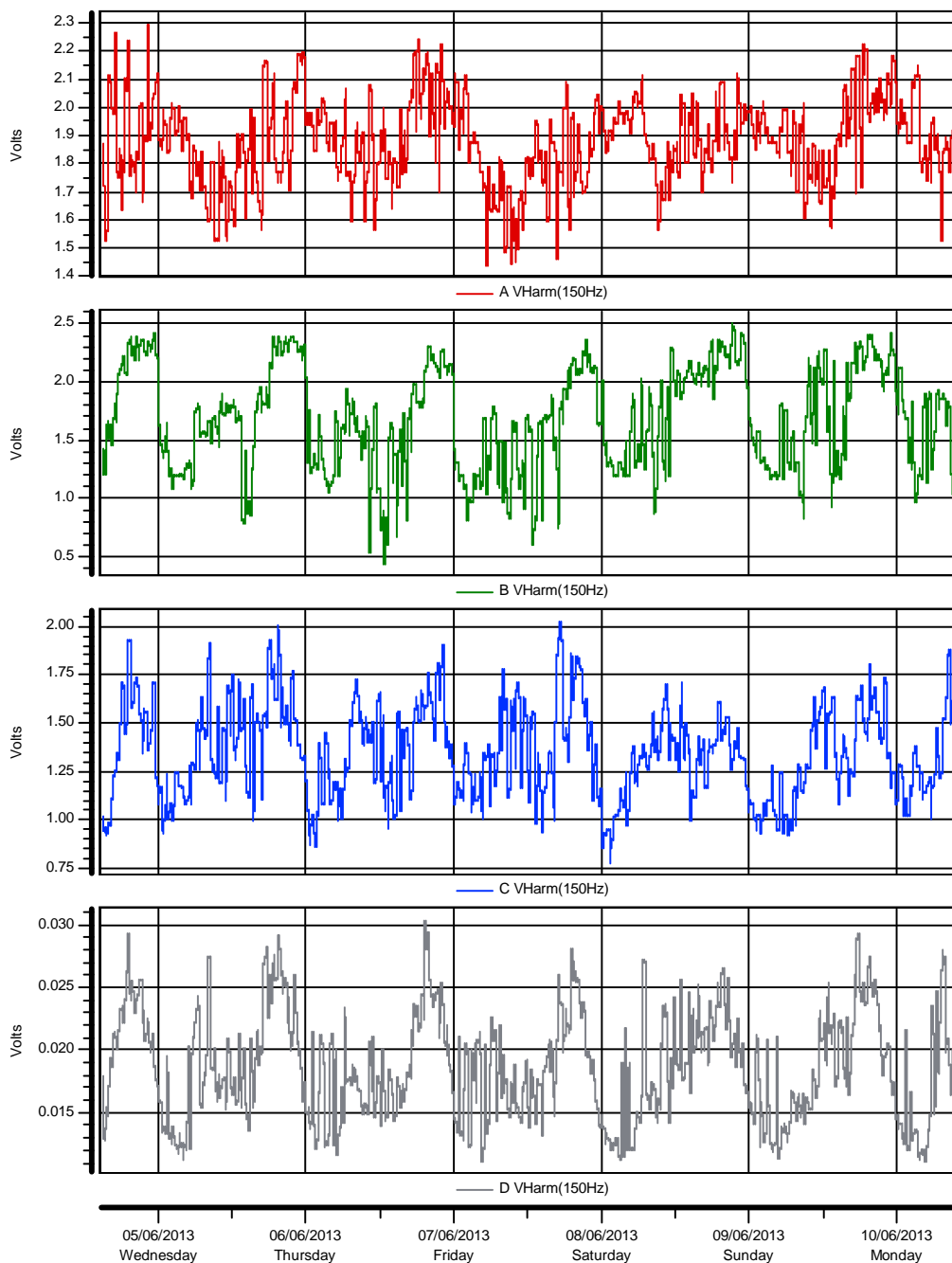
Customer ENW		ABB Ref.	
Project Howard Street Report Filter Load Balance & PFC		Cust. Ref.	
Dealt with by MR	Date 20/06/2013	Issue 0	Page 17 of 34

### Timeplot Power Factor, PF



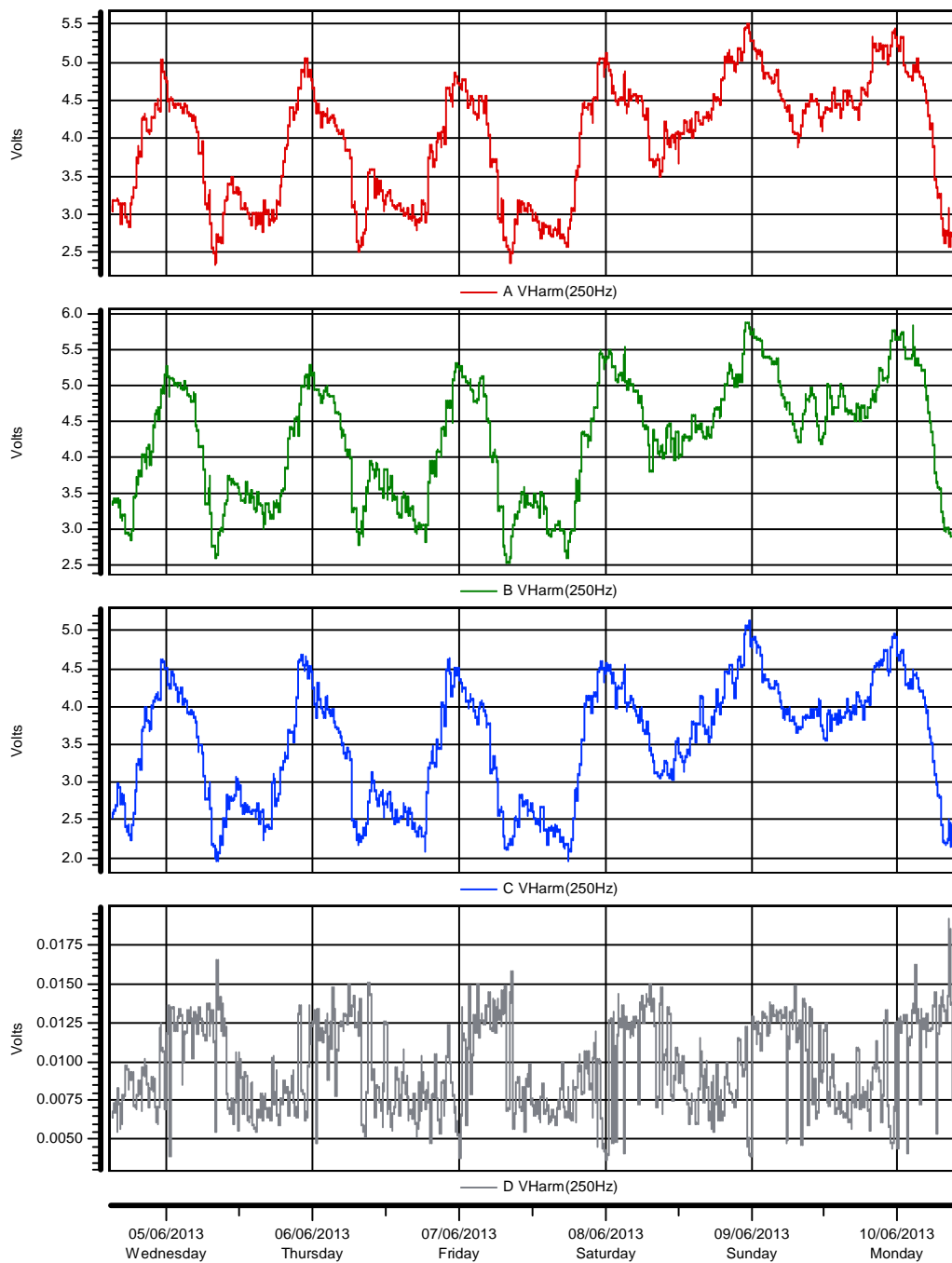
<i>Customer</i> ENW		<i>ABB Ref.</i>	
<i>Project</i> Howard Street Report Filter Load Balance & PFC		<i>Cust. Ref.</i>	
<i>Dealt with by</i> MR	<i>Date</i> 20/06/2013	<i>Issue</i> 0	<i>Page</i> 18 of 34

### Timeplot Voltage Spectra



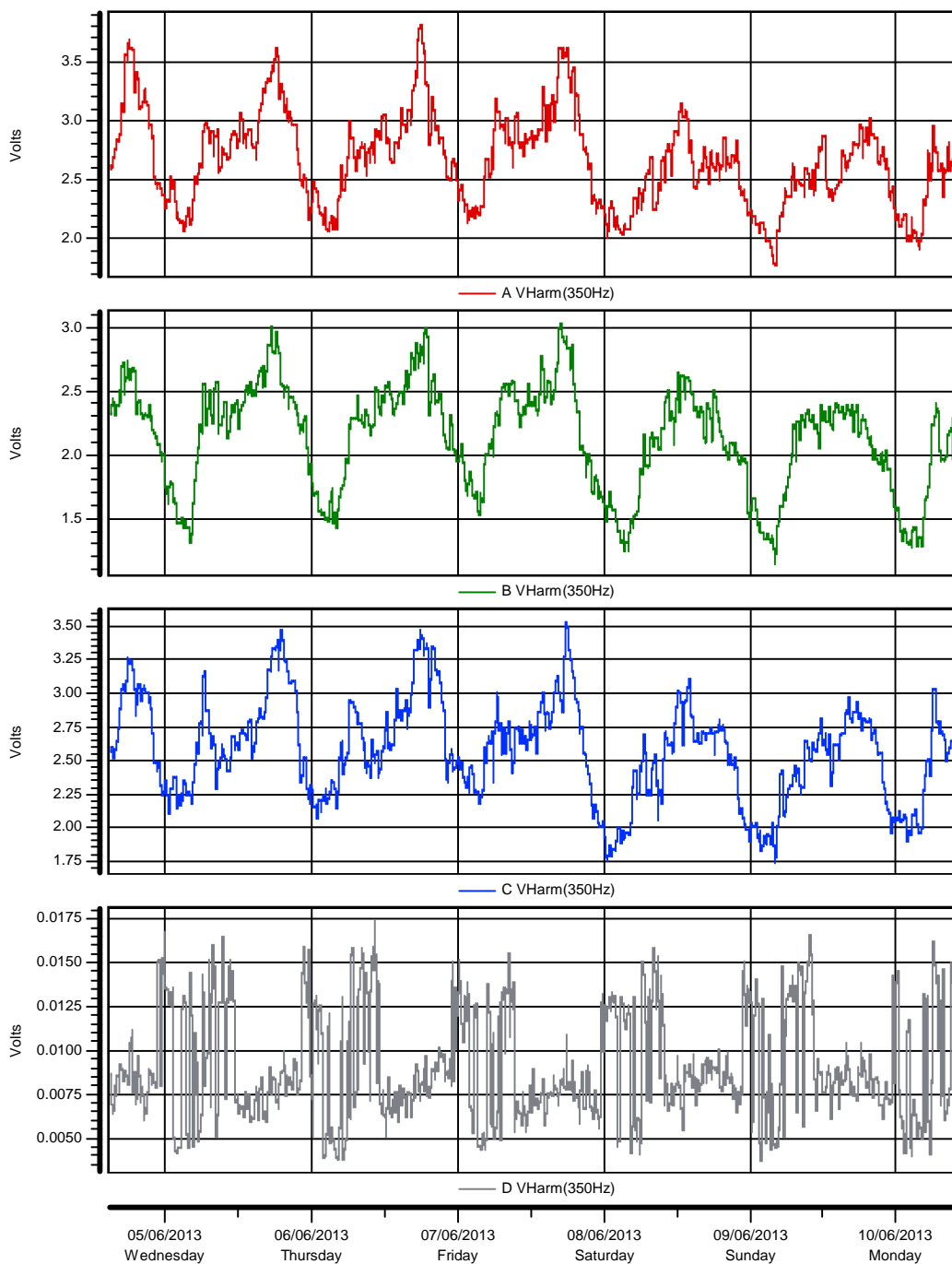
<i>Customer</i> ENW		<i>ABB Ref.</i>	
<i>Project</i> Howard Street Report Filter Load Balance & PFC		<i>Cust. Ref.</i>	
<i>Dealt with by</i> MR	<i>Date</i> 20/06/2013	<i>Issue</i> 0	<i>Page</i> 19 of 34

### Timeplot Voltage Spectra



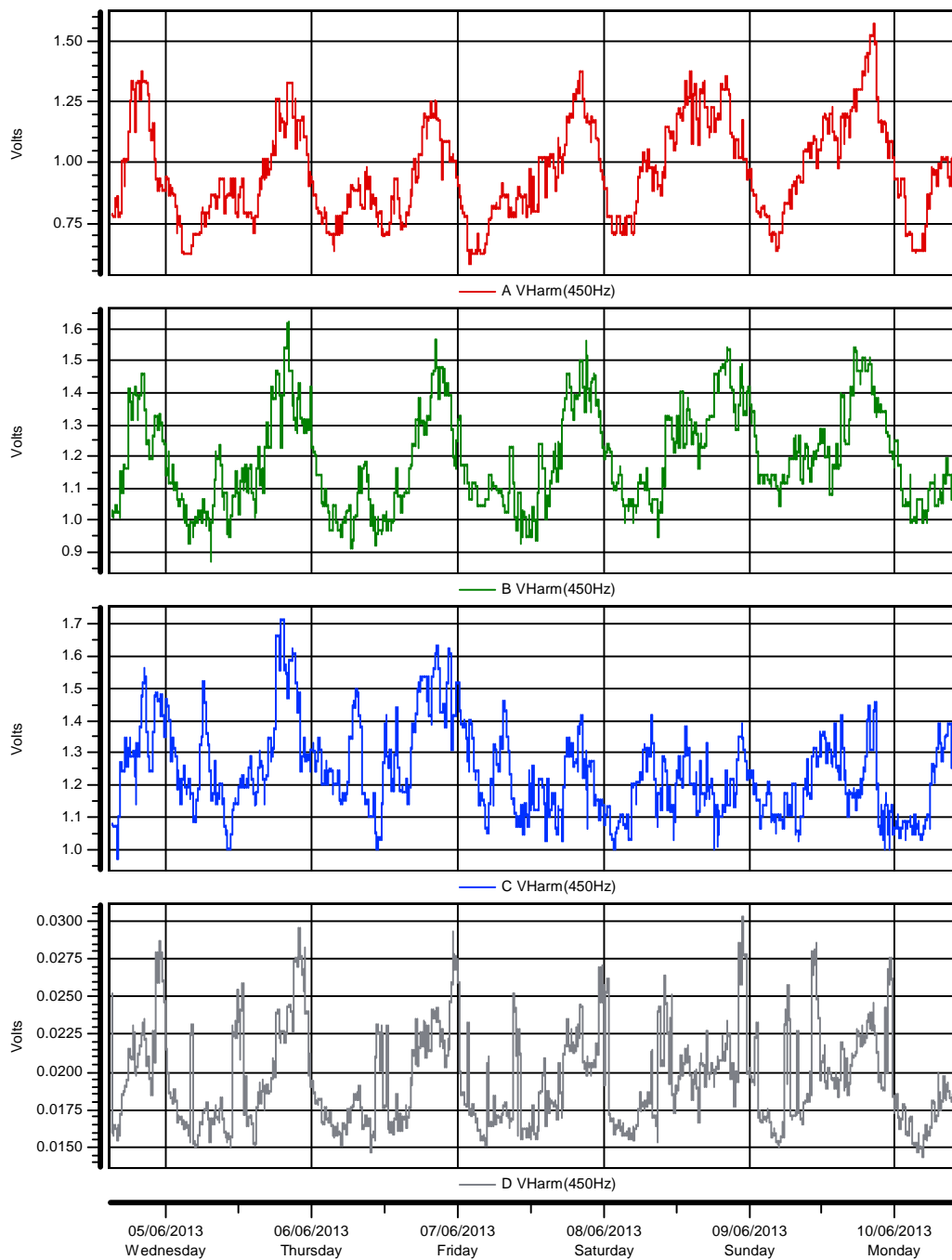
<i>Customer</i> ENW		<i>ABB Ref.</i>	
<i>Project</i> Howard Street Report Filter Load Balance & PFC		<i>Cust. Ref.</i>	
<i>Dealt with by</i> MR	<i>Date</i> 20/06/2013	<i>Issue</i> 0	<i>Page</i> 20 of 34

### Timeplot Voltage Spectra



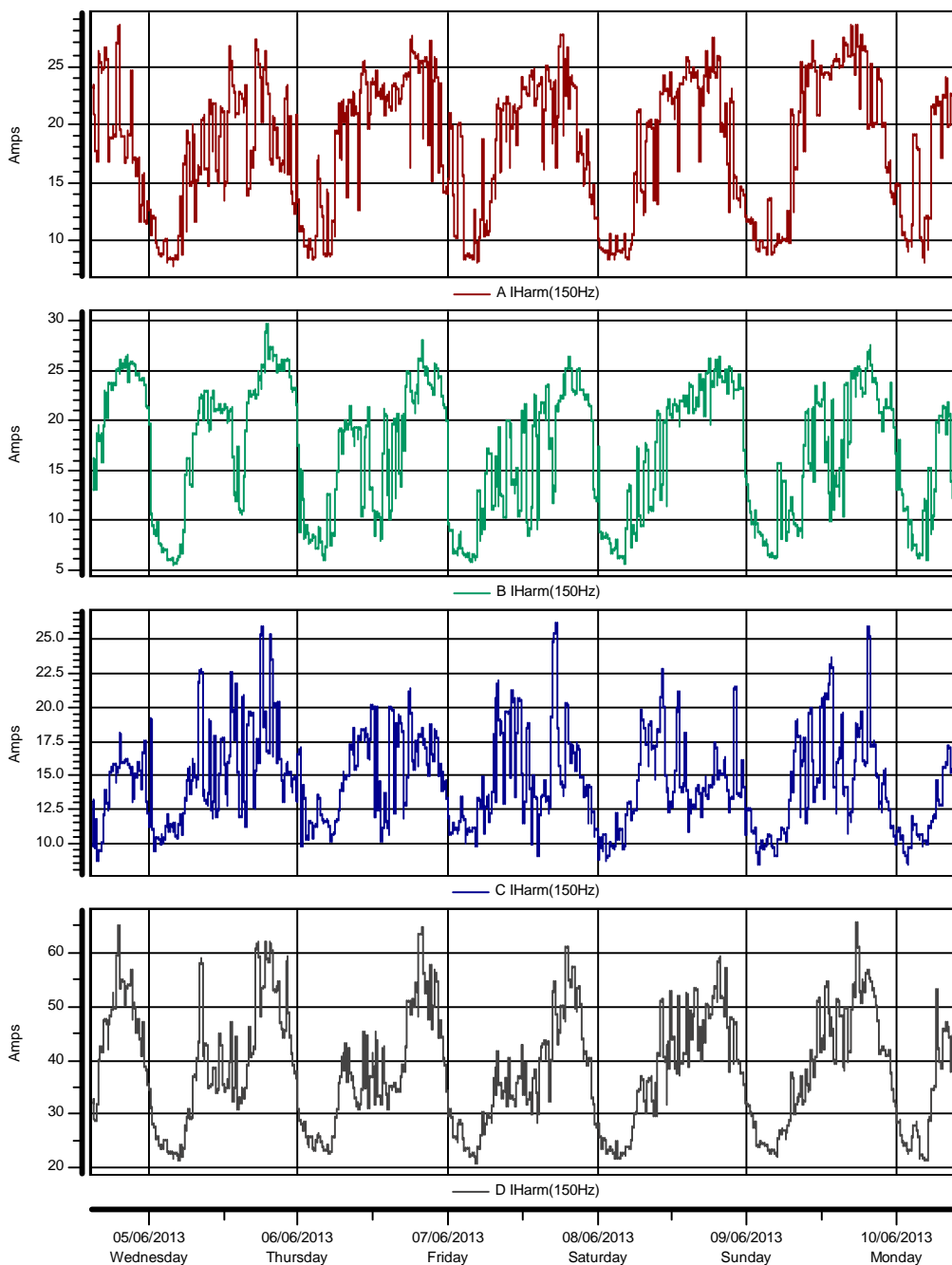
<i>Customer</i> ENW		<i>ABB Ref.</i>	
<i>Project</i> Howard Street Report Filter Load Balance & PFC		<i>Cust. Ref.</i>	
<i>Dealt with by</i> MR	<i>Date</i> 20/06/2013	<i>Issue</i> 0	<i>Page</i> 21 of 34

### Timeplot Voltage Spectra



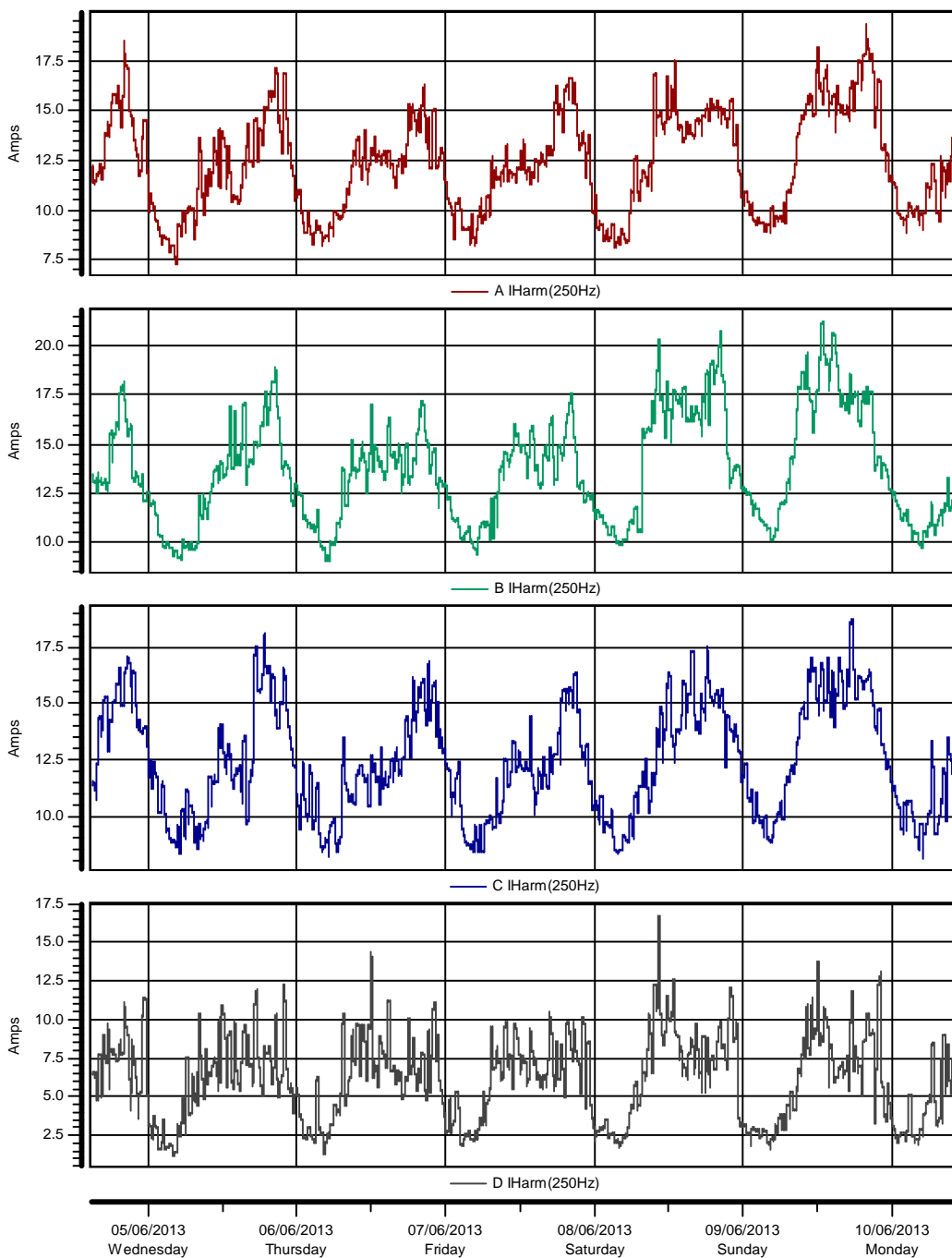
<i>Customer</i> ENW		<i>ABB Ref.</i>	
<i>Project</i> Howard Street Report Filter Load Balance & PFC		<i>Cust. Ref.</i>	
<i>Dealt with by</i> MR	<i>Date</i> 20/06/2013	<i>Issue</i> 0	<i>Page</i> 22 of 34

### Timeplot Current Spectra



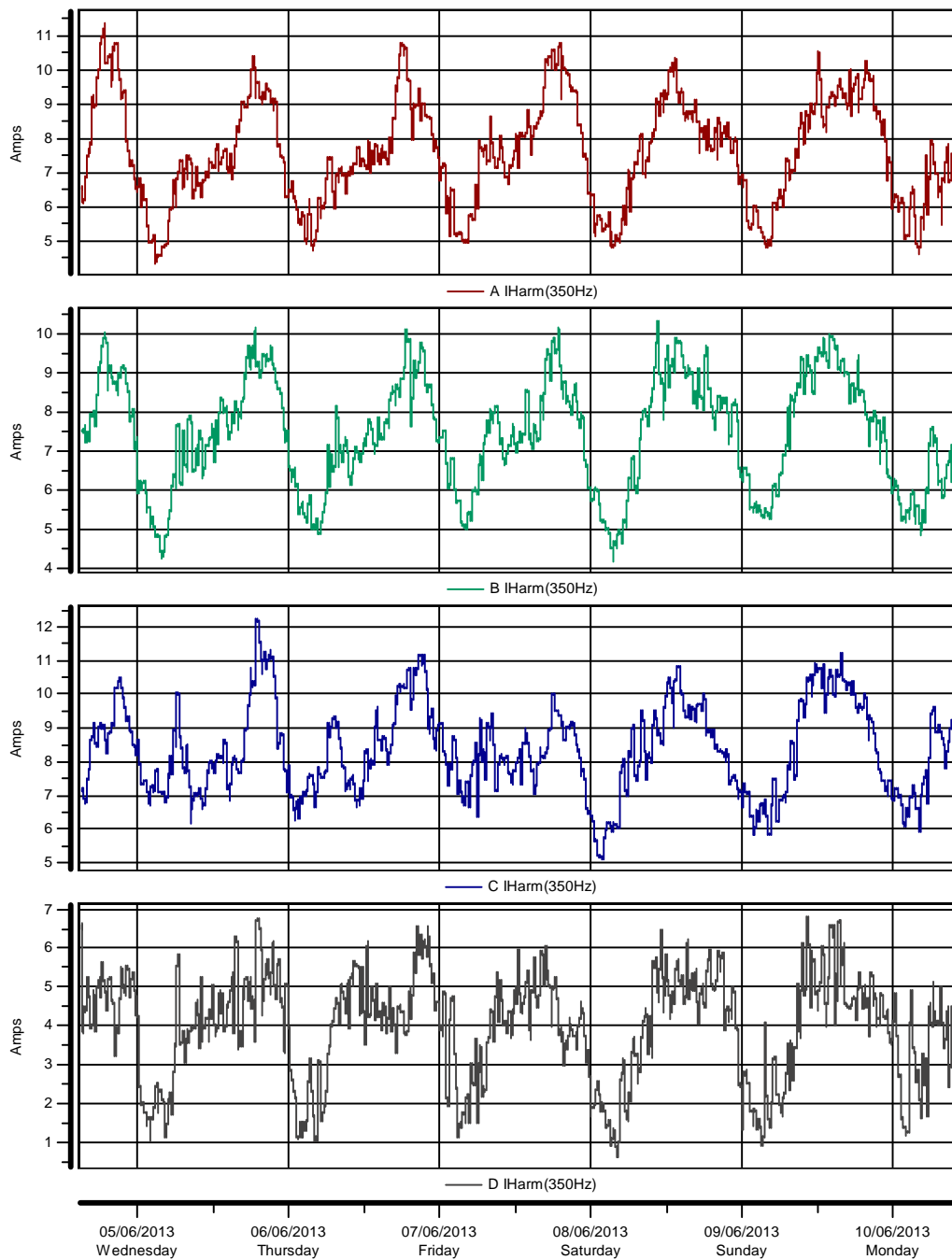
<i>Customer</i> ENW		<i>ABB Ref.</i>	
<i>Project</i> Howard Street Report Filter Load Balance & PFC		<i>Cust. Ref.</i>	
<i>Dealt with by</i> MR	<i>Date</i> 20/06/2013	<i>Issue</i> 0	<i>Page</i> 23 of 34

### Timeplot Current Spectra



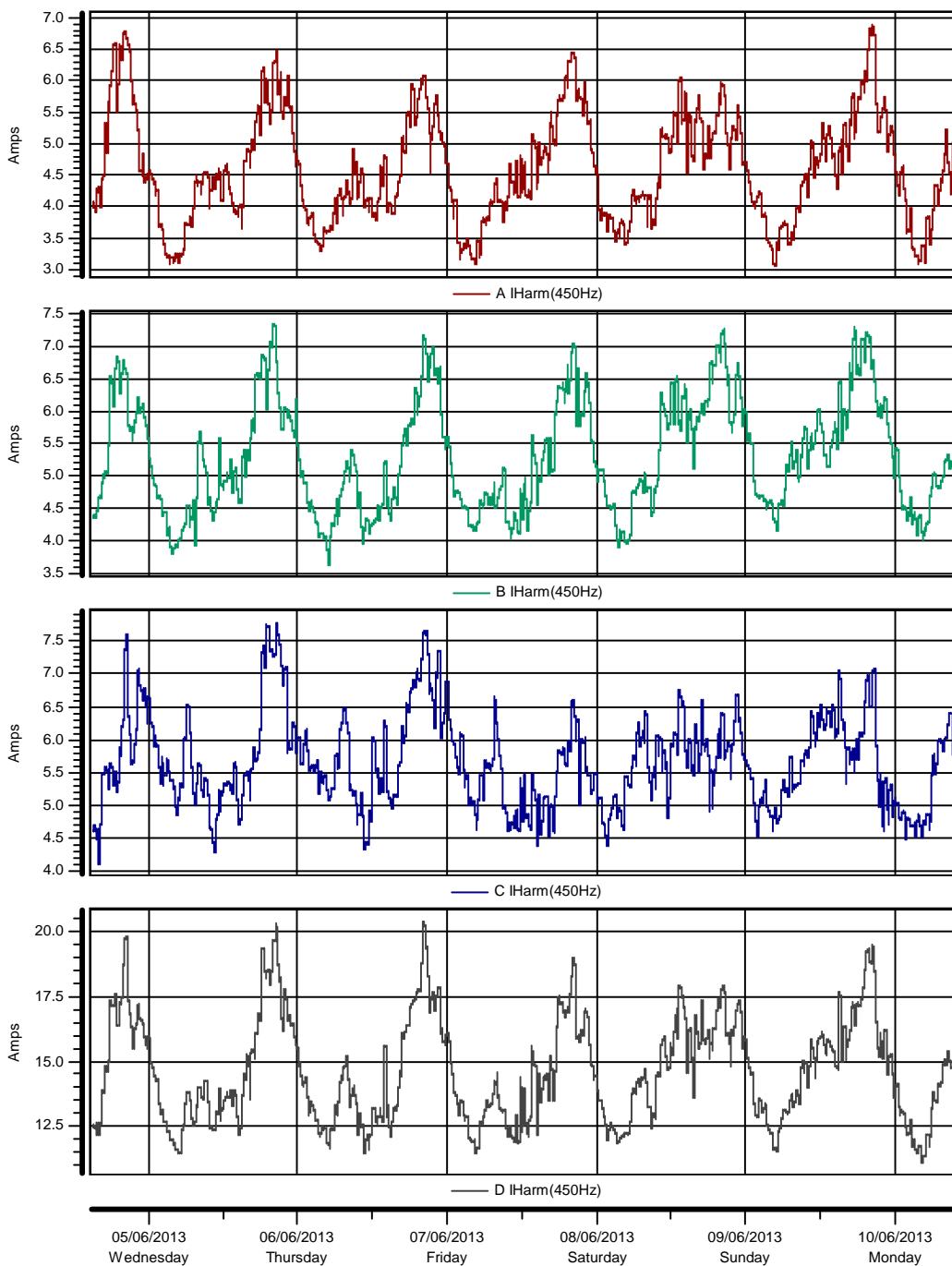
<i>Customer</i> ENW		<i>ABB Ref.</i>	
<i>Project</i> Howard Street Report Filter Load Balance & PFC		<i>Cust. Ref.</i>	
<i>Dealt with by</i> MR	<i>Date</i> 20/06/2013	<i>Issue</i> 0	<i>Page</i> 24 of 34

### Timeplot Current Spectra



Customer ENW		ABB Ref.	
Project Howard Street Report Filter Load Balance & PFC		Cust. Ref.	
Dealt with by MR	Date 20/06/2013	Issue 0	Page 25 of 34

### Timeplot Current Spectra

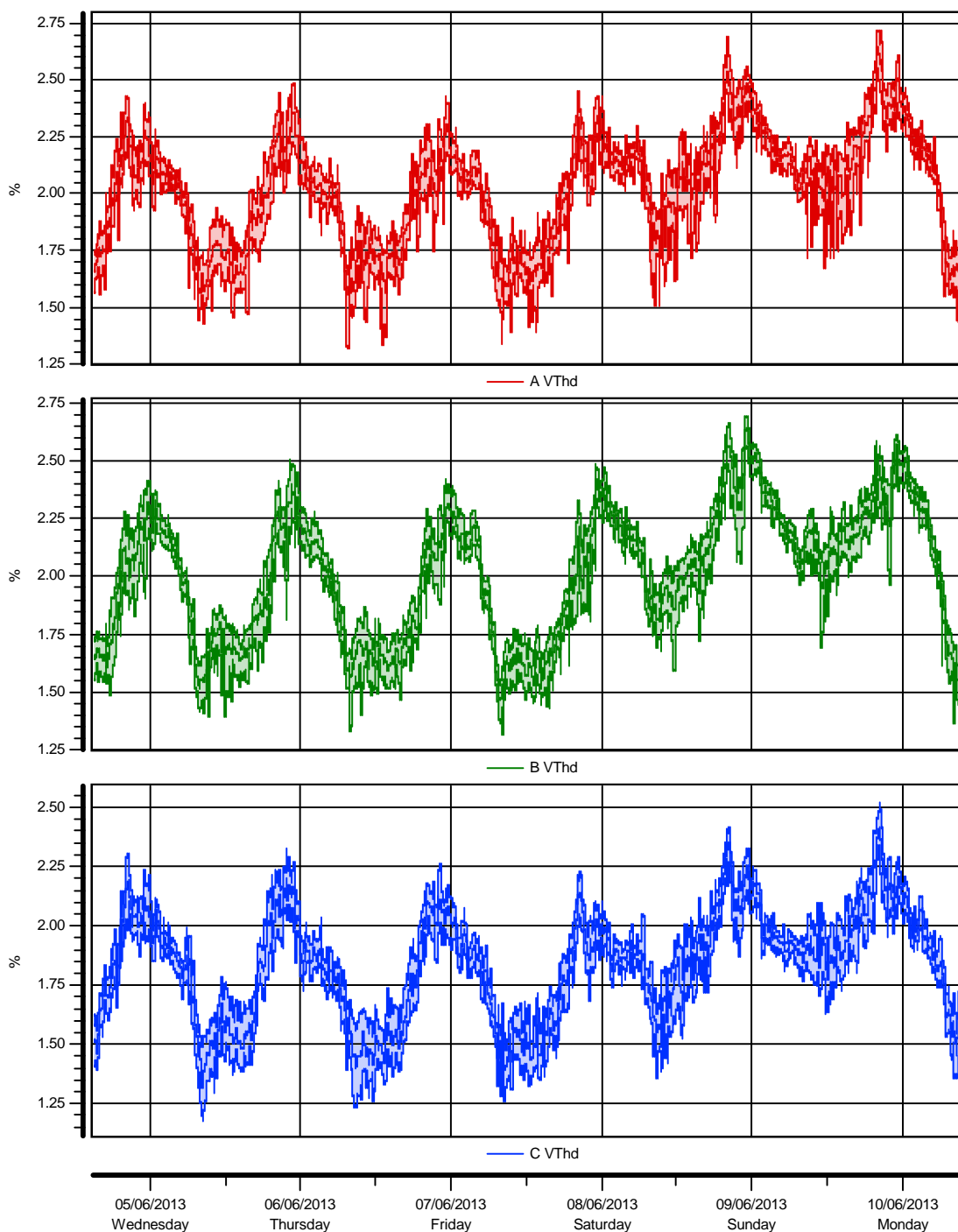


<i>Customer</i> ENW		<i>ABB Ref.</i>	
<i>Project</i> Howard Street Report Filter Load Balance & PFC		<i>Cust. Ref.</i>	
<i>Dealt with by</i> MR	<i>Date</i> 20/06/2013	<i>Issue</i> 0	<i>Page</i> 26 of 34

**VTHD TIMEPLOTS**

Site: howd st filt load bal and pfc

Measured from 04/06/2013 14:50:00.0 to 10/06/2013 10:35:00.0



<i>Customer</i> ENW		<i>ABB Ref.</i>	
<i>Project</i> Howard Street Report Filter Load Balance & PFC		<i>Cust. Ref.</i>	
<i>Dealt with by</i> MR	<i>Date</i> 20/06/2013	<i>Issue</i> 0	<i>Page</i> 27 of 34

## MIN/MAX/AVG POWER REPORT

Site: howd st filt load bal and pfc

Measured from 04/06/2013 14:50:00.0 to 10/06/2013 10:35:00.0

### POWER

#### ACTIVE POWER, P (W)

	A	B	C	TOTAL
Min kW	-23.85	-18.93	-17.04	-56.26 on 05/06/2013 11:50:00
Max kW	45.88	56.55	54.27	114.08 on 06/06/2013 22:10:00
Median kW	11.16	13.00	15.04	40.61
Average kW	10.08	12.24	14.47	36.79

#### APPARENT POWER,S (VA)

	A	B	C	TOTAL
Min kVA	3.46	3.51	3.19	11.81 on 05/06/2013 15:10:00
Max kVA	46.35	57.06	54.60	115.90 on 06/06/2013 22:10:00
Median kVA	12.22	13.71	15.66	42.87
Average kVA	13.45	14.83	16.40	44.67

#### REACTIVE POWER Q, AT FUND. FREQ. (VAR)

	A	B	C	TOTAL
Min kVAR	-3.048	-2.836	-1.832	-3.414 on 05/06/2013 13:10:00
Max kVAR	4.830	5.530	5.397	8.195 on 08/06/2013 11:50:00
Median kVAR	-0.011	0.520	1.253	1.615
Average kVAR	0.085	0.548	1.188	1.821

#### POWER FACTOR, PF

	A	B	C	TOTAL
Min	-0.995	-0.996	-0.993	-1.000 on 04/06/2013 18:10:00
Max	0.993	0.995	0.995	1.000 on 04/06/2013 19:50:00
Median	0.895	0.954	0.961	0.958
Average	0.153	0.441	0.676	0.297

### DEMAND

#### REAL POWER DEMAND

	A	B	C	TOTAL
Min kWh/h				-32.01 on 05/06/2013 14:20:00
Max kWh/h				98.58 on 06/06/2013 22:10:00
Median kWh/h				40.71
Average kWh/h				36.79

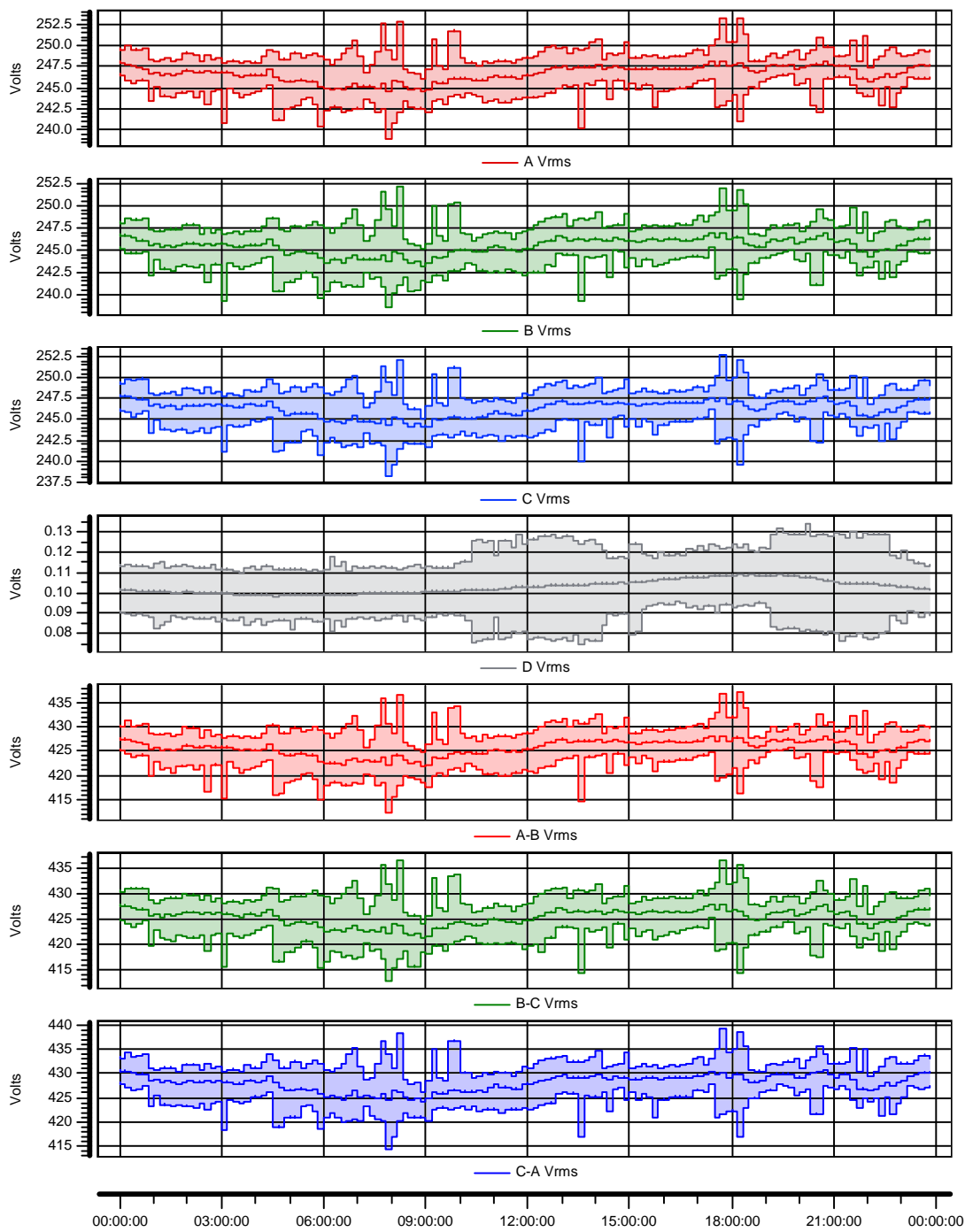
### ENERGY

#### ENERGY - INTEGRATED ACTIVE POWER (W-HRS)

	A	B	C	TOTAL
kWh	1413.2	1714.0	2026.9	5154 on 10/06/2013 10:35:00

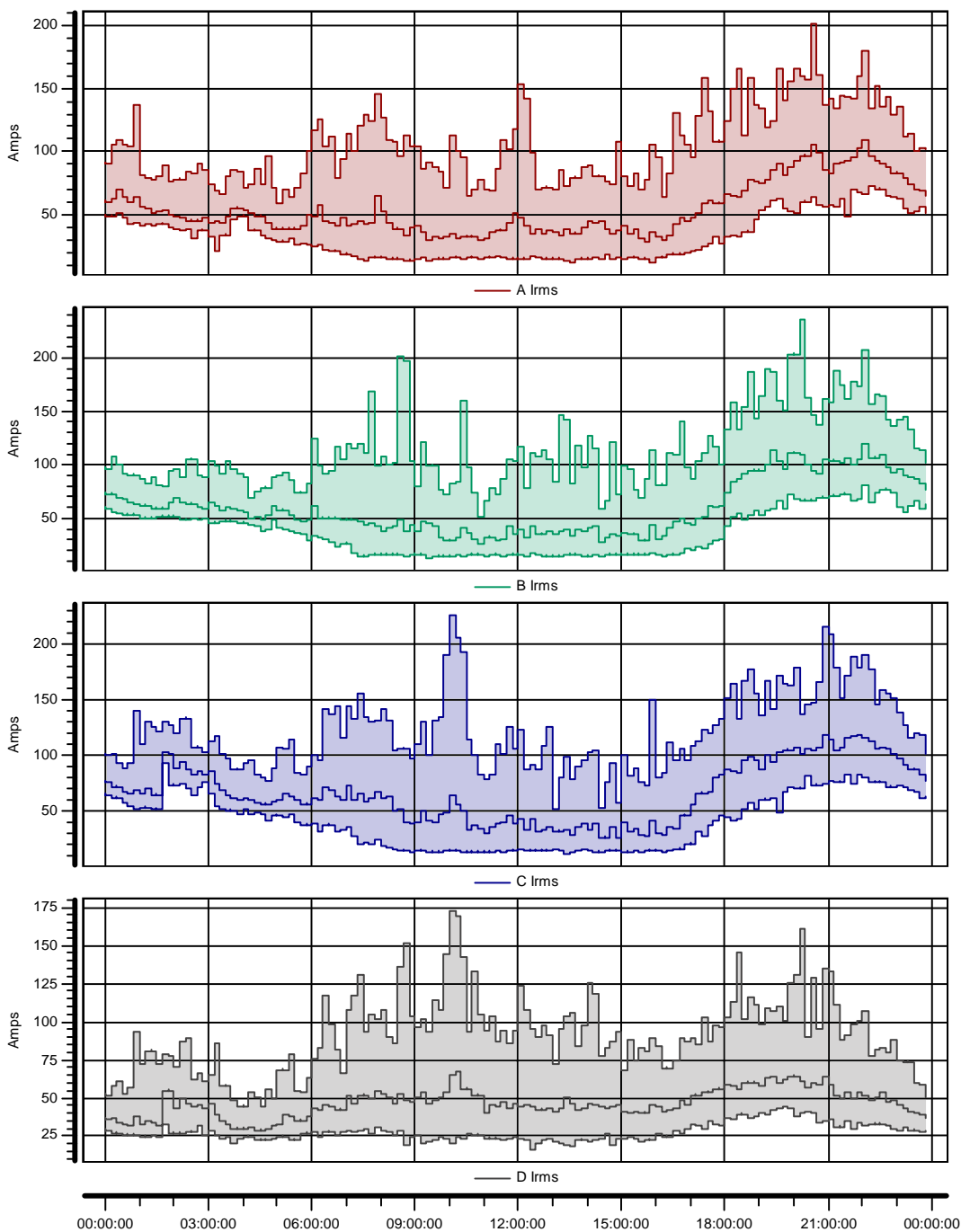
<i>Customer</i> ENW		<i>ABB Ref.</i>	
<i>Project</i> Howard Street Report Filter Load Balance & PFC		<i>Cust. Ref.</i>	
<i>Dealt with by</i> MR	<i>Date</i> 20/06/2013	<i>Issue</i> 0	<i>Page</i> 28 of 34

### Load Profile Voltage RMS value



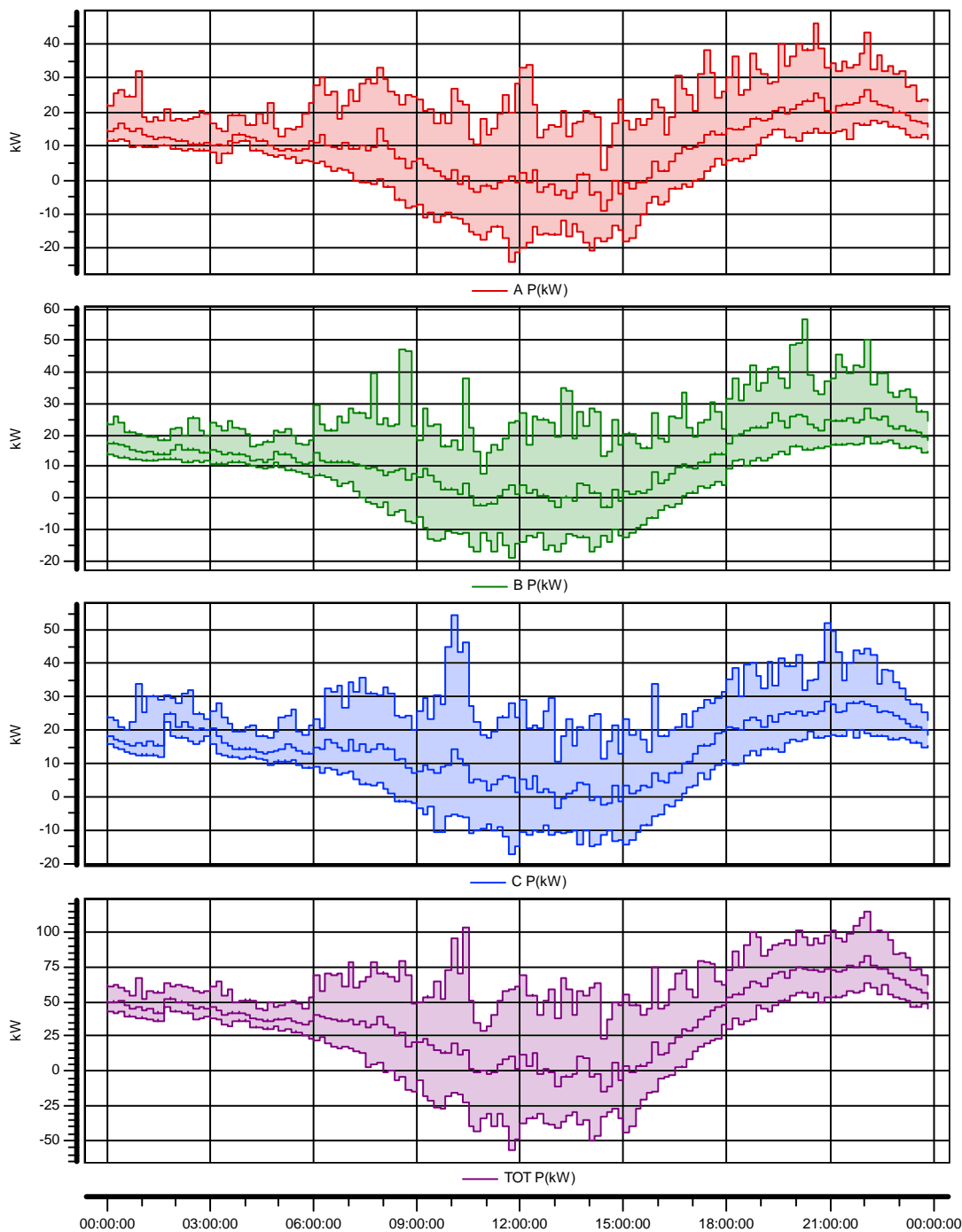
<i>Customer</i> ENW		<i>ABB Ref.</i>	
<i>Project</i> Howard Street Report Filter Load Balance & PFC		<i>Cust. Ref.</i>	
<i>Dealt with by</i> MR	<i>Date</i> 20/06/2013	<i>Issue</i> 0	<i>Page</i> 29 of 34

### Load Profile Current RMS value



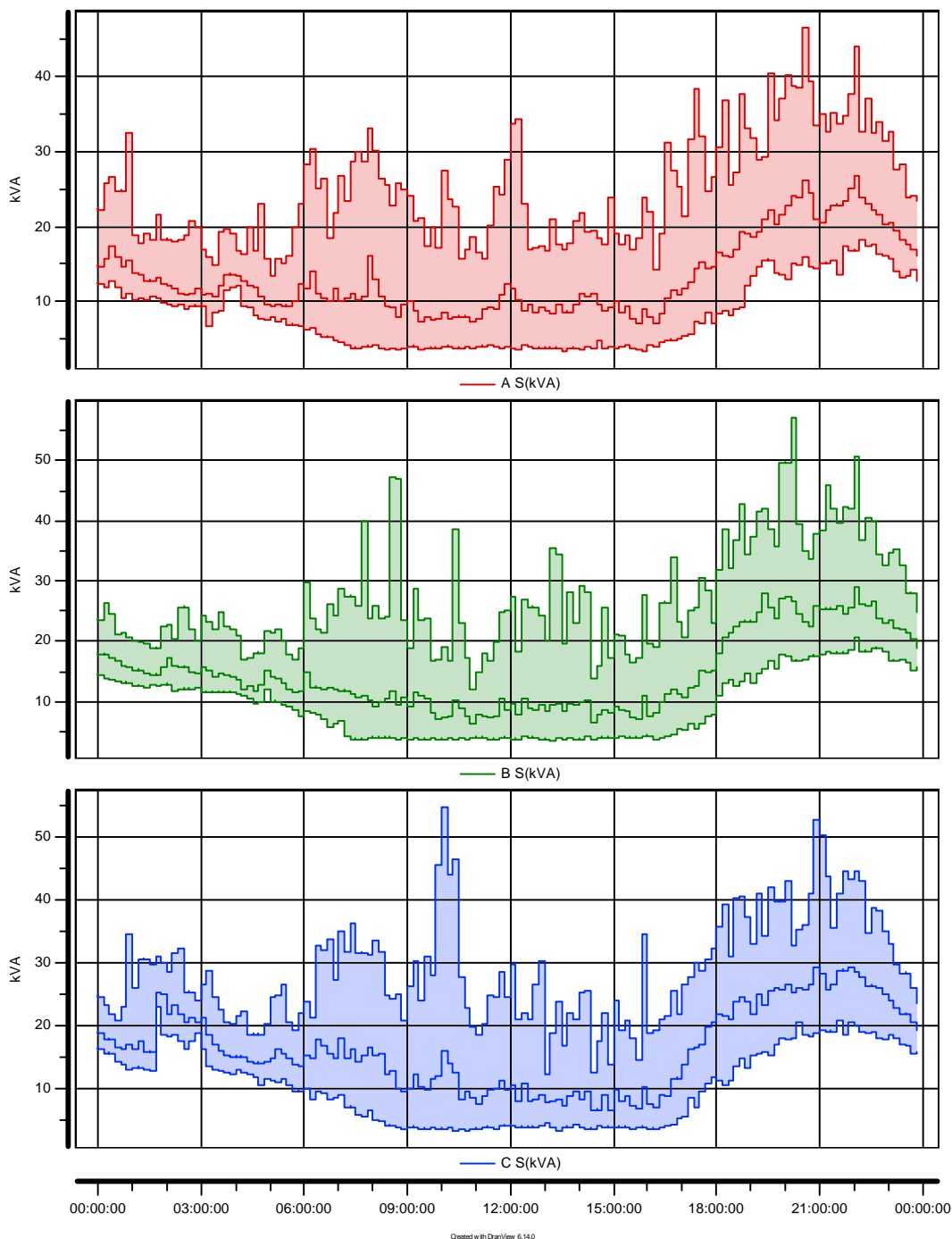
Customer ENW		ABB Ref.	
Project Howard Street Report Filter Load Balance & PFC		Cust. Ref.	
Dealt with by MR	Date 20/06/2013	Issue 0	Page 30 of 34

### Load Profile Active power, P (W)



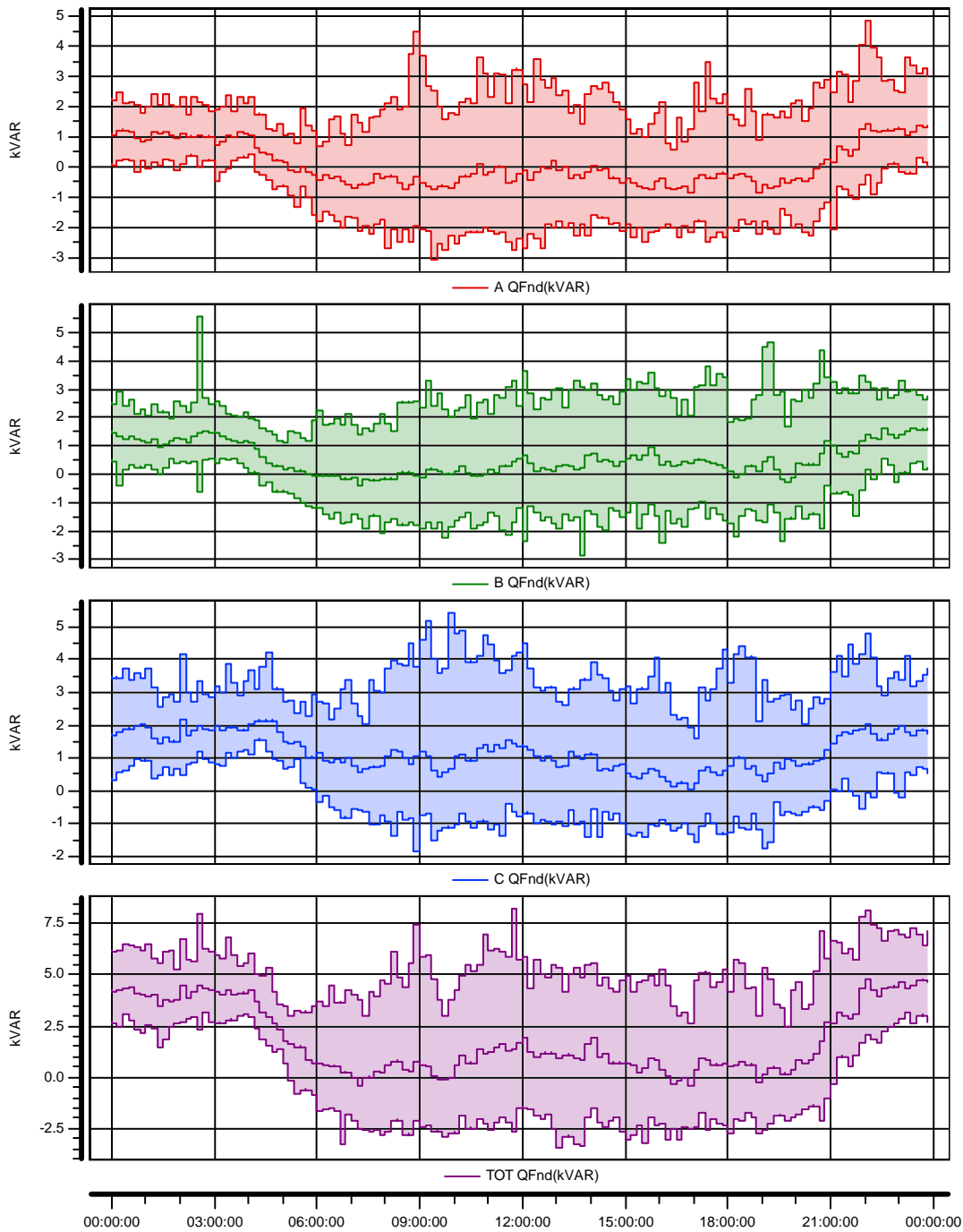
Customer ENW		ABB Ref.	
Project Howard Street Report Filter Load Balance & PFC		Cust. Ref.	
Dealt with by MR	Date 20/06/2013	Issue 0	Page 31 of 34

**Load Profile**  
**Apparent power, S (VA)**



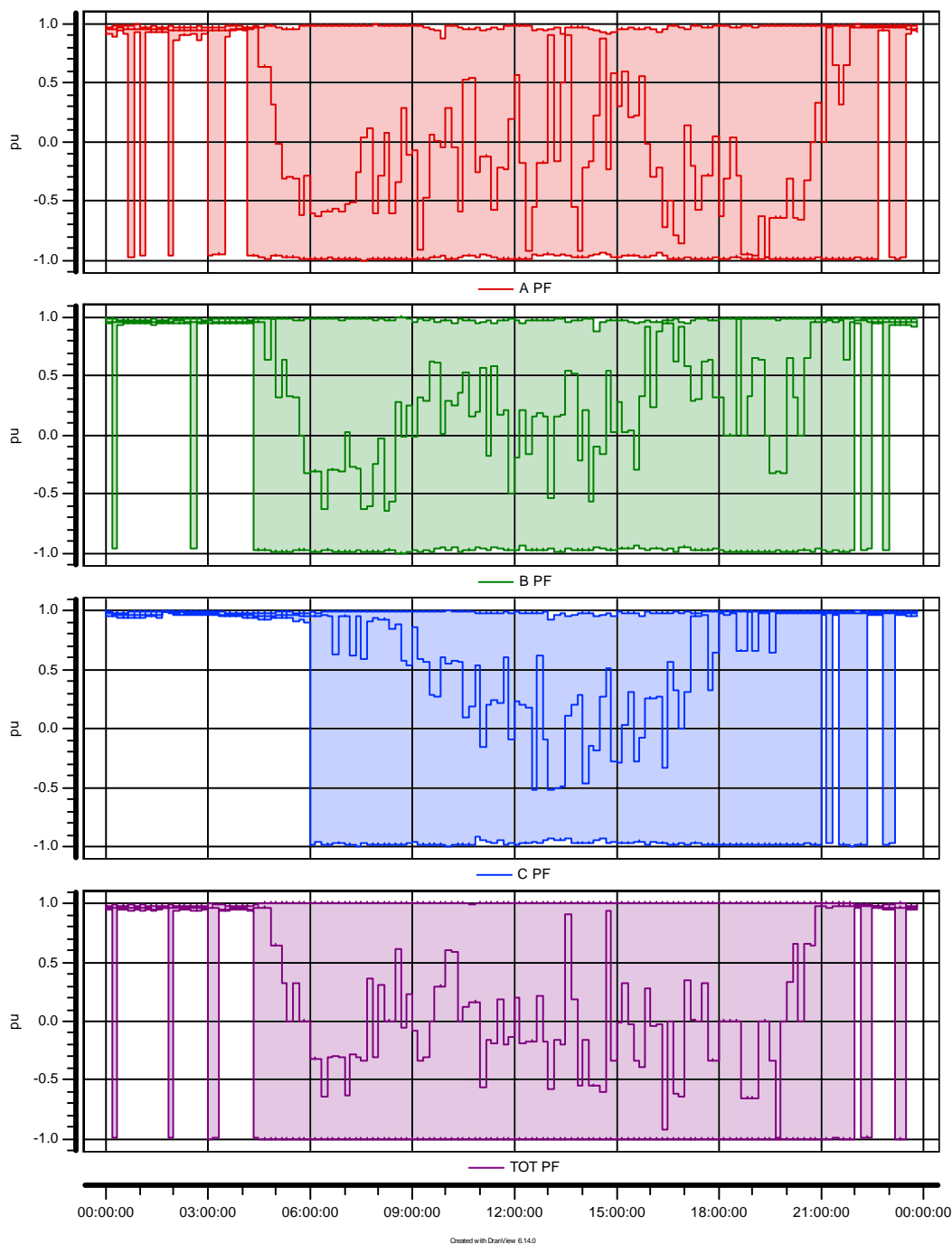
Customer ENW		ABB Ref.	
Project Howard Street Report Filter Load Balance & PFC		Cust. Ref.	
Dealt with by MR	Date 20/06/2013	Issue 0	Page 32 of 34

Load Profile  
Reactive power Q, at fund. freq. (VAR)



Customer ENW		ABB Ref.	
Project Howard Street Report Filter Load Balance & PFC		Cust. Ref.	
Dealt with by MR	Date 20/06/2013	Issue 0	Page 33 of 34

### Load Profile Power Factor, PF



<i>Customer</i> ENW		<i>ABB Ref.</i>	
<i>Project</i> Howard Street Report Filter Load Balance & PFC		<i>Cust. Ref.</i>	
<i>Dealt with by</i> MR	<i>Date</i> 20/06/2013	<i>Issue</i> 0	<i>Page</i> 34 of 34

## HARMONICS COMPARED AGAINST LIMITS

Site: howd st filt load bal and pfc

Measured from 04/06/2013 14:50:00.0 to 10/06/2013 10:35:00.0

G5/4 Stage 1 Curr. Harm. >16A per Phase

Measured Current Harmonics

	Limit	CHA	CHB	CHC	Status
H02	28.90 A	3.61	4.51	5.55	PASSED
H03	48.10 A	23.83	24.61	23.06	PASSED
H04	9.00 A	1.67	2.87	1.87	PASSED
H05	28.90 A	16.95	18.91	16.84	PASSED
H06	3.00 A	0.99	1.41	0.80	PASSED
H07	41.20 A	9.71	9.26	11.36	PASSED
H08	7.20 A	0.74	1.08	1.60	PASSED
H09	9.60 A	6.18	6.66	6.91	PASSED
H10	5.80 A	0.56	0.82	0.69	PASSED
H11	39.40 A	2.77	2.35	3.30	PASSED
H12	1.20 A	0.54	0.78	0.93	PASSED
H13	27.80 A	4.61	4.25	5.37	PASSED
H14	2.10 A	0.40	0.66	0.76	PASSED
H15	1.40 A	3.38	2.99	2.94	FAILED
H16	1.80 A	0.43	0.56	0.55	PASSED
H17	13.60 A	1.67	1.82	1.45	PASSED
H18	0.80 A	0.31	0.39	0.37	PASSED
H19	9.10 A	2.97	2.66	2.71	PASSED
H20	1.40 A	0.26	0.31	0.22	PASSED
H21	0.70 A	1.24	0.98	0.96	FAILED
H22	1.30 A	0.20	0.20	0.17	PASSED
H23	7.50 A	0.83	0.78	1.06	PASSED
H24	0.60 A	0.15	0.13	0.09	PASSED
H25	4.00 A	1.10	0.86	0.87	PASSED
H26	1.10 A	0.09	0.08	0.08	PASSED
H27	0.50 A	0.45	0.39	0.50	FAILED
H28	1.00 A	0.08	0.07	0.07	PASSED
H29	3.10 A	0.60	0.58	0.67	PASSED
H30	0.50 A	0.05	0.05	0.05	PASSED
H31	2.80 A	0.48	0.43	0.45	PASSED
H32	0.90 A	0.05	0.04	0.04	PASSED
H33	0.40 A	0.23	0.27	0.32	PASSED
H34	0.80 A	0.04	0.04	0.03	PASSED
H35	2.30 A	0.28	0.26	0.29	PASSED
H36	0.40 A	0.03	0.02	0.03	PASSED
H37	2.10 A	0.22	0.18	0.23	PASSED
H38	0.80 A	0.02	0.02	0.03	PASSED
H39	0.40 A	0.14	0.15	0.19	PASSED
H40	0.70 A	0.02	0.02	0.02	PASSED
H41	1.80 A	0.17	0.15	0.16	PASSED
H42	0.30 A	0.02	0.02	0.02	PASSED
H43	1.60 A	0.15	0.13	0.14	PASSED
H44	0.70 A	0.02	0.02	0.02	PASSED
H45	0.30 A	0.09	0.08	0.08	PASSED
H46	0.60 A	0.02	0.01	0.02	PASSED
H47	1.40 A	0.06	0.06	0.06	PASSED
H48	0.30 A	0.01	0.01	0.02	PASSED
H49	1.30 A	0.07	0.06	0.07	PASSED
H50	0.60 A	0.00	0.00	0.00	PASSED