

# PLACEMENT REPORT



UNIVERSITY OF ULSTER  
SCHOOL OF ELECTRICAL & MECHANICAL ENGINEERING

**COURSE:** BEng (HONS) Electronic Systems  
**PLACED AT:** FG WILSON (ENGINEERING) LTD  
**ACADEMIC TUTOR:** Mr George Jackson

## Colin McCord

25/05/2001

## **CONTENTS**

Introduction	Page 1
Section 1 – Organisation	Pages 2 to 4
Section 2 - Work	Pages 5 to 9
Section 3 - Technical	Pages 10 to 12
Section 4 - Innovation	Pages 13 to 15
Section 5 - Skills	Pages 16 to 18
Section 6 - Summary	Pages 19 to 20
Appendix 1 – Directions to Larne Site	Page 21
Appendix 2 – Directions to Monkstown Site	Page 22
Appendix 3 – Directions to Springvale Site	Page 23
Appendix 4 – Industrial Placement CDROM	Page 24

## INTRODUCTION



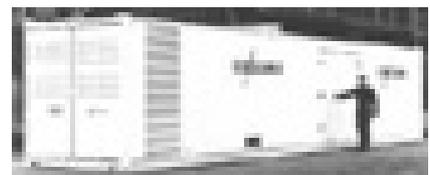
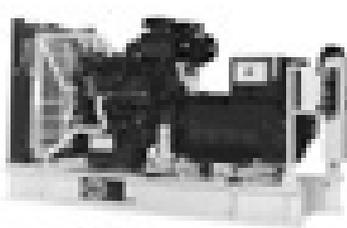
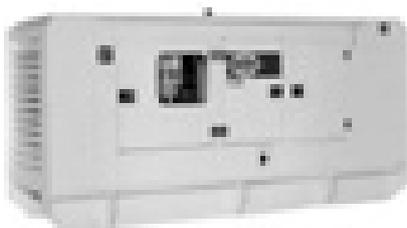
This report contains in-depth comprehensive information about my placement year at FG Wilson (Engineering) LTD at their UK headquarters based in Larne. I started work on Monday 24<sup>th</sup> of July 2000 and expect placement to end September 2001.

FG Wilson has three main plants in Northern Ireland: Larne, Monkstown and Springvale. The Larne plant is the largest at 700,000 square feet and is the largest Genset assembler in Europe. Since June 1999 FG Wilson has been a wholly owned subsidiary of Caterpillar Incorporated.

This report is split into 6 main sections: -

- 1) **Organisation** – Comprehensive detailed information about FG Wilson including: Nature of business; products and markets; main customers and suppliers; main competitors; organisation structure and employment; and financial structure etc...
- 2) **Work** – Description of the work, responsibilities and authority, which I was given during my placement. Includes: variety of experience; level of responsibility given; How my work changed; Monitored; examples of leadership; and human relations.
- 3) **Technical** – In-depth comprehensive technical information about the Modbus Communication protocol I developed for the Access 4000 controller. This is not a description of what was done, but demonstrates some of the technical knowledge required for development of this communication protocol.
- 4) **Innovation** – FG Wilson's attitude and approach to innovation, change and new ideas. Contains my comments (including examples: e.g. breakthrough scheme) on the organisation's perceived attitude to change and its approach to innovation and improvement.
- 5) **Skills** – Comments on the benefit of my placement year at FG Wilson including the skills I've acquired or improved upon which would be valuable to an employer.
- 6) **Summary** – Summary of the whole placement experience from seeking a placement organisation to the time of writing this report.

**Note:** I've made references to my logbook throughout this report, as much of the detail is contained there. It's recommend that you follow these references as a larger and more detailed picture of my placement experience can be seen. An electronic copy of my logbook is included in my industrial placement CDROM (Appendix 4 – page 24).



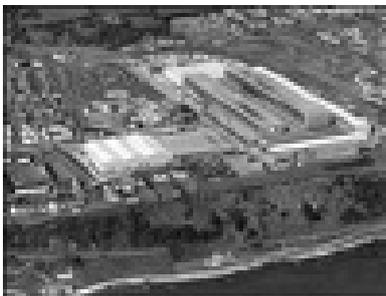
## SECTION 1 - ORGANISATION

### FG Wilson (Engineering) Ltd

FG Wilson began life as a family-run general manufacturing business in 1966 in an old textile mill in Belfast, Northern Ireland. It was not until the early '70's that the company started to focus on the design and manufacture of diesel powered generating sets. The Wilson family wholly owned the company until 1994 when acquired by Emerson Electric Co. In 1996 Emerson Electric and Caterpillar Inc signed a joint venture agreement.

FG Wilson has since June 1999 been a wholly owned subsidiary of Caterpillar Incorporated. The company is the largest diesel generating set manufacturer in Europe and third largest in the world. FG Wilson has three main facilities in Northern Ireland, with the group headquarters in Larne.

#### **Larne**



The Larne plant is 700,000 sq ft with more than 1,500 employees.

#### **Monkstown**



The Monkstown plant is 300,000 sq ft with more than 400 employees.

#### **Springvale**

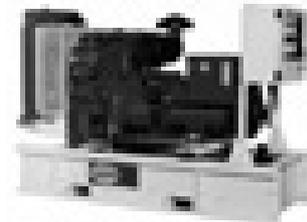
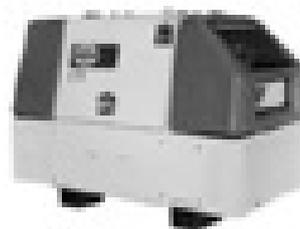


The Springvale plant is 230,000 sq ft with more than 400 employees.

### Nature of the Business

The company is one of the largest employers and exporters in Northern Ireland with a workforce of over 2,500 and yearly sales in excess of 35,000 generating sets, which are exported to more than 170 countries worldwide. FG Wilson lies comfortably within the UK's Top 100 Exporters and won the prestigious Queen's Award for Export Achievement three times last decade. Over 90% of current production is exported.

FG Wilson produce a wide range of diesel generating sets covering power outputs from 8 to 6,500 kVA which includes small generators for standby domestic use, up to complete power stations supplying electricity for national grids.



### FG Wilson Worldwide

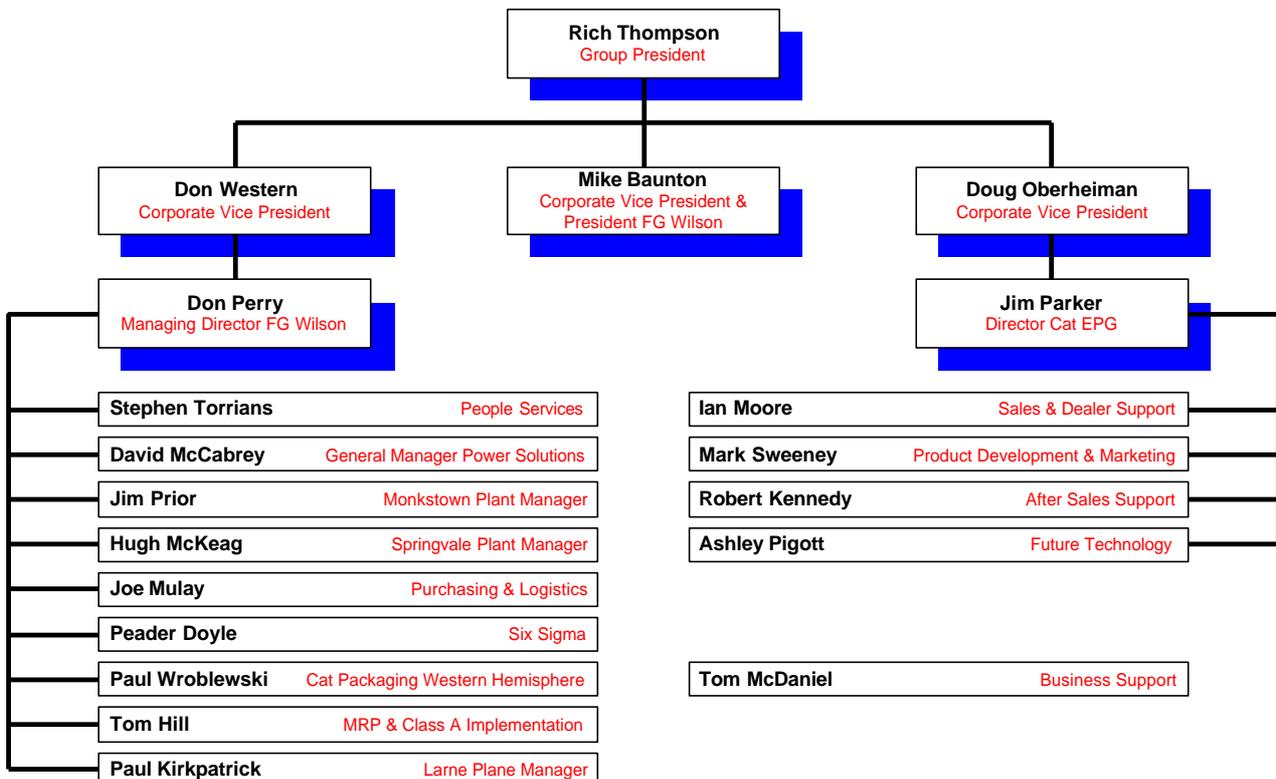
FG Wilson is a multinational company exporting to more than 170 countries worldwide. The company is able to operate on a worldwide scale because of its' extensive network of subsidiary offices and dealers. In addition to the manufacturing plants, the company has 14 major offices

located around the world. Independent dealers support these offices and increase FG Wilson sales by selling their products to the generator markets across the globe.



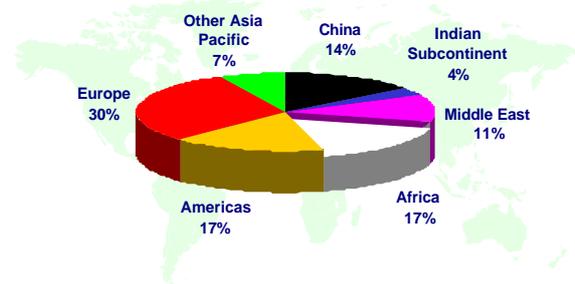
**Organisation Structure and Employment**

FG Wilson’s mission is to recruit, retain and develop the highest quality employee. They aim to build a team of professionals that are always learning, are customer focused, respect and trust each other, and are continuously making the best use of their abilities. Simplified organisational structure for FG Wilson is shown below: -

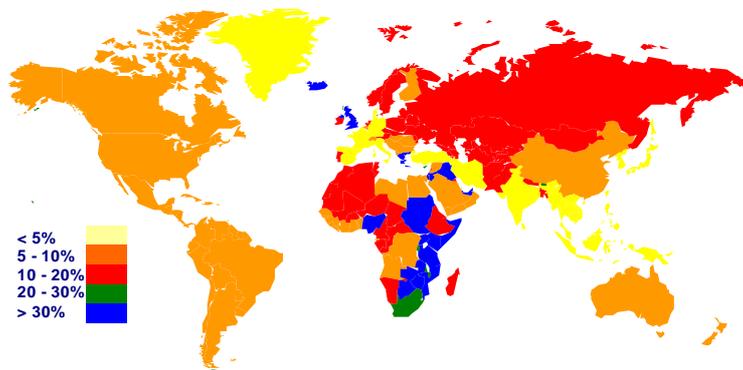


**Main Customers**

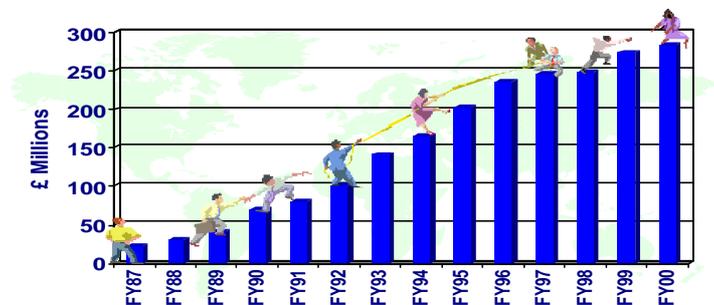
Private enterprises, hospitals, factories and countries in the wake of natural disasters.



**Market Position**



**Financial Structure**



**Products**

Diesel generating sets, base frames, trailers, fuel tanks, exhaust silencers, control panels, switchgear, acoustic ducts, canopies & container type enclosures.

**Competitors**

Cummins, DDC, Geko, Honda, Kubota and Caterpillar.

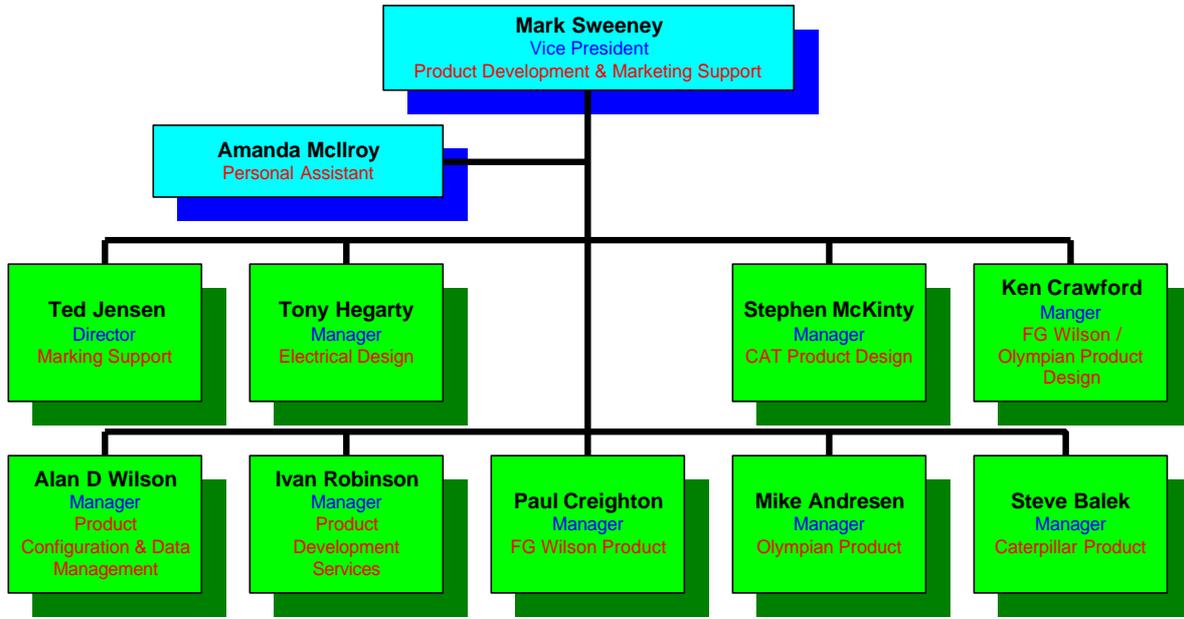
**Suppliers**

Perkins, Leroy Somer, Covrad, Bearward, Elite Electronics, UK Solenoid, Crompton, ABB, RS Components and IMO.

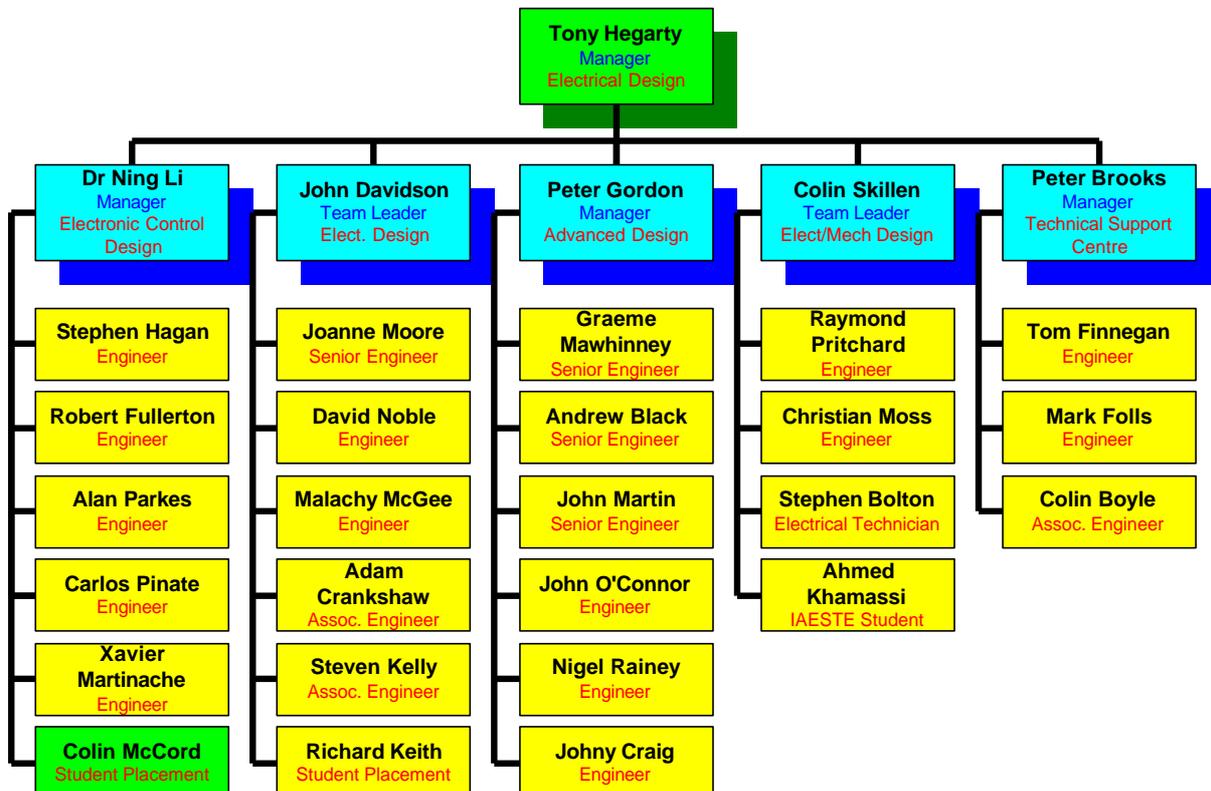
## SECTION 2 – WORK

### Which part of the organisation do I work for?

The following block diagram is a simplified version of organisational structure of the “Product Development & Marketing Support Team”. Every month I attend PDMS group meetings, which are used for exchanging ideas and displaying statistics on last months Sales, on time deliveries, etc...



Tony Hegarty responsibilities include the department I work in “Electronic Control Design”:-



Dr Ning Li manages department “Electronic Control Design” and is my Industrial Placement Supervisor.

## Work

The following summaries the work I've carried out to date, **Note** I've made references to my logbook throughout this section, as much of the detail is contained there.

The first project I was given was a communications protocol for the Access 4000 control panel called ModBus. Access 4000 already had a communication protocol called GenAccess this protocol was developed by Dr Ning Li and works well, the problem was that this protocol was not a standard protocol even through FG Wilson made the design open access some customers would prefer to use the popular communication protocol ModBus.



Access 4000

The Access 4000 series control panel is a microprocessor based autostart generator set control system. The design provides for high accuracy for all metering and protection functions, together with the obvious benefits of a large alphanumeric LCD.

The use of an open protocol communication interface ensures compatibility with most building management or supervisory control systems.



Access 2000 – Autostart Module

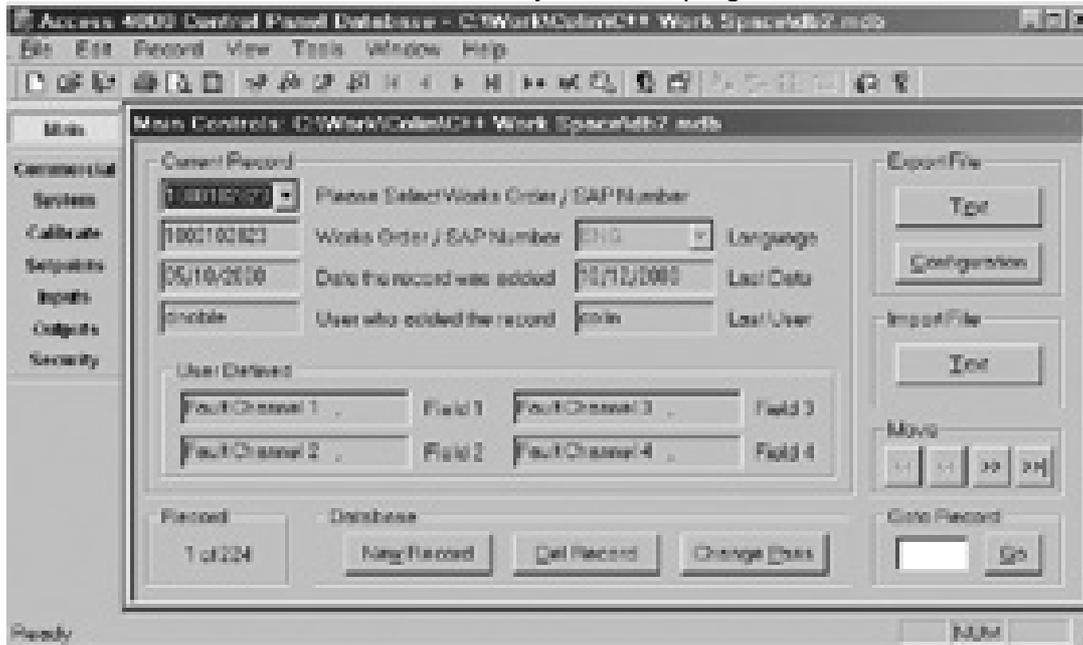
Using the programming language C, I developed code for implementing this protocol on the Access 4000. Test program for testing the protocol was written, and used to test the communications. ModBus has since been released and is now included as standard with every new Access 4000 control panel. Greater detail on the work carried out on the ModBus protocol can be found in my logbook Weeks 2 to 7.

Next I was involved with the testing of 3 Modular control units “Autostart Module”, “Basic Module” and “AC Module”, which become known as Access 1000 & 2000. This including checking the software (written in C) for possible problems and functional tests carried out in the lab. See Weeks 8 to 10 in my logbook for more details.

Next I developed a small MS dos based program using Turbo C 3.0 for DOS designed for testing the communications on a CI Tel Panel for Access 4000. The program was design to be simple to used and had to be reliable, as every CI Panel will be tested using this program before its shipped to the customer. See Week 11 in logbook for details.

Next project was a database using “Microsoft visual C++ 6.0” (ODBC Data Source, MS Access 97 Database, DAO). This database will contain all the configuration details of every Access 4000 sold, which can be exported to a text file and uploaded directly to Access 4000 control panel. The reason why Microsoft visual C++ is being used is that Internet communications are going to be added at a later date. I spent some time working on this project, as I had never programmed in C++ before, hence I spent a couple of weeks learning the language and creating small test programs. The database program is now compete and is in used by over 30 engineers who can access the data through LAN in real time. See Weeks 12 to 24 in logbook for details.

## Screen shot of my database program



I have written many small dos and windows programs: -

- Access Annunciator test program - a small dos program to allow the test engineers to easily test the communications of every Access Annunciator made, see week 37 in bgbook for details.
- Serial number generator – a small windows based program for generation of serial number for my Access 4000 database program, see week 20 in logbook for details.
- Serial generator for GenAccess 1.1 – a small windows based program for generating and storing serial numbers for the FG Wilson GenAccess 1.1 software, see week 25 in logbook for details.
- GenModBus – a small windows based program for monitoring and controlling the Access 4000 control panel using the ModBus communication protocol I developed. The program will be made available to customers as an example master program for ModBus communications on Access 4000. See Weeks 26 & 27 in logbook for details.
- Access 4000 language text editor – a small dialog based windows program, for creating and editing access 4000 language text files, which are then uploaded directly to Access 4000 control panel. See Week 22 in logbook for details.
- Load – a small dialog based windows program, propose of which is to load \*.txt and \*.S19 files to the Access 4000 control panel. The communication protocol used is extremely simple when compared with ModBus; hence program code was reasonably simple. The program has now been released and has replaced the original DOS program; engineers using the program have not reported any problems. The program is easy to use, small and runs on a variety of operating systems (Win95/98/NT/ME/2000). See Week 29 in logbook for details.

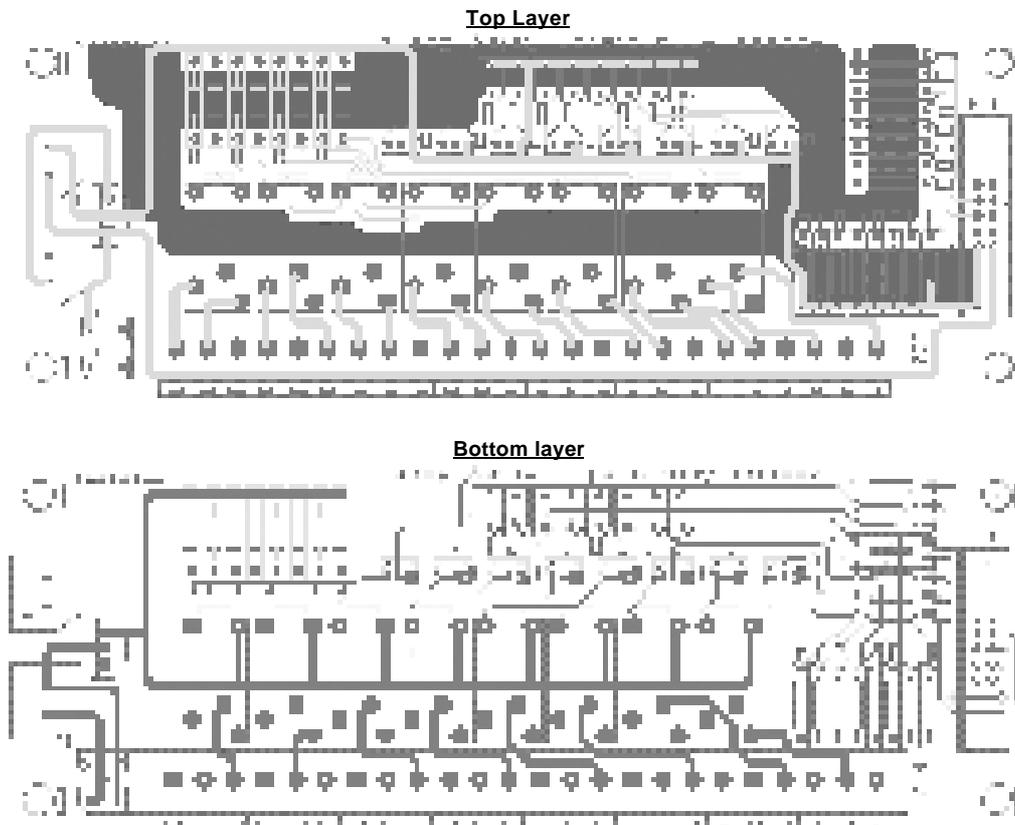
Most of the work above is software related, although most involved some sort of hardware, e.g. I carried out my own testing procedure on my ModBus communications protocol first on an Access 4000 controller connected to a Genset simulator box, then on an actual genset. Any problems that

were identified were fixed, and tested again. When I was happy that the protocol was working correctly and was sure there were no possible problems I passed the protocol to Ning Li, who got some experienced engineers to carry out their own testing procedure, they found no faults and the protocol was not modified again and has now been released. My complete testing procedure along with results (including screen dumps) was included in my ModBus technical report.

I've been involved with many different types of work: -

- Soldering of components to prototype Access Annunciator PCB Board.
- Soldering of components to prototype Tel Panel PCB Board, see week 34 in logbook.
- Functional tests of Access Annunciator.
- Functional and voltage transient tests of Tel Panel, see week 28 in logbook.
- Design of Access Annunciator plastic label using AutoCAD, see week 31 in logbook.
- Design of template of creating cut out labels for Access Annunciator using AutoCAD.
- Design of mail merge document to use in conjunction with my Serial generator program for GenAccess 1.1, automatically print disk labels with correct serial number. See week 25 in logbook.
- Costing of PCB components Access Annunciator, see week 32 in logbook.
- Concept design carried on Access 3000 configuration communication protocol, see week 33 in logbook.
- ModBus technical report, see week 7 in logbook.
- Access 4000 database program technical report, see week 31 in logbook.

Design of relay board PCB for Access 4000/3000 remote Annunciator using CADStar 3.0, see weeks 35 & 36 in logbook. Screen shot of design shown below (PCB 165mm X 60mm): -



It was my responsibility to order components and build 5 prototype relay boards as soon as the PCB boards were manufactured and delivered. I am also responsible for testing of the prototype PCB boards.

## **Variety of Experience**

It's clear from the summarisation of work the work I've carried out that I have gained a lot of experience in many aspects of engineering including; software developed (C, C++, Visual basic, etc...), Hardware (PCB Design, Testing, soldering of prototypes PCBs, etc...), which included use of many windows applications (MS Word, MS Outlook, MS Excel, MS Access, CADstar 3.0, CADstar 4.5, AutoCAD R14, Turbo C for Dos 3.0, SAP, etc...) and use of many pieces of equipment (Oscilloscope, Multimeters, Soldering iron, etc...). I feel I've gained a wide range of experience and knowledge from my placement at FG Wilson and enjoyed every minute, which should prepare me for a career as an engineer.

## **Monitored**

I was not monitored directly; when I was given a task I was left to complete it without anyone standing over my shoulders, if I had any problems or queries I could ask one of my colleagues or manager Dr Ning Li for help. I was able to complete all tasks without any help; all that was needed was additional technical information or suggestions.

I carried out many checks on my own work before passing anything on; for example most bugs in programs were weeded out before anyone else got to see them. The first project I worked on was the ModBus communications protocol, Dr Ning Li checked program code and found no problems, after which any other programs I written the program was checked by other people, but not the program structure or code.

## **Human Relations**

I worked in departed Electronic Control (Manager Dr Ning Li) at present there are 5 others in the group along with myself. We interacted with are section head just as any other member of the group, informally with a relaxed atmosphere. It's quite a small group everyone helping each other.

Most of the time I do not have direct contact to customers, but there was one occasion I had to demonstrate the ModBus communications protocol in front of several customers who were interested in using the protocol. The demonstration took place in bay F (test bays), with an Access 4000 connected to Genset and laptop running my DOS based test program.

The reason why I did the demonstration is that I developed the protocol and had written the only test program that exists. The test program was low level and required the user to have detailed knowledge of the protocol along with the Address Allocation tables (Windows program GenModbus had not been written at this stage, I developed it after in the event of future demonstrations). The demonstration went well and there were no technical problems (protocol performed flawlessly). The customers went away with a clear picture of what the protocol is capable of and passed all of their tests (see week 19 in my logbook for more details).

FG Wilson discourages workers from being members of trade unions, and I have had no contact with any during my placement. Early in the New Year FG Wilson sent letters to every employee (including myself) asking if they were a member of a trade union and if they were in favour of trade unions.

I've had no experience with trade unions and have mixed perceptions, they may force the company to improve working conditions and pay, but on the other hand may critically damage the company if strikes go ahead, hence company will lose money and may miss out in critical market opportunities, hence the workforce may need to be reduced to save money, hence save the company.

## SECTION 3 – TECHNICAL

I developed, implemented and tested the Modbus communication protocol for access 4000. Tests were completed using software I developed specifically for the task. This section contains technical principles that were understood during the development and testing processes, and not a description of what was done (see logbook for description of what was done, weeks 2 to 7).

### Modbus Communications Protocol

Modbus protocol is a messaging structure, widely used to establish master-slave communication between intelligent devices. A Modbus message sent from a master to a slave contains the address of the slave, the “command”, the data, and a check sum (CRC).

Since Modbus protocol is just a messaging structure, it is independent of the underlying physical layer. It is traditionally implemented using RS232, RS422, or RS485 over a variety of media.

Modbus has two transmission modes: -

- 1) **ASCII mode:** Each eight-bit byte in a message is sent as 2 ASCII characters.
- 2) **RTU (Remote Terminal Unit) mode:** Each eight-bit byte in a message is sent as two four-bit hexadecimal characters.

The Basic structure of a Modbus frame is shown below: -

Address	Function	Data	Checksum
---------	----------	------	----------

### Modbus on Access 4000

Access 4000 controller uses RTU transmission mode. The data format is 8 bits, 1 stop bit, and no parity. Baud rate is adjustable (9600bps, 14000bps, 19200bps, 32768bps or 38400bps). The maximum waiting time for a master to get a response is 128ms.

### **RTU Framing**

In RTU mode, message starts with a silent interval of at least 3.5 character times. This is most easily implemented as a multiple of character times at the baud rate that is being used on the network.

Networked devices monitor the network bus continuously, including during silent intervals, when the first field (the address field) is received, each device decodes it to find out if it is the addressed device.

The entire message frame must be transmitted as a continuous stream. If a silent interval of more than 1.5 character times occurs before completion of the frame, the receiving device flushes the incomplete message and assumes that the next byte will be the address field of a new message.

Similarly, if a new message begins earlier than 3.5 character times following a previous message, the receiving device will consider it a continuation of the previous message.

## Address Field

The address field of a message frame contains eight bits. Valid slave device addresses are in the range of 0 to 247 in Modbus protocol. On Access 4000, the individual slave devices can be assigned addresses in the range of 1 to 15.

A Master addresses a slave by placing the slave address in the address field of the message. When the slave sends its response, it places its own address in the address field of the response to let the master know which slave is responding.

## Function Field

The function code field of a message frame contains eight bits. Valid codes are in the range of 1 to 255 in Modbus. Of these, some codes are supported in the Access 4000 controller. When a message is sent from a master to a slave device the function code field tells the slave what kind of action to perform. When the slave responds to the master, it uses the function code field to indicate either a normal response or that some kind of error occurred (called an exception response).

## Contents of the Data Field

The data field of messages sent from a master to slave devices contains additional information, which the slave must use to take the action defined by the function code. This can include items like discrete and register relative addresses, the quantity of items to be handled, and the count of actual data bytes in the field.

If no error occurs, the data field of a response from a master contains the data requested. If an error occurs, the field contains an exception code that the master application can use to determine the next action to be taken.

## Contents of the Error Checking Field

When RTU mode is used for character framing, the error-checking field contains a 16-bit value implemented as two eight-bit bytes. The error check value is the result of a Cyclical Redundancy Check calculation performed on the message contents.

The CRC field is appended to the message as the last field in the message. When this is done, the low order byte of the field is appended first, followed by the high-order byte. The CRC high-order byte is the last byte to be sent in the message.

The polynomial value for CRC calculation in Access 4000 is A001h.

## Address Range and Support Function Codes

Data Type	Relative Address	Function Code	Description
Coils	00h – 0Fh	01	Read Coil Status (e.g. Start, Stop, Estop, Reset)
Coils	00h – 0Fh	05	Force Single Coil (e.g. Start, Stop, Estop, Reset)
Discrete Inputs	00h – 2Fh	02	Read Input Status (e.g. High/Low battery voltage)
Input Registers	00h – 1Fh	04	Read Input Registers (e.g. Phase A,B or C Voltage)
Holding Registers	00h – 20h	03	Read Holding Registers (e.g. Frequency low setpoint)
Holding Registers	00h – 20h	06	Preset Single Register (e.g. Frequency low setpoint)

### Exception Responses

When a master device sends a query to a slave device, three possible events may occur: -

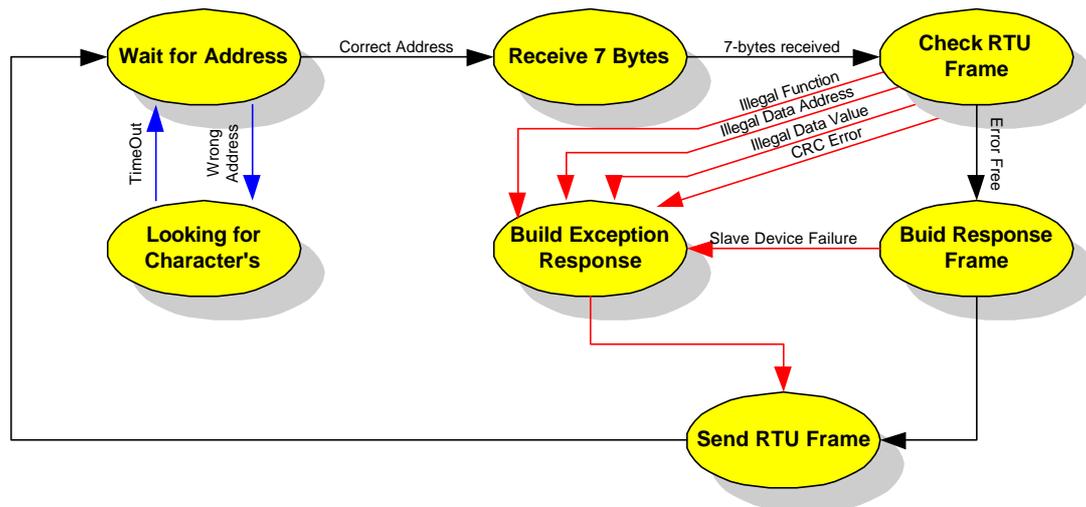
- 1) Normal response.
- 2) Slave does not receive the query, no response is returned and master will eventually process a time out condition.
- 3) Slave receives the query, but detects an error, the slave will return an exception response.

The Exception response message has two fields that differentiate it from a normal response: -

- ◆ Function field: Exception response function code = query function + 80h.
- ◆ Data field: return the exception code defined below.

Code	Name	Meaning
01h	Illegal Function	The function received is not an allowable action for the addressed slave
02h	Illegal Data Address	The address referenced in the data field is not an allowable address for the addressed slave.
03h	Illegal Data Value	The amount of data requested from the slave was too large for the slave to return a single response.
04h	Slave device failure	The slave cannot perform the function requested by the master.
09h	CRC error	The calculated CRC is different from the received CRC.
0Ah	Garbled Message	The data received by the slave is too short to be a valid Modbus message.

### Modbus Protocol Block Diagram



### Example Modbus Message

Query Message

Byte	Contents	Example (Hex)
1	Slave Address	02
2	Function	01
3	Starting Address Hi	00
4	Starting Address Lo	01
5	No. of Points Hi	00
6	No. of Points Lo	0A
7	CRC Low	ED
8	CRC High	FE

Request to read coils 01h to 0Ah from slave 2

Response Message

Byte	Contents	Example (Hex)
1	Slave Address	02
2	Function	01
3	Byte Count	02
4	Data (address 08-01)	02
5	Data (address 10-09)	00
6	CRC Low	FC
7	CRC High	9C

Status is indicated as: 1 = ON; 0 = OFF. The least significant bit (LSB) of the first data byte contains the coil addressed in the query. Other coils follow towards the high order end of this byte, and 'low order to high order' in subsequent bytes.

## **SECTION 4 – INNOVATION**

FG Wilson has a good attitude and approach to innovation; there are a number of schemes that are designed to encourage innovation (Breakthrough, ICP, Performance Award Scheme, etc.).

Once a month I attend PDMS meetings, which starts with a presentation about last month's profits, orders, on time deliveries, and details of breakthrough ideas that have been successfully implemented. Then question, answers and ideas flow freely throughout the group, encouraging innovation.

Once a month a glossy magazine is handed-out to every employee. This magazine keeps the employee up-to-date on company affairs, including charity events, breakthrough implementations, the latest information about 6-sigma, SAP, sport, etc. Employees that have made a difference are included along with a short story, in an attempt to motivate others.

FG Wilson management's behaviour encourages (e.g. breakthrough, ICP and Performance Award schemes) new ideas and improvements (quality, cost reduction, etc.). This includes ideas from my self; within are group (electronic control design) ideas flow freely throughout the group, I also have the same opportunity as any other employee of filling in a breakthrough form with an idea and if implemented would be entitled for a reward.

### **Example of Innovation**

I developed windows based Modbus Master program (GenModbus), Access 4000 language text editor, and my access 4000 load programs without anyone telling me to create them. I realised the need for these programs, then developed and tested them. All three programs are use daily throughout FG Wilson and the world, without my innovation they would not exist (See logbook for details).

### **Breakthrough Scheme**

This FG Wilson Initiative gives every employee the opportunity to improve products, practices, technologies and services. The purpose of the scheme is to initiate a cost reduction culture within the company across all three sites. FG Wilson realises that employee ideas can help achieve the following objectives: -

- ◆ Cost Reduction.
- ◆ Elimination of wasteful practices.
- ◆ Identification of cost led improvements.
- ◆ Promotion of teamwork within a culture of continuous improvement and development.

Rewards range from pens, mugs, sweatshirts to cash prizes based on the realised savings in the first year of implementation of the idea e.g. If estimated saving = £50,000 then the cash prize = £500. No matter how small the improvement or cost saving, every valid idea receives recognition.

Ideas for the scheme can be submitted though and employees supervisor, using the breakthrough idea proposal form. All ideas submitted to the breakthrough scheme will be acknowledged within three working days of receipt.

The scheme administrator will ensure that all ideas are fully evaluated and assessed. This assessment will check that the savings and implementation costs have been accurately estimated.

Further clarification may be required from the originator before the idea is accepted for implementation. If an idea is not implemented, the employee will receive a letter detailing the reason for the decision.

## Rewards

Awards for successful ideas will be based around the estimated savings for each idea. There are three levels that can be summarised as follows: -

Level	Approved By	Savings Range	Awarded to	Award	Timing
1	Supervisor	All accepted	Originator	Pens, mugs	Instant
2	Breakthrough team	£5K to £20K	Implementation Team	£50 or £100	On Implementation
3	Vice President	Min £20K	Implementation Team	1% of net saving	2mths after Imp.
Lottery	Breakthrough team	All implemented ideas	Originator	Up to £5000	Bi-yearly (June & Dec)

## Example Implemented Breakthrough ideas

- ◆ Change hinge on B series Olympian Canopy sourced an improved design of hinge at lower cost, implemented 01/04/2000 with an annual net saving of £61,625.
- ◆ Change 0.75 cables to 0.5 in TEL control panel assemblies, implemented 01/03/2000 with an annual net saving of £432.

## ICP (Incentive Compensation Plan)

As an incentive to achieve/beat Y2000 accountable profit target, this plan provides a payment of 4% of an Y2000 base pay if the target is met. A maximum payout of 8% can be earned based on achieving a much higher accountable profit result.

Payout formula: -

Y2000 ICP	Performance Factor	Payout
Threshold	0.3 of target	1.2% X base pay
Business Plan	0.8 of target	3.2% X base pay
Target	1.0 of target	4% X base pay
Maximum	2.0 of target	8% X base pay

I received my ICP £81.81 on the 20<sup>th</sup> February 2001.

## Actions to Help achieve/Beat Target

- 1) Help us make all shipments on time, meet the customer promise date.
- 2) Help us save cost by findings ways to work more efficiently.
- 3) Tell us your cost saving suggestions to reducer any/all company expense.
- 4) Be sure all of our products and work output are of high quality.
- 5) In general, anything we can do to increase sales or reduce costs will improve profit.

## Performance Award Scheme

Five Performance Levels: -

- R1:** Exceptional performance (8% of the workforce).
- R2:** Exceeded job expectations regularly (17% of the workforce).
- R3:** Met all job expectations (60% of the workforce).
- R4:** Met some job expectations; sustained improvement required (10% of the workforce).

**R5: Did not meet job expectations (5% of the workforce).**

Employee pay rise: -

Rating	R5	R4	R3	R2	R1
<b>Above Midpoint</b>	0%	0%	3%	4%	6%
<b>Below Midpoint (113%-126%)</b>	0%	0%	3%	5%	7%
<b>Below Midpoint (100%-112%)</b>	0%	2%	3.5%	6%	9%

The Performance Award Scheme is designed to encourage employees to work harder at a higher standard. The percentage weightings for the performance levels are set (e.g. 5% of the workforce will always be at R5). The Scheme rewards good workers, while weeding out the bad (R5 workers will be asked to leave, if no attempts for improvement are made). An employee's level is calculated throughout the year and he/she will be alerted if at risk of falling into level R5.

This is one of caterpillar's worldwide strategies; even caterpillars 10 vice presidents will be given a level (1 at R5, 1 at R4, 6 at R3, 1 at R2, and 1 at R1).

I attended the meeting that informed the PDMS group about this scheme, the meeting overran by 2 hours as many employees were asking questions: many to do with levels R5 and R4. I got the impression that a large percentage of employees were more worried about what would happen at levels R5 and R4 than the benefits of R3 – R1 and felt that the process could be unfair. Senior management listened to their questions and tried their best to answer them, but this scheme is a caterpillar worldwide strategy and FG Wilson has no option but to comply.

## **SECTION 5 – SKILLS**

During my placement year I gained and improved upon many different skills, which I could take to an employer after graduation. These skills cover a wide range of engineering, including software, electronic and mechanical. Personal skills such as report writing were improved, and my self-confidence is higher. The following is a list of some of these skills along with a brief description.



### **C Programming using Borland Turbo C for Dos 3.0**

I've been familiar with C programming for two years before the start of placement, as there was a Module (Algorithmic programming) in First and Second year of my BEng (hons) Electronic Systems course; hence this skill is not a new skill but an enhancement of an existing one. Even though I've only been writing programs in C for three years I've been writing programs in other programming languages such as BASIC for more than 10 years.

For FG Wilson I've written a number of programs and subroutines in C, the most important would be the Modbus communication protocol for Access 4000 (12 A4 Pages long). I started to design the Modbus test program before I started working on the protocol for Access 4000, and at a later date added new tests, selectable baud rate, etc... (25 A4 Pages long).

Many functions from the Modbus test program were reused in the CI panel test program (baudrate, readchar, sendchar etc...); hence programming time was reduced. This program carries out a simple loop back test on the communications of the CI panel (3 separate tests). I wrote two versions of an Access Annunciator Test program (one is for advanced users, the other is foolproof), which is used to test Annunciator communications.

The single most important skill I've gained is serial communications using C, and now have a good knowledge of several different types of communication protocols including various error checking methods. The most important thing to remember when writing any program is that you must have a good flexible program structure that is easy to read and reusable. Writing reusable code saves large amounts of time in future programs.



### **Microsoft Visual C++ 6.0**

Before my placement year I had never used this program and had never programmed in object orientated programming, so this is a new skill that I learned during my placement year. I downloaded final year notes for the OOP Module from the Internet and picked up the basics, but these notes were too simplistic for the real world. The best and quickest way of learning a new programming language is to look at example programs and play around with them.

I've written many windows based C++ programs during my placement at FG Wilson, I spent two weeks getting familiar with the language and operation of the application, then started work on my Access 4000 database program learning new concepts on the fly. The database program had to retrieve data directly from an MS Access \*.mdb file and lucky there was plenty of documentation on the web giving ideas on how to achieve this. There are many different ways for accessing \*.mdb files (SQL, ODBC, DAO, etc.) from stand alone C++ programs, I decided after some research that DAO was the best for this occasion.

After completion of my database program I created many small programs for FG Wilson. Load.exe and GenModbus.exe incorporated serial communications, which were completely different from the technique used in C. I discovered direct access to the hardware is not allowed under Windows NT.

Interaction with the serial port was achieved through a file handle and various WIN32 communication API's. This method is Windows 95 compatible.

Other Windows based C++ programs I developed include: Access 4000 language text editor, Serial Generator for Access 4000 Database program, Serial Generator for GenAccess 1.1.

I feel I've gained a powerful new skill, which will prove to be extremely useful in the future. Infact I have MS Visual C++ 6.0 installed on my home computer system and have already created small useful programs that I use on daily bases, such as "GateKeeper". I have detailed knowledge on serial communications and how to interact with Microsoft Access \*.mdb files.



### **Zuken CADstar 4.5**

This is a new skill; CADstar is the world leader in PCB design software. I spent one week familiarising myself with the software and followed a self-tech tutorial. Then I designed the relay board PCB for Access annunciator, prototype boards have since been manufactured and so far it has passed all tests. The relay board has two electric layers, major physic considerations such as board size and position of components, were taken very seriously. The design included a ground plane, space for heat sink, etc...

This is an important new skill, which will be extremely useful in future employment. I am capable of creating a PCB for almost any circuit, taking into consideration component positions (RF emissions, noise, and physical limitations), reducing noise by adding ground planes, Thickness of tracks (12 for small signals and 50 for GND and VCC), gaps between tracks (depended on voltage and current) etc...



### **AutoCAD Release 14**

Enhancement of an existing skill as AutoCAD was covered in my BTEC National Diploma in Engineering and I also have a City & Guilds certificate. I carried out many different jobs for FG Wilson in AutoCAD an example would be the front cover design for Access annunciator and push in labels.



### **Report Writing**

Enhancement of an existing skill as I have typed many reports both in my BEng and BTEC courses. I've typed many reports for FG Wilson; the two main ones are "Modbus Communications on Access 4000 – Technical Report" and "Access 4000 Database – Technical Report". The Modbus technical report is 57 pages long and the database technical report is 59 pages long, including front cover, contents, introduction, results, screen dumps, conclusions, appendixes etc... Many smaller reports are written regularly, it's important to clearly document your work.



### **People Skills**

Enhancements of people skills: such as working in a group, sharing of ideas, use of telephone and email on daily bases. One example would be when I demonstrated the capabilities of the ModBus communication protocol to a number of FG Wilson customers interested in making use of the protocol (See week 19 in logbook for details). As a result of my placement at FG Wilson I've gained valuable experience in developing my people skills, which will become useful throughout my future career as an engineer.



### Electronic Workbench 5.0a

Enhancements of an existing skill, as I have worked with electronic workbench in both BEng and BTEC courses in the past. Electronic Workbench is powerful circuit simulation software, which allows you to quickly and easily test ideas before building the circuit for real on bread or vero board. I have used the application many times to help test circuit ideas, simulating operating conditions, using virtual multimeter and virtual oscilloscope to check the circuit is operating as expected.



### Other skills, which have been gained or enhanced, include: -

- ◆ Soldering.
- ◆ Use electronic metering equipment such as Multimeters, Oscilloscopes, etc...
- ◆ Use of Microsoft Office including; Access, Word, PowerPoint, Excel, and Outlook.
- ◆ Internet searching.
- ◆ Technical jargon.
- ◆ Use of a diary to keep track of meetings etc...



### Note

Only some of the skills and experiences gained from my placement at FG Wilson are mentioned above, more detailed information can be found in my logbook. Overall I'm happy with the amount of experience and wide range of skills I've developed during my placement year at FG Wilson, which I should benefit from in my future career as an engineer.



### Influence on my career Planning

My placement year at FG Wilson has reinforced my ambition of becoming an engineer specialising in electronics and/or software. Ever since as far back as I can remember I've always been interested not just in the use of something, but how it works. I've also had a keen interest in computer programming and wrote my first small programs over 10 years ago on an Amstrad CPC 464 personal computer running BASIC.

A career as an engineer is a challenging one but the rewards are high. For example the Modbus communication protocol I developed for Access 4000 was challenging, but when finished the satisfaction of seeing it working correctly after the weeks of problems is a tremendous feeling of accomplishment, which makes all the hard work seem worthwhile. This feeling of accomplishment increased when the Modbus Protocol was officially released and included as standard with every new Access 4000 controller with software upgrades available for existing customers.

## **SECTION 6 – SUMMARY**

### **Seeking a Placement Organisation**

I gained valuable experience on how to prepare and participate in formal Interviews, as I attended a number of Job Interviews, including Digital, Yelo, ITI and FG Wilson.

ITI seemed Interested as I attended two Interviews; one formal and the other casual, but were to slow in making up their minds. I attended one Interview for FG Wilson; it was on Wednesday 19<sup>th</sup> July 2000, on Friday 21<sup>st</sup> I received a phone call from FG Wilson offering me placement. I accepted and started work on Monday 24<sup>th</sup> of July 2000. On Saturday 22<sup>nd</sup> of July I received a letter from ITI offering me placement, but by this time I was already placed and declined. Three other Interviews were cancelled first thing Monday morning.

FG Wilson had a number of important advantages over ITI, if I had received both offers at the same time I still would have picked FG Wilson over ITI. These Advantages included: pay (hourly rate, hence I get paid for overtime), 33 days Holiday pay, location (10-minute walk from house, hence no travel expenses). I've now been working in FG Wilson for some time and I'm sure I made the right choice.

### **Placement Experience**

I've gained a wide range of experience and self-confidence during my placement year. I was given my own desk, computer (including email and Internet access) and telephone on the first floor of the main office block. Also are group "Electronic Control Design" controls a small electronic lab, which I used on many occasions (building of prototypes, testing, etc...).

The work varied right across the engineering field, including Electronics (both Analogue and digital), Software (C, Visual C++, Visual Basic, Assembly) and Mechanical (AutoCAD). Are group "Electronic Control Design" is quite small, hence it's important to work as a team with ideas flowing freely throughout the group. I found the work challenging, but satisfying with a great feeling of accomplishment when finished.

### **FG Wilson gained from my Employment**

The Modbus communication protocol I developed has now been released and is included as standard with every new Access 4000 controllers, with software upgrades available for all existing Access 4000 customers. The Access 4000 Database program I developed has also been released and is in use daily by up to 60 engineers.

The Load program I developed for uploading \*txt (both configuration and language files) and \*s19 (main code) files to Access 4000 controller has now been released and has now replaced the old MS DOS based version, the program is already in use by hundreds of engineers across the world.

GenModbus the windows based master program I developed for monitoring an Access 4000 controller using Modbus communications, will be made available to all Access 4000 customers who can downloaded freely without charge from the Internet. This program is design to demonstrate fully all Modbus features, in a simple user-friendly environment.

The Access annunciator relay board PCB I design is due to be released soon, when released 1000s of them will be sold every year to all corners of the globe.

I've developed many other programs (e.g. Tel Panel communication Test, Access Annunciator communication Test, Modbus test program etc...) that have been released and are in use daily throughout FG Wilson, others will be released in the near future (e.g. Access 4000 language text editor).

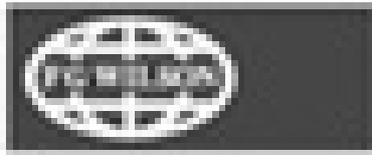
I feel that FG Wilson has benefited and will continue to benefit from the work I carried out long after my placement as been completed.

### **Comments on University's Placement Process**

Overall I'm satisfied with the placement process and have no major complaints, but there always room for improvement.

One aspect I disliked (inconvenience) was the use of a protected Microsoft Access \*.mde for the CV. The first problem was I'm running Microsoft Access 2000 on my home computer system and it refused to load it because it was a protect file. So I was forced to install Office 97, corrupting Office 2000. When I completed entering my details, I discovered I could not print the form, hence I was unable to create a hard copy. Another disadvantage was that you could not return to the form after data had been entered to check and if necessary make changes, the only way was to view the data in table form, which was not ideal. After completion of the CV I removed Office 97 and reinstalled Office 2000. The whole process took 3½ hours, while if the CV was in standard \*.mdb format it would of only took 10 minutes (As Access 2000 can load and save Access 97 \*.mdb files). I believe that there is room for improvement in the CV database system, making it easier to use and more compatible, as Microsoft Access 97 is old and obsolete.

## APPENDIX 1 – DIRECTIONS TO LARNE SITE



### DIRECTIONS TO LARNE SITE

10, Wilson, Old Downside Road  
Larne, Co Antrim, BT27 6JF  
Northern Ireland

For a complete map of the site visit [www.igps.com](http://www.igps.com)

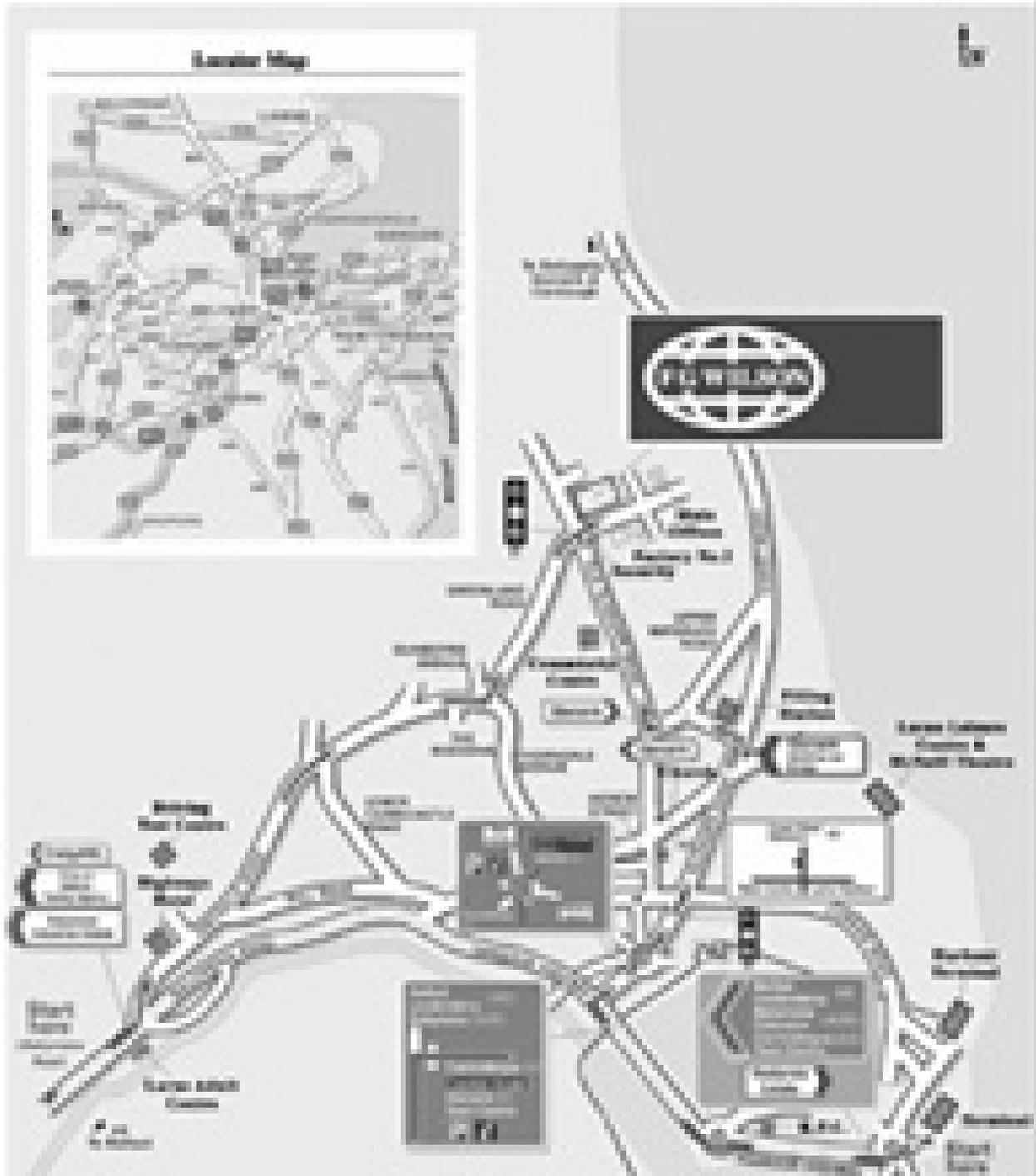
### Public Transport

**By Bus:**  
Bus 201 (Larne) is approximately 40 minutes from Larne. Bus 202 (Larne) is approximately 40 minutes from Larne.

**By Train:**  
Larne Station is approximately 10 minutes from Larne. Larne Station is approximately 10 minutes from Larne.

**By Taxi:**  
Larne Station is approximately 10 minutes from Larne. Larne Station is approximately 10 minutes from Larne.

**By Car:**  
Larne Station is approximately 10 minutes from Larne. Larne Station is approximately 10 minutes from Larne.



## APPENDIX 2 – DIRECTIONS TO MONKSTOWN SITE



100 Wilson, 170 South Road  
Monkstown, Co. Dublin, D18-002,  
Republic of Ireland

100 Wilson, 170 South Road  
Monkstown, Co. Dublin, D18-002,  
Republic of Ireland

Full contact details for our offices are available on our website

### Public Transport

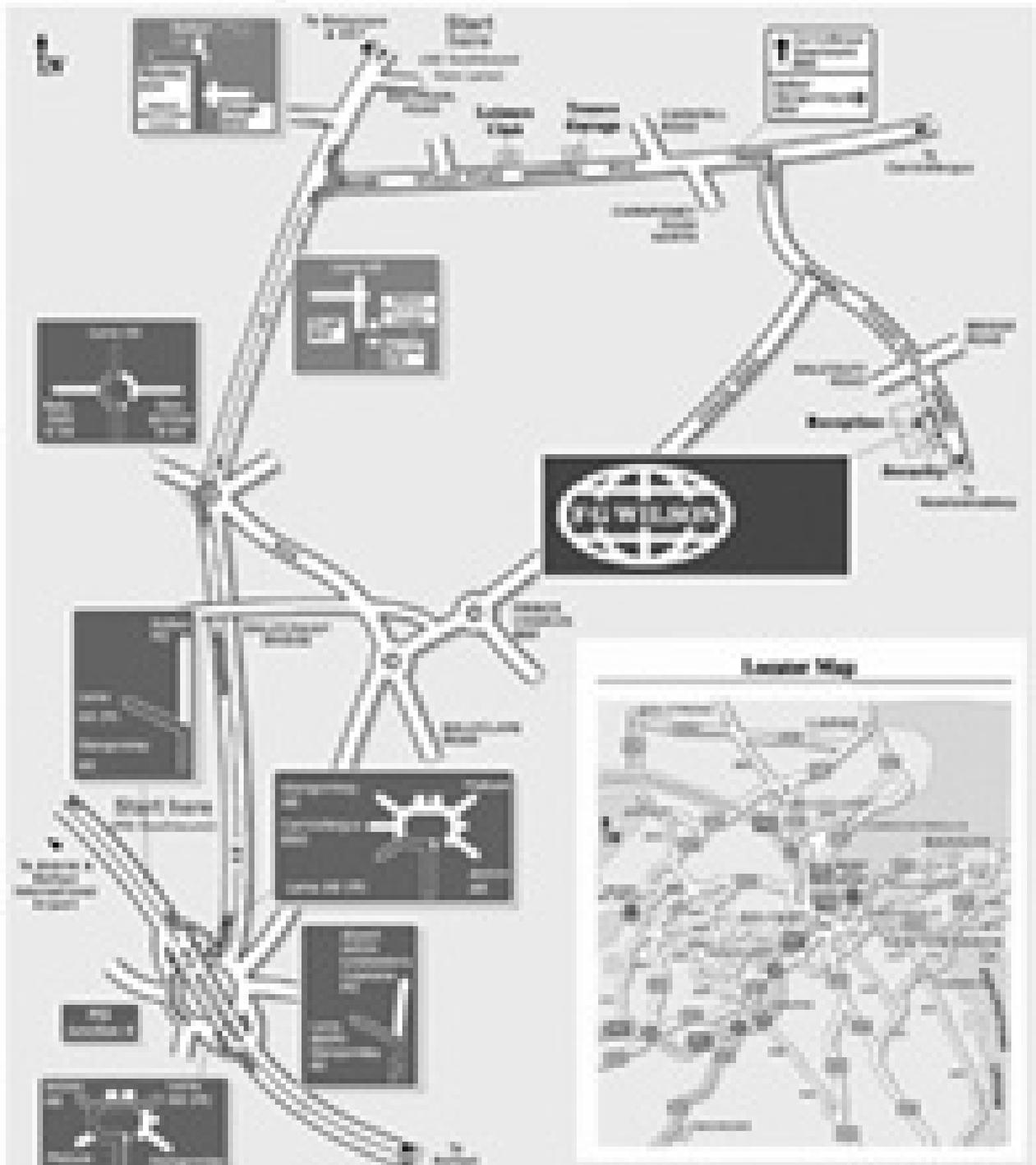


**By Bus**

Bus routes to Monkstown are approximately 10 minutes from the Dublin City Centre.  
Bus routes to Monkstown are approximately 10 minutes from the Dublin City Centre.

**By Train**

Trains to Monkstown are available from Dublin City Centre.

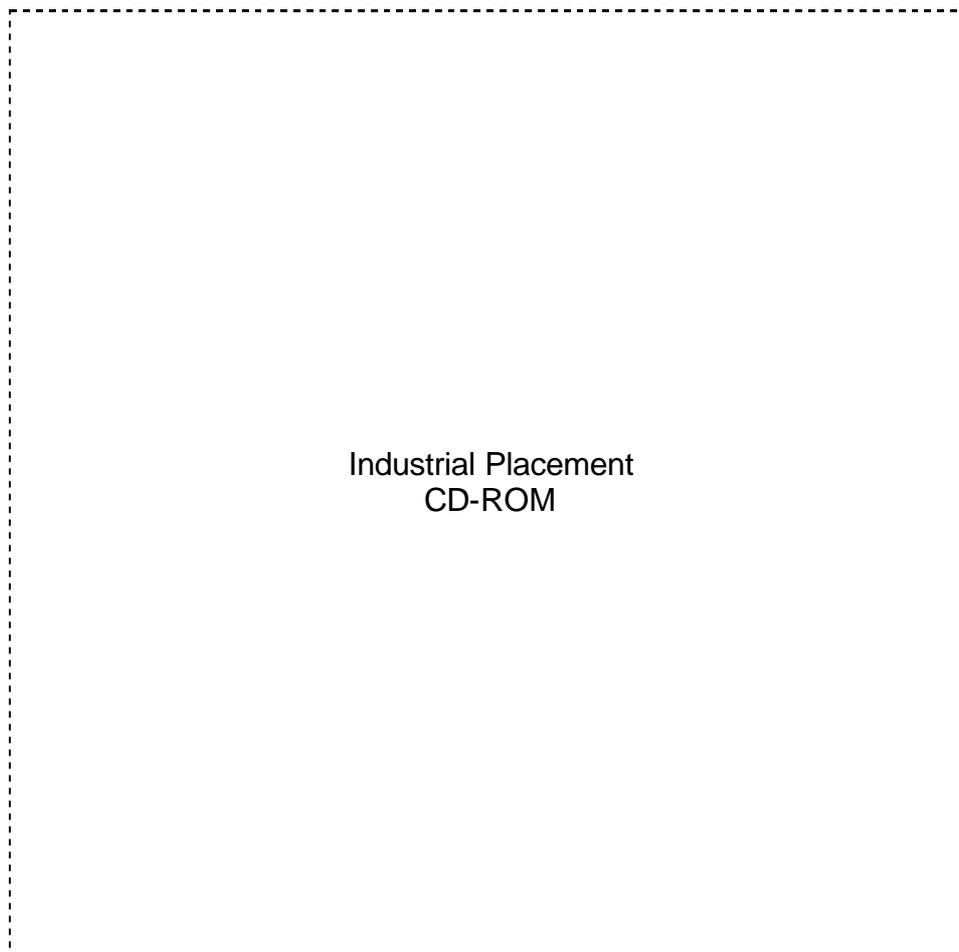




## **APPENDIX 4 – INDUSTRIAL PLACEMENT CDROM**

This CD-ROM contains lots of additional information about my placement experience at FG Wilson. The main document is a copy of my logbook to date, which has over 40 weeks of entries containing comprehensive information about the work I carried out for FG Wilson.

Other documents are included, for example my “ModBus Communications Protocol – Technical Report” and “Access 4000 Database Program – Technical Report” I wrote for FG Wilson are included. Note these documents are ©Copyrighted to FG Wilson, hence I’ve stored them in a protected PDF file with printing, editing, and text/graphic selection tools disabled.



A number of programs I’ve written in Visual C++ and C has been included; note the source code has not been included for ©copyright reasons. Many of these programs are ©copyright to FG Wilson and are for demonstration use only and cannot be used for commercial use without their authorization.

All documents are in PDF format; Adobe Acrobat reader 4.05 (or above) is required to view them. This freeware application is included on the CD and can be installed if required.

Many other useful files are included like: photos, web links, email addresses, maps, freeware and shareware applications.