TWO PHASE FLOW BY USING ELECTRICAL TOMOGRAPHY

By

Faizatul Khasanah Sugeng

Dissertation submitted in partial fulfillment
of the requirements for the
Bachelor of Engineering (Hons)
(Electrical and Electronics Engineering)

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Universiti Teknologi PETRONAS
Bandar Sri Iskandar
31750 Tronoh
Perak Darul Ridzuan

CERTIFICATION OF APPROVAL

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Approved by:

....
(Ir. Dr. Idris Ismail)
Project Supervisor

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK
JUNE 2010

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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(FAIZATUL KHASANAH SUGENG)

ABSTRACT

Electrical Tomography has been widely used in the industry to obtain the cross sectional images. Three types of electrical tomography are being applied; Electrical Resistance Tomography (ERT), Electrical Capacitance Tomography (ECT) and Electrical Impedance Tomography (EIT). The aim of this project is to improve the performance of current flow rigs to enable bubble flow regime, to fabricate new sensor of ERT for data acquisition and to calculate the void fraction using the image processing techniques. ECT sensor is calibrated and studied but it is not fabricated for this project. Dual ERT sensor is designed and tested using data acquisition unit and software available in the laboratory. The ITS M3000 dual-modality provides information on the multiphase flow pattern, flow regime, composition and velocity. It produces conductivity and permittivity maps from multi-electrode sensors arranged around the pipe. Aside from using the Multi-Modal Tomography (MMTC) software, LCR meter can also be used to obtain data measurement result. However, this project only covers a part of ERT which are designing and fabricating the ERT prototype.

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CHAPTER 1

INTRODUCTION

This chapter will describe the background of study, problem statement of the project, objectives to be achieved and scopes of study involved in this project. It provides the overview of the project with details included in the next few chapters.

1.1 Background of Study

Two phase flow meter or commonly known as multiphase flow meter is being used in the oil and gas industry for measuring flow rates in a pipeline. Schlumberger Oilfield Glossary defines multiphase meter as a device that can be used to measure individual fluid flow rates of oil and gas when more than one fluid is flowing through a pipeline. It provides accurate readings even when different flow regimes are present in the multiphase flow. It gives real time information on well capabilities during production and it helps to increase the production. Multiphase meter has the advantages of continuous well monitoring, no separator needed, low cost, weigh less and it requires less space especially on platform with limited area.

The conventional test separator had been used before the multiphase meter is introduced in the industry. The test separator has more complex system as compared to the multiphase meter system which is much simpler. Figure 1 and Figure 2 shown are the conventional test separator system and multiphase meter system, respectively.

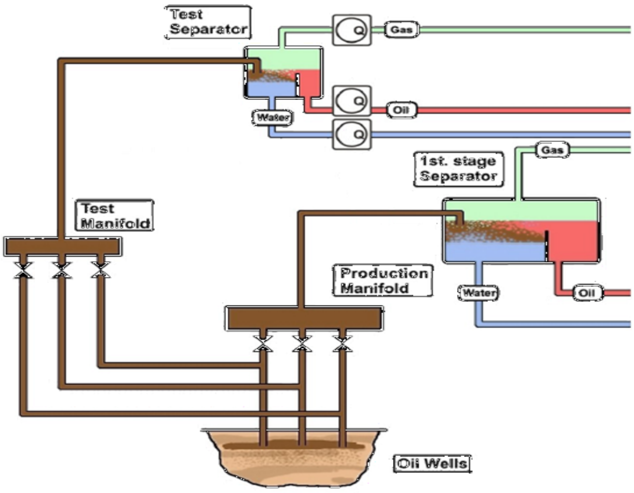


Figure 2: Conventional Test Separator (Roxar, 2009)

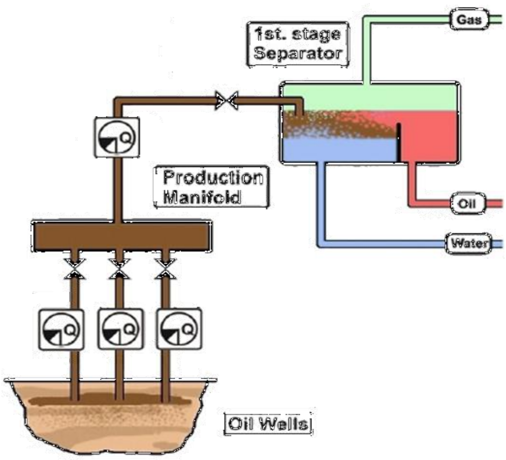


Figure 1: Multiphase Meter (Roxar, 2009)

Tomography has been widely used in medical and industry applications. It is used to obtain cross-sectional images of objects by non-destructive means. The general principle underpinning tomography technique is to enclose the objects to be studied by a number of non-intrusive sensors (transducer) and then acquire measurements from these sensors (Loh W.W. *et al.* 1999). Tomography involves projection data gathering from various directions and then will be fed into a tomographic reconstruction software algorithm processed by a computer. Typical configuration of electrical resistance tomography is shown in Figure 3.

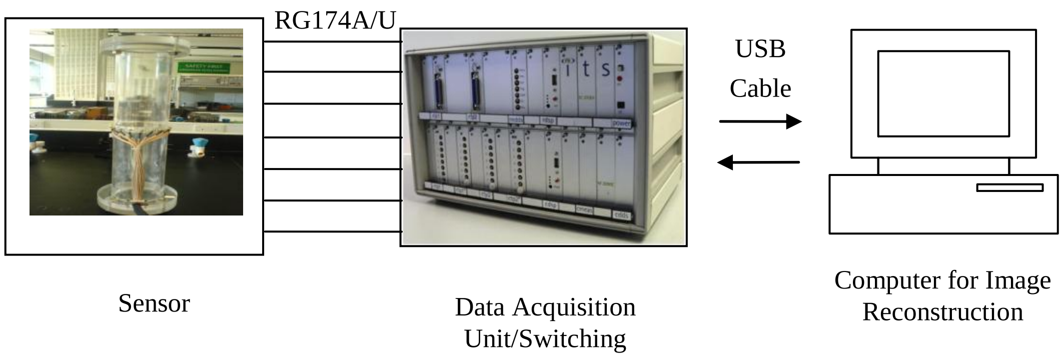


Figure 3: Basic Tomography Configuration

This technique has the advantages of producing a cross sectional distribution information where the flow regime can be identified, the solids' fraction profile and the velocity profile can be derived and the volumetric flow rate can be measured (S. Liu *et al.* 2005). There are many types of tomography sensors had been introduced in the industry such as ionizing radiation, optical, positron emission (PET), nuclear magnetic resonance (NMR), acoustic and electrical. The most popular tomography sensors used in the oil and gas industry are the electrical type; Electrical Capacitance Tomography (ECT), Electrical Resistivity Tomography (ERT) and Electrical Magnetic Tomography (EMT**).**

1.2 Problem Statement

Multiphase meter concept was introduced in August 1984 and already in the industry since 1992 (Roxar, 2009). Previously in the oil and gas industry, the conventional way for well testing is using the test separator. It has the disadvantages of inaccurate readings, works independently by separating the elements and it is physically impossible to completely separate the phases for independent measurement (Jo Agar, 2001). Therefore, multiphase meter is introduced to replace the conventional test separator. No separation needed and hence the crude is measured continuously as it flows through the meter. The readings can be obtained instantaneously on the operator workstation.

Currently, PETRONAS Carigali Sdn. Bhd. (PCSB) has installed numbers of multiphase flow meter on the platforms from various manufacturers since 2002 (DFIC, 2009). ERT is known as the simplest technique to be used in obtaining a cross sectional image in a vessel. In order to get a better result, dual plane sensor is being used in this project where more area can be observed compared to only one plane. Therefore, this project will help to produce more accurate data by using dual plane sensor.

1.3 Objectives

This project is implemented to achieve its objectives. The objectives of this project are to improve the performance of current flow rigs in order to enable bubble flow regime. The current flow rig does not provide a sufficient air flow to allow the bubble flow in the column, therefore the flow rig need to be reconstructed. In order to suit the requirements, a new dual ERT sensor is to be fabricated for data acquisition analysis. Analysis need to be done which in this project, the void fraction is being calculated by applying the image processing technique and raw voltage data analysis.

1.4 Scope of Study

Various kinds of theory and knowledge need to be applied in order to complete the project. It includes the understanding of tomography system and the two phase flow behavior. The tomography system is an essential part in this project which it includes the data acquisition unit, image processing and to design the sensor. These will help to analyze the data obtained in the project. The sensor is designed for 16 electrodes in a plane and therefore, there are 32 electrodes for both dual planes. The raw data measurement is obtained using the data acquisition unit which is the Multimodal Tomography Configurator (MMTC). Another important aspect need to be understood is the behavior of two phase flow. This project is focusing on the bubble flow regime and therefore, a particular understanding on the bubble flow dynamic is necessary for this project. From the void fraction calculation, the right flow regime can be identified. A test rig is to be designed and constructed for dynamic flow test where it is built to meet the requirement of bubble flow regime.

CHAPTER 2

LITERATURE REVIEW

There are many types of tomography techniques used in the industry. The most common technique used is the Electrical Tomography. This chapter will describe on the Electrical Tomography in details.

2.1 Electrical Tomography

The Electrical Tomography is non-intrusive, of high temporal resolution (1 ms achievable), low cost, no radiation hazard and easy to implement (C.G. Xie *et al.* 1995). It is a popular measurement technique used in the oil and gas industry to measure the multiphase flow regimes. The information about the contents of process vessels and pipelines can be obtained by applying this technique. Multiple electrodes are arranged around the boundary of the vessel at fixed locations in such a way that they do not affect the flow or movement of materials.

2.1.1 Electrical Capacitance Tomography (ECT)

ECT has been developed for imaging the industrial processes containing dielectric permittivity (ε) of material. The flow regime of multiple fluids flowing through a pipe can be observed using ECT in multiphase flow meters. It is mostly suitable for process involving insulating mixtures of different permittivity. The advantages of using ECT sensors are it has no radiation, rapid response, relatively low cost, being non-intrusive and non-invasive and withstanding high temperature and pressure (I. Ismail *et al.* 2005). The ECT sensor is shown in Figure 4. It consists of one plane of capacitance layer where 12 electrodes are in fixed equidistance inside the pipe wall.

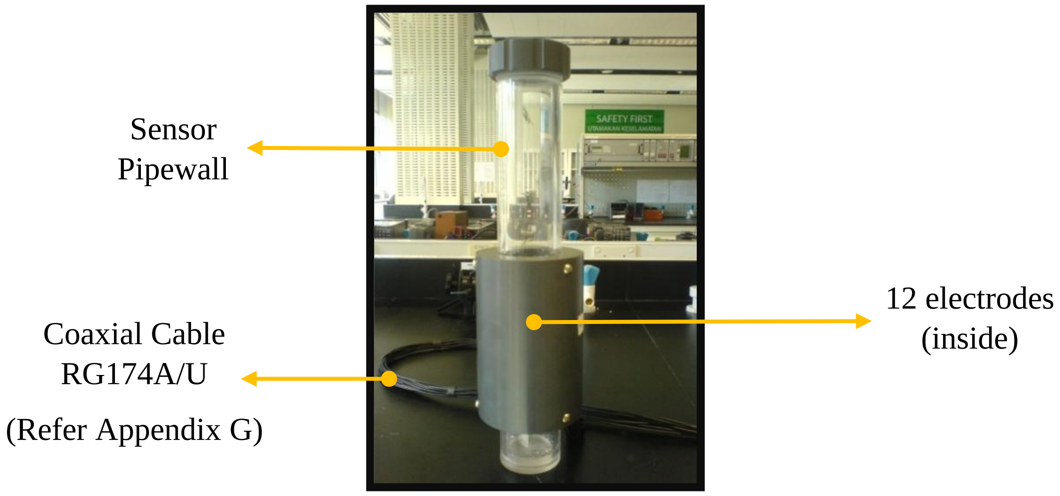


Figure 4: ECT Sensor

2.1.2 Electrical Resistance Tomography (ERT)

Electrical Resistance Tomography (ERT) is a measurement technique used to obtain a cross sectional images of the electrical conductivity (σ) in process vessels and pipeline (ITS, 2007). ERT sensor is a non-intrusive but invasive sensor. It is used to measure aqueous based processes which the measured materials are different in conductivity characteristics (Z. Cui *et. al*, 2009). The ERT system produces a cross-sectional image of the electrical conductivity (σ) distribution in pipelines or process vessel. It is emphasizing the quantity measured rather than the images. The ERT sensor is shown in Figure 5. It consists of single plane sensor with 16 electrodes are fixed around the vessel wall.

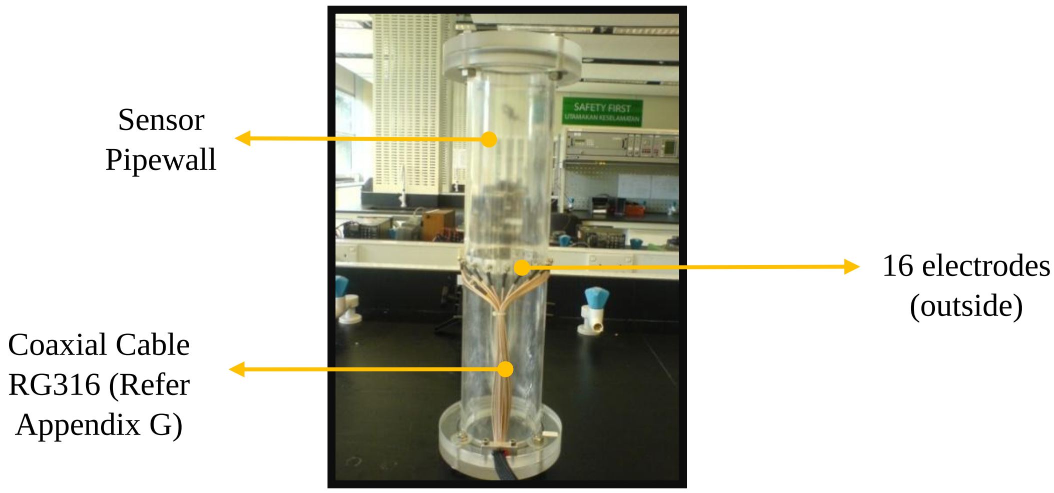


Figure 5: ERT Sensor

2.2 Flow Regime

Flow regime map provides the general illustration of the flow regime for vertical and horizontal flows. The descriptions and classifications of multiphase flow in a pipe and the flow regime map can be used to estimate the expected flow regimes under given circumstances are well-established (M. Brown, 2007). Multiphase flow regimes have no sharp boundaries and therefore it changes smoothly from one regime to another. The flow regime map is shown in Figure 6. Flow regime in vertical upward flow can be categorized into few profiles which are Bubbly flow regime, Taylor flow regime, Slug-bubbly flow regime, Churn flow regime and Annular flow regime.

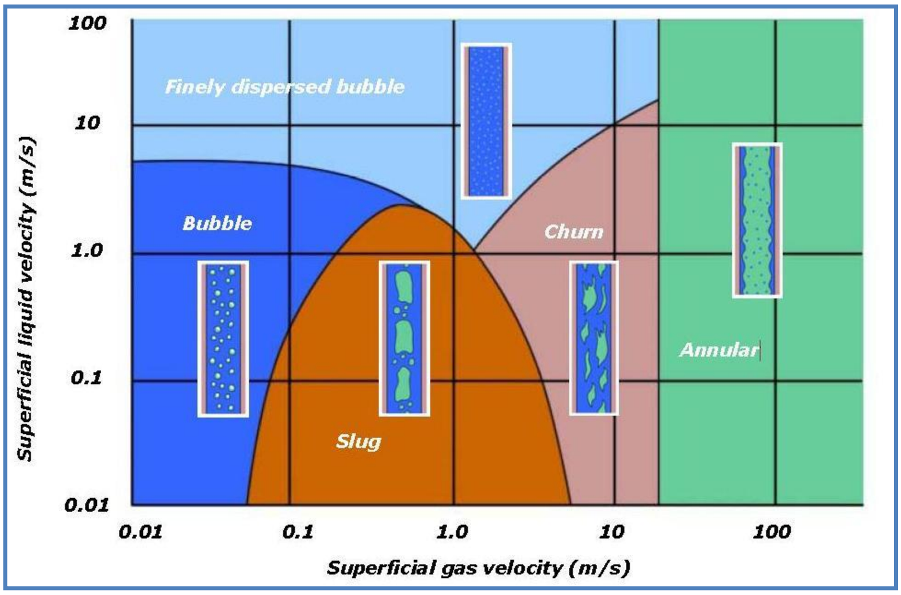


Figure 6: Flow Regime Map (Sidsel et. al, 2005)

Bubbly flow regime occurs at very high liquid velocities and low gas velocities. It is observed by fast rising bubbles presence with a diameter equal to or less than the pipeline. It is the most ideal situation. The elements are floated separately and bubbles are located on top of the pipeline. A Wavy flow will occur due to higher velocity in gas as it has lower friction. Taylor flow regime or known as Slug flow regime consists of gas bubbles with lengths greater than the pipeline diameter that move along the pipeline separated from each other by liquid slugs.

The Churn flow regime occurs at very high gas velocities and wave or ripple motion is observed at the bubble tail. The increasing of gas flow rate with low liquid velocity in Churn flow will results in annular flow. A continuous gas phase is observed in the central core of the pipeline with the liquid phase is displaced to form an annulus between the pipeline wall and the gas. Annular flow will create a momentarily reverse flow or bi-directional flow. The difference in flow regime is illustrated in Figure 7.

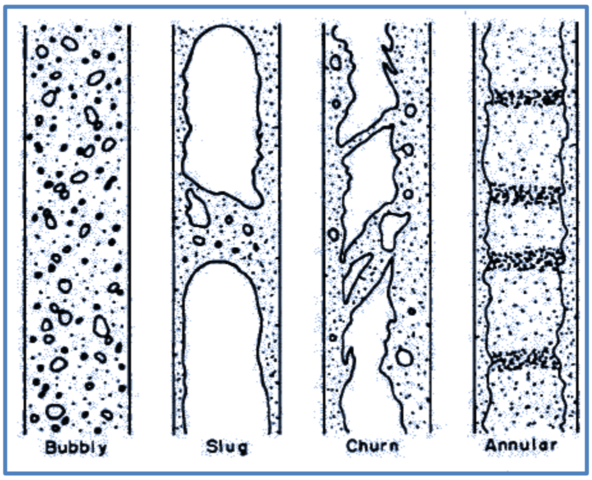


Figure 7: Flow Regime in Multiphase Flow (A. Rashid et. al, 2001)

All flow regimes however, can be grouped into dispersed flow, separated flow, intermittent flow or a combination of these (Sidsel *et. al*, 2005).

- Dispersed flow is characterised by a uniform phase distribution in both the radial and axial directions. Examples of such flows are bubble flow and mist flow.
- Separated flow is characterised by a non-continuous phase distribution in the radial direction and a continuous phase distribution in the axial direction. Examples of such flows are stratified and annular.
- Intermittent flow is characterised by being non-continuous in the axial direction, and therefore exhibits locally unsteady behaviour. Examples of such flows are elongated bubble, churn and slug flow. The flow regimes are all hydrodynamic two-phase gas-liquid flow regimes.

2.3 Superficial Velocity

2.3.1 Superficial Gas Velocity

Superficial gas velocity, $V_{s,\ gas}$ is the gas velocity flowing through a pipe without liquids. The total output of gas provided that it operates within the operating temperature and pressure, divided by the cross sectional area of the pipe. It can be expressed in terms of equation (1). (Sidsel et. al, 2005)

$$v_{s,gas} = \frac{Q_{gas}}{A} \quad \ldots (1)$$

where, $v_{s,gas}$ = Superficial gas velocity, m/s

Q_{gas} = Gas volume flow rate, m^3/s

A = cross-sectional area of pipe, m^2

2.3.2 Superficial Liquid Velocity

Superficial liquid velocity, $V_{s,\ liquid}$ is the liquid velocity flowing through a pipe without gasses. It has a similar equation with the superficial gas velocity. It can be expressed in terms of equation (2). (Sidsel et. al, 2005)

$$v_{s,liquid} = \frac{Q_{liquid}}{A} \quad \ldots (2)$$

where, $v_{s,liquid}$ = Superficial gas velocity, m/s

Q_{liquid} = Gas volume flow rate, m^3/s

A = cross-sectional area of pipe, m^2

The multiphase mixture velocity can be expressed by summation of both superficial gas velocity and superficial liquid velocity, as shown in equation (3). (Sidsel et. al, 2005)

$$V_m = V_{s,gas} + V_{s,liquid} \quad \ldots (3)$$

where, V_m = Multiphase mixture velocity, m/s

2.4 ECT Sensor Characteristics

In most application, ECT electrode is mounted outside the ECT pipeline which is called external electrode ECT sensor (Yang *et al.* 1997). The external electrode can avoid polluting and eroding by inner media, and affecting from the inner media static, so that non-intrusive measurement is realized (D. Yang *et al.* 2009). Various design parameters of ECT sensor can affect the overall sensor performance. A very low noise level, a wide dynamic measurement range, high immunity to stray capacitance to earth and be able to measure at high speed are the characteristics of an ideal ECT sensor. ECT sensor of 8 electrodes is being used in this project. The electrodes are built from conductive plate which has direct contact to the measuring area. Figure 8 shown is the measurement for capacitance mode.

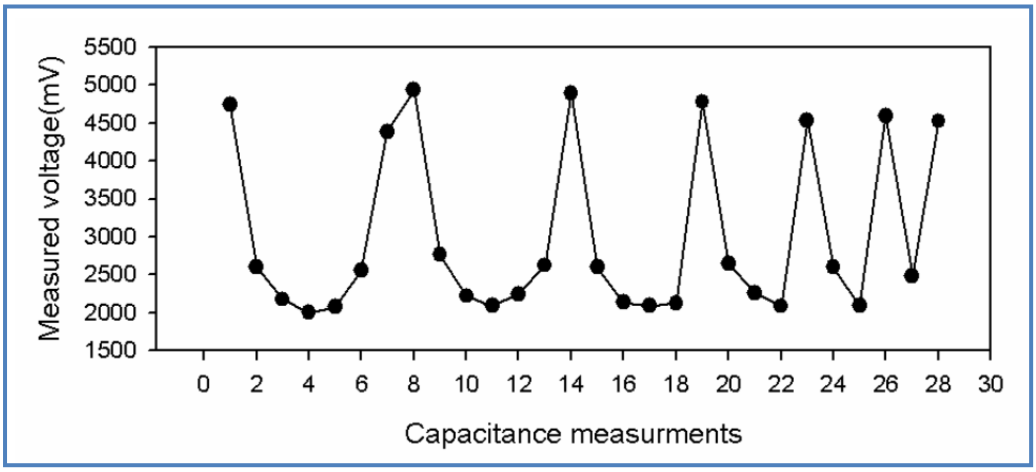


Figure 8: Measurement for Capacitance Mode (Z.Cui et. al 2009)

Capacitance is defined as measure of the ability of two conductors to store charge when a given potential difference is established between them (E. Brown, 2007). ECT has to be designed to meet certain criteria in order to get a good performance. The design criteria for ECT sensor are as follows (PTL, 2001):

a. Internal or external electrodes
b. Number of electrodes

c. Capacitance value
d. Total electrode length
e. Length of measurement electrodes and guard electrodes
f. Screening arrangement
g. Connecting leads
h. Electrostatic precautions

2.5 ECT Sensor Design

ECT has two types of fixing the electrodes; internal or external. In choosing the internal or external electrodes is depends on the vessel wall materials. An acrylic material is used for this project. Therefore, either internal or external electrodes can be applied. The external electrodes arrangement is selected for this project as it is much simpler and no rigid accuracy is needed compared to the internal electrodes. It has no direct contact with the fluid flow inside the pipe and thus, the measurement is non-invasive.

The number of electrodes will affect the sensitivity and image capture rates. The radial resolution can be improved by increasing the number of electrodes. In an ECT system, due to the overlapping capacitance, therefore the value of capacitance will be the same. The possible number of standalone independent capacitance measurements per image for a system can be calculated by:

$$M=\frac{N(N-1)}{2} \qquad \ldots (4)$$

where,

M = Total capacitance measurements required for image Reconstruction

N = Number of electrodes

The capacitance value is calculated based on equation (5). The measurement of capacitance data is determined by:

$$C = \frac{\varepsilon_0 \varepsilon_r A}{d_p} \qquad \ldots (5)$$

where C = capacitance (F)

ε_0 = permittivity of free space, 8.854×10^{-12}

ε_r = permittivity of the dielectric constant

A = area of the plate (m)

d_p = distance between plates (m)

The sensor is to be designed to measure between a higher capacitance (C_{max}) value with a lower capacitance value (C_{min}). It has to be able to image the materials with a high (E_2) and low (E_1) permittivity. The measured capacitance between adjacent electrodes (C_A) with lower permittivity (E_1) material value must follow the equation (6) in order to allow capacitance of higher permittivity material will be less than C_{max}. The capacitance for opposite electrodes (C_O) with lower permittivity material value must follow equation (7) in order to have a noise free measurement. The value of K is a constant which is typically 50.

$$C_A < C_{max} \frac{E_1}{E_2} \qquad \ldots (6)$$

$$C_O > K C_{min} \qquad \ldots (7)$$

The total electrode length (L_t) including the measurement and driven guard electrodes must be at least equal to the diameter of the pipe. The sensitivity of the sensor is depends on the length of electrode.

The maximum (L_{max}) and minimum (L_{min}) length of measurement electrode is shown in equation (8) and equation (9), respectively. The length of driven guard electrodes can be calculated using equation (10).

$$L_{min} = \frac{C_{min}}{K_2} \quad \ldots (8)$$

$$L_{max} = \frac{C_{max}}{K_1} \quad \ldots (9)$$

$$L_t = L_m + 2L_g \quad \ldots (10)$$

where,

L_t = Total electrode length

L_m = Length of measurement electrodes

L_g = Length of drive guard electrodes

The measuring electrodes must be surrounded by earthed, as shown in Figure 9. The measuring and guard electrodes must be connected to the measuring unit by screened coaxial connecting leads. The electrodes are usually made of copper (refer Appendix H). The measurement and guard electrodes are to be connected to the capacitance measuring unit by screened coaxial cables and terminated un SMB coaxial connectors (refer Appendix I). The connecting leads must be less than 1.5 meters. All measurement and guard electrodes have to be earthed in order to avoid the electrostatic from occur. These earthed areas are attached to the sensor by an individual discharge resistor.

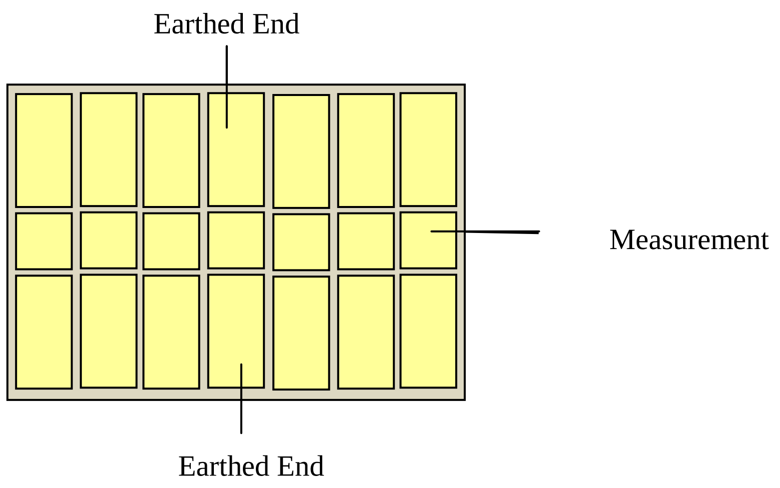


Figure 9: ECT Sensor Arrangement

2.6 ERT Measurement Strategies

There are few types of measurement strategies involved in order to obtain the measurement data which re normal adjacent, fast adjacent, linear adjacent and conducting boundary. In this project, the normal adjacent measurement strategy is being used.

2.6.1 ***Normal Adjacent***

The adjacent protocol is the most common measurement strategy used (H.S Tapp *et. al*, 2003). Electrical current flow is induced between a pair of adjacent electrodes, and the differential potential (voltage) of the remaining pairs of adjacent electrodes are measured. This process is repeated all independent measurements are taken as shown in Figure 10.

This method produces N^2 measurements where N is the number of electrodes. Therefore, the total independent measurements, M is shown as equation (11).

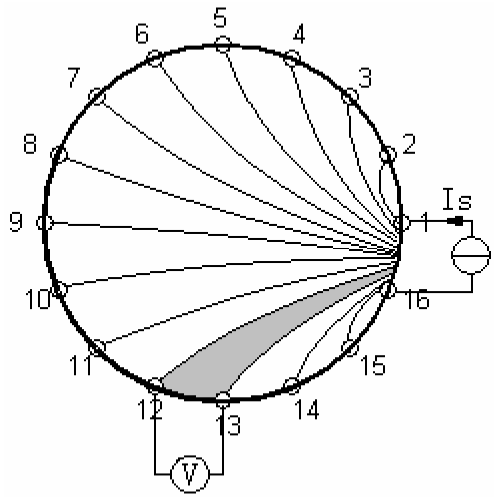


Figure 10: Adjacent Measurement (Z. Cui *et. al*, 2009)

$$M = \frac{N(N-1)}{2} \quad \ldots (11)$$

However, the voltage is not measured at the current injecting electrode in order to avoid the electrode contact impedance problems. Thus, equation (2) is reduced to equation (12).

$$M = \frac{N(N-3)}{2} \quad \ldots (12)$$

*2.6.2 **Others***

Another method used is the fast adjacent technique. This method is suitable for fast data collection which the measurement does not requires any on-line image processing. It has the same process as the normal adjacent method. Linear measurement strategy applies to a vertical series of electrodes mounted on a linear rod or in a vessel. It uses the same process as the adjacent method. The setting is shown as in Figure 11.

Figure 11: Linear Measurement Strategy (ITS, 2007)

The conducting boundary measurement technique is applied to pipelines and vessels with conducting boundaries. The conducting boundaries act as current sink in order to reduce the common-mode voltage across the measurement electrodes (H.S Tapp *et. al*, 2003). The effects of electromagnetic interference is reduced when the earthed conducting boundary act as a shield as shown in Figure 12. The voltages are measured at the electrodes while the conducting vessels are grounded.

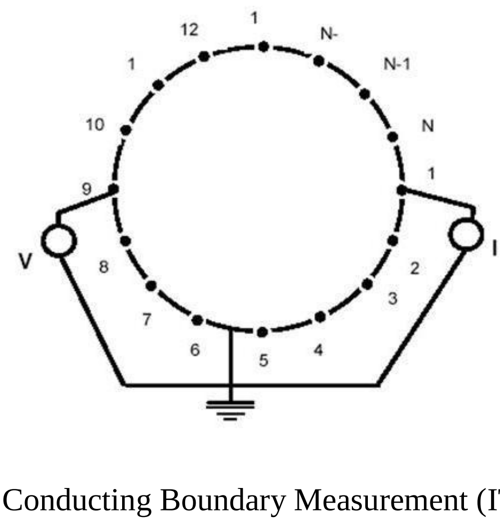


Figure 12: Conducting Boundary Measurement (ITS, 2007)

2.7 ERT Sensor Characteristics

In Electrical Resistance Tomography (ERT) sensor, the electrodes must be in direct contact with the material inside the vessels or pipeline. The electrodes also should be non-invasive as possible while being invasive at the same time. In order to obtain a reliable measurement, the process fluid inside the vessels should be continuous and less conductive than the electrodes (Z. Cui *et. al*, 2009). Typical types of electrodes used in the industry are made of metallic. The electrodes positioning is another important factor need to be considered in designing the ERT sensor. Electrodes are located at equal distance around the periphery of the vessels at fixed locations in order to map the electrical conductivity across plane.

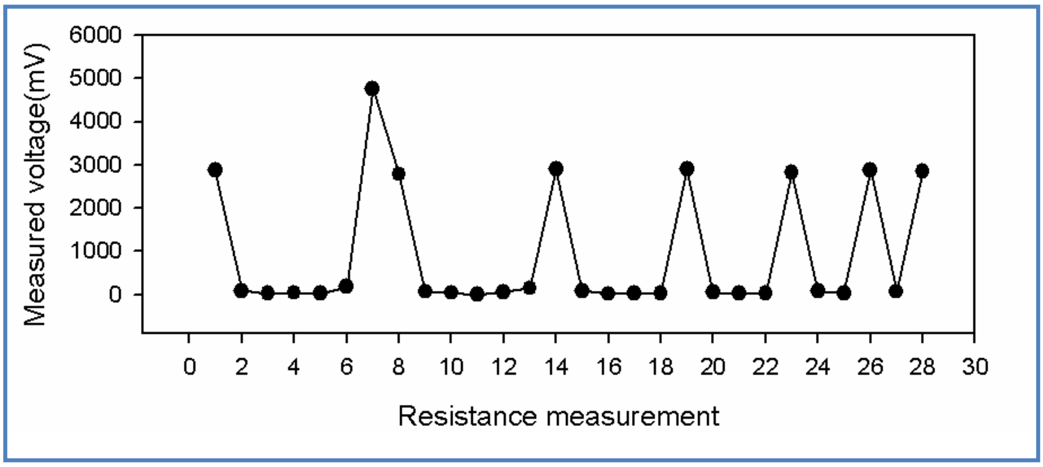


Figure 13: Measurement for Resistance Mode (Z.Cui *et. al* 2009)

The size of electrodes is an important factor and the optimal size is dependent on number of parameters. Ideally, the current injecting electrodes should have a large surface area to ensure that even current density is generated while the voltage measuring electrodes should have a small surface area in order to avoid averaging across several equipotentials (M. Akrama *et. al*, 2008). The number of electrodes is selected based on the time taken to acquire data and reconstruct the images. Another element need to be considered in constructing an ERT sensor is the length of the signal carrying cable which is connected between the electrodes and data acquisition. It is important in order to reduce the effect of environmental noise and interference. Figure 13 shown is the measurement for resistance mode.

2.8 Flow Parameter

The local volume fraction distribution can be determined from the conductivity distribution. Maxwell equation is used to determine the local volume fraction, α_c as shown in equation (13). It calculates the concentration of the dispersed phase in a continuous background. (Loh W.W. *et al.* 1999, ITS 2007)

$$\alpha_c = \frac{2\sigma_1 + \sigma_2 - 2\sigma_{mc} + \frac{\sigma_{mc}\sigma_2}{\sigma_1}}{\sigma_{mc} - \frac{\sigma_2}{\sigma_1} + 2(\sigma_1 - \sigma_2)} \quad \ldots (13)$$

where,

α_c = Local volume fraction distribution of dispersed material

σ_1 = Conductivity of continuous phase, mS/cm

σ_2 = Conductivity of dispersed phase, mS/cm

σ_{mc} = Local mixture conductivity distribution, mS/cm

2.9 ERT Sensor Design

Typical Electrical Resistance Tomography (ERT) sensor consists of 16 electrodes separated at equal distance which are mounted in vessels. The number of electrodes can vary depending on requirements. The configuration is either in a single plane or up to eight planes. Shape of the electrodes is designed based on few factors including the measurement protocols. The simplest is to use the same electrodes as both source and detection (H.S Tapp *et. al*, 2003). Figure 14 shows the ERT sensor design of two planes in a vessel.

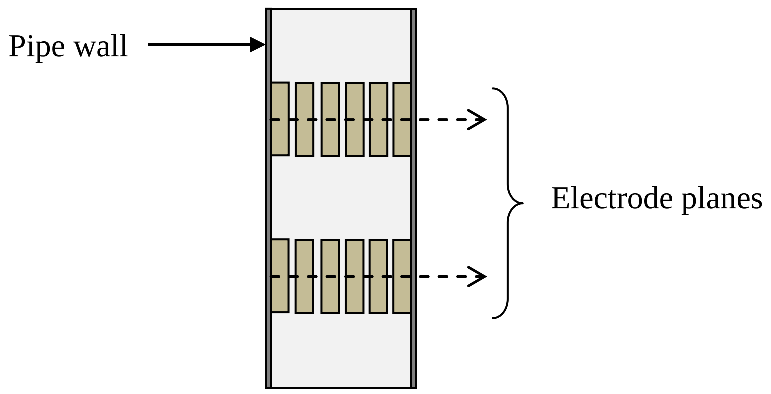


Figure 14: ERT Sensor Design of Dual Planes

The optimum electrodes shape for normal adjacent is rectangular where the angular thickness of the electrode is twice the separation as shown in Figure 15(a), with the same electrodes used as both source and detector (H.S Tapp *et. al*, 2003). Separate electrodes configuration are used for more complex sensor design with either nested or interleaved as shown in Figure 15(b) and Figure 15(c), respectively. In nested configuration, the rectangular is used as source and the circular as the detector. Meanwhile in interleaved electrode configuration, the circular is the source and rectangular acting as the detector. (H.S Tapp *et. al*, 2003)

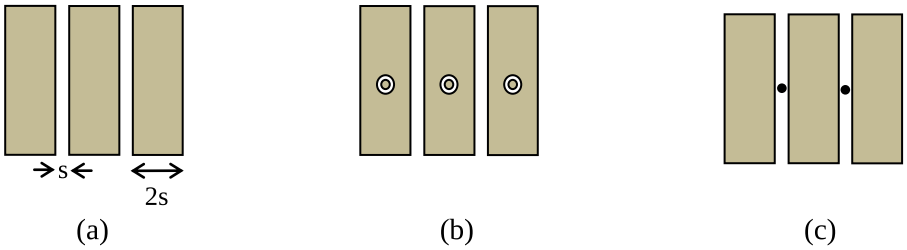


Figure 15: Electrodes Configuration

(a) Electrode is twice the separation
(b) Nested electrodes
(c) Interleaved electrodes

2.10 Image Reconstruction and Analysis

The main idea of ERT technique is to determine the unknown conductivity distribution in the system using the voltage data measured at the boundary by applying a proper image reconstruction algorithm. There are two types of typical problems involved in image reconstruction for ERT sensor; forward problem and inverse problem. ERT is non-linear, thus the image reconstruction is also ill-posed and ill-conditioned (H.S Tapp *et. al* 2003, M. Akrama *et. al* 2008).

The image reconstruction grid represents the interior cross section of the vessel consists of a square grid of 20×20 which equivalents to 400 pixels (ITS, 2007). Only 316 pixels are used for the reconstruction image as some of the pixels are located outside the vessel circumference as shown in Figure 16.

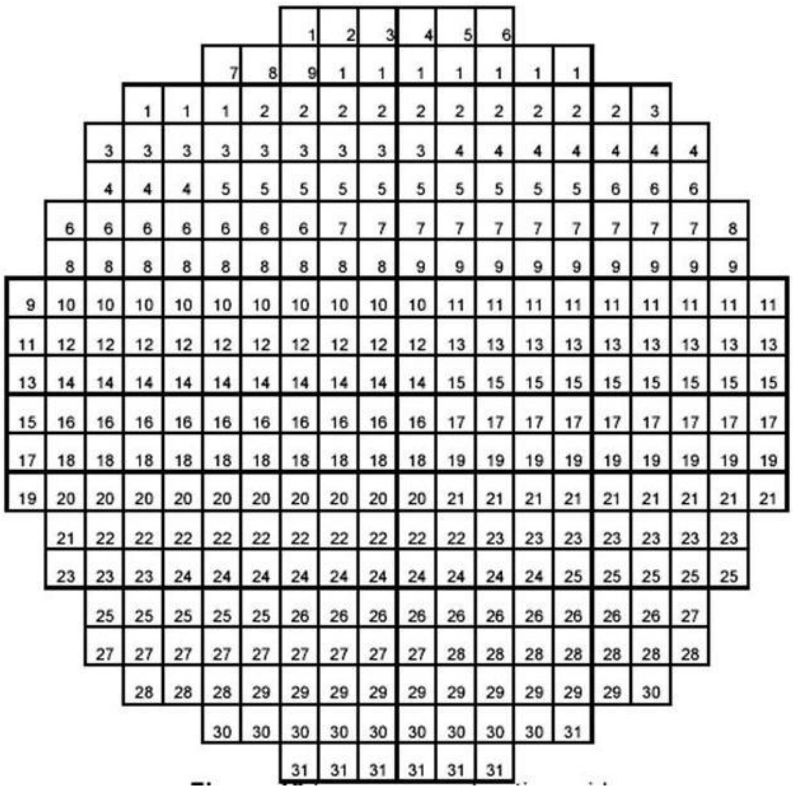


Figure 16: Image Reconstruction Grid (Q.F. Lee, 2006)

2.10.1 ***Forward Problem***

The forward problem needs to be solved before the inverse problem can be solved. In forward problem, the objective is to obtain the boundary voltage measurement with known electrical conductivity distribution (ITS, 2007). The voltage distribution, V can be determined by applying the Laplace equation in equation (14) since the conductivity distribution, σ and current injection, I_0 are known (M. Akrama *et. al* 2008).

$$\nabla.(\sigma.\nabla V) = 0 \qquad \text{… (14)}$$

where σ = Conductivity distribution

V = Voltage distribution

The boundary conditions are given as in equation (15) and (16) where n is the unit normal vector and assume that no current source inside the system (M. Akrama *et. al* 2008).

$$V = V_0 \qquad \text{… (15)}$$

$$\sigma \frac{\partial V}{\partial n} = I_0 \qquad \text{… (16)}$$

where I_0 = Current injection

V_0 = Conductivity of second phase

n = Unit normal vector

2.10.2 Inverse Problem

The inverse problem is to determine the unknown conductivity distribution from a finite number of boundary voltage measurements. The image is reconstructed via matrix or vector multiplication. It shows the mixture for low to high colour range conductivity and the scale below the image represents the conductivity of the flow inside the vessel. The sensitivity matrix needs to be calculated in order to solve the inverse problem as shown in equation (8) (Z. Cui *et. al* 2009).

$$S_{i,j}(x,y) = \int_s \frac{\nabla \varphi_i}{I_i} \cdot \frac{\nabla \varphi_j}{I_j} ds \qquad \dots (8)$$

where $S_{i,j}$ = Sensitivity matrix

φ = Electric potential

I = Current injected

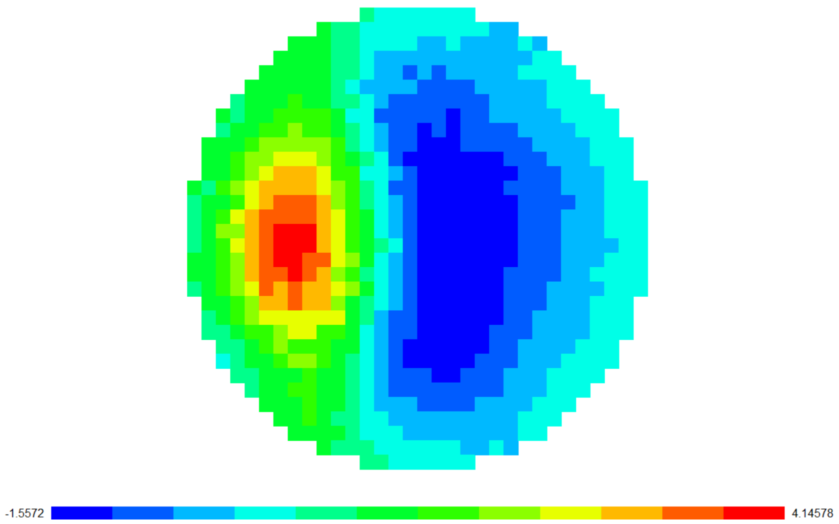


Figure 17: Tomogram image (ITS, 2007)

CHAPTER 3

METHODOLOGY

3.1 Procedure Identification

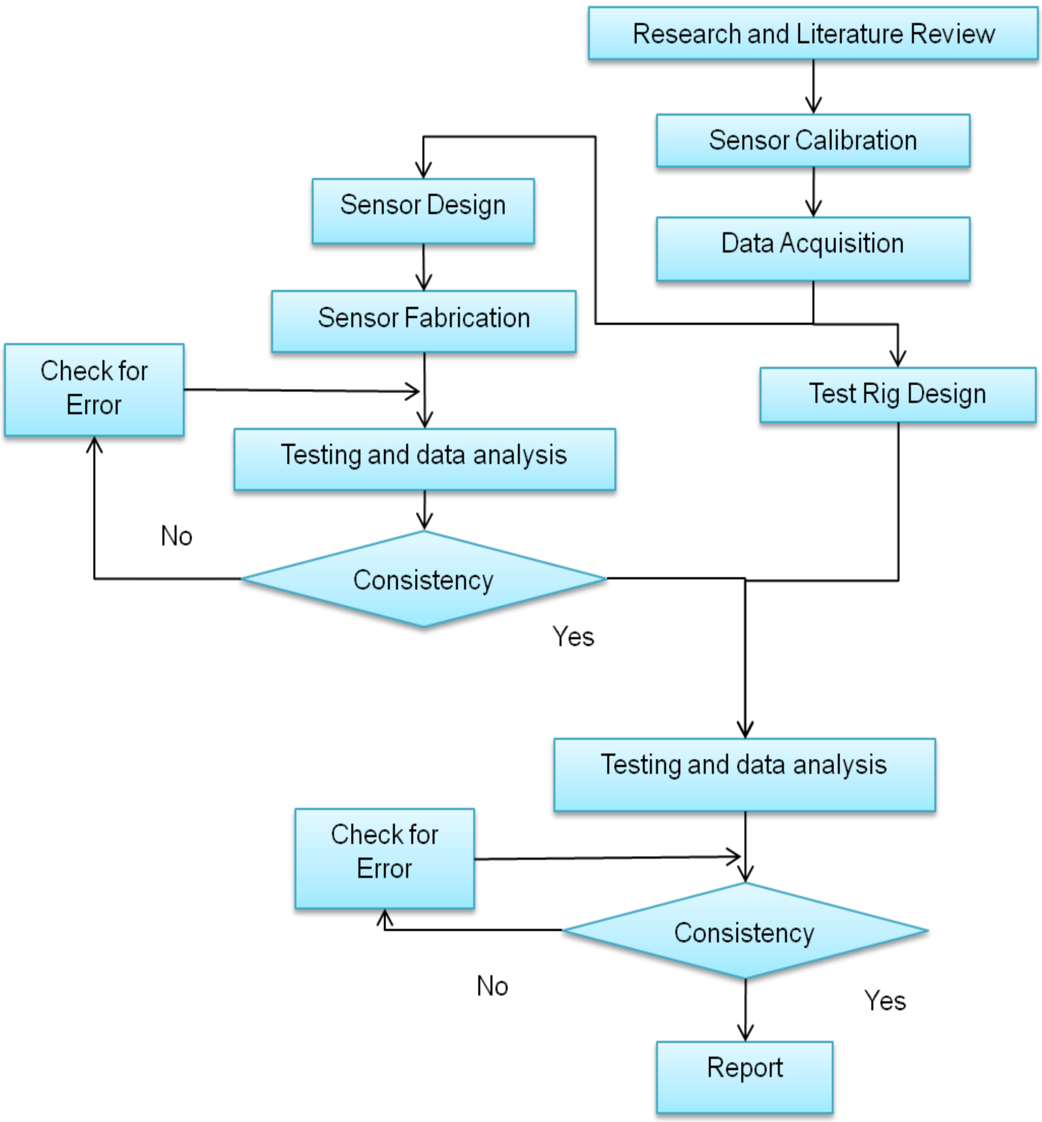


Figure 18: Project Flow Chart

3.2 Project Activities

Gantt chart is attached in Appendix A for reference. The literature review is the main activity during the first semester followed by designing the sensor. The rest of activities are conducted during the second semester of the final year project. During Final Year Project I is focused more on the literature review and designing the sensor. Materials are procured at this stage to avoid any late delivery matter. Final Year Project II is focused more on fabricating the ERT sensor, installation and testing the sensor performances. Softwares used in this project are the Multi-modal Tomography System (MMTS) and ITS Tomography Toolsuite which are available in the laboratory.

In order to get the measurement of the sensor performance, both Multi-modal Tomography System (MMTS) and ITS Tomography Toolsuite are being used in this project. The voltage measurement produced in the software is used to reconstruct the graph profile using Microsoft Excel. The performances of both ITS M300 sensors and fabricated sensors are analyzed based on the results produced from ITS Tomography Toolsuite.

The experiments for the sensor are conducted in the laboratory. This project is to observe the performance using air in water mixture for bubble flow regime. ERT sensor has no calibration as the high and low reference data are not required. Thus, it only takes the measurement data of the water filled in the ERT sensor. After each experiment is conducted, the result will be compared to the reference measurement result. If the result is not satisfied, the experiment has to be conducted again until the desired results are obtained. ERT sensor will be installed together with the test rig to observe the performance. Steps taken in order to obtain the data are shown in Figure 19.

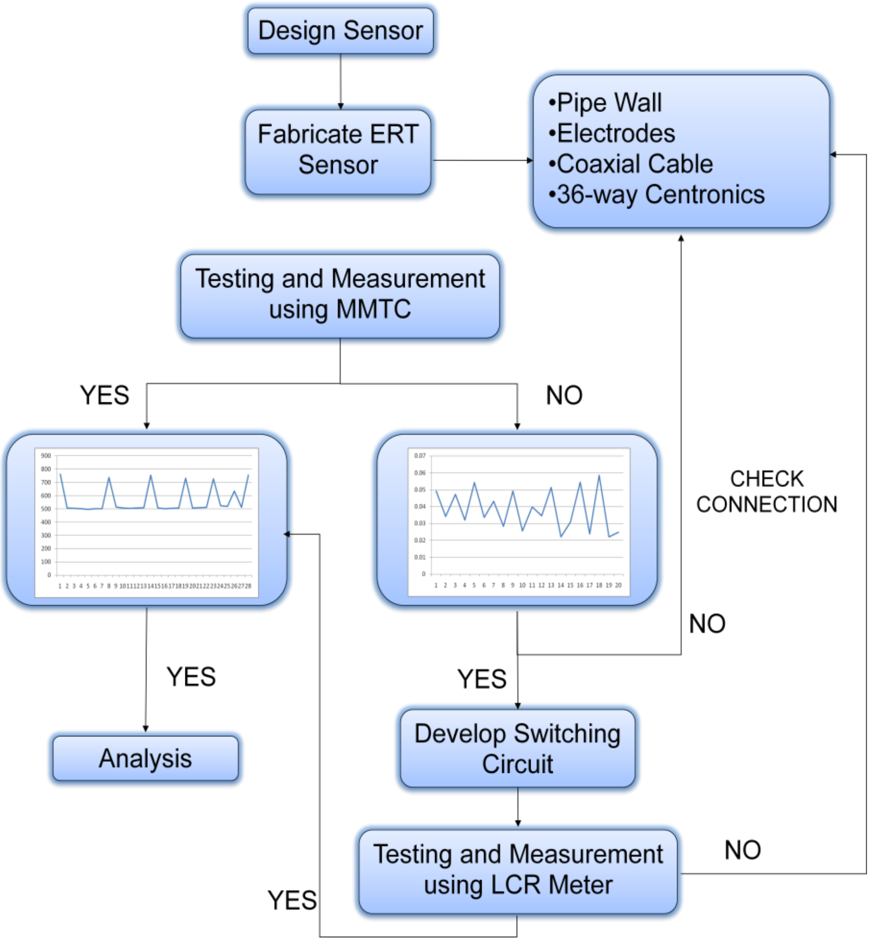


Figure 19: Data Measurement Process

Figure 19 above shown is about the process to obtain the data measurement of sensor. Sensor is first designed and fabricated during the first stage. It is fabricated using few main components and equipments which are the pipe wall, electrodes, coaxial cable and 36-way centronic plug. Later, the sensor is tested and the accuracy is measured by connecting the sensor with the data acquisition unit. The sensor is well functioning if the output graph is similar in the figure and it has to be checked if the graph is not as expected. Later in the project, the sensor is tested using the LCR meter instead of data acquisition unit available in the laboratory. There are problems in acquiring data from the data acquisition unit and therefore the LCR meter is being used. Details will be discussed more in the next sections.

3.3 Tools and Equipments

3.3.1 Hardware

Table 1: List of Hardware (ERT Sensor)

No.	Equipment/Item	Description
1	PVC 3” cylinder pipe 	It is used as the column of the ERT sensor where the liquid will flow through the pipe in order for the ERT sensor to measure.
2	RG174/AU Coaxial Cable 	It is connected to the data acquisition unit for measurement purposes. Refer to Appendix G.
3	Aluminum Plate 	The aluminum plate act as part of the electrodes where it will be the base of the electrodes
4	Screw and nut 	These will be the main electrodes inside the PVC wall pipe and it will be attached to the aluminum plate.
5	Crimping tool 	It is used to crimp the coaxial cable with the eyelet to ensure the connection is tight enough.
6	Eyelet 	Eyelet is used as termination for the coaxial cable and will be connected to the electrodes.
7	36-way Centronic Plug 	It will be connected to the data acquisition unit for data measurement and analysis. Refer to Appendix J.

Table 2: List of Hardware (Switching Circuit)

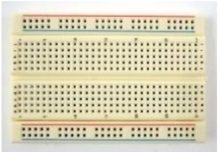
No.	Equipment/Item	Description
1	Breadboard 	It is used to place all components for connection.
2	Single Core Wire 	It is used to connect all components in order to conduct.
3	DIP Switch 	Switch with two positions of ON and OFF.
4	36-way Centronic Socket 	Connected with the 36-way centronic plug. Refer to Appendix K.
5	Solder Kit 	Equipments used to solder electronic components.
6	LCR meter 	A programmable instrument for measuring impedance parameters.

Table 3: List of Equipments (Test Rig)

No.	Equipment	Description
1	Water Tank 	Water tank is used to store the water for the dynamic test and it is located before the water pump.
2	Water Pump 	The water pump is used to pump the water from the tank to the pipeline and to give enough pressure for water to flow in the riser.
3	Hand Valve 	It is functions to control and regulate the amount of water or air go through the pipeline.
4	Flowmeter 	It acts as indicator of gas or liquid flow in a pipeline. It measures the flow rate or quantity of a moving fluid or gas.
6	PVC pipe 	It is used as a pipeline for liquid and gas flow in the test rig. It allows the liquid and gas to flow through the PVC pipe.

3.3.2 Software

3.3.2.1 Multi-Modal Tomography System v2.9 (MMTS)

The Multi-Modal Tomography System (MMTS) software is provided to observe the characteristics and behavior of liquid flow inside the pipelines. General steps taken to get the measurement data is shown in Figure 20.

Step 1
Connect sensor to the data acquisition unit

Step 2
Connect power adapter lead to the system

Step 3
Switch the front panel ‘Gray’ button (red light)

Step 4
Switch the sensor power on (back panel) – blinking light at front panel

Step 5
Open Multi-Modal Tomography (MMTC) software

Step 6
Open file (eg. ‘ERT-onep-1’)

Step 7
Change ‘ERT/ECT cal’ in the flow chart window to ‘low’

Step 8
Change ‘Write ERT/ECT cal’ in the flow chart window to ‘multiple frame’ (0)

Step 9
Click ‘Run’ button to get measurement data

Step 10
Repeat Step 7 with ‘high’ (1) and ‘none’ (2)

Figure 20: General Measurement Guide in MMTC

Basically, both ERT and ECT measurements are similar with the only difference is, ERT do not has to be calibrated as it only has one measurement (on-line) as compared to ECT. Measurement guide for ECT and ERT sensor using MMTC are attached in Appendix B and Appendix C, respectively. Both sensors are tested using water and air. Details of ‘ERT/ECT Cal’ are as follows:

Table 4: 'ERT/ECT Cal' Options

	ERT Sensor	**ECT Sensor**
Low (0)	Filled with water	Filled with air
High (1)	Filled with water	Filled with water
None (2)	Filled with air and water	Filled with air and water

3.3.3 Test Rig Design using Microsoft Visio

The test rig is designed using the Microsoft Visio where it creates the Piping and Instrumentation diagram (P&ID). It is designed to suit the requirements of the flow rate and specifications. The P&ID diagram is shown in Figure 21.

.

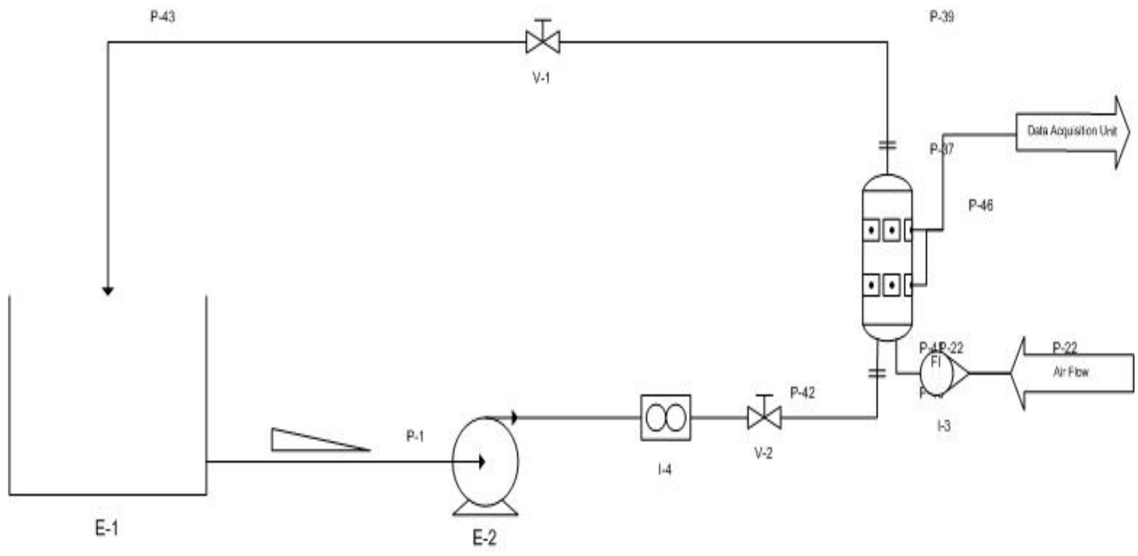


Figure 21: P&ID Diagram for Test Rig Design

3.4 Sensor Design Specification

The Electrical Resistance Tomography (ERT) specifications are obtained as follows:

i. The total independent measurement, M as shown in Equation (12) can be calculated as shown below, with N = 16 electrodes.

$$M = \frac{N(N-3)}{2}$$

$$= \frac{8(8-3)}{2}$$

$$= 20$$

Therefore, the total independent measurement, M is 20.

ii. Pipe diameter, d : 8.5cm

iii. Pipe length, l : 32cm

iv. No. of electrodes, N : 8 electrodes

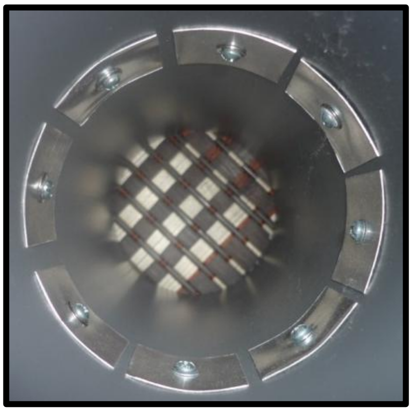
v. No. of planes : 1 plane

vi. Cable type : 9 core cable

vii. Cable length : 100cm

viii. Termination : 36-way Centronics

(a) Side view



(b) Top view

Figure 22: Fabricated ERT Sensor of 1 Plane 8 Electrodes

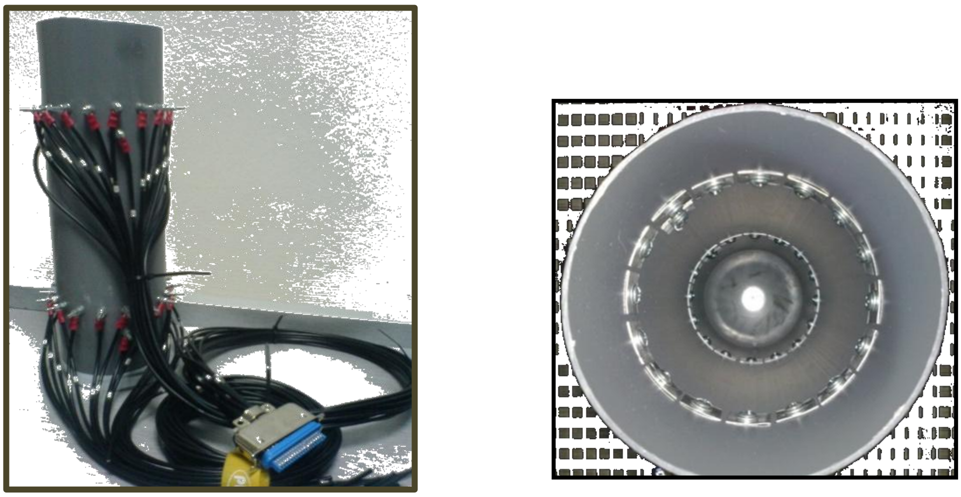
Another ERT sensor has been fabricated to improve the current sensor performance. The specifications are obtained as follows:

i. The total independent measurement, M as shown in Equation (12) can be calculated as shown below, with N = 16 electrodes.

$$M = \frac{N(N-3)}{2}$$
$$= \frac{16(16-3)}{2}$$
$$= 104$$

Therefore, the total independent measurement, M is 104.

ii. Pipe diameter, d : 8.5cm
iii. Pipe length, l : 32cm
iv. No. of electrodes, N : 16 electrodes
v. No. of planes : 2 planes
vi. Cable type : Coaxial Cable (RG174A/U)
vii. Cable length : 100cm
viii. Termination : 36-way Centronics



(a) Side view (b) Top view

Figure 23: Fabricated ERT Sensor of 2 Planes 16 Electrodes

3.5 Data Measurement using LCR Meter

The sensor is tested using the LCR Meter (Figure 25) instead of Multimodal Tomography Software due to problem with the data acquisition unit. Therefore, a switching circuit is designed to ease the measurement process (Figure 24). All 16 electrodes are to be tested via coaxial cable and it uses the adjacent measurement technique.

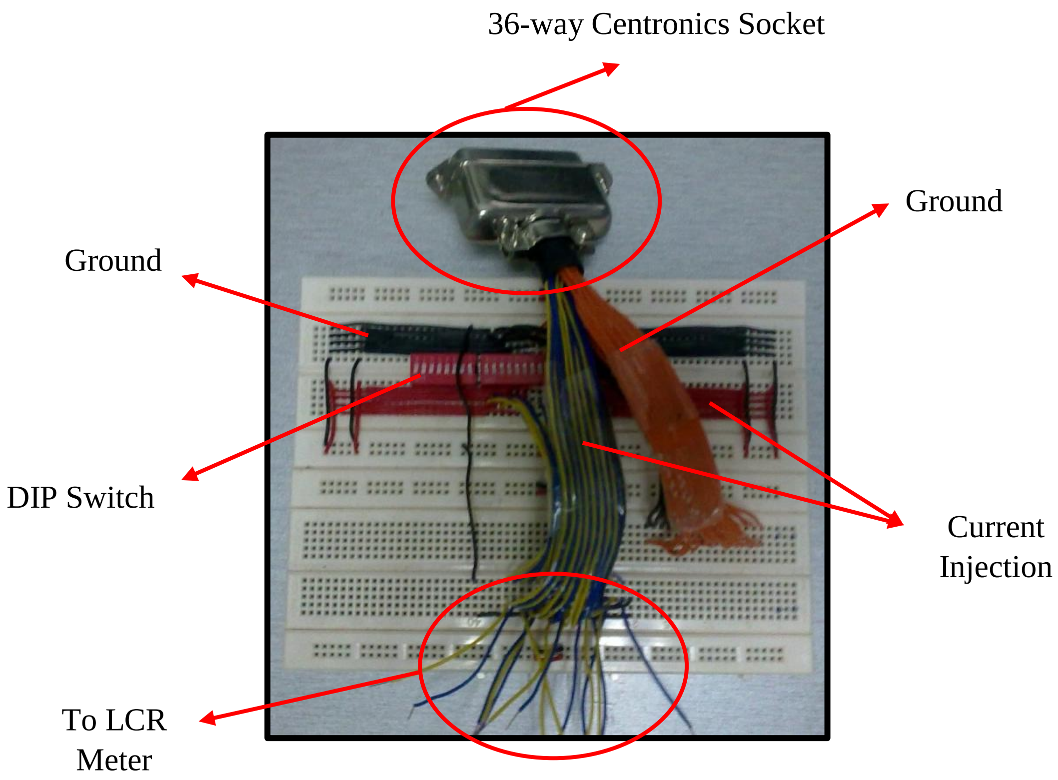


Figure 24: Switching Circuit

The measurement circuit consists of DIP switches and wires which the ERT sensor is connected via 36-way centronic plug. Two electrodes are to be measured, and the other electrodes need to be grounded. Therefore, using the circuit, it is can be easily switched the electrodes that are need to be grounded.

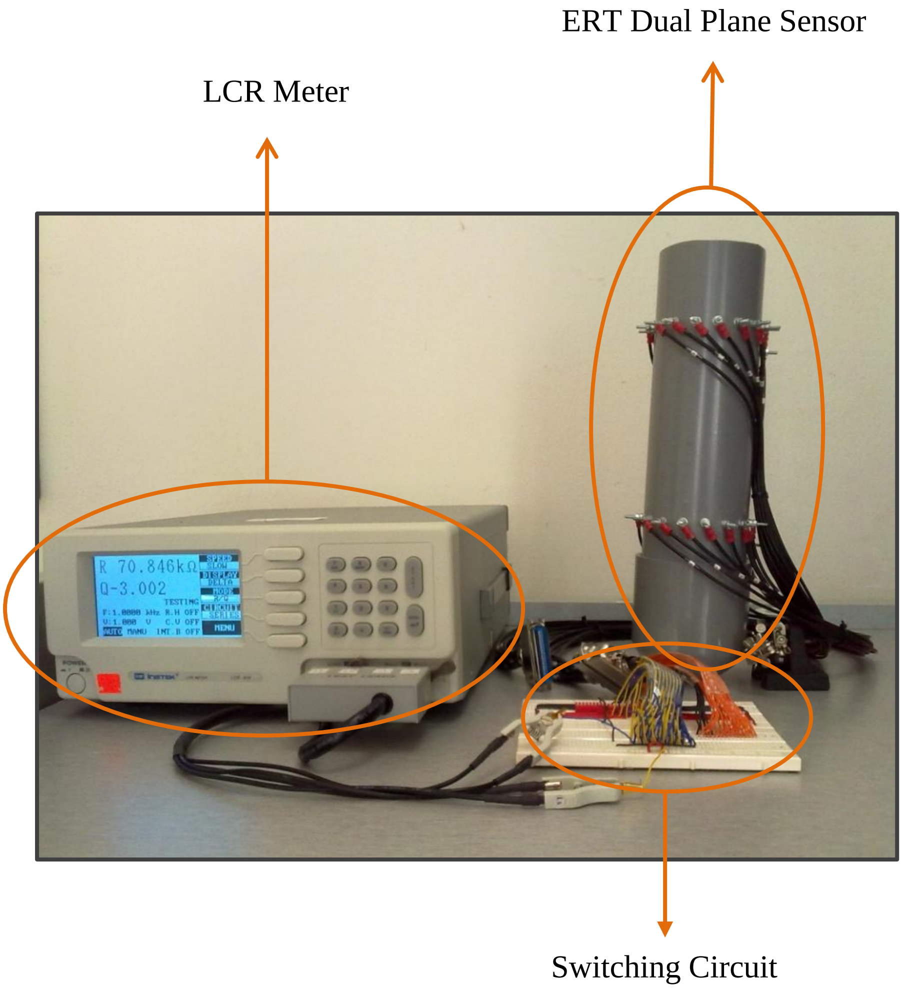


Figure 25: Equipment Setup for Data Measurement

CHAPTER 4

RESULTS AND DISCUSSIONS

Fabrication, experiments and testing have been conducted in order to achieve the objectives of this project. Results for all experiments conducted are being discussed clearly in this chapter.

4.1 Void Fraction Calibration for m30000 ECT Sensor

ECT sensor is calibrated using the Multi-modal Tomography System (MMTS) and ITS Tomography Toolsuite available in the laboratory. The calibration need to be performed before every experiment is conducted. A good graph is when the graph produced is symmetrical as discussed in Chapter 2. The ITS M3000 ECT sensor produces results shown for Low and High calibration in Figure 26 and Figure 27, respectively.

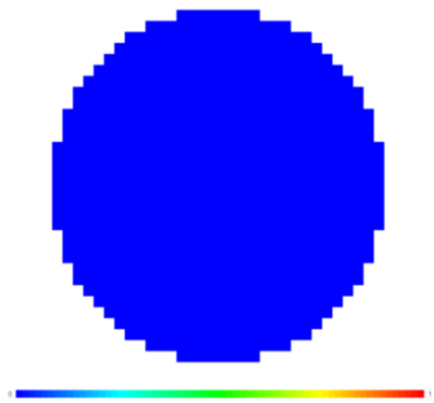


Figure 26: Low Calibration Image using the M3000 ECT Sensor

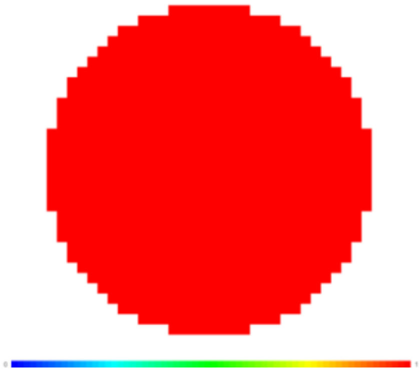


Figure 27: High Calibration Image using the M3000 ECT Sensor

Figure **26** above shows a tomogram image of low calibration where the ECT sensor is filled with air. The permittivity of air is 1. For high calibration, higher permittivity materials are being used which is shown in Figure 27. The ECT sensor is tested with rice and water. Rice has permittivity of 3.5 meanwhile water has permittivity of 80. The image for high permittivity are the same color because both have higher permittivity as compared to air (ε=1).

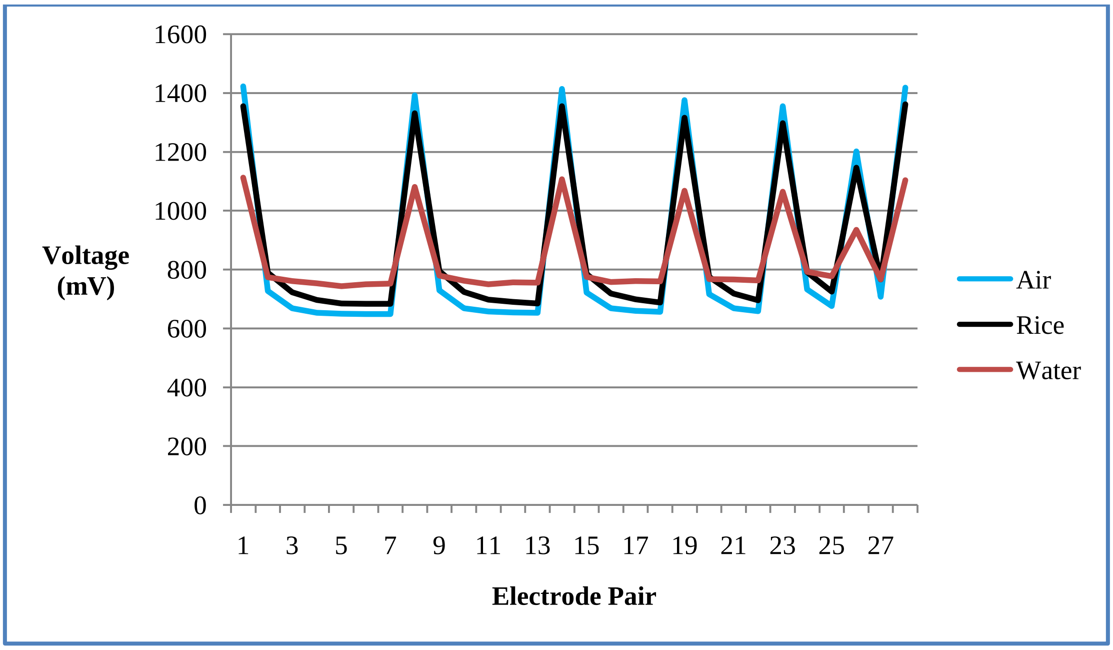


Figure 28: Calibration Graph for M3000 ECT Sensor

Figure 28 shows the calibration graph for both low and high permittivity materials. The low calibration gives a higher voltage compared to the high calibration. This is due to less permittivity will gives higher voltage measurement. Air, water and rice has permittivity of 1 (low calibration), 80 (high calibration) and 3.5 (high calibration), respectively. The graph shown are said to be symmetrical where the peaks are measured at the nearest adjacent electrode pairs. The further the adjacent pairs the lower the voltage will be.

Figure 29 and Table 5 show the voltage measurement graph and individual voltage measurement obtained from MMTC for air (ε=1) and rice (ε=3.5), respectively. The results shown are measured using one plane of 8 electrodes ECT sensor. From equation (4) discussed in Chapter 2, an ECT sensor of 8 electrodes will gives 28 measurement data per plane. This sensor has a minimum voltage value of 683.7mV, maximum of 1360.17mV and mean voltage of 870.215mV. Multiple frames of 220 frames are taken to get this data measurement. Refer to Appendix D for each data measurement taken.

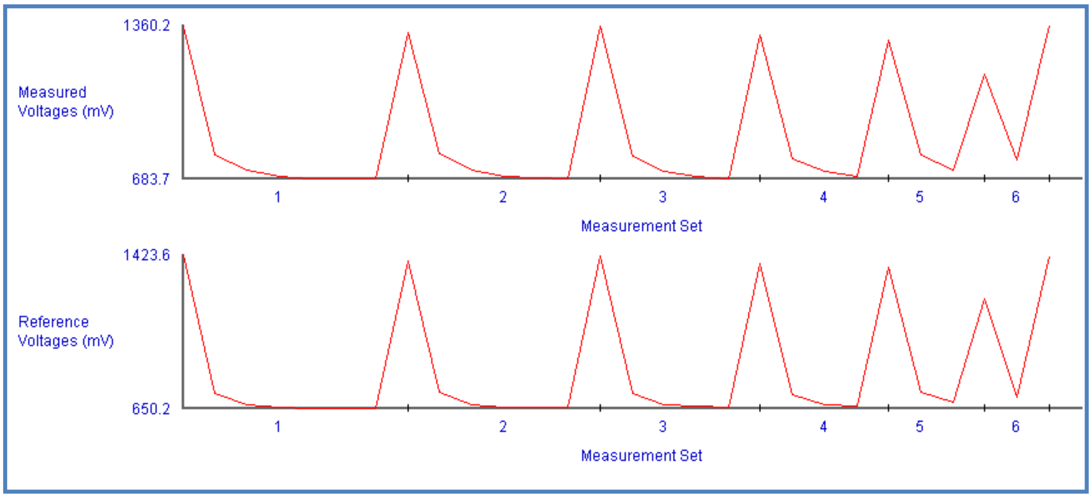


Figure 29: Voltage Measurement for 8 Electrodes ECT Sensor (Rice, ε=3.5)

Table 5: Voltage Measurement for Each Current Injection Pairs (Air and Rice)

Current Injection Points	Voltage Measurement Points						
	2	**3**	**4**	**5**	**6**	**7**	**8**
1	1354.326	788.8514	722.378	696.2067	684.7116	683.4873	683.6609
2		1330.792	794.0522	723.282	697.6014	689.5086	684.4636
3			1353.858	785.1527	718.2443	698.3567	687.4035
4				1315.644	774.9019	718.0834	695.083
5					1296.335	791.4908	725.0529
6						1145.264	765.6937
7							1360.904

Another measurement is taken for air and water mixture where the results are shown in Figure 30 and Table 6. The voltage measurement graph and individual voltage measurement obtained from MMTC for air (ε=1) and water (ε=3.5) are illustrated, respectively. An ECT sensor of one plane of 8 electrodes is being used in this measurement. Therefore, it also produces 28 data measurement, similar with previous measurement. This sensor has a minimum voltage value of 745.467mV, maximum of 1106.59mV and mean voltage of 839.14mV. Multiple frames of 108 frames are taken to get this data measurement. Refer to Appendix E for each data measurement taken.

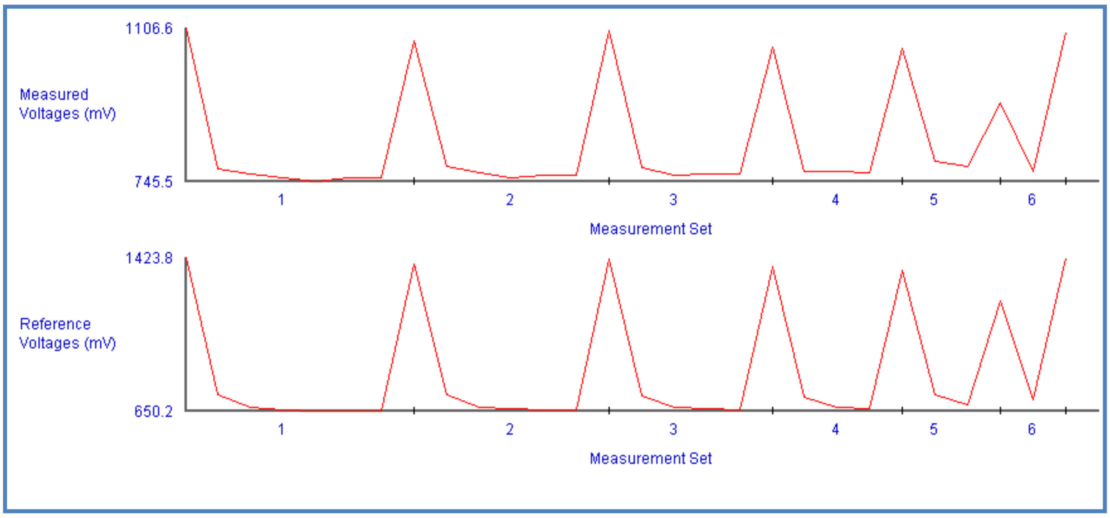


Figure 30: Voltage Measurement for 8 Electrodes ECT Sensor (Water, ε=80)

Table 6: Voltage Measurement for Each Current Injection Pairs (Air and Water)

Current Injection Points	Voltage Measurement Points: 2	3	4	5	6	7	8
1	1112.008	774.2812	761.0253	752.7339	743.4769	750.4481	751.8244
2		1080.98	779.1392	762.2509	750.5285	756.0181	755.9519
3			1106.291	774.6734	757.3204	760.9642	759.4411
4				1067.331	767.7897	766.7993	763.1108
5					1064.256	792.3793	777.596
6						935.0162	766.6624
7							1103.274

4.2 Void Fraction Calibration for m3000 ERT Sensor

The ERT sensor is tested using the Multi-modal Tomography System (MMTS) and ITS Tomography Toolsuite available in the laboratory. The testing is performed by applying 8 electrodes. This is the online measurement since ERT does not require any calibration and therefore, liquid is filled in the sensor. The measurement is taken using the ITS m3000 ERT sensor and the ITS data acquisition unit. It is expected to get similar result with the ITS M300 ECT sensor. A good graph is when the graph produced is symmetrical as discussed in Chapter 2.

There are three conditions in 'ERT Cal' need to be done before the on-line measurement is taken; Low (0), High (1) and None (2). It produces tomographic images similar with ECT sensor. The on-line tomographic image is shown in Figure 31. Since this testing used 8 electrodes, therefore it gives 20 data measurement per plane, based on equation (12). This sensor has a minimum voltage value of 0.0240588mV, maximum of 0.399377mV and mean voltage of 0.183406mV. Total numbers of 68 frames are taken to get this data measurement. Refer to Appendix F for each data measurement taken.

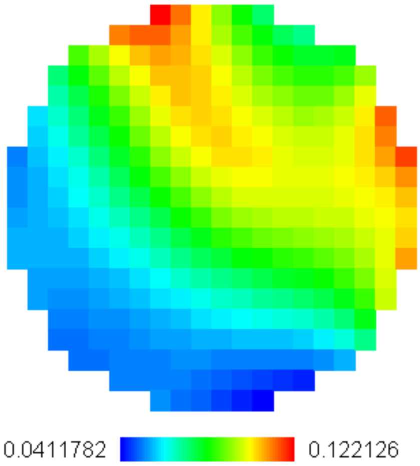


Figure 31: Tomographic Image when 'ERT Cal' is None (2)

Table 7: Voltage Measurement for Each Current Injection Pairs (Air and Water)

Current Injection Pairs	Voltage Measurement Pairs					
	02-03	***03-04***	***04-05***	***05-06***	***06-07***	***07-08***
08-01	0.1737	0.02406	0.2019	0.1446	0.3637	
01-02		0.1474	0.3109	0.03159	0.3709	0.274
02-03			0.3265	0.09651	0.1653	0.04272
03-04				0.0678	0.1888	0.07347
04-05					0.3993	0.08661
05-06						0.151

The measurement graph is redrawn using Microsoft Excel by using the data obtained in ITS Toolsuite. The result shown in Figure 32 is not as expected as it has a non-symmetrical graph. It should have the similar symmetrical shape with ECT sensor due to the adjancent measurement method used as discussed in Chapter 2. Further testing is not applicable since there are problems in acquiring data from the data acquisition unit for ERT sensor.

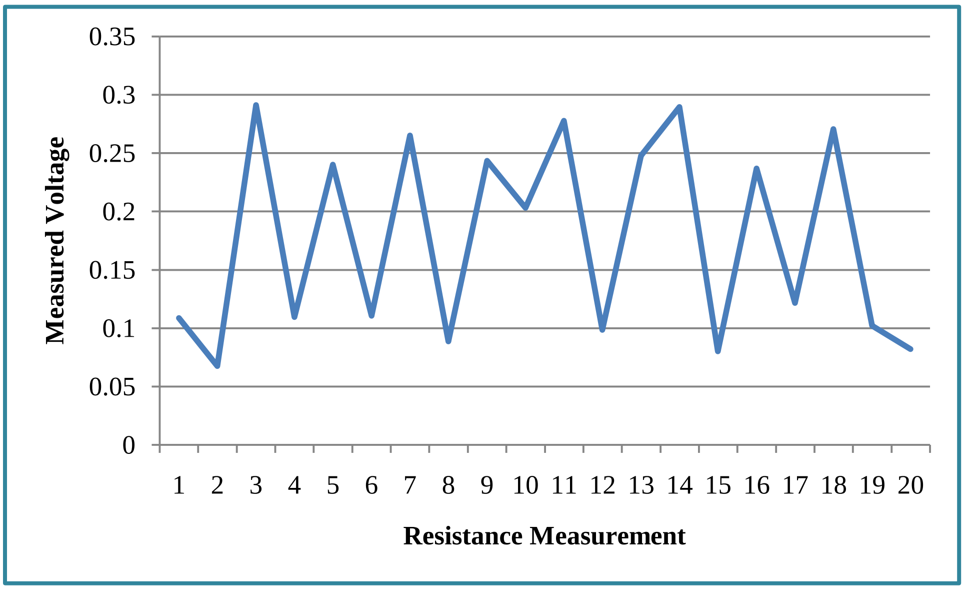


Figure 32: Measurement for m3000 ERT Sensor

4.3 Performance of Fabricated ERT Sensor

The performances of fabricated sensor for both single and dual plane are supposed to be tested using the data acquisition unit of ITS Toolsuite software. Due to problems with the data acquisition unit, the measurement is not possible and therefore, LCR meter is being used instead of ITS Toolsuite software. The setup for measuring the performance of the sensors is shown in Figure 25. The result of sensor should be better with the sensor using the coaxial cable. The initial sensor of 8 electrodes of 1 plane is using the 8 core cable and has no grounding cable. Then the design is improved by using the RG174/AU coaxial cable with grounding cable connected to the system and it should produce a good result compared to the initial sensor.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

Conclusion has been made for this project and recommendations are proposed to further improve this project in the future. The conclusion is based on the results and discussions of experiments conducted and recommendations are made to enhance the project in the next stage.

5.1 Conclusion

In designing the ERT sensor, the requirements should be met to ensure a good data measurement can be obtained. In this project, an ERT has been designed based on the specifications discussed in Chapter 5. It is fabricated to suit the requirement of Multi-Modal Tomography (MMTC) software. The ECT sensor is not fabricated and only calibrated during the first phase.

Data acquisition unit is used to obtain the data from both ERT and ECT sensors. It gives a good visualization on multiphase flow inside the vessels. It has been shown in the tomographic images discussed in Chapter 4. During the second phase of this project, the data acquisition unit is no longer been used as it has problem in acquiring the data from ERT sensor. The data acquisition unit is not able to communicate with the MMTC software.

As conclusion, from the experiment that has been conducted, the result for m3000 ECT sensor is having a good. Meanwhile for m3000 ERT sensor, a better result can be obtained after the problem discussed above has been solved. The tomography system is suitable to obtain the cross sectional images for the air in water flow inside the pipeline. The fluid mechanics knowledge is applied in this project to determine the void fraction and behaviour of the two phase flow in a pipe. ERT sensor prototypes of single and dual planes have been fabricated and the performance tests should be tested using the LCR meter if data acquisition is not applicable. ERT of dual plane sensor using the coaxial cable and proper grounding should provide a better result compared the single plane sensor.

5.2 Recommendations

As for recommendation for this project, the ERT sensor can be designed better in order to get more accurate data. The data acquisition unit is very useful in providing the data measurement. Due to limited time, the data measurement using LCR meter is not available. Therefore, all the equipments that have been setup can be used for future improvement. Due to limited time, only static experiment is done throughout this project. Thus, a dynamic analysis test can be done using a test rig proposed. The test rig is to be fabricated in the next project phase where all the details had been obtained. Thus, all data obtained need to be analyzed after all measurement are gathered.

Construction of the sensor should be more careful because the distance between electrodes and the soldering technique would highly affect the performance of the sensor. Therefore, the design can be improved and simulated using COMSOL Multiphysics software. It is useful to obtain a simulation of electromagnetic module if this software is fully utilized. It is highly recommended to fully understand the multiphase flow in a pipeline in order to get better results in the future.

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APPENDICES

APPENDIX A

GANTT CHART AND KEY MILESTONES FOR FYP 1 AND FYP 2

GANTT CHART AND KEY MILESTONES FOR FYP 1

NO	DETAILS / WEEK	1	2	3	4	5	6	7	8	9	Mid-semester Break	10	11	12	13	14
1	Selection of Project Topic															
2	Preliminary Research Work															
3	Submission of Preliminary Report				●											
4	Project Work															
	i. Sensor Design															
	ii. Test Rig Design															
5	Submission of Progress Report								●							
6	Seminar								●							
7	Project Work Continuation															
8	Submission of Interim Report Final Draft														●	
9	Oral Presentation															●

GANTT CHART AND KEY MILESTONES FOR FYP 2

NO	DETAILS / WEEK	1	2	3	4	5	6	7	8	9	Mid-semester Break	10	11	12	13	14
1	Literature Review for ERT															
2	Fabrication of ERT Sensor															
3	Submission of Progress Report				●											
4	Project Work															
	i. Test Rig Design and Fabrication															
	ii. Sensor Installation															
5	Submission of Progress Report								●							
6	Testing and Commissioning								●							
7	Project Work Continuation															
8	Submission of Interim Report Final Draft														●	
9	Oral Presentation															●

APPENDIX B

MEASUREMENT GUIDE FOR ECT SENSOR USING MMTC SOFTWARE

STEP 1

Connect ECT to Data Acquisition Unit via SMB connector

STEP 2

Connect adapter power lead to the system

STEP 3

Switch the front panel 'Grey' button (red light)

STEP 4

Switch the ECT power on (back panel)-blinking light at front panel

STEP 5

Open Multi-Modal Tomography Configurator (MMTC)

STEP 6

Open file 'ECT-onep-1'

STEP 7

Change 'ECT Cal' in the flow chart window to low (0)

STEP 8

Change 'Write ECT' in the flow chart window to multiple frame '0'

STEP 9

Click 'RUN' to get the measurement data

STEP 10

Repeat from STEP 5 for 'ERT Cal' in high (1) then change to None (2)

APPENDIX C

MEASUREMENT GUIDE FOR ERT SENSOR USING MMTC SOFTWARE

STEP 1

ERT sensor is filled with water

STEP 2

Connect ERT to Data Acquisition Unit via 36 way connector

STEP 3

Connect adapter power lead to the system

STEP 4

Switch the front panel 'Grey' button (red light)

STEP 5

Switch the ERT power on (back panel)-blinking light at front panel

STEP 6

Open Multi-Modal Tomography Configurator (MMTC)

STEP 7

Open file 'ERT-onep-1'

STEP 8

Change 'ERT Cal' in the flow chart window to low (0)

STEP 9

Change 'Write ERT' in the flow chart window to multiple frame '0'

STEP 10

Click 'RUN' to get the measurement data

STEP 11

Repeat from STEP 5 for 'ERT Cal' in high (1) then change to None (2)

APPENDIX D

MEASUREMENT DATA FOR ECT M3000 SENSOR (AIR AND RICE)

Voltage Mi 1 plane(s) 220 frame for test8-ectp1-8e

Wallclock'	DAS Time	Frame	Plane	28 Voltage Data																											
12:32:10	0	Reference	1	1423.55	728.572	669.979	654.472	651.099	650.244	650.321	1390.07	731.075	669.902	659.203	658.168	654.67	1415.32	723.291	670.589	661.107	657.418	1377.24	717.934	670.866	660.241	1358.59	733.929	670.297	1202.32	709.264	1419.67
12:30:09	0	1	1	1423.55	728.572	669.979	654.472	651.099	650.244	650.321	1390.07	731.075	669.902	659.203	658.168	654.67	1415.32	723.291	670.589	661.107	657.418	1377.24	717.934	670.866	660.241	1358.59	733.929	670.297	1202.32	709.264	1419.67
12:30:09	0	2	1	1352.92	768.904	722.402	698.23	664.014	663.379	663.547	1329.56	794.155	723.489	697.895	689.454	684.358	1352.69	785.302	718.466	698.367	687.393	1314.38	775.031	718.058	695.131	1295.13	791.59	725.078	1144.14	785.843	1359.82
12:30:09	0	3	1	1353.54	769.332	722.848	698.581	665.012	663.869	664.035	1330.24	794.506	723.81	697.955	689.805	684.676	1353.22	785.669	718.666	698.611	687.729	1315.08	775.397	718.513	695.345	1295.54	791.804	725.427	1144.8	786.067	1360.21
12:30:10	0	4	1	1354.15	769.683	722.863	698.666	665.272	663.898	664.02	1330.53	794.857	723.888	698.108	689.988	684.905	1353.59	785.943	718.88	698.718	687.775	1315.67	775.58	718.651	695.452	1296.05	792.003	725.565	1144.92	786.27	1360.36
12:30:11	0	5	1	1354.06	769.667	722.955	698.78	665.302	664.02	664.097	1330.63	794.918	723.947	698.062	690.079	684.938	1353.57	785.852	718.865	698.686	687.836	1315.52	775.611	718.605	695.559	1296.2	792.17	725.658	1144.93	786.438	1360.53
12:30:11	0	6	1	1353.3	768.996	722.589	698.261	664.722	663.502	663.807	1330.02	794.307	723.642	697.865	689.484	684.493	1352.81	785.531	718.422	698.474	687.515	1314.71	775.244	718.376	695.269	1295.45	791.896	725.397	1144.35	785.98	1360.09
12:30:12	0	7	1	1353.42	769.255	722.695	698.444	665.028	663.715	663.745	1329.96	794.475	723.826	697.802	689.683	684.631	1352.99	785.516	718.651	698.535	687.576	1315.05	775.336	718.376	695.345	1295.84	791.865	725.366	1144.52	786.117	1360.17
12:30:13	0	8	1	1353.85	769.515	723.046	698.78	665.18	663.974	663.944	1330.36	794.704	723.932	697.97	689.988	684.905	1353.37	785.714	718.834	698.764	687.775	1315.23	775.595	718.666	695.543	1296.05	792.094	725.611	1145.1	786.224	1360.7
12:30:13	0	9	1	1353.51	769.24	722.695	698.459	664.921	663.839	663.791	1329.81	794.307	723.581	697.955	689.606	684.367	1353.14	785.363	718.483	698.657	687.47	1314.79	775.015	718.3	695.299	1295.5	791.88	725.321	1144.48	785.995	1360.07
12:30:14	0	10	1	1353.14	769.042	722.512	698.291	664.753	663.44	663.592	1329.46	794.216	723.23	697.834	689.499	684.432	1352.43	785.256	718.391	698.352	687.302	1314.59	775.031	718.117	694.994	1295.07	791.636	725.015	1144.15	785.782	1359.82
12:30:14	0	11	1	1354.11	769.637	723.046	698.841	665.165	663.913	664.142	1330.6	794.902	723.962	698.23	690.018	684.88	1353.71	785.78	718.849	698.794	687.805	1315.54	775.534	718.636	695.528	1296.13	792.094	725.55	1145.22	786.331	1360.58
12:30:15	0	12	1	1353.95	769.515	722.879	698.52	665.256	663.898	664.051	1330.39	794.902	723.794	698.23	689.912	684.905	1353.39	785.791	718.819	698.687	687.775	1315.34	775.473	718.605	695.498	1296.06	792.247	725.565	1145.02	786.255	1360.67
12:30:15	0	13	1	1353.65	769.225	722.758	698.49	664.997	663.73	663.776	1329.96	794.536	723.642	697.818	689.713	684.585	1352.93	785.684	718.651	698.535	687.653	1315.14	775.305	718.3	695.192	1295.59	791.804	725.366	1144.89	786.117	1360.09
12:30:16	0	14	1	1354.2	769.683	723.077	698.719	665.302	663.913	664.234	1330.95	795.07	723.947	698.062	690.14	685.058	1353.71	786.035	718.941	698.81	687.988	1315.72	775.702	718.681	695.85	1296.56	792.338	725.748	1145.31	786.545	1360.85
12:30:17	0	15	1	1354.14	769.683	722.955	698.719	665.089	663.959	663.898	1330.58	794.811	723.81	697.924	689.927	684.89	1353.42	785.882	718.895	698.749	687.988	1315.42	775.595	718.651	695.559	1296.23	792.216	725.55	1145.02	786.392	1360.58
12:30:17	0	16	1	1353.79	769.408	722.833	698.52	665.15	663.73	663.883	1330.31	794.78	723.687	697.909	689.942	684.938	1353.37	785.791	718.819	698.625	687.683	1315.34	775.504	718.529	695.467	1295.89	791.972	725.488	1144.78	786.545	1360.3
12:30:18	0	17	1	1353.28	768.981	722.604	698.352	664.753	663.684	663.807	1329.75	794.322	723.535	697.85	689.53	684.539	1352.78	785.364	718.468	698.275	687.439	1314.59	775.198	718.102	695.177	1295.36	791.85	725.092	1144.38	785.797	1360.04
12:30:19	0	18	1	1353.68	769.484	722.879	698.581	664.997	663.837	663.944	1330.08	794.735	723.962	697.924	689.774	684.738	1353.14	785.836	718.758	698.81	687.729	1315.2	775.473	718.452	695.33	1295.83	792.079	725.397	1144.86	786.178	1360.35
12:30:20	0	19	1	1353.57	769.072	722.741	698.413	664.86	663.455	663.822	1330.08	794.338	723.55	697.894	689.667	684.524	1352.7	785.577	718.559	698.52	687.637	1314.73	775.229	718.361	695.284	1295.84	791.88	725.366	1144.48	785.995	1360.1
12:30:20	0	20	1	1353.8	769.347	722.728	698.551	664.997	663.684	663.944	1330.3	794.643	723.596	697.924	689.912	684.707	1353.13	785.78	718.697	698.657	687.591	1315.29	775.427	718.407	695.421	1295.85	791.896	725.305	1144.96	786.072	1360.2
12:30:21	0	21	1	1353.98	769.683	723.123	698.687	665.256	663.944	664.219	1330.57	794.857	724.039	698.169	690.034	684.951	1353.66	785.836	718.958	698.977	687.79	1315.49	775.702	718.727	695.604	1296.12	792.293	725.626	1145.02	786.499	1360.75
12:30:21	0	22	1	1353.91	769.591	723.031	698.795	665.241	663.944	664.112	1330.62	794.582	724.023	698.123	689.973	684.829	1353.71	785.913	718.819	698.902	687.836	1315.4	775.55	718.697	695.574	1296.12	792.14	725.717	1144.99	786.468	1360.68
12:30:22	0	23	1	1353.24	769.301	722.787	698.352	664.966	663.669	663.829	1330.04	794.399	723.687	697.94	689.728	684.692	1352.96	785.608	718.422	698.581	687.515	1314.96	775.229	718.468	695.33	1295.74	791.789	725.473	1144.43	785.98	1360.23
12:30:22	0	24	1	1353.72	769.332	722.772	698.627	665.089	663.776	663.913	1330.25	794.48	723.764	697.909	689.835	684.783	1353.13	785.928	718.636	698.703	687.668	1315.11	775.534	718.437	695.299	1295.89	791.972	725.519	1144.75	786.178	1360.39
12:30:23	0	25	1	1353.24	769.087	722.619	698.307	664.768	663.532	663.837	1329.82	794.429	723.565	697.787	689.56	684.417	1352.96	785.44	718.422	698.413	687.378	1314.65	775.076	718.437	695.192	1295.33	791.835	725.321	1144.48	785.858	1360
12:30:24	0	26	1	1353.45	769.255	722.909	698.383	665.028	663.715	663.822	1330.07	794.567	723.825	697.909	689.591	684.753	1353.11	785.577	718.697	698.672	687.454	1314.71	775.427	718.3	695.299	1295.6	791.972	725.336	1144.35	786.3	1360.38
12:30:24	0	27	1	1353.83	769.408	722.924	698.627	665.028	663.898	663.959	1330.19	794.582	723.81	697.863	689.805	684.753	1353.37	785.852	718.712	698.625	687.729	1314.96	775.458	718.544	695.437	1295.99	792.14	725.534	1144.72	786.224	1360.58
12:30:25	0	28	1	1353.43	769.271	722.802	698.52	665.043	663.806	664.005	1330.05	794.48	723.826	697.863	689.713	684.646	1353.05	785.485	718.513	698.611	687.653	1314.96	775.305	718.361	695.314	1295.65	791.987	725.458	1144.43	786.067	1360.23
12:30:26	0	29	1	1354.5	769.851	723.153	698.871	665.318	664.112	664.356	1330.85	795.101	724.054	698.367	690.232	684.938	1354.09	786.096	718.941	698.977	688.095	1315.92	775.702	718.958	695.849	1296.4	792.369	725.885	1145.45	786.545	1361.04
12:30:27	0	30	1	1353.36	769.148	722.634	698.459	664.844	663.455	663.761	1329.86	794.292	723.611	697.879	689.576	684.448	1352.9	785.485	718.391	698.413	687.393	1314.71	775.244	718.102	695.131	1295.62	791.713	725.366	1144.57	785.934	1359.92
12:30:27	0	31	1	1353.31	769.316	722.728	698.383	664.905	663.593	663.868	1330.02	794.338	723.535	697.802	689.713	684.432	1352.96	785.501	718.346	698.596	687.576	1314.71	775.244	718.376	695.406	1295.47	791.88	725.336	1144.84	786.01	1360.15
12:30:28	0	32	1	1353.58	769.118	722.695	698.459	664.921	663.839	663.776	1329.92	794.399	723.55	697.787	689.56	684.478	1352.92	785.608	718.544	698.52	687.5	1314.94	775.198	718.346	695.192	1295.53	791.743	725.198	1144.52	785.965	1360.03
12:30:28	0	33	1	1353.43	769.225	722.94	698.398	664.014	663.502	663.883	1330.1	794.567	723.687	697.924	689.789	684.631	1353.19	785.592	718.605	698.55	687.5	1314.82	775.214	718.361	695.345	1295.66	791.804	725.488	1144.49	786.01	1360.08
12:30:29	0	34	1	1352.79	768.919	722.405	698.2	664.554	663.425	663.349	1329.32	794.231	723.184	697.482	689.393	684.264	1352.47	785.165	718.224	698.153	687.21	1314.47	774.847	718.132	694.979	1294.9	791.59	724.954	1143.86	785.705	1359.45
12:30:30	0	35	1	1353.68	769.393	722.909	698.535	664.738	663.837	663.974	1330.07	794.719	723.687	697.955	689.667	684.707	1353.42	785.669	718.681	698.733	687.607	1315.17	775.397	718.529	695.376	1295.96	791.941	725.336	1144.73	786.163	1360.41
12:30:30	0	36	1	1353.51	769.316	722.68	698.474	664.829	663.593	663.776	1330.13	794.506	723.504	697.741	689.728	684.8	1353.08	785.501	718.483	698.474	687.5	1314.85	775.29	718.361	695.238	1295.67	791.926	725.351	1144.55	786.102	1360.07
12:30:31	0	37	1	1353.14	769.057	722.741	698.352	664.829	663.593	663.578	1329.78	794.231	723.397	697.787	689.53	684.448	1352.87	785.424	718.529	698.367	687.424	1314.59	775.122	718.193	695.223	1295.41	791.575	725.366	1144.41	785.965	1360.1
12:30:31	0	38	1	1353.82	769.301	722.848	698.627	664.905	663.929	663.883	1330.22	794.689	723.596	697.879	689.896	684.692	1353.33	785.73	718.636	698.581	687.622	1315.28	775.382	718.636	695.421	1295.6	792.155	725.611	1144.89	786.178	1360.58
12:30:32	0	39	1	1353.77	769.591	722.772	698.612	665.028	663.745	664.051	1330.53	794.796	723.718	697.955	689.82	684.905	1353.59	785.836	718.91	698.733	687.836	1315.34	775.565	718.529	695.452	1295.85	792.079	725.534	1144.95	786.27	1360.59
12:30:33	0	40	1	1353.13	769.225	722.589	698.215	664.646	663.455	663.7	1329.84	794.322	723.611	697.879	689.622	684.448	1352.95	785.516	718.376	698.504	687.439	1314.55	775.229	718.407	695.284	1295.51	791.682	725.305	1144.43	785.965	1360.09
12:30:34	0	41	1	1353.46	769.24	722.65	698.368	664.936	663.807	663.898	1330.01	794.506	723.626	697.94	689.667	684.631	1353.01	785.714	718.544	698.52	687.393	1314.84	775.275	718.391	695.253	1295.6	792.003	725.382	1144.49	786.117	1360.38
12:30:34	0	42	1	1353.68	769.53	722.802	698.597	664.997	663.883	663.99	1330.3	794.826	723.825	697.924	689.881	684.722	1353.4	785.699	718.712	698.749	687.744	1315.17	775.412	718.544	695.467	1295.83	792.109	725.641	1144.83	786.361	1360.64
12:30:35	0	43	1	1353.39	769.316	722.65	698.398	664.738	663.578	663.837	1329.78	794.429	723.474	697.741	689.515	684.509	1352.99	785.592	718.513	698.642	687.47	1314.87	775.351	718.254	695.055	1295.44	791.88	725.275	1144.51	786.058	1359.91
12:30:35	0	44	1	1352.95	768.843	722.604	698.261	664.57	663.44	663.623	1329.7	794.261	723.474	697.85	689.53	684.448	1352.61	785.364	718.254	698.306	687.393	1314.45	774.965	718.3	695.177	1295.35	791.575	725.244	1144.28	785.837	1359.95
12:30:36	0	45	1	1354.4	769.805	723.108	698.719	665.363	664.173	664.188	1330.89	794.994	723.993	698.184	690.049	685.058	1353.8	786.081	719.048	698.871	688.004	1315.69	775.733	718.849	695.666	1296.43	792.43	725.778	1145.39	786.682	1361.1
12:30:36	0	46	1	1353.79	769.683	723.031	698.642	665.18	663.822	664.081	1330.54	794.597	723.888	698.046	690.003	684.88	1353.59	785.898	718.636	698.718	687.882	1315.31	775.672	718.544	695.559	1295.99	792.186	725.595	1144.78	786.255	1360.71
12:30:37	0	47	1	1354.06	769.484	722.925	698.78	665.226	663.929	664.142	1330.46	794.673	723.794	698.001	689.82	684.768	1353.56	785.898	718.666	698.779	687.988	1315.11	775.565	718.605	695.513	1296.06	792.109	725.687	1144.96	786.346	1360.68
12:30:38	0	48	1	1354.41	769.759	723.062	698.841	665.348	664.173	664.356	1330.86	795.025	724.161	698.352	690.095	685.028	1354.12	786.157	719.032	699.145	687.988	1315.87	775.794	718.849	695.864	1296.49	792.415	725.824	1145.28	786.667	1361.08
12:30:38	0	49	1	1354.28	769.698	723.138	698.749	665.226	664.097	664.173	1330.78	794.765	723.932	698.23	690.11	684.997	1353.77	785.882	718.819	698.902	687.836	1315.56	775.687	718.727	695.681	1296.36	792.308	725.855	1145.24	786.575	1361
12:30:39	0	50	1	1353.68	769.408	722.787	698.505	664.921	663.839	663.959	1330.19	794.521	723.642	697.756	689.622	684.631	1353.08	785.592	718.681	698.581	687.546	1314.99	775.351	718.391	695.38	1295.79	791.713	725.366	1144.7	786.133	1360.24
12:30:39	0	51	1	1353.71	769.286	722.741	698.535	664.844	663.822	663.913	1330.22	794.597	723.718	697.879	689.713	684.692	1353.33	785.714	718.575	698.703	687.653	1315.16	775.244	718.62	695.33	1295.65	791.987	725.443	1144.89	786.316	1360.52
12:30:40	0	52	1	1353.72	769.301	722.802	698.551	664.966	663.791	663.913	1330.14	794.551	723.687	697.94	689.652	684.676	1353.13	785.623	718.513	698.626	687.683	1314.97	775.321	718.391	695.345	1295.77	791.957	725.58	1144.8	786.117	1360.29
12:30:41	0	53	1	1353.53	769.377	722.772	698.734	665.058	663.898	663.913	1330.19	794.582	723.81	697.924	689.866	684.692	1353.39	785.714	718.697	698.764	687.683	1315.16	775.458	718.513	695.391	1296.06	792.033	725.717	1144.75	786.27	1360.67
12:30:41	0	54	1	1353.68	769.423	722.879	698.673	665.028	663.852	663.974	1330.34	794.673	723.794	698.046	689.85	684.768	1353.46	785.836	718.636	698.718	687.576	1315.31	775.534	718.513	695.513	1295.89	792.17	725.55	1144.8	786.239	1360.65
12:30:42	0	55	1	1353.82	769.591	723.001	698.025	665.211	663.837	664.173	1330.39	794.704	723.871	698.001	689.881	684.905	1353.59	785.852	718.712	698.764	687.775	1315.32	775.611	718.513	695.528	1296.11	792.262	725.717	1144.93	786.331	1360.7

12:30:42	8	56	1	1354.15	769.606	723.093	696.795	685.259	683.99	684.142	1330.85	794.735	724.084	698.108	690.003	685.104	1353.71	785.959	718.849	698.071	688.066	1315.42	775.763	718.788	695.742	1296.31	792.399	725.885	1145.24	786.499	1361.05
12:30:43	8	57	1	1354.08	769.728	723.123	696.673	685.287	684.066	684.158	1330.69	794.887	723.947	698.153	690.14	685.104	1353.74	786.05	718.926	698.071	687.943	1315.74	775.778	718.773	695.85	1296.4	792.293	725.855	1145.35	786.59	1361.14
12:30:43	8	58	1	1354.01	769.576	722.94	696.871	685.134	683.959	684.097	1330.27	794.857	724.023	698.016	689.973	684.768	1353.77	785.898	718.849	698.902	687.79	1315.46	775.55	718.91	695.82	1296	792.369	725.595	1145.13	786.361	1360.59
12:30:44	8	59	1	1353.88	769.454	722.894	696.719	684.936	683.791	684.142	1330.34	794.719	723.871	697.955	689.85	684.966	1353.59	785.791	718.773	698.749	687.851	1315.16	775.595	718.559	695.482	1296.17	792.155	725.488	1144.93	786.346	1360.75
12:30:45	8	60	1	1353.66	769.316	722.726	696.627	684.89	683.425	683.929	1330.13	794.429	723.733	697.879	689.713	684.646	1353.31	785.546	718.636	698.718	687.775	1314.94	775.336	718.513	695.376	1295.76	792.003	725.595	1144.72	786.133	1360.29
12:30:45	8	61	1	1354.09	769.637	722.97	696.81	685.012	684.081	684.249	1330.39	794.811	723.855	698.001	689.942	684.799	1353.54	785.745	718.849	698.81	687.775	1315.49	775.473	718.529	695.498	1296	792.094	725.687	1145.07	786.423	1360.82
12:30:46	8	62	1	1354.41	769.774	723.397	696.749	685.302	683.99	684.356	1330.85	795.088	724.161	698.169	690.171	685.272	1353.83	786.142	719.063	699.009	687.943	1315.71	775.885	718.803	695.681	1296.47	792.323	725.901	1145.45	786.484	1360.9
12:30:46	8	63	1	1354.18	769.652	723.123	696.764	685.241	684.02	684.127	1330.74	794.858	723.993	698.001	690.003	684.936	1353.54	785.959	718.895	698.902	687.927	1315.63	775.58	718.513	695.681	1296.32	792.308	725.763	1145.13	786.484	1360.85
12:30:47	8	64	1	1354.01	769.454	722.985	696.642	685.119	683.944	684.051	1330.37	794.75	723.962	698.26	689.85	684.905	1353.82	785.791	718.742	698.855	687.76	1315.4	775.473	718.651	695.452	1296.25	792.14	725.55	1144.83	786.377	1360.85
12:30:48	8	65	1	1353.71	769.484	722.924	696.673	685.073	683.99	683.99	1330.33	794.765	723.718	698.001	689.942	684.768	1353.51	785.867	718.712	698.977	688.036	1315.29	775.611	718.636	695.391	1295.98	792.125	725.55	1144.86	786.239	1360.69
12:30:48	8	66	1	1353.85	769.362	722.818	696.642	685.012	683.715	684.035	1330.17	794.612	723.81	697.924	689.789	684.829	1353.34	785.699	718.605	698.718	687.866	1315.09	775.458	718.468	695.406	1295.86	792.018	725.458	1144.8	786.194	1360.38
12:30:49	8	67	1	1353.54	769.148	722.695	696.49	684.952	683.654	683.776	1330.01	794.49	723.703	697.894	689.835	684.631	1353.25	785.485	718.529	698.642	687.531	1314.82	775.244	718.437	695.345	1295.57	791.972	725.336	1144.61	786.224	1360.21
12:30:50	8	68	1	1353.08	768.996	722.512	696.169	684.722	683.593	683.684	1329.75	794.139	723.382	697.65	689.377	684.28	1352.58	785.333	718.224	698.245	687.378	1314.36	775.076	718.346	695.101	1295.21	791.806	725.107	1144.2	785.812	1359.82
12:30:50	8	69	1	1353.33	769.087	722.665	696.368	684.921	683.517	683.7	1329.85	794.307	723.459	697.772	689.58	684.6	1352.84	785.47	718.513	698.459	687.454	1314.8	775.153	718.178	695.162	1295.41	791.759	725.397	1144.35	785.859	1360.13
12:30:51	8	70	1	1352.73	768.919	722.466	696.123	684.646	683.303	683.623	1329.23	794.246	723.397	697.36	689.423	684.264	1352.34	785.18	718.376	698.245	687.271	1314.41	774.97	718.117	694.963	1294.92	791.682	725.107	1144.06	785.705	1359.75
12:30:51	8	71	1	1353.59	769.393	722.772	696.535	684.905	683.791	684.035	1330.13	794.796	723.749	697.863	689.927	684.554	1353.24	785.638	718.636	698.625	687.576	1315.13	775.29	718.391	695.421	1295.47	791.85	725.519	1144.77	786.224	1360.49
12:30:52	8	72	1	1353.63	769.24	722.787	696.49	684.966	683.745	683.822	1330.18	794.46	723.764	697.955	689.622	684.57	1353.33	785.638	718.697	698.625	687.668	1315.18	775.275	718.437	695.36	1295.85	791.987	725.443	1144.73	786.27	1360.38
12:30:52	8	73	1	1353.65	769.454	722.879	696.719	685.028	683.883	684.005	1330.36	794.643	723.81	697.802	689.881	684.722	1353.3	785.684	718.697	698.657	687.561	1315.17	775.488	718.468	695.452	1295.83	791.941	725.595	1144.88	786.316	1360.35
12:30:53	8	74	1	1354	769.454	722.985	696.734	685.15	683.822	684.112	1330.54	794.826	723.886	698.062	689.973	684.814	1353.77	785.943	718.849	698.779	687.76	1315.34	775.443	718.803	695.513	1296.08	792.277	725.702	1145.1	786.316	1360.81
12:30:54	8	75	1	1353.72	769.484	722.909	696.581	685.104	683.776	683.883	1330.25	794.536	723.764	697.97	689.957	684.631	1353.25	785.806	718.651	698.672	687.744	1315.11	775.336	718.529	695.391	1295.88	791.987	725.595	1144.72	786.285	1360.58
12:30:54	8	76	1	1353.05	769.301	722.558	696.322	684.738	683.639	683.822	1329.81	794.338	723.581	697.772	689.606	684.448	1352.76	785.47	718.3	698.595	687.424	1314.64	775.168	718.315	695.162	1295.38	791.743	725.244	1144.38	785.919	1359.84
12:30:55	8	77	1	1353.46	769.377	722.695	696.413	684.844	683.593	683.776	1330.02	794.353	723.581	697.848	689.82	684.539	1353.05	785.699	718.391	698.611	687.668	1314.73	775.26	718.422	695.223	1295.67	791.926	725.458	1144.43	786.072	1360.17
12:30:56	8	78	1	1353.88	769.637	722.94	696.78	685.18	683.807	683.959	1330.58	794.735	723.794	698.138	689.896	684.692	1353.51	785.852	718.559	698.886	687.775	1315.11	775.443	718.636	695.223	1295.94	792.369	725.412	1144.93	786.499	1360.47
12:30:56	8	79	1	1353.39	769.194	722.772	696.566	684.753	683.745	683.837	1329.95	794.551	723.687	697.848	689.499	684.463	1353.22	785.638	718.437	698.611	687.424	1314.8	775.305	718.452	695.147	1295.84	791.987	725.351	1144.58	786.209	1360.17
12:30:57	8	80	1	1353.19	769.194	722.512	696.23	684.753	683.318	683.639	1329.85	794.277	723.397	697.65	689.499	684.325	1352.84	785.485	718.285	698.352	687.5	1314.41	775.183	718.239	695.162	1295.3	791.86	725.198	1144.15	786.067	1360.13
12:30:57	8	81	1	1354.47	769.652	723.184	696.993	685.195	684.081	684.432	1330.95	794.949	724.222	698.199	690.14	685.134	1354.17	786.098	719.093	699.008	687.988	1315.78	775.982	718.712	695.788	1296.84	792.478	725.794	1145.42	786.59	1361.1
12:30:58	8	82	1	1354.01	769.637	722.955	696.81	685.165	683.929	683.929	1330.6	794.872	723.901	698.184	689.927	684.905	1353.73	785.775	718.697	698.749	687.912	1315.32	775.55	718.697	695.82	1296.23	792.415	725.611	1144.92	786.423	1361.04
12:30:59	8	83	1	1354.12	769.515	722.985	696.734	685.012	683.868	684.158	1330.45	794.704	723.855	698.138	689.896	684.86	1353.54	785.821	718.742	698.81	687.821	1315.26	775.473	718.651	695.559	1296.25	792.231	725.595	1144.96	786.361	1360.5
12:30:59	8	84	1	1354.12	769.683	723.046	696.719	685.15	683.974	684.02	1330.58	794.78	723.84	698.184	690.049	684.951	1353.62	786.02	718.819	698.918	687.912	1315.4	775.55	718.727	695.696	1296.59	792.415	725.717	1145.01	786.438	1360.87
12:31:00	8	85	1	1353.97	769.637	723.108	696.764	685.272	684.005	684.051	1330.83	794.872	724.039	698.046	690.079	684.966	1353.36	786.004	718.86	699.008	687.821	1315.46	775.748	718.666	695.835	1296.12	792.277	725.748	1145.1	786.529	1360.87
12:31:00	8	86	1	1352.87	768.935	722.711	696.078	684.6	683.547	683.562	1329.4	794.368	723.336	697.497	689.469	684.358	1352.41	785.485	718.33	698.245	687.363	1314.45	774.954	718.193	694.994	1295.18	791.468	725.214	1144.12	785.675	1360.01
12:31:01	8	87	1	1353.89	769.408	723.108	696.535	685.119	684.081	684.005	1330.42	794.704	723.901	698.077	689.942	684.753	1353.42	785.775	718.742	698.794	687.714	1315.28	775.504	718.59	695.36	1295.99	792.201	725.58	1144.86	786.27	1360.64
12:31:02	8	88	1	1354.08	769.698	722.88	696.78	685.119	683.761	684.081	1330.82	794.719	723.886	698.092	689.82	684.844	1353.86	785.882	718.697	698.84	687.729	1315.09	775.488	718.651	695.437	1296.08	792.354	725.534	1145.02	786.484	1360.47
12:31:02	8	89	1	1354.01	769.392	722.924	696.581	685.119	683.761	684.097	1330.34	794.765	723.794	698.001	689.713	684.768	1353.62	785.684	718.62	698.749	687.76	1315.22	775.427	718.483	695.253	1295.99	792.109	725.488	1144.77	786.316	1360.62
12:31:03	8	90	1	1353.51	769.515	723.016	696.642	685.119	683.868	684.081	1330.33	794.673	723.871	698.001	689.789	684.829	1353.19	785.76	718.712	698.565	687.729	1315.16	775.488	718.483	695.528	1295.98	792.018	725.473	1144.58	786.178	1360.5
12:31:04	8	91	1	1354.41	769.744	723.138	696.887	685.318	683.868	684.249	1330.97	794.765	724.191	698.23	690.003	684.951	1354.03	786.142	718.758	698.932	687.912	1315.46	775.901	718.788	695.574	1296.49	792.43	725.763	1145.18	786.529	1360.99
12:31:04	8	92	1	1353.94	769.606	723.016	696.673	685.165	683.868	683.929	1330.71	794.719	723.901	698.123	689.942	684.921	1353.48	785.913	718.819	698.901	687.775	1315.25	775.717	718.742	695.467	1296.15	792.247	725.733	1145.12	786.529	1360.85
12:31:05	8	93	1	1353.82	769.622	723.108	696.673	685.165	683.791	684.081	1330.4	794.918	723.794	698.046	690.003	684.966	1353.48	785.836	718.788	698.947	687.836	1315.32	775.488	718.636	695.543	1295.91	792.216	725.687	1145.01	786.361	1360.79
12:31:05	8	94	1	1354.48	769.683	723.199	696.871	685.287	683.99	684.387	1330.95	794.994	724.1	698.306	690.14	684.997	1353.89	785.959	718.971	699.054	688.05	1315.57	775.855	718.803	695.986	1296.81	792.43	725.748	1145.41	786.636	1361.04
12:31:06	8	95	1	1353.75	769.53	722.955	696.764	685.073	683.883	683.883	1330.39	794.826	723.84	698.001	689.866	684.585	1353.37	785.684	718.62	698.749	687.714	1315.11	775.55	718.513	695.299	1296.05	792.277	725.443	1144.8	786.239	1360.85
12:31:06	8	96	1	1353.56	769.194	722.818	696.535	684.997	683.7	683.959	1329.91	794.658	723.611	697.802	689.789	684.57	1353.14	785.592	718.773	698.581	687.531	1314.94	775.412	718.33	695.452	1295.86	791.941	725.382	1144.81	786.041	1360.47
12:31:07	8	97	1	1354.08	769.591	722.924	696.856	685.211	683.868	684.112	1330.58	794.826	723.855	698.23	689.896	684.814	1353.69	785.836	718.849	698.902	687.698	1315.19	775.656	718.62	695.437	1296.12	792.155	725.58	1145.01	786.377	1360.69
12:31:08	8	98	1	1353.58	769.393	722.695	696.474	685.012	683.684	683.853	1330.19	794.582	723.718	697.955	689.896	684.646	1353.17	785.745	718.468	698.581	687.515	1314.88	775.305	718.468	695.33	1295.8	792.064	725.458	1144.81	786.209	1360.52
12:31:08	8	99	1	1353.85	769.622	722.97	696.719	685.211	684.005	684.127	1330.36	794.826	723.947	698.275	689.973	684.89	1353.57	785.928	718.803	699.025	687.744	1315.49	775.611	718.483	695.437	1295.98	792.384	725.733	1145.02	786.285	1360.79
12:31:09	8	100	1	1354.48	769.683	723.184	696.917	685.302	684.051	684.249	1330.71	795.086	724.191	698.306	690.095	685.073	1354.11	786.004	719.078	699.208	687.943	1315.67	775.809	718.834	695.803	1296.55	792.491	725.931	1145.36	786.606	1361
12:31:10	8	101	1	1353.43	769.194	722.695	696.398	684.89	683.806	683.807	1329.99	794.521	723.703	697.802	689.713	684.432	1353.01	785.379	718.513	698.565	687.607	1314.82	775.137	718.437	695.299	1295.82	792.018	725.336	1144.55	786.067	1360.23
12:31:10	8	102	1	1353.05	768.858	722.451	696.23	684.676	683.394	683.623	1329.5	794.368	723.428	697.619	689.469	684.341	1352.5	785.258	718.208	698.413	687.378	1314.47	775.107	718.224	695.024	1295.3	791.59	725.092	1144.22	785.843	1359.83
12:31:11	8	103	1	1353.27	769.026	722.695	696.337	684.799	683.593	683.837	1329.82	794.399	723.565	697.726	689.515	684.493	1352.81	785.485	718.437	698.367	687.408	1314.67	775.153	718.376	695.345	1295.33	791.972	725.351	1144.44	786.026	1360.04
12:31:33	8	104	1	1352.82	769.209	722.726	696.184	684.614	683.455	683.592	1329.58	794.124	723.23	697.695	689.454	684.417	1352.53	785.47	718.315	698.321	687.408	1314.26	775.092	718.208	694.946	1294.9	791.529	725.092	1144.11	785.843	1359.52
12:31:34	8	105	1	1352.88	769.042	722.421	696.398	684.738	683.593	683.517	1329.43	794.17	723.413	697.589	689.53	684.341	1352.47	785.272	718.422	698.336	687.18	1314.64	775.076	718.101	695.208	1295.09	791.514	725.229	1144.08	785.843	1359.74
12:31:34	8	106	1	1353.68	769.393	722.726	696.612	685.043	683.807	683.974	1330.33	794.536	723.749	697.924	689.896	684.8	1353.33	785.852	718.62	698.901	687.729	1315.19	775.244	718.361	695.253	1295.84	791.926	725.488	1144.84	786.102	1360.13
12:31:34	8	107	1	1353.82	769.408	722.802	696.656	685.069	683.791	683.929	1330.22	794.689	723.794	697.818	689.728	684.753	1353.21	785.73	718.666	698.474	687.637	1315.08	775.336	718.681	695.36	1295.7	792.064	725.382	1144.72	786.164	1360.29
12:31:35	8	108	1	1353.51	769.347	722.879	696.612	684.997	683.623	683.929	1330.11	794.551	723.687	697.909	689.774	684.631	1353.21	785.699	718.681	698.611	687.729	1314.9	775.427	718.483	695.33	1295.59	791.86	725.275	1144.8	786.102	1360.26
12:31:35	8	109	1	1353.95	769.316	722.833	696.658	685.069	683.868	683.898	1330.45	794.719	723.916	698.108	689.713	684.753	1353.51	785.73	718.788	698.626	687.79	1315.22	775.534	718.483	695.345	1295.85	792.033	725.458	1144.72	786.361	1360.33
12:31:35	8	110	1	1353.25	769.179	722.558	696.352	684.738	683.562	683.776	1329.87	794.338	723.52	697.802	689.606	684.57	1352.87	785.44	718.376	698.55	687.378	1314.58	775.26	718.376	695.131	1295.36	791.835	725.122	1144.23	785.934	1359.69
12:31:36	8	111	1	1353.51	769.469	722.772	696.535	684.936	683.715	683.929	1329.96	794.49	723.687	697.787	689.82	684.676	1353.36	785.546	718.513	698.581	687.837	1314.91	775.336	718.468	695.345	1295.5	791.882	725.397	1144.38	786.058	1359.86

12:31:36	8	112	1	1353.79	789.438	722.94	696.027	684.997	683.852	684.005	1330.4	794.858	723.855	697.94	689.896	684.844	1353.37	785.699	718.666	696.764	687.76	1315.22	775.504	718.59	695.421	1295.97	792.186	725.626	1144.78	788.183	1360.42
12:31:36	8	113	1	1353.57	789.469	722.924	696.668	685.009	683.822	684.097	1330.31	794.889	723.749	696.136	689.912	684.829	1353.36	785.913	718.636	696.01	687.714	1315.13	775.595	718.59	695.421	1295.8	792.033	725.534	1144.83	788.087	1360.42
12:31:36	8	114	1	1353.51	789.347	722.758	696.027	685.020	683.745	683.866	1330.04	794.582	723.642	697.924	689.82	684.753	1353.11	785.577	718.559	696.636	687.607	1314.77	775.302	718.391	695.253	1295.53	791.865	725.427	1144.52	788.117	1360.04
12:31:37	8	115	1	1354.49	789.728	723.23	696.932	685.318	684.158	684.341	1330.86	795.131	724.206	698.306	690.125	684.997	1353.8	786.03	718.91	696.994	687.912	1315.67	775.702	718.865	695.788	1296.26	792.186	725.778	1145.27	788.514	1360.9
12:31:37	8	116	1	1353.36	789.164	722.589	696.398	684.89	683.532	683.7	1329.84	794.445	723.535	697.772	689.545	684.554	1352.78	785.379	718.59	696.52	687.485	1314.73	775.214	718.3	695.162	1295.44	791.774	725.107	1144.43	785.919	1359.8
12:31:37	8	117	1	1353.43	789.24	722.865	696.398	685.043	683.807	683.883	1330.2	794.628	723.703	698.016	689.774	684.615	1353.02	785.745	718.666	696.657	687.546	1314.8	775.336	718.422	695.376	1295.53	791.835	725.427	1144.43	785.995	1360.06
12:31:38	8	118	1	1353.59	789.362	722.833	696.398	685.104	683.684	683.99	1330.16	794.597	723.825	697.94	689.683	684.875	1353.11	785.745	718.544	696.535	687.729	1314.74	775.244	718.391	695.192	1295.87	791.835	725.412	1144.8	786.01	1360.21
12:31:38	8	119	1	1353.74	789.423	722.848	696.642	685.043	683.837	683.913	1330.06	794.873	723.779	698.092	689.744	684.844	1353.36	785.699	718.758	696.703	687.637	1315.17	775.443	718.468	695.437	1295.8	791.941	725.458	1144.8	788.239	1360.36
12:31:38	8	120	1	1353.75	789.301	722.833	696.581	684.966	683.578	683.822	1330.24	794.843	723.749	697.97	689.805	684.585	1353.16	785.714	718.62	696.718	687.485	1314.93	775.443	718.452	695.437	1295.77	791.804	725.427	1144.67	788.087	1360.1
12:31:38	8	121	1	1354.14	789.53	723.092	696.78	685.104	684.081	684.203	1330.63	794.796	723.901	698.245	690.034	684.89	1353.62	785.943	718.956	696.993	687.927	1315.43	775.58	718.651	695.62	1296.03	792.125	725.55	1145.07	788.316	1360.65
12:31:39	8	122	1	1353.69	789.377	722.924	696.52	684.936	683.852	683.929	1330.19	794.858	723.596	697.879	689.774	684.982	1353.34	785.775	718.636	696.687	687.821	1315.06	775.302	718.437	695.314	1295.83	791.926	725.351	1144.8	788.087	1360.33
12:31:39	8	123	1	1353.59	789.393	722.758	696.474	685.020	683.776	683.913	1330.07	794.567	723.718	697.818	689.774	684.554	1353.37	785.745	718.437	696.535	687.561	1314.94	775.351	718.437	695.208	1295.73	792.048	725.488	1144.64	788.148	1360.07
12:31:39	8	124	1	1353.53	789.255	722.772	696.444	684.966	683.761	683.868	1329.96	794.536	723.596	697.848	689.591	684.707	1353.14	785.623	718.667	696.443	687.531	1314.91	775.302	718.391	695.391	1295.59	791.758	725.351	1144.83	788.072	1360.04
12:31:40	8	125	1	1353.07	789.072	722.512	696.291	684.799	683.501	683.73	1329.53	794.377	723.428	697.619	689.469	684.417	1352.87	785.47	718.376	696.321	687.393	1314.55	775.103	718.193	695.04	1294.99	791.651	725.198	1144.14	785.919	1359.71
12:31:40	8	126	1	1353.36	789.179	722.68	696.444	684.044	683.715	683.654	1329.81	794.49	723.581	697.726	689.652	684.524	1353.16	785.409	718.529	696.581	687.607	1314.68	775.214	718.468	695.223	1295.46	791.85	725.382	1144.49	785.904	1359.98
12:31:40	8	127	1	1354.15	789.591	723.153	696.887	685.195	683.99	684.203	1330.46	794.857	723.84	698.123	690.018	684.844	1353.73	785.959	718.849	696.962	687.943	1315.71	775.733	718.697	695.589	1296.02	792.262	725.656	1145.1	788.606	1360.66
12:31:40	8	128	1	1354.01	789.545	722.94	696.887	685.119	683.868	684.158	1330.57	794.719	723.993	698.108	689.973	684.982	1353.54	785.943	718.849	696.025	687.714	1315.43	775.504	718.575	695.543	1295.88	792.17	725.611	1144.98	788.331	1360.41
12:31:41	8	129	1	1353.48	789.484	722.863	696.444	684.997	683.898	683.898	1330.17	794.704	723.733	698.031	689.85	684.707	1353.43	785.714	718.651	696.764	687.607	1315.09	775.473	718.544	695.574	1295.73	791.972	725.427	1144.89	788.239	1360.33
12:31:41	8	130	1	1354.23	789.545	723.23	696.871	685.287	684.081	684.219	1330.63	794.811	724.039	698.153	690.11	684.968	1353.96	786.035	719.003	696.993	687.897	1315.81	775.763	718.895	695.757	1296.15	792.293	725.748	1144.98	788.484	1360.65
12:31:41	8	131	1	1353.37	789.24	722.68	696.581	684.905	683.562	683.883	1330.1	794.292	723.581	697.787	689.622	684.661	1352.99	785.531	718.651	696.409	687.592	1314.9	775.321	718.407	695.284	1295.59	791.804	725.412	1144.43	785.965	1360.04
12:31:42	8	132	1	1354.35	789.606	723.092	696.764	685.256	684.02	684.219	1330.59	794.75	724.006	698.245	690.034	684.875	1353.75	785.882	718.956	696.764	687.851	1315.4	775.656	718.62	695.482	1296.06	792.109	725.626	1145.07	788.27	1360.59
12:31:42	8	133	1	1353.94	789.53	723.138	696.703	685.195	684.066	684.035	1330.56	794.78	723.947	698.245	690.003	684.921	1353.79	785.867	718.895	696.886	687.775	1315.42	775.534	718.697	695.421	1296.25	792.14	725.687	1144.98	788.3	1360.55
12:31:42	8	134	1	1354.21	789.744	722.924	696.886	685.15	683.974	684.127	1330.62	794.902	723.993	698.062	690.11	684.844	1353.65	785.913	718.849	696.779	687.882	1315.4	775.504	718.651	695.513	1295.94	792.277	725.55	1144.89	788.239	1360.66
12:31:42	8	135	1	1354.26	789.637	722.909	696.703	685.195	683.944	684.158	1330.49	794.948	723.855	698.108	689.973	684.783	1353.66	785.867	718.88	696.871	687.836	1315.36	775.595	718.727	695.528	1296.06	792.338	725.641	1145.06	788.407	1360.64
12:31:43	8	136	1	1354.21	789.835	723.092	696.835	685.211	684.02	684.158	1330.59	794.902	724.084	698.291	690.064	684.844	1353.73	786.081	718.88	696.962	687.973	1315.71	775.717	718.758	695.635	1296.29	792.186	725.824	1145.28	788.468	1360.91
12:31:43	8	137	1	1353.88	789.561	722.985	696.673	685.195	683.974	684.188	1330.46	794.78	723.886	698.062	689.881	685.043	1353.63	785.898	718.926	696.825	687.653	1315.46	775.656	718.59	695.452	1295.98	792.186	725.717	1144.84	788.346	1360.67
12:31:43	8	138	1	1353.05	788.965	722.405	696.322	684.692	683.501	683.578	1329.84	794.261	723.336	697.589	689.393	684.31	1352.7	785.272	718.391	696.428	687.363	1314.26	775.061	718.147	694.963	1295.04	791.651	725.122	1144.15	785.705	1359.75
12:31:44	8	139	1	1353.13	789.179	722.68	696.337	684.738	683.562	683.745	1329.72	794.46	723.642	697.695	689.622	684.509	1352.88	785.531	718.651	696.474	687.561	1314.91	775.153	718.3	695.299	1295.25	791.728	725.183	1144.29	788.026	1359.95
12:31:44	8	140	1	1353.63	789.408	723.001	696.612	684.966	683.776	684.001	1330.49	794.735	723.825	698.123	689.866	684.8	1353.39	785.806	718.651	696.84	687.775	1315.26	775.443	718.666	695.467	1295.66	792.033	725.519	1144.95	788.102	1360.5
12:31:44	8	141	1	1354.11	789.698	723.001	696.856	685.119	683.929	684.219	1330.56	795.009	724.006	698.092	690.125	684.936	1353.63	785.928	718.834	696.886	687.837	1315.34	775.733	718.651	695.803	1296.22	792.155	725.534	1144.98	788.392	1360.55
12:31:44	8	142	1	1353.82	789.408	723.046	696.596	685.020	683.745	683.944	1330.27	794.567	723.779	698.016	689.896	684.86	1353.37	785.791	718.712	696.749	687.714	1315.32	775.458	718.636	695.452	1295.89	792.048	725.443	1144.7	788.194	1360.46
12:31:47	8	143	1	1353.97	789.545	723.092	696.841	685.15	684.035	684.264	1330.62	794.902	724.039	698.26	689.957	684.921	1353.77	786.05	718.987	696.764	687.927	1315.4	775.626	718.742	695.666	1296.02	792.247	725.626	1145.04	788.392	1360.63
12:31:47	8	144	1	1353.91	789.499	722.985	696.688	685.009	683.791	684.142	1330.39	794.872	723.871	698.001	689.85	684.814	1353.45	785.775	718.727	696.81	687.729	1315.17	775.595	718.666	695.437	1296.03	792.17	725.443	1145.01	788.361	1360.33
12:31:47	8	145	1	1354.06	789.759	723.016	696.703	685.256	684.001	684.234	1330.51	794.872	723.962	698.184	690.156	684.875	1353.66	786.004	718.803	696.039	687.851	1315.32	775.733	718.727	695.513	1296.02	792.247	725.534	1145.12	788.361	1360.73
12:31:47	8	146	1	1354.12	789.591	722.955	696.78	684.997	683.944	684.203	1330.54	794.872	723.977	698.138	689.927	684.905	1353.8	785.821	718.88	696.794	687.698	1315.37	775.611	718.712	695.543	1295.89	792.201	725.611	1145.04	788.423	1360.55
12:31:48	8	147	1	1353.88	789.454	722.985	696.734	685.165	683.868	684.188	1330.42	794.719	723.962	698.016	689.896	684.921	1353.4	785.745	718.849	696.794	687.79	1315.32	775.489	718.636	695.513	1295.96	792.247	725.534	1144.95	788.453	1360.44
12:31:48	8	148	1	1354.01	789.622	723.108	696.764	685.287	684.051	684.097	1330.71	794.902	724.023	698.123	690.018	684.905	1353.62	786.02	718.803	696.886	687.973	1315.45	775.702	718.819	695.711	1296.32	792.354	725.778	1145.12	788.377	1360.67
12:31:48	8	149	1	1354.36	789.912	723.23	696.993	685.363	684.295	684.417	1330.83	795.009	724.069	698.306	690.247	684.968	1354.03	786.065	719.079	696.984	688.065	1315.63	775.992	718.773	695.833	1296.49	792.201	725.824	1145.36	788.575	1361.02
12:31:48	8	150	1	1353.6	789.53	722.772	696.551	685.134	683.837	683.929	1330.31	794.613	723.825	697.879	689.82	684.89	1353.34	785.699	718.727	696.687	687.683	1315.23	775.534	718.483	695.467	1295.8	791.987	725.397	1144.9	788.224	1360.32
12:31:49	8	151	1	1353.89	789.576	722.985	696.734	685.318	683.868	684.219	1330.43	794.75	723.962	698.138	690.049	684.905	1353.54	785.791	718.651	696.918	687.851	1315.28	775.763	718.758	695.543	1295.91	792.155	725.595	1144.83	788.3	1360.5
12:31:49	8	152	1	1353.71	789.347	722.94	696.474	684.044	683.7	683.852	1329.82	794.521	723.626	697.848	689.622	684.707	1352.99	785.623	718.529	696.55	687.515	1314.64	775.153	718.3	695.208	1295.39	791.835	725.427	1144.43	788.056	1360.18
12:31:49	8	153	1	1353.24	789.316	722.68	696.52	684.997	683.791	683.944	1330.05	794.475	723.626	698.001	689.698	684.722	1353.25	785.653	718.62	696.611	687.485	1314.97	775.244	718.452	695.376	1295.44	791.926	725.229	1144.81	788.072	1360.01
12:31:50	8	154	1	1353.65	789.408	722.863	696.78	685.134	683.913	683.959	1330.25	794.521	723.855	697.894	689.835	684.799	1353.3	785.852	718.773	696.636	687.744	1314.97	775.489	718.651	695.391	1295.79	792.109	725.58	1144.98	788.407	1360.35
12:31:50	8	155	1	1353.92	789.561	722.985	696.902	685.009	683.868	684.158	1330.19	794.857	723.901	697.955	689.912	684.921	1353.74	785.821	718.697	696.825	687.912	1315.31	775.504	718.575	695.543	1295.83	792.308	725.672	1145.01	788.255	1360.53
12:31:50	8	156	1	1353.83	789.667	723.092	696.825	685.424	683.913	684.188	1330.77	794.828	724.069	698.26	690.064	685.028	1353.91	786.05	718.926	696.993	687.988	1315.55	775.687	718.742	695.742	1296.18	792.186	725.733	1144.98	788.499	1360.78
12:31:50	8	157	1	1354.27	789.744	723.092	696.841	685.028	684.142	684.249	1330.6	794.979	723.962	698.199	690.125	684.951	1353.63	786.004	718.895	696.947	688.095	1315.6	775.656	718.865	695.62	1296.14	792.231	725.488	1145.18	788.499	1360.58
12:31:51	8	158	1	1353.54	789.454	723.079	696.612	685.073	683.807	683.99	1330.3	794.582	723.764	698.199	689.866	684.829	1353.42	785.806	718.697	696.81	687.653	1315.13	775.443	718.666	695.452	1295.8	791.835	725.595	1144.81	788.209	1360.39
12:31:51	8	159	1	1353.94	789.606	723.153	696.734	685.134	684.112	684.051	1330.43	794.994	723.977	698.031	689.973	684.768	1353.69	786.111	718.758	696.918	687.821	1315.14	775.504	718.758	695.543	1295.99	792.201	725.473	1145.1	788.453	1360.47
12:31:51	8	160	1	1353.74	789.53	723.001	696.688	685.333	683.913	684.035	1330.37	794.857	723.962	698.031	689.668	684.768	1353.72	785.882	718.819	696.871	687.79	1315.34	775.626	718.681	695.589	1296.12	792.262	725.565	1145.02	788.285	1360.42
12:31:51	8	161	1	1354.08	789.652	723.092	696.78	685.104	684.005	684.081	1330.49	794.858	724.054	698.123	689.988	685.043	1353.42	785.928	718.91	696.871	688.08	1315.37	775.611	718.727	695.65	1296.06	792.17	725.717	1144.98	788.59	1360.67
12:31:52	8	162	1	1354.38	789.759	723.321	696.871	685.424	684.264	684.341	1330.92	795.147	724.069	698.428	690.278	685.165	1354.04	786.218	718.91	697.208	688.141	1315.71	775.901	719.002	695.881	1296.72	792.445	725.733	1145.62	788.545	1361.07
12:31:52	8	163	1	1354	789.561	723.084	696.871	685.104	683.852	684.112	1330.31	794.873	723.993	698.031	689.881	685.073	1353.45	785.791	718.926	696.855	687.79	1315.31	775.397	718.712	695.498	1295.94	792.186	725.473	1144.8	788.407	1360.44
12:31:52	8	164	1	1353.57	789.438	723.016	696.581	685.058	683.822	683.929	1330.46	794.597	723.764	697.985	689.607	684.661	1353.42	785.714	718.666	696.718	687.714	1314.99	775.427	718.529	695.467	1295.88	792.109	725.55	1144.78	788.239	1360.29
12:31:53	8	165	1	1353.39	789.347	722.512	696.444	684.692	683.654	683.874	1329.81	794.567	723.718	697.758	689.591	684.554	1352.85	785.485	718.605	696.336	687.576	1314.79	775.153	718.361	695.3	1295.24	791.835	725.427	1144.31	788.056	1359.94
12:31:53	8	166	1	1353.4	789.087	723.031	696.429	684.966	683.807	683.791	1329.99	794.612	723.52	697.772	689.683	684.493	1353.05	785.501	718.437	696.581	687.515	1314.64	775.28	718.407	695.253	1295.53	791.896	725.229	1144.49	785.653	1360.01
12:31:53	8	167	1	1352.92	788.95	722.589	696.169	684.631	683.486	683.593	1329.52	794.2	723.443	697.68	689.454	684.219	1352.69	785.302	718.361	696.291	687.393	1314.47	775	718.208	694.994	1295.31	791.575	725.076	1144.34	785.736	1359.62

12:31:53	8	168	1	1353.65	769.130	722.68	696.474	684.799	683.654	683.974	1330.01	794.368	723.718	697.879	689.759	684.707	1352.9	785.608	718.603	698.52	687.698	1314.93	775.103	718.62	695.314	1295.45	791.835	725.366	1144.52	788.148	1360.1
12:31:54	8	169	1	1353.01	768.998	722.726	696.169	684.722	683.471	683.593	1329.76	794.292	723.474	697.88	689.484	684.448	1352.7	785.501	718.285	698.598	687.332	1314.36	775.198	718.224	695.253	1295.44	791.821	725.214	1144.2	785.919	1359.77
12:31:54	8	170	1	1353.04	769.103	722.726	696.322	684.703	683.502	683.807	1329.84	794.353	723.565	697.848	689.591	684.539	1352.78	785.592	718.544	698.443	687.302	1314.56	775.103	718.239	695.314	1295.44	791.867	725.321	1144.2	785.827	1360.01
12:31:54	8	171	1	1353.33	769.194	722.848	696.551	684.936	683.7	683.868	1329.95	794.399	723.703	697.848	689.774	684.676	1353.02	785.653	718.529	698.764	687.698	1314.62	775.368	718.468	695.421	1295.59	791.88	725.382	1144.51	786.087	1360.03
12:31:55	8	172	1	1353.14	769.286	722.711	696.352	684.844	683.593	683.715	1329.76	794.46	723.581	697.787	689.683	684.692	1352.9	785.409	718.376	698.611	687.378	1314.68	775.137	718.361	695.192	1295.33	791.804	725.26	1144.25	785.843	1359.67
12:31:55	8	173	1	1353.19	768.904	722.497	696.429	684.448	683.593	683.654	1329.37	794.216	723.336	697.604	689.408	684.387	1352.52	785.455	718.361	698.184	687.439	1314.32	774.908	718.422	695.009	1294.89	791.789	725.107	1144.14	785.904	1359.42
12:31:55	8	174	1	1353.05	768.981	722.38	696.276	684.661	683.349	683.593	1329.49	794.078	723.382	697.497	689.454	684.432	1352.44	785.195	718.453	698.275	687.317	1314.5	775.061	718.132	694.948	1295.04	791.58	725.076	1144.11	785.873	1359.68
12:31:55	8	175	1	1353.5	769.271	722.758	696.459	684.799	683.807	684.005	1329.82	794.597	723.764	697.726	689.713	684.57	1353.08	785.638	718.605	698.565	687.653	1314.79	775.26	718.407	695.345	1295.42	792.064	725.26	1144.6	786.026	1359.98
12:31:56	8	176	1	1353.59	769.545	722.909	696.505	685.119	683.852	684.097	1330.33	794.536	723.733	697.909	689.759	684.829	1353.37	785.638	718.773	698.794	687.79	1315.11	775.473	718.559	695.345	1295.89	792.003	725.534	1144.73	786.3	1360.42
12:31:56	8	177	1	1353.31	769.423	722.772	696.52	684.921	683.532	683.837	1329.99	794.582	723.749	697.865	689.652	684.539	1353.31	785.714	718.498	698.625	687.515	1315.06	775.368	718.391	695.314	1295.64	792.018	725.443	1144.7	786.133	1360.1
12:31:56	8	178	1	1353.45	769.271	722.741	696.566	684.829	683.852	683.822	1329.79	794.689	723.611	697.833	689.698	684.509	1353.08	785.608	718.59	698.642	687.561	1314.64	775.302	718.483	695.147	1295.58	791.85	725.275	1144.67	786.087	1360.07
12:31:56	8	179	1	1353.65	769.368	722.787	696.459	684.966	683.776	683.822	1330.1	794.643	723.611	697.863	689.82	684.631	1353.24	785.623	718.651	698.626	687.637	1314.96	775.368	718.285	695.314	1295.59	791.972	725.336	1144.81	786.072	1360.38
12:31:57	8	180	1	1353.3	769.286	722.619	696.383	684.69	683.468	683.776	1329.88	794.338	723.687	697.741	689.652	684.585	1353.02	785.531	718.59	698.52	687.592	1314.79	775.198	718.407	695.33	1295.47	791.835	725.366	1144.41	786.133	1360.21
12:31:57	8	181	1	1353.17	769.148	722.634	696.413	684.799	683.578	683.837	1329.79	794.475	723.642	697.619	689.622	684.57	1352.66	785.485	718.559	698.504	687.485	1314.5	775.229	718.208	695.07	1295.19	791.713	725.244	1144.35	786.041	1359.75
12:31:57	8	182	1	1353.63	769.423	722.894	696.642	685.073	683.807	684.02	1330.11	794.658	723.871	698.016	689.85	684.829	1353.19	785.714	718.742	698.764	687.683	1315.16	775.611	718.468	695.437	1295.8	792.079	725.58	1144.92	786.255	1360.44
12:31:58	8	183	1	1353.62	769.103	722.894	696.551	684.829	683.639	683.837	1329.9	794.612	723.642	697.787	689.774	684.738	1353.22	785.501	718.605	698.55	687.698	1314.67	775.302	718.376	695.238	1295.47	791.911	725.458	1144.38	786.058	1360
12:31:58	8	184	1	1353.31	769.103	722.802	696.597	684.814	683.654	683.883	1329.82	794.582	723.749	697.787	689.698	684.661	1352.92	785.699	718.437	698.428	687.515	1314.73	775.275	718.33	695.147	1295.44	791.88	725.198	1144.48	786.072	1360.13
12:31:58	8	185	1	1354.11	769.789	723.001	696.871	685.165	684.066	684.249	1330.77	795.131	723.962	698.077	689.988	685.073	1353.75	785.898	719.019	698.932	688.004	1315.37	775.595	718.575	695.574	1296	792.247	725.595	1145.01	786.453	1360.65
12:31:59	8	186	1	1353.1	769.072	722.538	696.2	684.676	683.593	683.715	1329.88	794.246	723.55	697.758	689.484	684.646	1352.63	785.256	718.544	698.413	687.515	1314.55	775.031	718.147	695.177	1295.33	791.575	725.168	1144.14	786.026	1359.97
12:31:59	8	187	1	1353.36	769.225	722.482	696.337	684.69	683.623	683.868	1329.79	794.46	723.581	697.711	689.637	684.692	1352.98	785.394	718.544	698.459	687.256	1314.67	775.198	718.285	695.192	1295.3	791.804	725.244	1144.38	785.934	1360.03
12:31:59	8	188	1	1353.6	769.408	722.772	696.474	684.936	683.800	683.913	1330.08	794.612	723.672	697.833	689.683	684.646	1353.13	785.516	718.559	698.626	687.531	1314.93	775.229	718.529	695.376	1295.39	791.865	725.351	1144.84	786.285	1360.29
12:32:00	8	189	1	1353.54	769.255	722.772	696.505	685.012	683.73	683.883	1330.01	794.597	723.596	697.924	689.637	684.57	1353.19	785.699	718.559	698.581	687.546	1314.79	775.302	718.33	695.452	1295.57	791.926	725.412	1144.72	786.041	1360
12:32:00	8	190	1	1353.89	769.301	722.848	696.505	684.936	683.791	683.99	1330.14	794.582	723.687	697.863	689.82	684.88	1353.21	785.76	718.727	698.687	687.744	1314.99	775.443	718.62	695.345	1295.79	792.079	725.504	1144.89	786.163	1360.24
12:32:00	8	191	1	1353.66	769.53	723.031	696.627	685.073	683.852	683.974	1330.39	794.643	723.886	697.985	689.698	684.829	1353.42	785.669	718.681	698.855	687.775	1315.19	775.595	718.498	695.345	1296.02	791.865	725.519	1144.88	786.209	1360.53
12:32:00	8	192	1	1353.54	769.301	722.741	696.444	684.875	683.654	683.776	1329.79	794.506	723.718	697.787	689.713	684.707	1352.93	785.546	718.452	698.565	687.653	1314.94	775.305	718.452	695.467	1295.57	791.911	725.336	1144.6	786.026	1360.15
12:32:01	8	193	1	1353.04	768.981	722.538	696.276	684.783	683.547	683.639	1329.52	794.445	723.397	697.604	689.576	684.387	1352.63	785.272	718.407	698.397	687.592	1314.42	775.061	718.224	695.024	1295.1	791.651	725.137	1144.09	785.766	1359.68
12:32:02	8	194	1	1353.53	769.271	722.802	696.505	685.058	683.7	683.898	1330.13	794.582	723.718	697.833	689.728	684.554	1353.02	785.714	718.712	698.703	687.5	1315.02	775.214	718.483	695.223	1295.54	791.85	725.412	1144.81	786.01	1360.31
12:32:02	8	195	1	1353.3	769.255	722.618	696.368	684.69	683.578	683.73	1329.76	794.383	723.565	697.833	689.698	684.432	1352.92	785.485	718.529	698.443	687.5	1314.8	775.368	718.193	695.284	1295.36	791.774	725.214	1144.41	785.965	1360.01
12:32:03	8	196	1	1353.92	769.591	723.062	696.902	685.104	683.929	684.097	1330.46	794.826	724.115	698.046	689.942	684.814	1353.51	785.745	719.019	698.871	687.821	1315.17	775.458	718.605	695.482	1295.76	792.064	725.687	1144.88	786.407	1360.67
12:32:03	8	197	1	1353.5	769.148	722.741	696.444	684.799	683.715	683.852	1329.79	794.383	723.733	697.726	689.774	684.57	1352.98	785.638	718.407	698.565	687.561	1314.8	775.351	718.483	695.238	1295.51	791.835	725.351	1144.49	786.117	1360.03
12:32:03	8	198	1	1353.83	769.515	722.985	696.734	685.069	683.868	684.066	1330.57	794.704	723.779	697.97	689.988	684.722	1353.53	785.73	718.849	698.749	687.698	1315.23	775.443	718.575	695.513	1295.88	792.155	725.595	1144.84	786.255	1360.52
12:32:03	8	199	1	1354.21	769.683	723.23	696.978	685.409	684.264	684.371	1330.94	794.933	724.435	698.26	690.247	685.073	1353.92	786.098	719.002	698.977	687.698	1315.63	775.918	718.788	695.849	1296.20	792.231	725.794	1145.22	786.499	1360.65
12:32:04	8	200	1	1354.09	769.53	722.94	696.932	685.028	683.868	684.173	1330.59	794.887	723.901	698.092	690.018	684.88	1353.54	785.836	718.758	698.825	687.729	1315.37	775.702	718.666	695.559	1296.00	792.308	725.626	1145.04	786.621	1360.7
12:32:04	8	201	1	1354	769.515	723.031	696.703	685.104	683.959	684.127	1330.59	794.643	723.871	698.062	689.957	684.905	1353.33	786.035	718.834	698.733	687.851	1315.37	775.595	718.834	695.65	1296.22	792.231	725.641	1145.18	786.651	1360.73
12:32:05	8	202	1	1353.69	769.469	722.985	696.566	684.936	683.852	683.883	1330.07	794.597	723.703	697.833	689.868	684.707	1353.21	785.653	718.742	698.626	687.576	1314.97	775.427	718.483	695.437	1295.5	791.911	725.382	1144.41	786.148	1360.13
12:32:05	8	203	1	1353.18	769.103	722.421	696.352	684.753	683.286	683.73	1329.5	794.292	723.474	697.512	689.58	684.585	1352.58	785.44	718.361	698.321	687.241	1314.5	774.954	718.147	695.04	1295.12	791.545	725.198	1144.29	785.904	1359.85
12:32:05	8	204	1	1353.34	769.271	722.711	696.505	684.936	683.73	683.822	1329.98	794.506	723.52	697.863	689.82	684.509	1352.92	785.516	718.636	698.459	687.531	1314.74	775.103	718.224	695.192	1295.39	791.682	725.336	1144.49	786.058	1360.09
12:32:06	8	205	1	1354.08	769.606	723.046	696.703	685.195	683.99	684.234	1330.36	794.765	723.916	698.016	689.988	684.89	1353.51	785.806	719.017	698.764	687.912	1315.20	775.534	718.758	695.604	1296.09	792.17	725.611	1145.01	786.239	1360.68
12:32:06	8	206	1	1353.63	769.316	722.802	696.551	685.058	683.822	683.883	1330.2	794.536	723.657	697.924	689.85	684.951	1353.11	785.638	718.742	698.687	687.76	1314.98	775.137	718.62	695.314	1295.68	792.003	725.336	1144.51	786.209	1360.23
12:32:06	8	207	1	1354.15	769.622	722.924	696.749	685.256	683.898	684.066	1330.37	794.887	723.932	698.108	689.912	684.783	1353.54	785.821	719.019	698.916	687.912	1315.17	775.519	718.819	695.437	1296.05	792.17	725.534	1144.95	786.27	1360.53
12:32:06	8	208	1	1353.37	769.347	722.695	696.49	684.951	683.669	683.883	1330.16	794.46	723.703	697.848	689.759	684.631	1353.06	785.577	718.773	698.504	687.698	1315.11	775.275	718.529	695.36	1295.44	791.88	725.412	1144.58	786.178	1360.27
12:32:07	8	209	1	1353.53	769.347	722.818	696.535	684.997	683.7	683.959	1330.19	794.628	723.718	697.909	689.805	684.783	1353.34	785.684	718.773	698.703	687.653	1315.2	775.368	718.361	695.498	1295.76	791.987	725.458	1144.77	786.255	1360.35
12:32:07	8	210	1	1353.37	769.362	722.772	696.49	685.043	683.791	683.852	1330.1	794.49	723.718	697.894	689.576	684.768	1353.07	785.669	718.681	698.733	687.637	1315.09	775.29	718.437	695.376	1295.54	791.926	725.366	1144.58	786.133	1360.2
12:32:07	8	211	1	1353.65	769.362	722.818	696.627	684.921	683.639	683.929	1330.07	794.475	723.855	697.802	689.698	684.753	1353.27	785.714	718.544	698.55	687.698	1314.67	775.302	718.376	695.376	1295.53	791.941	725.336	1144.6	786.117	1360.15
12:32:08	8	212	1	1354.12	769.744	723.199	696.795	685.211	684.066	684.219	1330.82	794.796	724.115	698.138	690.049	685.089	1353.69	786.035	718.958	698.932	687.897	1315.61	775.641	718.712	695.696	1296.15	792.231	725.84	1145.15	786.438	1360.78
12:32:08	8	213	1	1354.3	769.759	723.169	696.825	685.424	684.112	684.341	1330.93	794.963	724.161	698.26	690.11	685.089	1353.98	786.126	718.91	699.039	688.065	1315.6	775.824	718.941	695.666	1296.26	792.369	725.946	1145.24	786.575	1360.87
12:32:08	8	214	1	1354.03	769.591	722.97	696.734	685.302	683.974	684.188	1330.58	794.719	723.84	698.184	689.912	684.88	1353.71	786.02	718.803	698.993	687.936	1315.17	775.611	718.636	695.635	1296.05	792.14	725.641	1144.92	786.392	1360.73
12:32:09	8	215	1	1354.03	769.652	723.031	696.795	685.195	683.959	684.173	1330.59	794.857	724.023	698.169	690.049	684.997	1353.66	786.098	718.91	698.703	687.836	1315.34	775.641	718.773	695.559	1296.02	792.17	725.748	1145.33	786.514	1360.78
12:32:09	8	216	1	1353.86	769.499	722.833	696.581	684.982	683.684	684.005	1330.34	794.612	723.81	697.97	689.868	684.753	1353.22	785.836	718.926	698.81	687.79	1315.13	775.458	718.651	695.498	1296.02	792.17	725.626	1144.73	786.316	1360.36
12:32:09	8	217	1	1354.38	769.851	723.321	697.009	685.333	684.112	684.31	1330.75	795.04	724.206	698.321	690.11	685.195	1354.08	786.05	718.987	699.023	687.698	1315.61	775.794	718.956	695.727	1296.4	792.399	725.931	1145.19	786.606	1361.11
12:32:10	8	218	1	1353.75	769.438	723.031	696.658	685.089	683.868	684.051	1330.57	794.658	723.871	697.894	689.698	684.88	1353.33	785.806	718.834	698.703	687.76	1315.16	775.458	718.636	695.345	1295.8	792.033	725.458	1144.81	786.407	1360.32
12:32:10	8	219	1	1354	769.499	722.955	696.658	685.104	683.929	683.99	1330.65	794.902	723.871	698.184	689.835	684.799	1353.62	785.836	718.834	698.901	687.882	1315.23	775.628	718.727	695.574	1296.14	792.201	725.595	1144.9	786.285	1360.79
12:32:10	8	220	1	1353.57	769.225	722.772	696.474	684.814	683.7	683.868	1330.01	794.506	723.703	697.94	689.759	684.646	1353.07	785.592	718.59	698.642	687.515	1314.7	775.26	718.498	695.299	1295.59	791.88	725.427	1144.63	786.194	1360.17

APPENDIX E

MEASUREMENT DATA FOR ECT M3000 SENSOR (AIR AND WATER)

Voltage file 1 plane(s) 108 frame for test5-ectp1-5e

Wallclock	DAS Time	Frame	Plane	28 Voltage Data																											
12:43:14	8	Reference	1	1423.83	728.953	669.918	654.777	661.313	660.168	660.519	1393.19	731.334	670.162	669.325	656.349	654.823	1415.4	723.596	670.833	661.447	657.83	1376.88	716.162	670.788	660.531	1356.91	734.051	676.449	1202.5	709.707	1419.96
12:42:41	8	1	1	1423.83	728.953	669.918	654.777	661.313	660.168	660.519	1393.19	731.334	670.162	669.325	656.349	654.823	1415.4	723.596	670.833	661.447	657.83	1376.88	716.162	670.788	660.531	1356.91	734.051	676.449	1202.5	709.707	1419.96
12:42:41	8	2	1	1106.53	775.214	762.866	754.716	745.437	752.518	753.861	1075.37	780.037	764.209	752.32	758.12	758.059	1100.52	775.865	759.112	762.943	761.523	1061.69	768.758	768.712	765.156	1059.34	793.605	779.747	930.22	767.979	1097.71
12:42:41	8	3	1	1105.8	774.847	762.47	754.319	744.887	752.106	753.556	1074.79	779.869	763.813	751.938	757.524	757.57	1100.18	775.26	758.761	762.607	761.065	1061.36	768.437	768.3	764.698	1058.61	793.224	779.136	929.701	767.399	1096.95
12:42:41	8	4	1	1106.11	775.183	762.729	754.579	745.253	752.228	753.739	1075.46	780.037	763.919	752.259	757.738	757.647	1100.4	775.595	758.913	762.805	761.325	1061.69	768.773	768.636	765.064	1058.64	793.315	779.182	930.037	767.644	1097.22
12:42:42	8	5	1	1105.92	775.092	762.561	754.503	745.055	752.259	753.633	1075.06	779.884	763.904	752.106	757.799	757.708	1100.49	775.534	758.913	762.546	761.218	1061.54	768.59	768.498	765.034	1058.73	793.33	779.243	929.946	767.567	1097.28
12:42:42	8	6	1	1106.2	775.26	762.943	754.548	745.345	752.35	753.755	1075.18	780.128	764.011	752.167	757.967	757.799	1100.67	775.624	758.959	762.836	761.447	1061.45	768.712	768.681	765.079	1058.79	793.452	779.487	930.098	767.537	1097.44
12:42:42	8	7	1	1105.8	774.893	762.424	754.38	744.918	752.045	753.358	1074.69	779.716	763.629	752.045	757.631	757.708	1100.09	775.321	758.745	762.515	761.004	1061.2	768.544	768.452	764.744	1058.3	793.315	779.014	929.701	767.476	1097.04
12:42:42	8	8	1	1106.59	775.366	763.08	754.823	745.452	752.534	753.877	1075.55	780.464	764.103	752.427	758.211	758.059	1100.98	775.685	759.264	763.05	761.6	1061.81	769.002	768.926	765.308	1059.07	793.758	779.655	930.342	768.056	1097.59
12:42:43	8	9	1	1105.71	774.71	762.561	754.213	744.887	751.893	753.268	1074.76	779.686	763.691	751.923	757.647	757.524	1099.97	775.366	758.606	762.515	761.004	1061.23	768.437	768.285	764.698	1058.33	793.04	779.121	929.61	767.476	1096.86
12:42:43	8	10	1	1105.96	774.924	762.576	754.151	745.147	752.335	753.449	1074.76	779.899	763.858	751.954	757.647	757.753	1100.09	775.397	758.868	762.714	761.081	1061.02	768.559	768.605	764.835	1058.46	793.315	779.319	929.762	767.476	1097.04
12:42:43	8	11	1	1105.96	774.909	762.546	754.441	745.07	752.274	753.587	1074.79	779.899	763.691	752.106	757.631	757.753	1100.24	775.412	758.623	762.607	761.142	1061.36	768.498	768.376	764.805	1058.36	793.285	779.304	929.671	767.476	1096.86
12:42:44	8	12	1	1106.17	775.031	762.546	754.503	745.223	752.259	753.51	1075.06	779.976	763.782	752.183	757.906	757.967	1100.27	775.611	758.959	762.882	761.218	1061.39	768.727	768.422	764.789	1058.7	793.361	779.396	929.884	767.628	1097.16
12:42:44	8	13	1	1105.8	775.046	762.897	754.487	745.055	752.32	753.846	1075.12	779.854	764.057	752.198	757.921	757.769	1100.61	775.687	758.852	762.714	761.294	1061.48	768.681	768.559	764.957	1058.76	793.269	779.426	930.098	767.613	1097.22
12:42:44	8	14	1	1106.32	775.214	762.744	754.579	745.208	752.228	753.724	1075.21	779.915	764.011	752.183	757.845	757.799	1100.52	775.565	759.02	762.805	761.371	1061.51	768.62	768.513	764.957	1058.58	793.422	779.518	929.884	767.689	1097.44
12:42:45	8	15	1	1105.96	774.68	762.485	754.441	744.872	751.938	753.159	1074.82	779.747	763.568	752.06	757.692	757.555	1099.94	775.412	758.684	762.485	761.004	1061.11	768.575	768.285	764.637	1058.46	793.086	778.999	929.732	767.582	1097.13
12:42:45	8	16	1	1105.74	774.817	762.21	754.106	744.933	752.06	753.282	1074.48	779.731	763.584	751.832	757.479	757.631	1100.06	775.153	758.562	762.653	761.142	1061.08	768.346	768.407	764.667	1058.06	793.117	779.09	929.518	767.17	1096.73
12:42:46	8	17	1	1105.8	774.878	762.653	754.319	744.887	752.122	753.496	1074.94	779.731	763.813	752.122	757.662	757.54	1100.21	775.473	758.669	762.637	761.096	1061.17	768.575	768.239	764.774	1058.49	793.269	779.182	929.854	767.521	1097.04
12:42:46	8	18	1	1106.75	775.473	762.958	754.747	745.421	752.564	754.045	1075.31	780.296	764.209	752.412	758.211	758.15	1100.76	775.687	759.112	763.294	761.508	1061.91	769.017	768.956	765.339	1058.85	793.697	779.93	930.312	768.056	1097.65
12:42:46	8	19	1	1106.14	775.061	762.653	754.548	745.024	752.289	753.846	1074.91	779.93	764.118	752.183	757.692	757.906	1100.76	775.534	758.837	762.637	761.325	1061.39	768.559	768.59	765.079	1058.61	793.376	779.472	930.068	767.659	1097.1
12:42:46	8	20	1	1106.5	775.198	762.973	754.731	745.238	752.412	753.846	1075.12	780.266	764.087	752.228	757.952	757.982	1100.58	775.656	759.158	762.897	761.325	1061.63	768.773	768.712	765.125	1058.73	793.605	779.472	930.129	767.735	1097.53
12:42:47	8	21	1	1106.62	775.504	763.004	754.854	745.406	752.763	753.923	1075.52	780.266	764.179	752.564	758.257	758.166	1100.96	775.962	759.173	763.172	761.6	1062.09	768.971	768.971	765.278	1059.22	793.804	779.808	930.312	768.147	1097.83
12:42:47	8	22	1	1106.01	774.802	762.454	754.487	745.024	752.122	753.465	1075.15	780.037	763.645	751.923	757.876	757.723	1100.18	775.244	758.913	762.729	761.004	1061.39	768.788	768.407	764.82	1058.7	793.361	779.243	929.732	767.72	1097.34
12:42:47	8	23	1	1106.53	775.382	762.912	754.625	745.487	752.518	753.953	1075.27	780.25	764.271	752.534	758.089	758.013	1101.04	775.87	759.173	762.988	761.523	1061.84	768.91	768.803	765.171	1059.01	793.666	779.564	930.098	767.689	1097.5
12:42:48	8	24	1	1106.72	775.351	763.126	754.762	745.528	752.625	754.045	1075.52	780.388	764.24	752.518	758.135	758.135	1101.07	775.809	759.219	763.233	761.763	1062.03	769.017	768.956	765.339	1059.25	793.681	779.716	930.403	767.964	1097.83
12:42:48	8	25	1	1106.35	775.306	762.775	754.67	745.406	752.381	753.877	1075.27	780.128	764.011	752.366	758.013	757.952	1100.82	775.733	759.127	762.958	761.447	1061.45	769.032	768.651	765.079	1059.04	793.529	779.472	929.946	767.766	1097.41
12:42:48	8	26	1	1106.78	775.382	763.004	754.792	745.36	752.534	753.907	1075.55	780.235	764.209	752.61	758.135	758.166	1100.82	775.946	759.356	763.05	761.676	1062.06	768.956	768.773	765.537	1059.19	793.62	779.793	930.556	768.025	1097.66
12:42:49	8	27	1	1106.41	775.183	762.897	754.777	745.36	752.473	753.907	1075.64	780.281	764.118	752.412	758.135	758.135	1100.82	775.84	759.142	763.156	761.6	1061.97	768.91	768.865	765.263	1059.1	793.804	779.564	930.281	767.995	1097.41
12:42:49	8	28	1	1106.23	775.076	762.668	754.64	745.238	752.366	753.724	1075.18	780.144	763.858	752.015	758.013	757.86	1100.67	775.58	758.99	762.775	761.264	1061.69	768.742	768.59	764.896	1058.76	793.452	779.319	930.007	767.75	1097.31
12:42:49	8	29	1	1105.53	774.786	762.363	754.197	744.826	751.908	753.388	1074.48	779.533	763.721	751.908	757.448	757.357	1100.21	775.26	758.486	762.485	761.065	1060.87	768.346	768.315	764.82	1058.15	792.949	779.029	929.549	767.231	1096.76
12:42:49	8	30	1	1105.86	775.092	762.378	754.396	745.086	752.091	753.465	1075	779.869	763.736	751.938	757.738	757.616	1100.21	775.412	758.898	762.607	761.004	1061.17	768.514	768.285	764.912	1058.36	793.101	779.289	929.762	767.446	1096.96
12:42:50	8	31	1	1106.59	775.198	762.958	754.609	745.314	752.503	753.831	1075.52	780.144	764.103	752.427	758.15	757.921	1100.76	775.626	759.005	763.004	761.569	1061.78	768.91	768.605	765.217	1058.88	793.544	779.609	930.098	767.934	1097.66
12:42:50	8	32	1	1106.41	775.137	762.668	754.487	745.024	752.457	753.755	1075.21	780.006	763.935	752.259	757.937	757.784	1100.46	775.611	758.913	762.927	761.34	1061.51	768.651	768.529	765.049	1058.64	793.544	779.441	929.762	767.521	1097.13
12:42:51	8	33	1	1106.07	775.092	762.622	754.579	745.162	752.244	753.663	1075.06	780.067	764.026	752.152	757.876	757.799	1100.46	775.641	759.036	762.668	761.233	1061.69	768.575	768.559	764.973	1058.79	793.346	779.503	929.854	767.705	1097.5
12:42:51	8	34	1	1106.2	775.015	762.714	754.518	745.238	752.274	753.755	1075.21	779.976	764.042	752.213	757.998	757.906	1100.34	775.58	758.959	762.866	761.279	1061.57	768.834	768.544	765.11	1058.55	793.483	779.503	929.854	767.827	1097.28
12:42:51	8	35	1	1106.01	775.107	762.622	754.701	745.116	752.167	753.617	1074.91	780.021	763.965	752.244	757.876	757.799	1100.31	775.58	758.683	762.622	761.31	1061.42	768.666	768.407	764.966	1058.88	793.498	779.396	930.007	767.644	1097.47
12:42:52	8	36	1	1106.01	775.306	762.927	754.487	745.147	752.289	753.831	1074.97	779.808	763.981	752.198	757.952	757.753	1100.37	775.702	758.776	762.851	761.279	1061.57	768.62	768.407	765.095	1058.79	793.3	779.38	930.129	767.766	1097.04
12:42:52	8	37	1	1106.56	775.412	762.973	754.762	745.345	752.549	754.029	1075.49	780.266	764.271	752.335	757.982	758.059	1100.82	775.763	759.066	762.988	761.676	1061.91	768.865	768.666	765.278	1059.16	793.804	779.564	930.037	767.903	1097.62
12:42:52	8	38	1	1106.56	775.519	762.912	754.93	745.513	752.625	754.106	1075.61	780.357	764.271	752.564	758.227	758.013	1100.92	775.931	759.142	763.202	761.722	1061.87	768.895	768.773	765.537	1059.13	793.819	779.747	930.251	768.193	1097.65
12:42:52	8	39	1	1106.78	775.443	763.034	754.946	745.528	752.64	753.923	1075.58	780.388	764.316	752.656	758.15	757.998	1100.85	776.007	759.356	763.019	761.661	1062.06	769.093	769.078	765.263	1059.19	793.773	779.731	930.373	767.934	1097.92
12:42:53	8	40	1	1106.41	775.275	762.927	754.777	745.36	752.625	753.831	1075.34	780.144	764.148	752.396	758.12	758.211	1100.82	775.672	759.203	763.111	761.523	1061.78	769.002	768.895	765.186	1059.19	793.865	779.793	930.22	767.964	1097.83
12:42:53	8	41	1	1106.5	775.412	762.958	754.655	745.498	752.534	753.938	1075.43	780.357	764.316	752.473	758.043	758.013	1100.85	775.946	759.112	763.111	761.554	1061.72	768.926	768.956	765.247	1059.01	793.636	779.854	930.251	767.995	1097.62
12:42:53	8	42	1	1106.72	775.275	762.988	754.686	745.36	752.64	753.907	1075.31	780.235	764.194	752.534	757.982	757.937	1100.95	775.778	759.081	762.988	761.63	1061.84	768.91	768.849	765.293	1059.16	793.559	779.731	930.403	767.857	1097.56
12:42:54	8	43	1	1106.29	775.107	762.698	754.762	745.314	752.32	753.617	1075.27	780.067	763.95	752.259	757.86	757.876	1100.4	775.778	759.127	762.882	761.355	1061.69	768.895	768.62	764.966	1058.94	793.59	779.472	930.068	767.857	1097.47
12:42:54	8	44	1	1106.81	775.641	763.248	755.021	745.757	752.732	754.38	1075.7	780.434	764.499	752.656	758.15	758.181	1101.19	776.297	759.448	763.156	761.844	1062.36	769.124	769.124	765.43	1059.46	793.941	779.976	930.678	768.224	1097.86
12:42:54	8	45	1	1106.26	775.214	762.927	754.564	745.147	752.503	753.816	1075.34	779.946	764.118	752.289	757.967	757.906	1100.58	775.748	759.005	762.775	761.6	1061.6	768.697	768.62	765.079	1058.91	793.575	779.518	930.098	767.75	1097.5
12:42:54	8	46	1	1106.62	775.382	762.927	754.777	745.376	752.595	753.846	1075.46	780.235	764.164	752.427	758.135	758.104	1100.92	775.794	759.325	763.172	761.569	1061.94	768.88	768.971	765.217	1059.01	793.788	779.777	930.342	767.964	1097.8
12:42:55	8	47	1	1106.14	775.061	762.607	754.38	745.314	752.259	753.663	1075	780.067	764.026	752.167	757.937	757.83	1100.46	775.626	758.929	762.79	761.187	1061.39	768.803	768.697	765.034	1058.76	793.361	779.426	929.793	767.659	1097.34
12:42:55	8	48	1	1105.8	775	762.821	754.533	745.055	752.32	753.617	1074.97	779.899	764.057	752.183	757.891	757.799	1100.21	775.672	758.868	762.744	761.249	1061.33	768.62	768.666	765.049	1058.91	793.3	779.396	929.946	767.628	1097.44
12:42:55	8	49	1	1106.17	774.964	762.683	754.701	745.314	752.457	753.678	1075.21	780.037	763.935	752.32	757.998	757.906	1100.49	775.595	758.929	762.698	761.401	1061.69	768.636	768.529	765.049	1058.85	793.529	779.503	930.037	767.796	1097.31
12:42:56	8	50	1	1106.38	775.168	762.836	754.823	745.376	752.579	753.861	1075.46	780.25	764.118	752.381	758.013	757.921	1100.85	775.748	759.036	762.836	761.447	1061.84	768.865	768.59	765.217	1059.13	793.529	779.503	930.342	767.857	1097.53
12:42:56	8	51	1	1106.84	775.488	762.927	754.93	745.421	752.702	754.075	1075.76	780.357	764.316	752.625	758.242	758.196	1101.07	775.855	759.219	763.202	761.691	1062.06	769.093	768.895	765.308	1059.25	793.865	779.777	930.434	768.056	1098.05
12:42:56	8	52	1	1106.17	774.97	762.683	754.487	745.009	752.289	753.633	1075.03	779.899	763.904	752.122	757.845	757.753	1100.46	775.458	758.929	762.805	761.249	1061.54	768.758	768.483	765.034	1058.79	793.59	779.579	930.007	767.705	1097.31

12:42:57	8	53	1	1106.26	775.321	762.653	754.777	746.314	752.457	753.999	1075.21	780.063	764.057	752.366	757.891	758.104	1100.67	775.67	759.02	762.973	761.493	1061.81	769.002	768.559	765.14	1059.04	793.544	779.67	930.22	767.964	1097.53
12:42:57	8	54	1	1106.32	775.306	763.05	754.854	746.391	752.488	753.923	1075.56	780.021	764.133	752.442	758.059	758.059	1100.76	775.977	759.051	762.958	761.447	1061.94	768.865	768.666	765.202	1059.22	793.636	779.64	930.159	768.066	1097.74
12:42:57	8	55	1	1106.66	775.672	763.004	754.792	746.711	752.763	754.046	1075.67	780.403	764.454	752.503	758.104	758.303	1100.98	776.007	759.28	763.339	761.661	1061.81	769.17	769.093	765.476	1059.25	793.727	779.96	930.373	768.066	1098.05
12:42:58	8	56	1	1106.72	775.519	763.004	754.777	746.437	752.81	754.046	1075.56	780.388	764.133	752.518	758.166	758.272	1100.64	775.977	759.158	762.958	761.462	1061.76	769.017	768.788	765.247	1059.13	793.819	779.716	930.434	767.979	1097.59
12:42:58	8	57	1	1106.14	775.061	762.729	754.625	746.162	752.213	753.755	1075.15	780.037	763.935	752.213	757.86	757.799	1100.52	775.702	758.883	762.851	761.187	1061.45	768.819	768.361	764.896	1058.7	793.452	779.365	930.068	767.537	1097.25
12:42:58	8	58	1	1106.04	775.122	762.714	754.518	744.918	752.274	753.571	1075.31	779.93	764.072	752.122	757.708	757.708	1100.49	775.596	758.913	762.637	761.371	1061.57	768.636	768.59	764.988	1058.73	793.463	779.335	930.068	767.781	1097.31
12:42:59	8	59	1	1105.49	774.603	762.149	754.121	744.673	751.816	753.266	1074.3	779.426	763.386	751.74	757.463	757.234	1099.94	775.153	758.364	762.347	760.928	1060.93	768.208	768.071	764.652	1058.15	792.934	778.999	929.488	767.14	1096.84
12:42:59	8	60	1	1105.92	774.863	762.637	754.467	744.933	752.106	753.587	1075.03	779.869	763.691	752.046	757.677	757.692	1100.34	775.397	758.868	762.5	761.111	1061.33	768.483	768.315	764.881	1058.64	793.101	779.228	929.823	767.582	1097.16
12:42:59	8	61	1	1105.74	774.832	762.286	754.213	746.009	751.908	753.358	1074.57	779.64	763.584	751.694	757.372	757.402	1099.85	775.168	758.578	762.47	760.974	1061.08	768.239	768.224	764.652	1058.27	793.117	779.029	929.488	767.231	1096.92
12:43:00	8	62	1	1105.83	774.954	762.622	754.35	744.933	752.091	753.449	1074.85	779.899	763.858	752.03	757.524	757.708	1100.06	775.412	758.715	762.775	761.233	1061.26	768.529	768.422	764.667	1058.46	793.162	779.213	929.671	767.46	1096.95
12:43:00	8	63	1	1105.92	774.954	762.515	754.35	746.009	752.106	753.465	1074.76	779.838	763.797	751.984	757.662	757.601	1100.15	775.382	758.699	762.683	761.126	1061.26	768.559	768.346	764.85	1058.52	793.208	779.396	929.762	767.537	1097.16
12:43:00	8	64	1	1106.23	774.847	762.607	754.38	746.162	752.106	753.404	1075.09	779.808	763.797	752.167	757.845	757.784	1100.18	775.519	758.913	762.637	761.126	1061.33	768.681	768.462	764.744	1058.79	793.452	779.258	929.884	767.476	1097.44
12:43:00	8	65	1	1105.59	774.771	762.256	754.304	746.04	752.015	753.358	1074.76	779.762	763.675	751.908	757.555	757.723	1099.94	775.244	758.501	762.378	761.004	1060.81	768.315	768.3	764.667	1058.39	793.132	779.213	929.549	767.338	1096.76
12:43:01	8	66	1	1105.43	774.634	762.347	754.121	744.658	751.908	753.465	1074.46	779.701	763.386	751.847	757.357	757.433	1099.73	775.168	758.425	762.363	760.913	1060.87	768.224	768.193	764.454	1058.24	793.132	778.831	929.488	767.399	1096.83
12:43:01	8	67	1	1106.23	774.939	762.607	754.467	744.933	752.122	753.617	1075.03	779.899	763.889	752.152	757.799	757.769	1100.12	775.473	758.639	762.653	761.187	1061.42	768.697	768.462	764.85	1058.55	793.33	779.365	929.915	767.582	1097.1
12:43:01	8	68	1	1106.01	775.153	762.912	754.518	746.238	752.244	753.677	1074.82	780.098	763.919	752.183	757.784	757.876	1100.37	775.473	758.822	762.897	761.249	1061.63	768.712	768.575	765.064	1058.73	793.575	779.472	929.976	767.736	1097.44
12:43:02	8	69	1	1106.23	775	762.515	754.467	746.055	752.274	753.556	1074.82	779.854	763.706	752.091	757.647	757.555	1100.37	775.336	758.791	762.622	761.126	1061.51	768.605	768.559	764.85	1058.73	793.254	779.197	929.946	767.552	1097.22
12:43:02	8	70	1	1106.32	775.198	762.76	754.762	746.284	752.396	753.8	1075.27	780.128	764.042	752.305	757.982	757.891	1100.82	775.763	758.99	762.943	761.523	1061.81	768.681	768.712	765.156	1058.94	793.544	779.579	930.129	767.872	1097.56
12:43:02	8	71	1	1105.77	774.71	762.332	754.075	744.76	751.801	753.51	1074.51	779.777	763.629	751.969	757.57	757.509	1099.82	775.29	758.379	762.531	760.989	1061.08	768.376	768.269	764.637	1058.18	793.147	778.999	929.579	767.476	1096.89
12:43:03	8	72	1	1106.01	774.985	762.622	754.441	746.07	752.122	753.617	1074.94	779.899	763.752	752.046	757.784	757.631	1100.24	775.427	758.639	762.729	761.05	1061.05	768.636	768.422	764.774	1058.55	793.269	779.228	929.793	767.369	1097.01
12:43:03	8	73	1	1105.89	775.092	762.698	754.467	746.086	752.289	753.556	1075.12	779.96	763.95	752.274	757.83	758.043	1100.67	775.565	759.005	762.805	761.233	1061.57	768.575	768.727	764.912	1058.79	793.62	779.564	930.129	767.766	1097.56
12:43:03	8	74	1	1106.11	774.97	762.698	754.472	746.177	752.122	753.709	1075.03	780.006	763.965	751.984	757.692	757.708	1100.43	775.397	758.852	762.683	761.355	1061.36	768.559	768.437	764.896	1058.61	793.254	779.335	929.823	767.582	1097.31
12:43:04	8	75	1	1106.04	775.061	762.622	754.518	746.086	752.183	753.694	1075.15	780.037	763.95	752.152	757.799	757.814	1100.61	775.687	758.974	762.805	761.401	1061.48	768.803	768.498	765.018	1058.76	793.422	779.441	929.915	767.689	1097.41
12:43:04	8	76	1	1106.44	775.351	762.851	754.823	746.376	752.412	753.861	1075.09	780.327	764.026	752.427	758.104	757.921	1100.95	775.778	759.142	763.05	761.569	1061.84	768.849	768.895	765.324	1058.79	793.666	779.546	930.22	767.872	1097.47
12:43:04	8	77	1	1105.71	775.061	762.622	754.35	746.024	752.213	753.465	1074.79	779.869	763.767	751.999	757.54	757.662	1100.31	775.321	758.578	762.578	761.065	1061.05	768.437	768.422	764.896	1058.46	793.315	779.335	929.793	767.552	1097.13
12:43:05	8	78	1	1105.8	774.985	762.714	754.289	744.979	752.228	753.663	1074.85	779.915	763.889	752.183	757.736	757.586	1100.46	775.488	758.883	762.653	761.142	1061.48	768.529	768.407	764.82	1058.58	793.391	779.197	929.823	767.567	1096.95
12:43:05	8	79	1	1106.07	774.939	762.668	754.467	746.086	752.122	753.556	1075.12	779.023	763.767	752.106	757.891	757.586	1100.58	775.488	758.837	762.882	761.218	1061.45	768.636	768.529	764.85	1058.64	793.468	779.472	930.007	767.537	1097.07
12:43:05	8	80	1	1106.01	774.985	762.714	754.579	746.177	752.228	753.663	1075.03	780.037	763.858	752.167	757.906	757.753	1100.34	775.641	758.852	762.698	761.218	1061.45	768.773	768.636	764.957	1058.67	793.422	779.35	929.793	767.75	1097.22
12:43:06	8	81	1	1106.07	775.29	762.836	754.606	746.253	752.427	753.816	1075.43	780.098	763.996	752.396	758.043	757.982	1100.64	775.778	759.097	762.927	761.462	1061.81	768.834	768.758	765.14	1058.85	793.681	779.518	930.068	767.918	1097.47
12:43:06	8	82	1	1106.29	775.412	762.744	754.625	746.238	752.289	753.663	1075.03	780.052	763.981	752.289	757.876	757.891	1100.52	775.626	758.837	762.821	761.416	1061.45	768.742	768.544	765.034	1058.85	793.544	779.503	929.915	767.872	1097.38
12:43:06	8	83	1	1105.8	775.107	762.775	754.35	746.07	752.137	753.663	1075.06	779.869	763.919	752.167	757.799	757.692	1100.4	775.58	758.852	762.683	761.279	1061.29	768.575	768.437	765.049	1058.73	793.3	779.38	930.037	767.796	1097.28
12:43:06	8	84	1	1105.86	775	762.531	754.335	744.933	752.137	753.617	1074.76	779.793	763.797	752.015	757.631	757.647	1100.18	775.321	758.669	762.622	761.233	1061.2	768.407	768.437	764.85	1058.64	793.239	779.228	929.823	767.491	1096.98
12:43:07	8	85	1	1105.62	774.832	762.332	754.258	744.948	751.969	753.373	1074.63	779.594	763.553	751.908	757.555	757.387	1100.03	775.26	758.471	762.424	761.004	1061.11	768.269	768.224	764.667	1058.3	793.239	779.045	929.549	767.445	1096.73
12:43:07	8	86	1	1105.89	774.832	762.454	754.35	746.147	752.183	753.48	1075.12	779.808	763.889	752.106	757.738	757.601	1100.15	775.519	758.715	762.714	761.203	1061.26	768.544	768.33	764.912	1058.58	793.437	779.335	929.762	767.598	1097.13
12:43:07	8	87	1	1106.62	775.488	763.095	754.915	746.528	752.81	754.075	1075.56	780.281	764.347	752.564	758.288	758.135	1100.89	775.931	759.203	763.08	761.569	1061.91	769.109	768.895	765.476	1059.19	793.849	779.701	930.251	768.071	1097.86
12:43:08	8	88	1	1106.01	774.985	762.668	754.441	746.162	752.183	753.677	1074.94	779.976	763.919	752.198	757.845	757.616	1100.4	775.596	758.807	762.683	761.294	1061.39	768.666	768.437	764.85	1058.73	793.33	779.35	929.823	767.735	1097.25
12:43:08	8	89	1	1106.59	775.427	762.836	754.777	746.376	752.518	753.892	1075.64	780.372	764.24	752.549	758.135	758.166	1100.89	775.855	759.325	763.019	761.554	1062	769.017	768.712	765.186	1059.22	793.681	779.655	930.464	767.888	1097.96
12:43:08	8	90	1	1105.89	774.97	762.622	754.533	746.116	752.305	753.648	1075.09	780.052	763.965	752.183	757.86	757.876	1100.61	775.656	758.776	762.851	761.355	1061.45	768.529	768.498	764.973	1058.61	793.452	779.335	929.946	767.674	1097.16
12:43:09	8	91	1	1106.47	775.306	762.866	754.836	746.513	752.595	753.953	1075.52	780.205	764.164	752.442	758.257	758.028	1100.73	775.672	759.142	763.126	761.539	1061.75	768.865	768.712	765.247	1059.13	793.758	779.67	930.434	767.888	1097.77
12:43:09	8	92	1	1106.35	775.122	762.668	754.564	746.223	752.35	753.739	1075.15	779.991	763.858	752.366	757.876	757.846	1100.61	775.626	758.929	762.927	761.371	1061.63	768.758	768.62	765.064	1058.67	793.468	779.67	930.129	767.903	1097.41
12:43:09	8	93	1	1106.78	775.473	763.156	754.884	746.666	752.732	754.182	1075.7	780.418	764.347	752.686	758.089	758.318	1101.28	775.992	759.341	763.172	761.92	1062.12	768.971	769.002	765.446	1059.37	793.834	779.838	930.556	768.056	1097.92
12:43:10	8	94	1	1106.29	775.183	762.76	754.64	746.192	752.457	753.892	1075.21	780.144	764.103	752.244	758.013	757.891	1100.76	775.748	759.036	763.019	761.386	1061.72	768.849	768.758	765.14	1058.94	793.62	779.546	930.068	767.857	1097.56
12:43:10	8	95	1	1106.75	775.443	763.034	754.869	746.574	752.656	753.953	1075.49	780.403	764.225	752.61	758.181	758.272	1100.85	775.992	759.127	763.126	761.783	1062.06	769.002	768.958	765.43	1059.4	793.758	779.808	930.342	767.979	1097.89
12:43:10	8	96	1	1106.35	775.412	762.912	754.579	746.391	752.488	753.77	1075.4	780.174	764.103	752.412	757.982	757.982	1100.7	775.763	759.142	762.882	761.416	1061.84	768.88	768.803	765.049	1059.04	793.666	779.472	930.281	767.842	1097.53
12:43:10	8	97	1	1105.74	774.924	762.439	754.258	744.994	752.167	753.434	1074.79	779.793	763.813	751.923	757.494	757.601	1100.31	775.382	758.623	762.546	761.126	1061.29	768.407	768.33	764.698	1058.27	793.269	778.984	929.915	767.567	1097.01
12:43:11	8	98	1	1105.62	774.893	762.546	754.304	744.979	751.984	753.602	1074.85	779.915	763.843	752.03	757.692	757.494	1100.24	775.534	758.73	762.653	761.081	1061.14	768.422	768.407	764.927	1058.27	793.254	779.197	929.793	767.521	1097.01
12:43:11	8	99	1	1106.14	775.107	762.653	754.467	746.116	752.32	753.678	1075.15	779.946	763.965	752.35	757.83	757.83	1100.49	775.672	759.112	762.851	761.325	1061.51	768.681	768.666	764.973	1058.76	793.483	779.564	930.19	767.674	1097.31
12:43:11	8	100	1	1106.62	775.321	762.912	754.792	746.498	752.534	753.999	1075.46	780.159	764.209	752.488	758.089	758.166	1100.79	775.931	759.158	762.958	761.584	1061.69	768.91	768.788	765.293	1059.07	793.697	779.67	930.556	767.918	1097.77
12:43:12	8	101	1	1105.96	775.046	762.714	754.609	746.147	752.137	753.602	1075.06	779.991	763.889	752.106	757.814	757.769	1100.34	775.565	758.883	762.775	761.279	1061.54	768.559	768.529	764.912	1058.79	793.452	779.426	929.915	767.598	1097.19
12:43:12	8	102	1	1106.29	775.275	762.79	754.64	746.253	752.442	753.816	1075.31	780.174	763.996	752.366	757.891	757.982	1100.67	775.702	758.944	762.866	761.386	1061.75	768.896	768.788	765.171	1058.88	793.559	779.426	930.251	767.918	1097.34
12:43:12	8	103	1	1106.01	775.107	762.668	754.518	746.162	752.259	753.785	1074.91	779.976	763.965	752.152	757.738	757.647	1100.58	775.565	758.868	762.775	761.294	1061.39	768.681	768.559	765.11	1058.55	793.376	779.289	929.823	767.689	1097.16
12:43:12	8	104	1	1106.17	775.168	762.744	754.457	746.253	752.427	753.571	1075.21	780.006	763.935	752.198	757.814	757.845	1100.58	775.641	758.959	762.79	761.432	1061.51	768.605	768.544	764.927	1058.82	793.346	779.594	930.037	767.75	1097.38
12:43:13	8	105	1	1105.96	775.183	762.561	754.503	746.192	752.228	753.663	1075.03	780.037	763.935	752.152	757.891	757.814	1100.37	775.611	758.944	762.897	761.218	1061.29	768.681	768.513	764.881	1058.7	793.575	779.38	929.884	767.705	1097.25
12:43:13	8	106	1	1106.11	775.107	762.805	754.609	746.208	752.35	753.77	1075.18	780.063	763.965	752.289	757.891	757.799	1100.37	775.84	759.02	762.805	761.462	1061.45	768.62	768.605	765.11	1058.91	793.468	779.457	930.037	767.827	1097.38
12:43:13	8	107	1	1106.36	775.183	762.836	754.716	746.36	752.503	753.831	1075.43	780.281	764.103	752.32	758.013	758.013	1100.7	775.809	759.051	763.004	761.508	1061.72	768.926	768.727	765.306	1058.91	793.575	779.67	930.159	767.857	1097.44
12:43:14	8	108	1	1106.59	775.427	762.943	754.976	746.467	752.686	753.984	1075.64	780.327	764.24	752.488	758.196	758.15	1100.79	776.084	759.341	763.065	761.584	1061.94	769.078	768.819	765.171	1059.31	793.712	779.747	930.251	768.071	1097.83

APPENDIX F

MEASUREMENT DATA FOR ERT M3000 SENSOR (WATER)

Voltage Me 1 plane(s) 68 frames for test4

Wallclock T	DAS Time	Frame	Plane	20 Voltage Data																			
13:44:28	8	Reference	1	0.097179	0.062829	0.208326	0.094165	0.069276	0.08051	0.128174	0.040779	0.151848	0.149856	0.211864	0.131703	0.194846	0.021246	0.064349	0.140876	0.011444	0.038036	0.056522	0.083184
13:43:30	8	1	1	0.14624	0.104954	0.133109	0.088906	0.156478	0.048694	0.106002	0.13338	0.107138	0.086224	0.238509	0.110055	0.454199	0.095659	0.088181	0.30816	0.095816	0.287325	0.044518	0.104185
13:44:12	8	2	1	0.009915	0.090758	0.186093	0.08708	0.179174	0.057395	0.231616	0.118232	0.244624	0.061682	0.321028	0.095966	0.287517	11.7209	0.090251	0.273959	0.077453	0.281105	0.131738	0.142326
13:44:12	8	3	1	0.16745	0.142518	0.366787	0.086433	0.104919	0.072124	0.235198	0.005425	0.253587	0.05004	0.367591	0.106517	0.126479	0.100481	0.126837	0.249621	0.092129	0.303032	0.100289	0.031939
13:44:13	8	4	1	0.196602	0.042334	0.28798	0.025299	0.251892	0.103923	0.193597	0.124452	0.394899	0.155639	0.319945	0.093387	0.333521	0.130725	0.069765	0.268123	0.13359	0.191474	0.137224	0.118861
13:44:13	8	5	1	0.164891	0.118206	0.153307	0.079637	0.160042	0.099205	0.317158	0.141321	0.215026	0.079357	0.5204	0.013619	0.215708	0.065852	0.075575	0.215516	0.150887	0.151761	0.025649	0.064139
13:44:13	8	6	1	0.148747	0.03117	0.296017	0.077802	0.341051	0.082258	0.284547	0.064768	0.305461	0.557248	0.24824	0.119682	0.234315	0.149961	0.0953	0.194549	0.202307	0.402168	0.185254	0.117498
13:44:13	8	7	1	0.034568	0.073906	0.198585	0	0.159955	0.09088	0.229266	0.102376	0.338884	0.127021	0.13518	0.078073	0.271426	0.028235	0.020477	0.220076	0.087412	0.191614	0.046266	0.043068
13:44:14	8	8	1	0.10221	0.043916	0.244283	0.109173	0.11479	0.117725	0.211462	0.085429	0.195825	0.553055	0.219517	0.062916	0.203495	0.079654	0.086748	0.1396	0.088111	0.254653	0.014205	0
13:44:14	8	9	1	0.13027	0.055063	0.269128	0.095449	0.293335	0.147795	0.212161	0.053211	0.328751	0.117516	0.193221	0.049638	0.283289	0.175348	0.080895	0.247664	0.06089	0.337557	0.140055	0.171521
13:44:14	8	10	1	0.133852	0.049192	0.303172	0.03863	0.284949	0.076806	0.243383	0	0.278397	0.468858	0.464001	0.135442	0.169198	0.144527	0.032489	0.261868	0.182267	0.188085	0.258147	0.11811
13:44:14	8	11	1	0.172701	0.095178	0.467827	0.13566	0.098402	0.108203	0.431381	0.005303	0.190636	0.318355	0.343742	0.124408	0.154801	0.124854	0.03476	0.257081	0.134865	0.318268	0.090137	0.041653
13:44:15	8	12	1	0.158086	0.100227	0.337766	0.238054	0.163956	0.076806	0.252014	0.115673	0.143077	0.111907	0.430507	0.081594	0.274081	0.132856	0.118713	0.170962	0.052258	0.290505	0.020215	0.077173
13:44:15	8	13	1	0.100358	0.072351	0.119866	0.092715	0.088879	0.1508	0.221639	0.134822	0.308518	0	0.229126	0.09841	0.141243	0.116537	0.076308	0.131266	0.048764	0.263843	0.083341	0.064891
13:44:15	8	14	1	0.013156	0.058409	0.211357	0.150581	0.248537	0.136071	0.271906	0.194095	0.390898	0.219097	0.213611	0.078379	0.351377	0.134953	0.115935	0.345227	0.099118	0.354784	0.073661	0.08701
13:44:15	8	15	1	0.158155	0.060383	0.294792	0.105801	0.088338	0.08514	0	0.043785	0.144335	0.026243	0.195362	0.044195	0.32302	0.052922	0.115384	0.365127	0.137923	0.277663	0.032113	0.059317
13:44:15	8	16	1	0.036892	0.082432	0.411847	0.209505	0.20678	0.126426	0.220381	0.031432	0.142378	0.081174	0.294576	0.091299	0.226663	0.115087	0.006657	0.117883	0.041583	0.226925	0.048013	0.079794
13:44:16	8	17	1	0.06192	0.073129	0.393405	0.099677	0.103783	0.041059	0.243305	0.128226	0.157474	0.186757	0.210475	0.081323	0.253063	0.150555	0.102298	0.406815	0.079654	0.376362	0.066393	0.053481
13:44:16	8	18	1	0.145252	0.04437	0.214249	0.200533	0.357143	0.142588	0.193221	0.196532	0.29952	0.085595	0.252984	0.131083	0.22191	0.07277	0.020495	0.290977	0.110492	0.250407	0.147148	0.053621
13:44:16	8	19	1	0.112484	0.037643	0.251272	0.07664	0.344039	0.172762	0.112991	0.093326	0.311157	0.033861	0.173557	0.069014	0.319858	0.11002	0.090784	0.224112	0.140771	0.277576	0.099275	0.052119
13:44:16	8	20	1	0.099843	0.009924	0.259239	0.014554	0.396751	0.043391	0.366735	0.085149	0.281245	0.500325	0.361039	0.146397	0.315874	0.09185	0.09447	0.284495	0.114161	0.202464	0.087814	0.092077
13:44:17	8	21	1	0.033939	0.05197	0.264708	0.160829	0.136643	0.062148	0.319377	0.14036	0.123823	0.274937	0.483307	0.072089	0.348913	0.239662	0.03193	0.258287	0.108832	0.332385	0.207391	0.065223
13:44:17	8	22	1	0.155631	0.057081	0.202001	0.117944	0.206902	0.10691	0.124548	0.054049	0.275724	0.09323	0.190304	0.114109	0.319596	0.177025	0.146475	0.320137	0.342029	0.338605	0.0698	0.155639
13:44:17	8	23	1	0.137434	0.028139	0.326541	0.155613	0.187596	0.109444	0.342265	0.055962	0.280354	0.198778	0.327239	0.10318	0.206797	0.217839	0.358977	0.36062	0.259125	0.243575	0.101616	0.192103
13:44:17	8	24	1	0.042002	0.083219	0.158986	0.142055	0.243628	0.114799	0.103713	0.201888	0.273085	0.06227	0.101887	0.047375	0.257326	0.001118	0.113794	0.309095	0.101127	0.332612	0.021857	0.017332
13:44:18	8	25	1	0.063283	0.055036	0.302307	0.149018	0.131581	0.110125	0.367614	0.107199	0.217385	0.293737	0.308196	0.06075	0.226331	0.111803	0.073434	0.297633	0.032428	0.144195	0.011234	0.004875
13:44:18	8	26	1	0.104028	0.068437	0.129903	0	0.187561	0.090784	0.122452	0.131852	0.142081	0.206622	0.160907	0.153412	0.241391	0.035276	0.012746	0.187997	0	0.188242	0.089631	0.101442
13:44:18	8	27	1	0.036141	0.047821	0.256986	0.023386	0.169809	0.038683	0.060566	0.143095	0.217333	0.279096	0.103958	0.062427	0.350783	0.093824	0.146004	0.173496	0.153578	0.313218	0.024967	0.109426
13:44:18	8	28	1	0.218914	0.0915	0.322365	0.072762	0.120975	0.139635	0.320854	0.260514	0.174824	0.516259	0.214616	0.10415	0.184975	0.048974	0.083664	0.128366	0.060383	0.157544	0.168848	0.075741
13:44:18	8	29	1	0.114484	0.084538	0.544039	0.071906	0.228759	0.008299	0.559746	0.100699	0.183	0.353246	0.458916	0.088268	0.223273	0.093807	0.070578	0.187718	0.173391	0.244135	0.144318	0.035625
13:44:19	8	30	1	0.149253	0.018092	0.41687	0.122216	0.402203	0.142571	0.440256	0.128296	0.257134	0.284669	0.264629	0.118599	0.411183	0.290645	0.038089	0.291903	0.141208	0.242335	0.133555	0.085752
13:44:19	8	31	1	0.034193	0.06073	0.281201	0.051385	0.190391	0.095816	0.274116	0	0.256906	0.312694	0.340754	0.102062	0.250861	0.233616	0.112973	0.216511	0.140561	0.221404	0.143968	0.160706
13:44:19	8	32	1	0.062855	0.082852	0.131423	0.150302	0.223413	0.116747	0.264227	0.112798	0.36352	0.190618	0.143418	0.10325	0.186233	0.055194	0.120233	0.200892	0.063143	0.369058	0.16165	0.060715
13:44:19	8	33	1	0.090103	0.102473	0.212152	0.173487	0.210851	0.204176	0.095187	0.091614	0.182564	0.256208	0.010527	0.13615	0.300149	0.021945	0.146615	0.261432	0.058042	0.19869	0	0

13:44:20	8	34	1	0.032917	0.05218	0.084887	0.031877	0.192662	0.116468	0.134551	0.124871	0.228794	0	0.133249	0.061457	0.160846	0	0.109164	0.303766	0.095711	0.426034	0.174719	0.055246
13:44:20	8	35	1	0.100621	0.029886	0.341802	0.132122	0.362996	0.169215	0.189369	0.097755	0.249533	0.458182	0.564272	0.119464	0.240797	0.315175	0.04534	0.22385	0.308082	0.236639	0.115122	0.08224
13:44:20	8	36	1	0.143287	0.16911	0.455955	0.072325	0.34797	0.161335	0.320408	0.082965	0.220827	0.202936	0.33795	0.111357	0.19282	0.250896	0.02129	0.29952	0.166664	0.162663	0.088722	0.092863
13:44:20	8	37	1	0.123937	0.076894	0.342274	0.144099	0.13041	0.098917	0.225562	0.086739	0.180065	0.169198	0.212947	0.088137	0.117009	0.047593	0.105513	0.107382	0.078501	0.232201	0.017839	0.051367
13:44:21	8	38	1	0.127187	0.039766	0.253744	0.05757	0.378179	0.097546	0.430262	0.182782	0.268211	0.315088	0.162366	0.183271	0.295205	0.17568	0.039897	0.315717	0.181183	0.3309	0.066725	0.085944
13:44:21	8	39	1	0.086442	0.055403	0.328524	0.231284	0.186093	0.19904	0.233616	0.09717	0.287465	0.085228	0.473383	0.165974	0.187823	0.120993	0.074963	0.14921	0.050127	0.174509	0.116922	0.070936
13:44:21	8	40	1	0.070062	0.057561	0.506466	0.077392	0.373636	0.09143	0.451089	0.011383	0.172203	0.279725	0.484932	0.199372	0.067669	0.113655	0.090583	0.275828	0.307977	0.192418	0.18038	0.050703
13:44:21	8	41	1	0.223605	0.016651	0.244466	0.191099	0.467076	0.060855	0.267608	0.062899	0.31846	0.317149	0.265267	0.205749	0.245323	0.086643	0.116529	0.287674	0.097091	0.399477	0.254688	0.057116
13:44:22	8	42	1	0.061274	0.06524	0.375261	0.121735	0.28909	0.123963	0.25875	0.054469	0.12136	0.184678	0.225405	0.111112	0.059072	0.03131	0.063598	0.154626	0.111156	0.115734	0.066935	0
13:44:22	8	43	1	0.04796	0.061711	0.247638	0.148249	0.340702	0.194977	0.174841	0.068507	0.246091	0.03746	0.434718	0.111139	0.312886	0.221945	0.056696	0.139845	0.098122	0.261135	0.052625	0.029929
13:44:22	8	44	1	0.176221	0.098908	0.090059	0.074133	0.119315	0.280441	0.102665	0.168735	0.215288	0.0282	0.379576	0.065083	0.318652	0.068455	0.108972	0.206867	0.004106	0.118145	0	0.01375
13:44:22	8	45	1	0.116389	0.058033	0.29766	0.107461	0.330673	0.121919	0.255919	0.054154	0.257535	0.222906	0.2405	0.030672	0.134953	0.102455	0.065161	0.247908	0.058793	0.336421	0.06849	0.03117
13:44:23	8	46	1	0.248398	0.096471	0.096934	0.083306	0.383997	0.103486	0	0.034027	0.334167	0.045514	0.152643	0.14451	0.431223	0.130882	0.05308	0.415866	0.149961	0.409506	0.13995	0.186827
13:44:23	8	47	1	0.078143	0.115017	0.497651	0.067832	0.220181	0.104115	0.591136	0.073627	0.090644	0.344091	0.33304	0.155893	0.222312	0.234455	0.073915	0.20947	0.176973	0.297808	0.128558	0.018346
13:44:23	8	48	1	0.068865	0.006814	0.14679	0.029222	0.194182	0.143566	0.25108	0.072473	0.331249	0.034926	0.203477	0.196628	0.308885	0.104167	0.155613	0.305967	0.019918	0.412389	0.079916	0.115419
13:44:23	8	49	1	0.046598	0.046414	0.246065	0.114336	0.097371	0.088408	0.087927	0.068953	0.092863	0.121639	0.215786	0.032638	0.332769	0.218119	0.068402	0.268228	0.066306	0.296637	0.053097	0.105041
13:44:23	8	50	1	0.093894	0.017856	0.233887	0.088032	0.162576	0.037215	0.451351	0.10125	0.359966	0.264559	0.187194	0.018721	0.227082	0.115821	0.043723	0.11313	0.235311	0.395913	0.1508	0.084721
13:44:24	8	51	1	0.114161	0.087333	0.208003	0.139548	0.235975	0.061912	0.281	0.069477	0.227257	0.088914	0.166752	0.0906	0.268176	0.154172	0.058024	0.128663	0.072683	0.35232	0.134097	0.088076
13:44:24	8	52	1	0.122434	0.075933	0.291247	0.064384	0.192488	0.111549	0.249018	0.071312	0.194969	0.040343	0.107129	0.099485	0.193169	0.146938	0.10781	0.125396	0.028916	0.263698	0.087534	0.116695
13:44:24	8	53	1	0.142204	0.085341	0.186276	0.194663	0.276021	0.32461	0.024574	0.15543	0.23428	0.066044	0.212205	0.005539	0.31673	0.108186	0.037853	0.193047	0.192068	0.272701	0.228445	0.208544
13:44:24	8	54	1	0.090068	0.07291	0.267888	0.136656	0.333241	0.186704	0.382608	0.033197	0.169931	0.431311	0.187831	0.180406	0.217979	0.080965	0.130052	0.381359	0.153281	0.360043	0.110842	0.035468
13:44:25	8	55	1	0.163397	0.080187	0.261963	0.091614	0.201206	0.107679	0.431835	0.045514	0.223535	0.085263	0.270264	0.053097	0.343934	0.180816	0.120879	0.341523	0.168691	0.101913	0.192418	0.120329
13:44:25	8	56	1	0.063746	0.037259	0.300027	0.064113	0.433442	0.135468	0.151839	0.113987	0.455317	0.082467	0.137329	0.025002	0.334744	0.013943	0.104255	0.238771	0.036551	0.413367	0.025037	0.094139
13:44:25	8	57	1	0.137119	0.052197	0.385115	0.167782	0.315315	0.082293	0.448966	0.05467	0.348826	0.333416	0.411664	0.047017	0.360183	0.144195	0.000847	0.43318	0.272055	0.147934	0.160165	0.126968
13:44:25	8	58	1	0.05812	0.029676	0.352923	0.005006	0.520138	0.056836	0.311358	0.126628	0.281594	0.439592	0.379035	0	0.351255	0.174893	0.029213	0.22081	0.06524	0.40395	0.181271	0.085123
13:44:26	8	59	1	0.092199	0.078597	0.575969	0.173635	0.166734	0.057378	0.479035	0.098218	0.172727	0.361808	0.491493	0.078248	0.00643	0.061903	0.067398	0.001695	0.07008	0.203268	0.099572	0.070359
13:44:26	8	60	1	0.057465	0.122766	0.454426	0.245445	0.043191	0.07008	0.268464	0.058208	0.218905	0.230803	0.243278	0.09033	0.015725	0.060365	0.123884	0.220547	0.152739	0.178563	0.017105	0.070394
13:44:26	8	61	1	0.115079	0.029676	0.282538	0.117525	0.332123	0.093265	0.255614	0.030969	0.250896	0.185621	0.261231	0.046912	0.328803	0.070674	0.068717	0.408003	0.098454	0.37347	0.129012	0.124312
13:44:26	8	62	1	0.127623	0.10318	0.245318	0.051743	0.227362	0.134271	0.324689	0.12758	0.258112	0.154347	0.454094	0.074203	0.257885	0.190391	0	0.236971	0.216634	0.279952	0.101913	0.128069
13:44:27	8	63	1	0.216267	0.087211	0.645289	0.02744	0.353718	0.06213	0.518128	0.12606	0.135879	0.18964	0.245812	0.100813	0.119001	0.125658	0.02592	0.162366	0.097476	0.256994	0.097825	0.068525
13:44:27	8	64	1	0.083035	0.043147	0.257579	0.115227	0.319351	0.120486	0.140124	0	0.208964	0.159431	0.262926	0.156897	0.25163	0.127842	0.123133	0.178825	0.085647	0.134586	0.078554	0.051035
13:44:27	8	65	1	0.031965	0.181105	0.297651	0.053901	0.23138	0.138901	0.29925	0.041015	0.228305	0.104517	0.302831	0.086145	0.292147	0.252399	0.020337	0.197013	0.20318	0.242859	0.083481	0.116572
13:44:27	8	66	1	0.134848	0.095536	0.442729	0.376475	0.218294	0.048904	0.37672	0	0.371522	0.111139	0.187194	0.170884	0.232219	0.08107	0.041146	0.134935	0.290907	0.380852	0.188539	0.072421
13:44:27	8	67	1	0.088259	0.034839	0.532866	0.133022	0.38232	0.063143	0.523737	0.064812	0.344668	0.28121	0.466883	0.178903	0.328576	0.194619	0.051481	0.220128	0.136368	0.329869	0.116957	0.079724
13:44:28	8	68	1	0.17374	0.024059	0.201905	0.144632	0.363712	0.174701	0.310877	0.031589	0.370928	0.273959	0.326532	0.096615	0.165301	0.042719	0.0678	0.188784	0.073469	0.389337	0.086608	0.150967

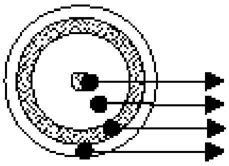
APPENDIX G

DATASHEET COAXIAL CABLE RG174A/U

	TECHNICAL DATA SHEET	code	MRG1740
		version	2
		date	2005-11-09
	R.F. CABLE 50 OHM RG 174 U CCS	page	1/2

APPLICATION
Coaxial cable used for Radio-frequency, designed according MIL-C-17F/119F

CONSTRUCTION



1) Conductor	7x0.16 mm copper clad steel wire
Diameter	0.5 mm
2) Dielectric	Solid PE
Diameter	1.50 mm ± 0.10 mm
3) Screen	braid
Material	0.1 mm tinned copper wire
Diameter	1.97 mm ± 0.11 mm
4) Sheath	PVC
Diameter	2.80 mm ± 0.10 mm
Color	black

REQUIREMENTS AND TEST METHODS
Test methods generally in accordance with MIL-C-17F/119F

1) Conductor		
Elongation at break	≥ 1%	
3) Screen		
Coverage	86 %	
Electrical characteristics		
Mean characteristic impedance	50 ± 2 Ohm	
DC resistance inner conductor	≤ 317 Ohm/km	
Capacitance at 1 kHz	100 ± 3 pF/m	
Velocity ratio	0.66 ± 0.02	
Insulation resistance	> 10^4 MOhm.km	
Voltage test of dielectric	3 kV dc	
Corona	≥ 1.5 kV ac	
Return loss at..	100 – 400 MHz	≥ 22.5 dB
	400 – 900 MHz	≥ 19.2 dB

APPENDIX H

DATASHEET AT525 35 MICRON COPPER FOIL SHIELDING TYPE

Technical Data

Issue 2 / July 2006

AT525 35 Micron Copper Foil Shielding Tape

General description

35 micron copper foil coated with a non-conductive acrylic adhesive supplied on a removable silicone release liner.

- Non-conductive acrylic adhesive
- Good high and low temperature resistance
- Can be easily soldered
- Easy unwind

Specification

- Tested in accordance with ASTM D-1000 latest issue, BS EN 60454 - Part 2 test methods (formerly VDE 0340, BS 3924).
- Tested and meets Flame Retardancy requirements of UL 510 (UL guide OANZ 2, File number E 86214 (M)

Technical Details

Technical details	BS value	ASTM value
Typical values		
Foil thickness:	0.035mm	1.4 mil
Adhesive thickness:	0.030mm	1.2 mil
Total thickness:	0.065mm	2.6 mil
Adhesion to steel:	4.5 N/cm	41 oz/in.
Tensile strength:	40 N/cm	23 lbs/inch
Temperature resistance:	-20°C to +155°C	Up to +311°F
RoHS compliant	Yes	
Storage Temperature	+12°C to +25°C	

NOTE
Except where indicated otherwise, the figures stated are average values and should not be regarded as MAXIMUM or MINIMUM values for specification purposes. The Company reserves the right to improve products and any change in specification will result in a re-issue of the relevant 'Technical Data Sheet'. Customers should satisfy themselves that the tape is suitable for their requirements whether after such modifications or otherwise. Please check that you have the latest issue of the 'Technical Data Sheet'. All slitting and length tolerances are to British Standards. Before use the customer is advised to consult the Health & Safety Data Sheet produced by the company for this product, which is available on request.

STORAGE
Tapes stored below the minimum recommended temperature will require warming up to that level before use. Up to 24 hours may be required for this to take place.

ADVANCE adhesive tapes

BS EN ISO 9001 Q05206 — Afera — INVESTOR IN PEOPLE

Advance Tapes International Limited, PO Box 122,
Abbey Meadows, Leicester, LE4 5RA.
Tel: 0116 251 0191. Fax: 0116 265 2046. www.advancetapes.com

AFERA
Association des Fabricants Européens de Rubans Auto-Adhésifs.

APPENDIX I

DATASHEET SMB CONNECTOR

Attributes

Attribute Type	Attribute Value
Type	SMA
Gender	Plug
Mounting	Cable Mount
Orientation	Straight
Termination Method	Crimp
Terminate To	RG174
Contact Termination Method	Solder
Cable Type	RG174

Over View

Cable plug - Crimp

Range Overview

Gold Plated - RS

SMA Connectors for semi-rigid and flexible cables.

SMA Solder (Semi-rigid cable)

- For use with semi-rigid coaxial cable
  Designed to provide high frequency performance at high power ratings in small diameters
  Stud contact types are provided in both captive and non-captive forms
  Connectors available for the two most commonly used microwave cables, RG402/U and RG405/U

SMA Crimp (Flexible cable)

- Used with a variety of flexible RF cables
  Suitable for design and development work and where large quantity usage requires repeatability in performance
  Available in non-captive contact form for optimum electrical performance
  Assembly is acheived by soldering the centre contact and crimping braid and outer sleeve

SMA Clamp (Flexible cable)

- Pressure sleeve clamp versions for use with flexible cables
  Captive contacts ensure correct positioning and mating
  Ideal for field service applications

Technical specification			
Working voltage	450Vdc or ac (peak)	VSWR	1.07 + 0.07 x f(GHz)
Proof voltage	1500Vdc or ac (peak)	Insertion loss	0.04 x √f(GHz) dB

Frequency range	DC to 18GHz (semi-rigid cable) DC to 12.4GHz (braided cable and elbow connectors)	Phase repeatability	±3° after 1000 mating cycles

Crimp tooling	
Cable Type	**Use crimp tool (s)**
RG58 RG174 RG223	456-431 456-778 456-431

Group Overview

SMA series, connectors

SMA series connectors

Connect with connectors that comply with BS 9210 N0006 and MIL-C-39012 standards. These connectors are gold-plated and there are versions for a wide variety of cable sizes, with different types of fastenings and assembly configurations. Assembly instructions are included.

electrical specifications for SMA	
Operating voltage	450V DC or AC (peak)
Test voltage	1,500V DC or AC (peak)
Voltage standing wave ratio (VSWR) (f = freq. in GHz)	
(figures indicated for straight connectors)	1.07+0.008f (semi-rigid cable)
	1.20+0.03f (braided cable)
Frequency margin	from DC up to 18GHz (semi-rigid cable)
	from DC up to 1GHz (braided cable and elbow connectors)

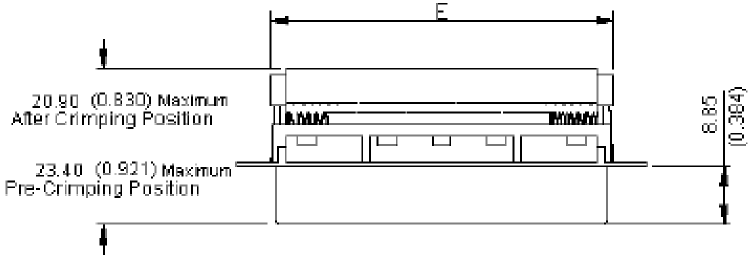
APPENDIX J

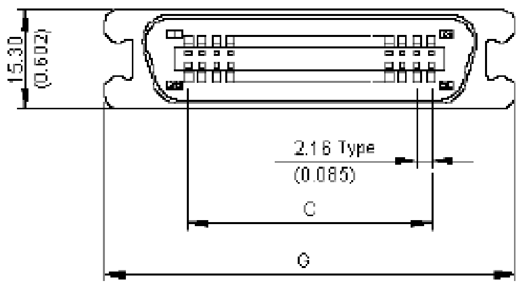
DATASHEET 36-WAY CENTRONIC PLUG

multicomp	PART NO. 5F30360M-10NN-XX

REVISIONS

ECN #	REV	DESCRIPTION	DRAWN	DATE	CHECKD	DATE	APPRVD	DATE
-	A	RELEASED	Veena	11/4/08	Suresh	11/4/08	G. C	25/4/08





Dimensions : Millimetres (Inches)

Specifications:

Current rating	: 1A : AWG28/1, 2A : AWG26.
Insulation resistance	: ≥1000 MΩ.
Dielectric with standing volatage	: 500V, at sea level.
Operating temperature	: - 55°C to 105°C (limited by cable).
Contact resistance	: ≤20mΩ.
Dielectric material	: Polyster resin and glass reinforced.
Contact material	: Phosphor bronze.
Contact plating	: Gold over nickel.
Wire size	: AWG26 and AWG28 stranded, 1.27mm conductor center flat cable.

TOLERANCES:

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE FOR REFERENCE PURPOSES ONLY.

DRAWN BY:	DATE:
Veena	11/04/08
CHECKED BY:	DATE:
Suresh	11/04/08
APPROVED BY:	DATE:
G.Cook	25/04/08

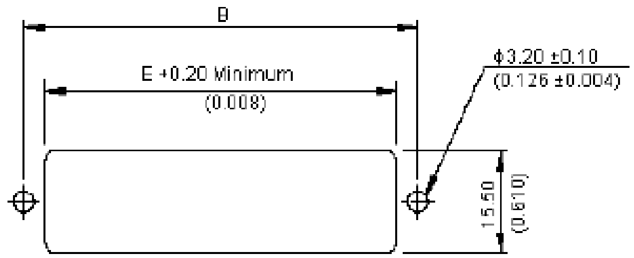
DRAWING TITLE:

IDC Centronic Plug - 36 Way

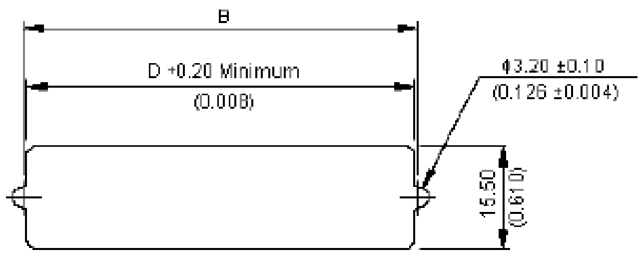
SIZE	DWG NO.	ELECTRONIC FILE	REV
A	M10000833	1099282_DWG	A

SCALE: NTS	U.O.M.: mm (Inches)	SHEET: 1 OF 3

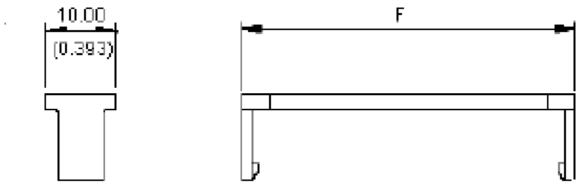
multicomp	PART NO. 5F30360M-10NN-XX									
		REVISIONS								
ECN #	REV	DESCRIPTION	DRAWN	DATE	CHECKD	DATE	APPRVD	DATE		
-	A	RELEASED	Veena	11/4/08	Suresh	11/4/08	G. C	25/4/08		



Recommended Front Mount Panel



Recommended Rear Mount Panel



Strain Relief

Dimensions : Millimetres (Inches)

Specification Table

G ±0.25 (0.010)	F ±0.25 (0.010)	E -0.25 (0.010)	C ±0.13 (0.005)	B ±0.13 (0.005)	Part Number
62.10 (2.445)	53.75 (2.027)	51.50 (2.315)	36.72 (1.446)	59.74 (2.352)	5F30360M-10NN-XX

Dimensions : Millimetres (Inches)

TOLERANCES:

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE FOR REFERENCE PURPOSES ONLY.

DRAWN BY:	DATE:
Veena	11/04/08
CHECKED BY:	DATE:
Suresh	11/04/08
APPROVED BY:	DATE:
G.Cook	25/04/08

DRAWING TITLE: IDC Centronic Plug - 36 Way

SIZE	DWG NO.	ELECTRONIC FILE	REV
A	M10000833	1099282_DWG	A

SCALE: NTS | U.O.M.: mm (Inches) | SHEET: 2 OF 3

multicomp	PART NO. 5F30360M-10NN-XX			

REVISIONS

ECN #	REV	DESCRIPTION	DRAWN	DATE	CHECKD	DATE	APPRVD	DATE
-	A	RELEASED	Veena	11/4/08	Suresh	11/4/08	G. C	25/4/08

Part Number Explanation:

5F	30	360	M	-	1	0	N	N	-	XX
Series Number	Contact and Connecting Types	Number of Contacts	Housing Construction Types		Color Codes	Contact Finish	Strain Relief	Mounting Types		Custombber

Series Number	: 5F = I.D.C. ribbon connector.
Contact and Connecting type	: 30 = Plug, coble to panel connecting type.
Number of Contacts	: 360 = 36 Positions.
Housing Construction Types	: M = With metal front shell.
Color Codes	: 1 = Blue.
Contact Finish	: 0 = Selectived gold flash over nickel.
Strain Relief	: N = Without strain relief.
Mounting Types	: N = Without mounting holes (Bail mounting type).
Customer	: XX = Inland.

http://www.farnell.com

http://www.newark.com

http://www.cpc.co.uk

TOLERANCES: UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE FOR REFERENCE PURPOSES ONLY.	DRAWN BY: Veena	DATE: 11/04/08	DRAWING TITLE: IDC Centronic Plug - 36 Way			
	CHECKED BY: Suresh	DATE: 11/04/08	SIZE A	DWG NO. M10000833	ELECTRONIC FILE 1099282_DWG	REV A
	APPROVED BY: G.Cook	DATE: 25/04/08	SCALE: NTS	U.O.M.: mm (Inches)	SHEET: 3 OF 3	

APPENDIX K

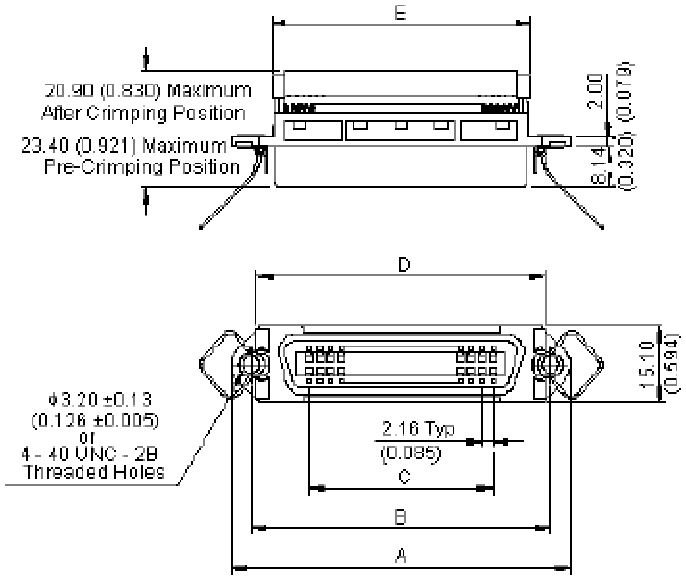
DATASHEET 36-WAY CENTRONIC SOCKET

multicomp

PART NO.

5F40360M-10NR-XX

REVISIONS								
ECN #	REV	DESCRIPTION	DRAWN	DATE	CHECKD	DATE	APPRVD	DATE
-	A	RELEASED	Veena	11/4/08	Suresh	11/4/08	G. C	25/4/08



Dimensions : Millimetres (Inches)

Specifications:

Current rating	: 1A : AWG28/1, 2A : AWG26.
Insulation resistance	: ≥1000 MΩ.
Dielectric with standing volatage	: 500V, at sea level.
Operating temperature	: - 55°C to 105°C (limited by cable).
Contact resistance	: ≤20mΩ.
Dielectric material	: PBT and glass reinforced.
Contact material	: Phosphor bronze.
Contact plating	: Gold over nickel.
Wire size	: AWG26 and AWG28 stranded, 1.27mm conductor center flat cable.

TOLERANCES:

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE FOR REFERENCE PURPOSES ONLY.

DRAWN BY:	DATE:
Veena	11/04/08
CHECKED BY:	DATE:
Suresh	11/04/08
APPROVED BY:	DATE:
G.Cook	25/04/08

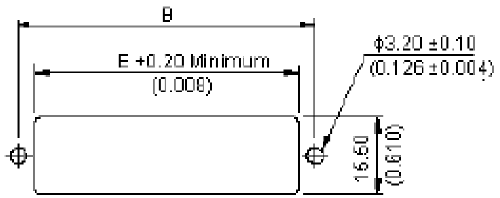
DRAWING TITLE:

IDC Centronic Socket - 36 Way

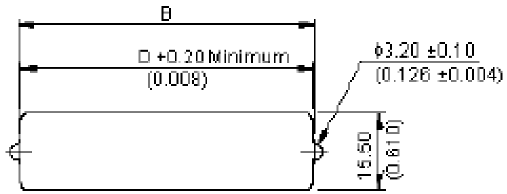
SIZE	DWG NO.	ELECTRONIC FILE	REV
A	M10000828	1099283_DWG	A

SCALE: NTS | U.O.M.: mm (Inches) | SHEET: 1 OF 3

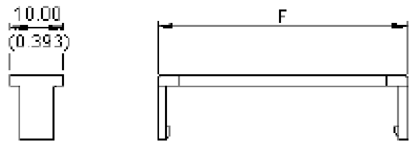
multicomp	PART NO. 5F40360M-10NR-XX	REVISIONS								
		ECN #	REV	DESCRIPTION	DRAWN	DATE	CHECKD	DATE	APPRVD	DATE
		-	A	RELEASED	Veena	11/4/08	Suresh	11/4/08	G. C	25/4/08



Recommended Front Mount Panel



Recommended Rear Mount Panel



Strain Relief

Dimensions : Millimetres (Inches)

Specification Table

F ±0.25 (0.010)	E ±0.25 (0.010)	D ±0.25 (0.010)	C ±0.13 (0.005)	B ±0.13 (0.005)	A ±0.25 (0.010)	Part Number
53.70 (2.445)	51.50 (2.027)	58.80 (2.315)	36.72 (1.446)	59.74 (2.352)	67.80 (2.669)	5F40360M-10NR-XX

Dimensions : Millimetres (Inches)

TOLERANCES:

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DRAWN BY:	DATE:
Veena	11/04/08
CHECKED BY:	DATE:
Suresh	11/04/08
APPROVED BY:	DATE:
G.Cook	25/04/08

DRAWING TITLE: IDC Centronic Socket - 36 Way

SIZE	DWG NO.		ELECTRONIC FILE	REV
A		M10000828	1099283_DWG	A
SCALE: NTS	U.O.M.: mm (Inches)		SHEET: 2 OF 3	

	PART NO.	REVISIONS								
multicomp	5F40360M-10NR-XX	ECN #	REV	DESCRIPTION	DRAWN	DATE	CHECKD	DATE	APPRVD	DATE
		-	A	RELEASED	Veena	11/4/08	Suresh	11/4/08	G. C	25/4/08

Part Number Explanation:

5F	40	360	M	-	1	0	N	R	-	XX
Series Number	Contact and Connecting Types	Number of Contacts	Housing Construction Types		Color Codes	Contact Finish	Strain Relief	Mounting Types		Custombер

Series Number : 5F = I.D.C. ribbon connector.
Contact and Connecting type : 40 = Socket, cable to panel connecting type.
Number of Contacts : 360 = 36 Positions.
Housing Construction Types : M = With metal front shell.
Color Codes : 1 = Blue.
Contact Finish : 0 = Selectived gold flash over nickel.
Strain Relief : N = Without strain relief.
Mounting Types : R = Without rivet through holes.
Customer : XX = Inland.

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http://www.cpc.co.uk

TOLERANCES:

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DRAWN BY:	DATE:
Veena	11/04/08
CHECKED BY:	DATE:
Suresh	11/04/08
APPROVED BY:	DATE:
G.Cook	25/04/08

DRAWING TITLE: IDC Centronic Socket - 36 Way

SIZE	DWG NO.	ELECTRONIC FILE	REV
A	M10000828	1099283_DWG	A

SCALE: NTS | U.O.M.: mm (Inches) | SHEET: 3 OF 3