

## PATENT ASSIGNMENT COVER SHEET

Electronic Version v1.1  
Stylesheet Version v1.2

EPAS ID: PAT4314689

<b>SUBMISSION TYPE:</b>	NEW ASSIGNMENT
<b>NATURE OF CONVEYANCE:</b>	TRANSFER OF RIGHTS BY OPERATION OF LAW
<b>CONVEYING PARTY DATA</b>	
<b>Name</b>	<b>Execution Date</b>
LEWIS FARRUGIA	03/30/2012
RYAN PEARSON	03/30/2012
<b>RECEIVING PARTY DATA</b>	
<b>Name:</b>	AIRBUS DEFENCE AND SPACE LIMITED
<b>Street Address:</b>	GUNNELS WOOD ROAD
<b>City:</b>	STEVENAGE, HERTFORDSHIRE
<b>State/Country:</b>	GREAT BRITAIN
<b>Postal Code:</b>	SG1 2AS
<b>PROPERTY NUMBERS Total: 1</b>	
<b>Property Type</b>	<b>Number</b>
<b>Application Number:</b>	15009789
<b>CORRESPONDENCE DATA</b>	
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<b>ATTORNEY DOCKET NUMBER:</b>	06154.P002U2
<b>NAME OF SUBMITTER:</b>	ROBERT KINBERG
<b>SIGNATURE:</b>	/Robert Kinberg/
<b>DATE SIGNED:</b>	03/10/2017
<b>Total Attachments: 23</b>	
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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

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In re Patent Application of:  
Lewis FARRUGIA et al.

U.S. Patent Application No.: 15/009,789

Art Unit: 2633

Filed: January 28, 2016

Examiner: Deppe, Betsy Lee

Confirmation No.: 6920

Atty. Docket No: 06154.002US2

For: MITIGATING A PHASE ANOMALY IN  
AN ANALOGUE-TO-DIGITAL  
CONVERTER OUTPUT SIGNAL

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Customer No:

**39564**

PATENT & TRADEMARK OFFICE

**TRANSFER OF RIGHTS BY OPERATION OF LAW**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Madam:

Lewis Farrugia, Ryan Pearson and Mark Gibson, all of Great Britain, are joint inventors of the invention described and claimed in the above-identified application. All inventors were employed by Astrium Ltd. (now named Airbus Defence and Space Ltd.), of Great Britain when the invention was made. An assignment of rights in the invention from Mr. Gibson to the employer Airbus Defence and Space Ltd. has been recorded in the U.S. Patent and Trademark Office Assignment Register. Inventors Lewis Farrugia and Ryan Pearson left the company before a written assignment of the invention was obtain and are presently unavailable for executing an assignment. However, as explained in the attached Statement of Robert Cork, a Chartered UK Patent Attorney, the law in Great Britain provides an invention made by an employee belongs to the employer if:

it was made in the course of the normal duties of the employee or in the course of duties falling outside his normal duties, but specifically assigned to him, and the circumstances in either case were such that an invention might reasonably be expected to result from carrying of his duties.

According to Mr. Cork' Statement, the above conditions are met, such that ownership of the invention belongs to the employer, Astrium Ltd., now Airbus Defence and Space Ltd. (see Appendix 2, PCT/IB/306, name change, attached to Mr. Cork's Statement).

More specifically, based on Mr. Cork's Statement and the appendices attached thereto, the invention was conceived as early as September 26, 2011, which is the date of the patent disclosure form submitted to Mr. Cork's law firm, Venner Shipley LLP, as evidenced by Appendix 1 to Mr. Cork's statement. The invention was subsequently constructively reduced to practice on March 30, 2012, as evidenced by the filing by Mr. Cork's firm of EP Application No. 12275035.9. Both inventors were employed by Astrium at the time the invention was conceived (see Appendix 3 attached to Mr. Cork's Statement) as a result of the inventors carrying out their normal duties and duties specifically assigned to them as part of their work on a specific project assigned to them, namely the Calibration Investigation project identified by code F71433.371, in Fig. 4 of Appendix 3 titled "Statement of Background to Patent Filing" prepared by Ralph Green, Research and Development Manager, Communications Products, Space Systems, Airbus Defence and Space Ltd. attached as an appendix to the Statement of Robert Cork referenced above.

In view of the above, the rights of this invention transferred by operation of law in Great Britain from inventors Farrugia and Pearson to their employer Astrium Limited, now known as Airbus Defence and Space Ltd., at least as early as March 30, 2012, which is the date the invention was made by virtue of the constructive reduction to practice upon the filing of EP Application No. 12275035.9. It is therefore requested that this transfer of rights be recorded in the U.S. Patent and Trademark Office Assignment Register, effective as of March 30, 2012.

Dated: March 10, 2017

Respectfully submitted,

Electronic signature: /Robert Kinberg/  
Robert Kinberg  
Registration No. 26,924  
FisherBroyles LLP  
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Attorney/Agent For Applicant

Attachments:

- Statement by Robert Cork
- Appendix 1. Copy of patent proposal form
- Appendix 2. Copy of Form PCT/IB/306 for PCT/EP2013/056397
- Appendix 3. Copy of a statement by Ralph Green

## **Statement on UK law in relation to rights to employees' inventions**

I, Robert Francis Cork of 54 Tennyson Avenue, New Malden, Surrey KT3 6LZ, UK

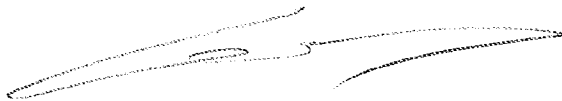
do solemnly and sincerely declare as follows:

1. I am a Chartered UK Patent Attorney, having been elected a Fellow of the Chartered Institute of Patent Attorneys on 14 October 2011, and am therefore qualified to advise on matters in relation to UK patent law.
2. Under section 39(1)(a) of the UK Patents Act 1977, reproduced in full below, inventions made in the course of employment are considered to belong to the employer:

39.-(1) Notwithstanding anything in any rule of law, an invention made by an employee shall, as between him and his employer, be taken to belong to his employer for the purposes of this Act and all other purposes if –

  - (a) it was made in the course of the normal duties of the employee or in the course of duties falling outside his normal duties, but specifically assigned to him, and the circumstances in either case were such that an invention might reasonably be expected to result from the carrying out of his duties;
3. On 3 October 2011, my firm (Venner Shipley) received instructions from our client, Astrium Limited, to draft and file a European (EP) patent application for a new invention relating to mitigating a phase-delay anomaly in analogue-to-digital converters. A copy of the patent proposal form, dated 26 September 2011 and naming Lewis Farrugia, Mark Gibson and Ryan Pearson as inventors, is included in the attached Appendix (Item 1).
4. On the basis of the information provided in the patent proposal form, Venner Shipley proceeded to draft a new EP patent application for the invention. The EP patent application was filed at the European Patent Office on 30 March 2012, and was given the official application number 12275035.9.
5. A PCT application claiming priority from EP12275035.9 was filed on 26 March 2013, and was given the official application number PCT/EP2013/056397.

6. On 1 July 2014, Astrium Limited changed its name to Airbus Defence and Space Limited, and the change of name of the Applicant for PCT/EP2013/056397 was recorded during the International phase. A copy of Form PCT/IB/306, dated 5 September 2014, is included in the attached Appendix (Item 2).
7. PCT/EP2013/056397 entered the US national phase on 30 September 2014, and the US national phase application was given the official application number US 14/502938. The present application (US 15/009,789) is a continuation of US 14/502938.
8. On the basis of the information provided in the attached statement by Ralph Green (Item 3 in the Appendix), it is my belief that at the time the invention was made, Lewis Farrugia, Mark Gibson and Ryan Pearson were all employed by Astrium Limited.
9. On the basis of the information provided in the attached statement by Ralph Green, it is furthermore my belief that the invention arose not only as the result of the inventors carrying out their normal duties within the ASP4 Engineering business unit, as shown in Fig. 2 in Item 3, but moreover as the result of the inventors carrying out duties specifically assigned to them as part of their work on the Calibration Investigation project, identified by the code F71433.371 in Fig. 4 of Item 3.
10. For at least the reasons set out above, it is my belief that under the UK Patents Act 1977, Astrium Limited is the first owner of the invention as described in EP12275035.9, and that Airbus Defence and Space Limited is therefore entitled to be granted a US patent to the invention based on US 15/009,789, as the sole owner.



.....  
SIGNED by Robert Cork, Chartered UK Patent Attorney and European Patent Attorney,

on 9 MARCH 2017

**Appendix**

1. Copy of patent proposal form
2. Copy of Form PCI/IB/306 for PCT/EP2013/056397
3. Copy of a statement by Ralph Green

# APPENDIX 1

astrium	ADS	Ref. : ADS.E.0185 Issue : 1 Rev. : Page : 1 / 9
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## PATENT PROPOSAL

Date : 26<sup>th</sup> September 2011

Case n° : nnnn (for patent office use)

**Title of Invention :** *(Meaningful to you and your colleagues, even in several years' time)*

**Systematic mitigation of the phase-delay anomaly with signal power of analogue-to-digital converters – dynamic post-correction scheme**

**Summary :** *(Briefly describe the purpose of the invention and the main claims which are made)*

Unexpected and anomalous phase-delay measurements returned by the DSP Calibrator, during its engineering development, and quickly attributed to previously undocumented behaviour within the analogue-to-digital converter specifically under conditions of large wanted input signal dynamic range, have provoked the need for economic mechanisms which systematically prevent, correct or at least mitigate these effects in the context of the precise measurement of phase-angle between a test CW tone and a given reference CW signal of identical frequency, using a synchronous quadrature correlation method.

This proposal describes one mechanism which claims to post-correct the phase-delay measurement anomalies with changing ADC signal load, arising out of the intrinsic behaviour of the ADC transducer itself. It is further claimed that improved correction precision may be achieved through the use of higher order variants of the basic correction scheme, at the expense of more elaborate parametric optimisation and real-time computational costs.

The basic concept behind the dynamic post-correction mechanism proposed here includes generating a real-time estimate of the postulated interferer within the digital domain, applying an appropriate scaling and rotation to this estimate, and subsequently correlating the scaled and rotated estimated interferer with an identical correlator to the main measurement correlator, thus generating in-phase and quadrature corrections. The final step involves I/Q subtraction of the derived corrections from the uncorrected I/Q outputs of the main measurement correlator prior to computing the desired phase-angle via an arctangent block such as a CORDIC. *See attached details at end of this proposal.*

**Deadline :** *(Is the invention to be disclosed outside Astrium UK? Please state when and to whom)*

Discussions with Test & Measurement vendors such as Agilent Technologies, Tektronix, LeCroy and Rohde & Schwarz along these lines are planned during 2012 Q1.

**Project/Product :** *(Is the invention to be used or proposed for a particular product/project ?)*

Future DSP/IP calibrators for systems requiring stricter phase tracking than Alphasat; any instrument requiring very precise measurement of phase-angle or phase-delay;

**Inventor(s) :** *(Full names, Astrium addresses and telephone numbers – Indicate inventor responsible for technical queries with an asterisk \*)*

Inventors: Lewis Farrugia(\*), Mark Gibson, Ryan Pearson

The copyright in this document is the property of Astrium SAS/Ltd/GmbH and the contents may not be reproduced or revealed to third parties without prior permission of that company in writing.

CharNb 14119  
 WordNb 2497  
 Filename 20110926\_Systematic\_mitigation\_of\_ADC\_phase-delay\_anomaly\_Patent  
 Proposal Form\_01.doc

**PATENT**  
**REEL: 041994 FRAME: 0599**



**Recommended Filings** : (State the country in which this patent is to be filed initially, and indicate propose foreign filings, e.g US, UK, F, D or European)

EU,UK,US

<b>Supported by</b> : APP	<b>Authorised</b> : Corporate
Ralph Green <b>Date</b> :	<b>Date</b> :

## DETAILS TO ENABLE EVALUATION OF PATENT PROPOSAL AND DRAFTING OF PATENT APPLICATION

This standard form shall be used to collect the answers to the check list and provide sufficient information in order to consider commencing the process of patent drafting. If you cannot answer a particular question, enter "not known". It is appreciated that tight deadlines on disclosure dates may require action to be taken at risk. However it is essential that all relevant information must be supplied as soon as possible.

### Note

Please explain any abbreviations, jargon or acronyms used in the description and, if it contains mathematical equations, ensure that every symbol used is identified. Please proof read the description (in particular, please ensure that any mathematical equations used are correct).

### PART 1: SUPPORTING INFORMATION

#### 1.1 DATE INVENTION MADE

September 2009

#### 1.2 DATE INVENTION PROVED

Partially proven during October 2009, but then de-prioritised due to flight programme pressures.

#### 1.3 OWNERSHIP

Astrium Ltd.; the idea has not been disclosed outside of the company.

#### 1.4 CONTRACTS

The development was part of the Alphasat DSP/IP flight programme.

#### 1.5 SECURITY CLASSIFICATION

Unclassified

#### 1.6 BUSINESS CASE

This invention has potential exploitation by all components of Astrium and indeed EADS, wherever there is a need for the precise measurement of phase-angle or phase-delay, for example but not exclusively, in the precise phase-tracking of beam-formed telecommunications payloads, and the calibration of navigation and radar payloads. Outside of the company, instrument manufacturers may apply this invention to the design of test equipment used in the verification and validation of complex systems.

#### 1.7 POTENTIAL EXPLOITATION

The invention could be exploited in the design of advanced vector network analysers, vector signal analysers, high-order digital modulation analysers and in any instrument where the accurate transduction of phase-angle over a large dynamic range of the input signal through an analogue-to-digital converter sensor

is core to the measurement of interest.

## 1.8 EXPERTS

*Agilent Technologies, LeCroy, Rohde & Schwarz, Tektronix.*

## PART 2: DESCRIBING YOUR INVENTION

### 2.1 TECHNICAL FIELD

The idea relates to the post-correction by algorithmic means (fixed or programmable) within digital hardware of the phase-delay anomaly with input signal power inherent within analogue-to-digital converters.

### 2.2 PRIOR ART

The topic of prior art has been extensively researched as part of the preparatory work leading up to this disclosure and reported in two deliverable documents referenced below.

#### **RP-DG0125795-ASTR Systematic mitigation of the phase-delay anomaly with signal power of analogue-to-digital converters – Patent Survey**

The above-referenced document describes the purpose, process and results of a Patent Survey with respect to this Astrium disclosure. Within the limits of the time and resources available, the conclusion is that no prior art exists in the public domain which would have a date priority on the disclosure described in this application.

#### **RP-DG0125796-ASTR Systematic mitigation of the phase-delay anomaly with signal power of analogue-to-digital converters – Literature Survey**

The above-referenced document shows that whilst the study and mitigation of the dynamic nonlinearities present in ADCs is still an active area of research, with the test, measurement and metrology sections of the electronic engineering community being the most active in this field, there is an almost exclusive focus on amplitude measurements. There appears to be little coverage of the modelling or mitigation of phase anomaly effects in the published literature.

The link that has been made within Astrium between the behaviour of an interferer described as arising from the Hamming code-weight, or its time derivative, is singularly absent from all the searched abstracts. This is believed to offer a key into resolving this issue since the interferer thus described, occurs precisely at the frequency of the fundamental, and with an intensity which is relatively decoupled from the fundamental's amplitude.

Another lacuna in the survey results is the topic of studying, mitigating or preventing particular classes of dynamic errors arising from the coupling of digital-to-analogue, especially from the point of view of IC design and manufacture.

None of the papers considered took a correlation approach, and in this the Astrium approach can be described as innovative, if refined sufficiently to operate over a wide dynamic range of signal amplitude.

It is interesting to note that large commercial companies involved in test and measurement such as Agilent, LeCroy, Rohde and Schwarz, and Tektronix are publically silent on this matter.

### 2.3 SUMMARY OF YOUR INVENTION

The core of the idea presented here is the correction of the phase-delay anomaly inherent in ADCs subject to digital-to-analogue crosstalk interference, using estimates of the interferer's amplitude and phase obtained by real-time synchronous correlation.

A practical realisation of the dynamic post-correction mechanism proposed here includes generating a real-time estimate of the postulated interferer within the digital domain, applying an appropriate amplitude scaling and phase rotation to this estimate, and subsequently correlating the scaled and rotated estimated interferer with an identical correlator to the main measurement correlator, thus generating in-phase and quadrature corrections. The final step involves the I/Q subtraction of the derived corrections from the uncorrected I/Q outputs of the main measurement correlator prior to computing the desired phase-angle via an arctangent block such as a CORDIC.

The invention described here addresses in a way that has not been generally described in the open literature to this point, a pathology in the behaviour of ADCs when measuring phase-angle. The empirical observations indicate that ADCs from different vendors and with different internal micro-architectures return phase-angle measurements which vary in a non-monotonic and highly nonlinear manner when subjected to changes in the input signal power.

The invention described here relies on the novel manner with which the interferer is described, thus making it amenable to being accurately estimated at little cost, directly from the ADC's output code words.

A further innovation is that the effect of the interference upon the phase-angle measurement, in the simplest case, is reduced to a dependency upon just two parameters, an amplitude scaling parameter and a phase rotation parameter, allowing for an economical realisation in hardware. However this does not represent an upper limit to the complexity and therefore to the improvement in precision that is potentially available from this technique. By postulating an interference mechanism that depends upon more factors, such as a non-uniform dependency upon each individual bit of the ADC's code word, and expending more effort in optimising the model parameters, a more sensitive version of the post-correction scheme may be constructed.

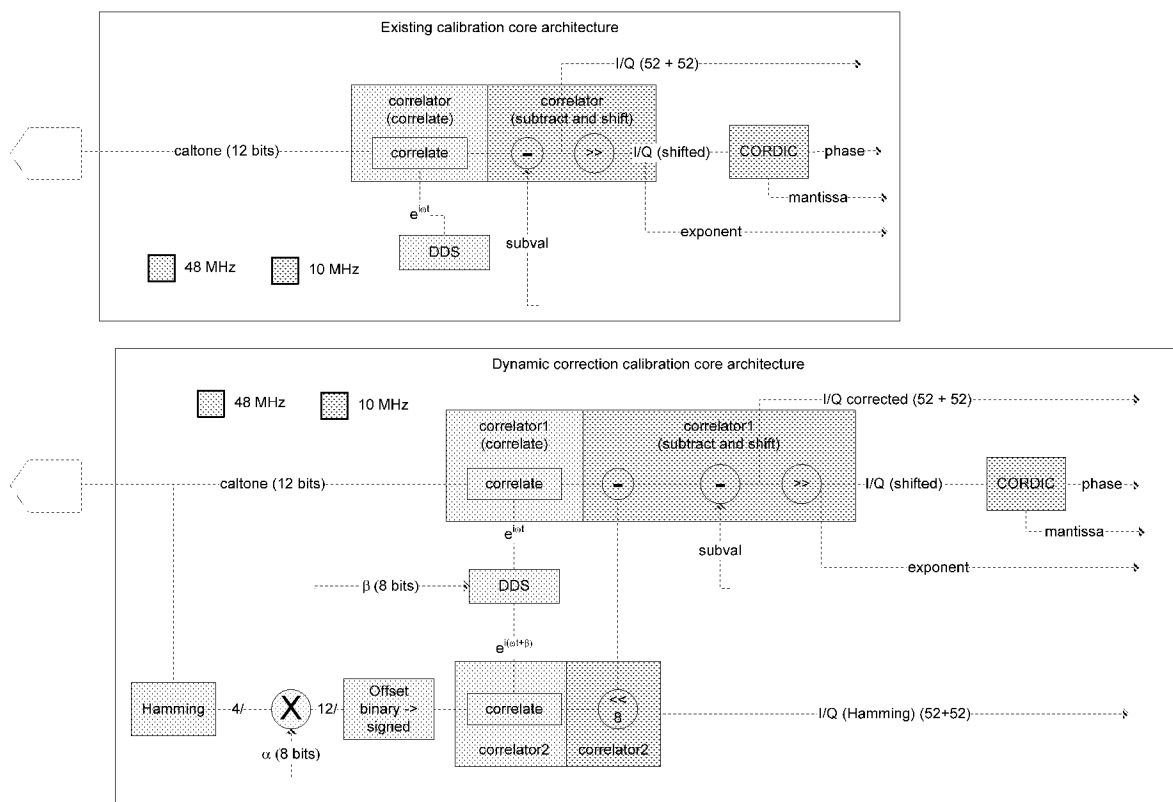
It may be envisaged that using higher orders and degrees of the fundamental Hamming description could lead to very powerful correction mechanisms being proposed in the future.

## 2.4 DETAILED EMBODIMENT OF YOUR INVENTION

The detailed embodiment of the invention is described in a separate deliverable document referenced here below.

### RP-DG0125797-ASTR Systematic mitigation of the phase-delay anomaly with signal power of analogue-to-digital converters – Initial Disclosure 01

The block diagram below is taken from the above document, and shows a comparison between an uncorrected synchronous correlator intended for phase-angle/delay measurement (top) and one realisation of the corrected version using the ideas contained in this proposal. Specifically, the sampling and wanted tone frequencies, as well as all the digital bus widths and associated arithmetic precisions shown in the block diagram below are given here as exemplars.



For reasons of hardware efficiency and observability of the correlation output of the estimated interferer, the architecture shown in the block diagram implements the scaling upstream of the correlator and rotates the internal quadrature references.

It is possible to envisage many other variants accomplishing the same function, but which optimise other features of the hardware realisation.

## GUIDANCE NOTES

### 1.1 DATE INVENTION MADE –

*approximate date the invention was first made or recorded*

### 1.2 DATE INVENTION PROVED –

*e.g. by making prototype, conducting experiment, performing simulation*

### 1.3 OWNERSHIP –

*Please give details of any other parties which may have a claim to ownership of the invention*

*Have you disclosed, to a third party, all or part of the invention already? If so, was the disclosure covered by a formal confidentiality agreement?*

*Is it valid? Are you aware of any existing patents, or published articles, relating to your invention?*

### 1.4 CONTRACTS –

*Does Astrium own the invention or was it funded, in whole or in part, by a customer, e.g. ESA? please give details*

### 1.5 SECURITY CLASSIFICATION –

*All patent applications are reviewed by the UK and French authorities to assess their significance in respect of national security. Is the invention likely to be classified (e.g. secret)? A security classification may negate any commercial prospects.*

### 1.6 BUSINESS CASE –

*What business units/products that will benefit from the invention?*

*What is the value to the Company? What commercial return is predicted?*

*Is it genuinely new? Does it rely on or merely improve on an existing idea?*

*Is it policeable? Would anyone notice if the patents were to be infringed?*

*Are we protecting or enhancing Company prestige? Will simple publication of the invention suffice?*

*Do we plan to subvert possible competitor advantage? What is the competition and its strength? Is simple publication sufficient?*

*Are the claims of the invention robust? Could a competitor avoid the patent by adopting an alternative approach?*

### 1.7 POTENTIAL EXPLOITATION –

*Please outline any potential license/spin-out company opportunities that ASTRIUM may benefit from that exploit your invention.*

### 1.8 EXPERTS –

*Who are the experts in the associated technology fields, both internal and external to ASTRIUM?*

## 2.1 TECHNICAL FIELD

- Describe in a sentence or two the technical field to which the invention relates (e.g. drilling holes in Aluminium alloys using a pulsed laser).

## 2.2 PRIOR ART

- The patent specification will tell the story of your invention – most inventions address a problem and this will be described in the patent application with respect to what was known by the public at the time the invention was made (a.k.a. the 'prior art').
- Hence, please provide a paragraph or two explaining what was known by the public (i.e. not just internally within ASTRIUM) at the time the invention was made. Please give any references of any technical literature (and copies where available) which supports this information.
- In particular, stress the problems with the prior art that your invention addresses

## 2.3 SUMMARY OF YOUR INVENTION

- Describe in a few paragraphs what your invention is/does. Summarise how it works. Try to describe this broadly and conceptually.
- In addition, remember to mention why or how your invention is an improvement on the existing technology, i.e. how it solves the problems you described with respect to the prior art
- Please flag the features of your invention that you consider to be new. Explain what it is about your invention that is special, clever and/or surprising.
- Also indicate which features of your invention are essential, particularly those that are essential to solve the problem(s) of the prior art.
- To avoid infringing the patent we will eventually obtain, our competitors will try to use alternatives to features of your invention that are not described in the patent specification. You should perform the same exercise – please describe any alternative features that you envisage and how they function. This includes any alternative uses and applications that the invention might have.

## 2.4 DETAILED EMBODIMENT OF YOUR INVENTION

- Under 2.3 above, a broad and conceptual description is requested. In addition, a detailed and specific description of an embodiment of your invention is required.
- Hence, provide a description of at least one reasonably practical embodiment of the invention together with drawings or sketches showing its construction and/or operation (i.e. if there is a demonstrator or prototype, describe it).
- If you have tested your invention, briefly describe the tests and provide any resulting data. Include comparative tests.

- *Inventors often seem unwilling to provide an embodiment in sufficient detail - the importance of the inventor providing a sufficient level of detail cannot be overemphasised. Inventors should aim to provide a written description at a similar level of detail as if it were to be the script of a presentation to explain the invention to an audience which is intelligent but with only a limited understanding of the relevant technical field. Remember, a picture saves a thousand words - and it need only be a sketch, precise engineering drawings are not required and, indeed, may be unsuitable.*
- *If more than one embodiment is currently being considered, please provide a description of all contemplated embodiments.*
- *Please describe any modifications or developments of the embodiment(s) that are envisaged.*



From the INTERNATIONAL BUREAU

**PCT**NOTIFICATION OF THE RECORDING  
OF A CHANGE(PCT Rule 92*bis*.1 and  
Administrative Instructions, Section 422)

To:

CORK, Robert  
Vanner Shipley LLP  
200 Aldersgate  
London EC1A 4HD  
ROYAUME-UNIRECEIVED  
12 SEP 2014

Date of mailing ( <i>day/month/year</i> ) 05 September 2014 (05.09.2014)		
Applicant's or agent's file reference RFC64682PCT1	<b>IMPORTANT NOTIFICATION</b>	
International application No. PCT/EP2013/056397	International filing date ( <i>day/month/year</i> ) 26 March 2013 (26.03.2013)	
1. The following indications appeared on record concerning:		
<input checked="" type="checkbox"/> the applicant <input type="checkbox"/> the inventor <input type="checkbox"/> the agent <input type="checkbox"/> the common representative		
Name and Address ASTRIUM LIMITED Gunnels Wood Road Stevenage Hertfordshire SG1 2AS United Kingdom	State of Nationality GB	State of Residence GB
	Telephone No.	
	Facsimile No.	
	E-mail address	
2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:		
<input type="checkbox"/> the person <input checked="" type="checkbox"/> the name <input type="checkbox"/> the address <input type="checkbox"/> the nationality <input type="checkbox"/> the residence		
Name and Address AIRBUS DEFENCE AND SPACE LIMITED Gunnels Wood Road Stevenage Hertfordshire SG1 2AS United Kingdom	State of Nationality GB	State of Residence GB
	Telephone No.	
	Facsimile No.	
	E-mail address <input type="checkbox"/> Notifications by e-mail authorized	
3. Further observations, if necessary:		
4. A copy of this notification has been sent to:		
<input checked="" type="checkbox"/> the receiving Office <input type="checkbox"/> the International Preliminary Examining Authority <input type="checkbox"/> the International Searching Authority <input checked="" type="checkbox"/> the designated Offices concerned <input type="checkbox"/> the Authority(ies) specified for supplementary search <input type="checkbox"/> the elected Offices concerned <input type="checkbox"/> other:		
The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer  Nissen Diana e-mail diana.nissen@wipo.int Telephone No. +4122 338 8054	
Facsimile No. +41 22 338 82 70		

Re: Assignment issue - VS1055 'SYSTEMATIC MITIGATION OF ADC PHASE-DELAY ANOMALY'

Lewis Farrugia, Mark Gibson, Ryan Pearson

**Statement of Background to Patent Filing - Ralph Green Research and Development Manager Communications Products, Anchorage Road, Portsmouth, PO3 5PU.**

Both Lewis Farugia (Astrium Payrole Number 3809) and Ryan Pearson (Payrole Number 161683) were full time employees in Astrium Payload Equipment (ASP) business during the period the invention was made and proven in September and October 2009 and arose as part of their normal employment tasks while they were working within the ASP 4 Engineering Group Headed by Dave O'Connor shown in Figure 1 below. They were working on a digitally signal processed (DSP) telecommunications satellite development funded with company R&D investment, this DSP was subsequently placed into Geo Synchronous orbit on the European Space Agency developed "Alphasat" platform.

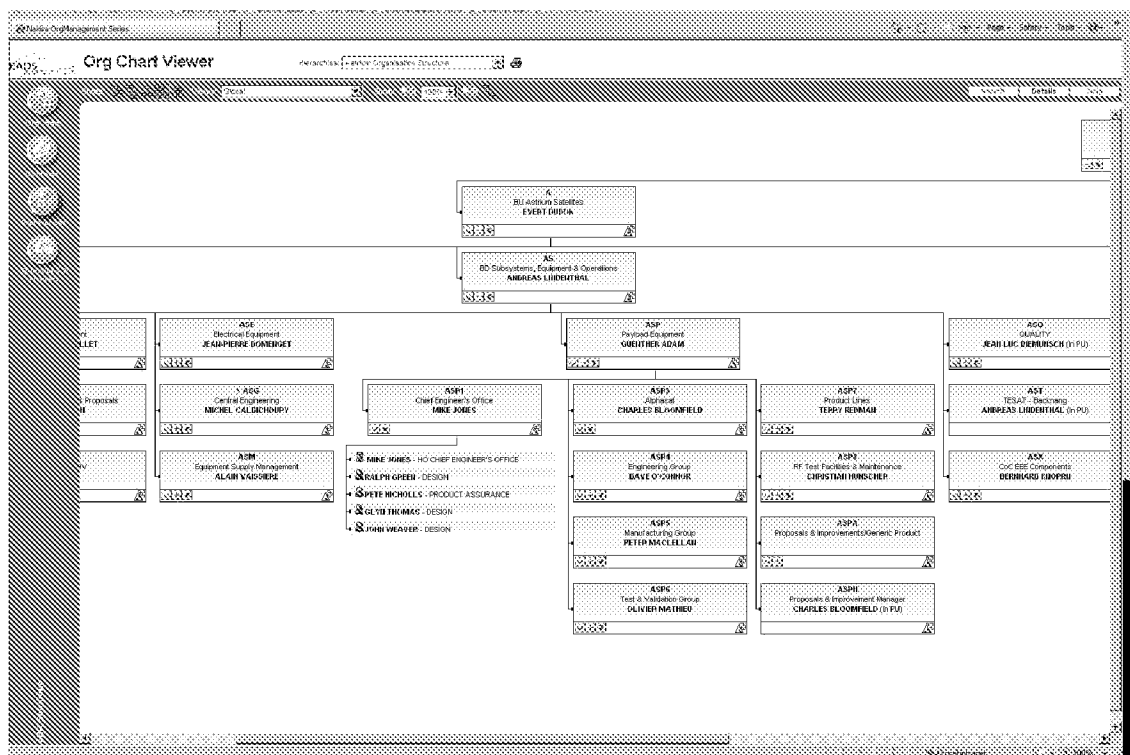


Figure 1: ASP organisation

At that time Lewis Farugia and Ryan Pearson are employees as indicated on the ASP 4 Engineering Organisational Chart shown in Figure 2 below

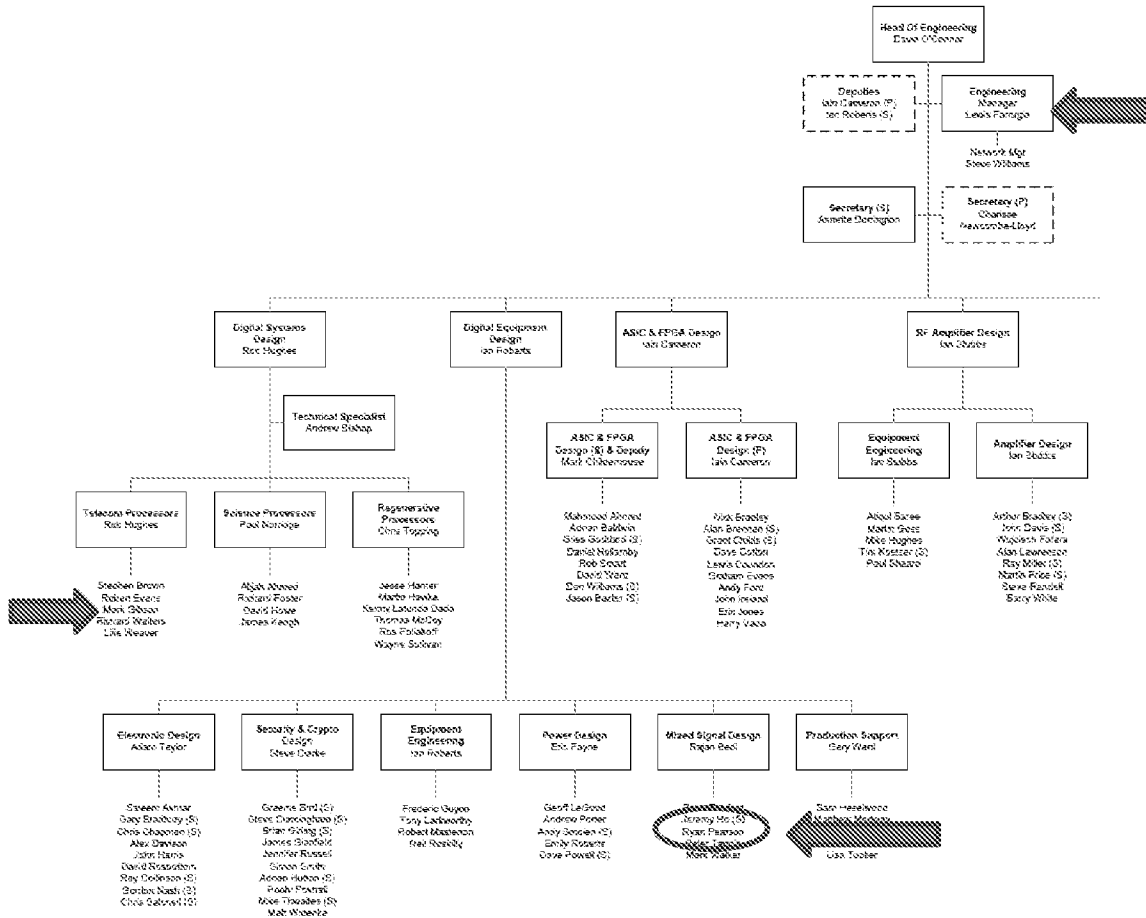
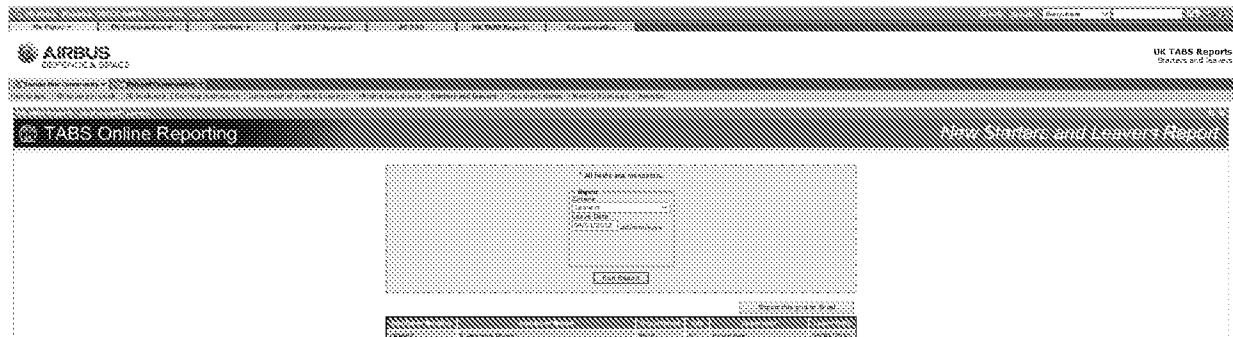


Figure 2: ASP4 Engineering organisation as of June 2009 [(S) indicates Sub-contractor

Both inventors were employed by the company until after the patent proposal was submitted

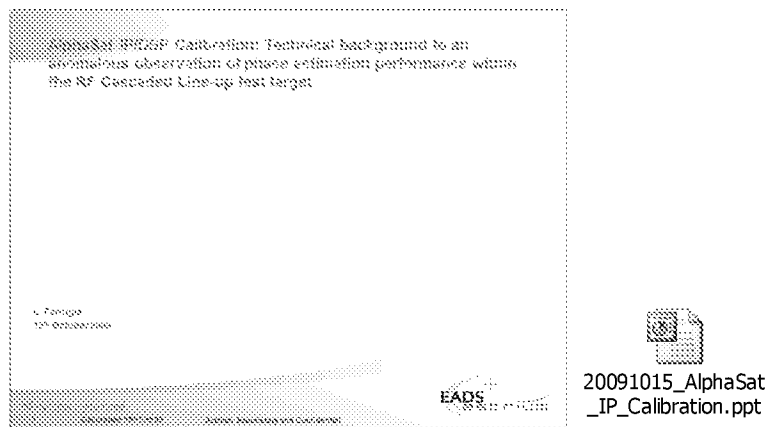
Ryan Pearson left the company on 5<sup>th</sup> January 2012



Lewis Farugia left the company on 29<sup>th</sup> July 2016



The inventors were specifically investigation calibration techniques associated with this DSP payload. An initial internal presentation on the findings was made by Lewis Farugia on 15<sup>th</sup> October 2009, attached as illustrated in Figure 3 which was referred to in the patent proposal of 26<sup>th</sup> September 2011 in the section 1.1 date of invention and 1.2 date invention proved.



**Figure 3: Title Page of Internal presentation on Initial Findings October 2009 and embedded file**

Below is an extract of employee bookings in 2009 from the company time recording system Figure 4 taken from Figure 5 for Lewis Farugia and Figure 6 for Ryan Pearson booking to F71433.371 which was the code assigned to the work on the Calibration Investigation.

Period	Department	Employee Number	SAP Number	Employee Name	Project	Charge Code	Hours	Date Uploaded
935	8673	3809	8034126	Farrugia L	F71433	371	- 36.33	13/12/2009
935	8673	3809	8034126	Farrugia L	F71433	371	36.33	06/09/2009
935	8678	161683	8035161	Pearson R	F71433	371	41.17	06/09/2009
935	8678	161683	8035161	Pearson R	F71433	371	- 41.17	13/12/2009
936	8673	3809	8034126	Farrugia L	F71433	371	30.33	06/09/2009
936	8673	3809	8034126	Farrugia L	F71433	371	- 30.33	13/12/2009
936	8678	161683	8035161	Pearson R	F71433	371	31.38	06/09/2009

936	8678	161683	8035161	Pearson R	F71433	371	- 31.38	13/12/2009
937	8673	3809	8034126	Farrugia L	F71433	371	- 40.87	13/12/2009
937	8673	3809	8034126	Farrugia L	F71433	371	40.87	13/09/2009
937	8678	161683	8035161	Pearson R	F71433	371	- 38.88	13/12/2009
937	8678	161683	8035161	Pearson R	F71433	371	38.88	20/09/2009
938	8673	3809	8034126	Farrugia L	F71433	371	36.72	04/10/2009
938	8673	3809	8034126	Farrugia L	F71433	371	- 36.72	13/12/2009
938	8678	161683	8035161	Pearson R	F71433	371	- 40.15	13/12/2009
938	8678	161683	8035161	Pearson R	F71433	371	40.15	20/09/2009
939	8673	3809	8034126	Farrugia L	F71433	371	- 44.65	13/12/2009
939	8673	3809	8034126	Farrugia L	F71433	371	44.65	04/10/2009
939	8678	161683	8035161	Pearson R	F71433	371	- 43.93	13/12/2009
939	8678	161683	8035161	Pearson R	F71433	371	43.93	04/10/2009
940	8673	3809	8034126	Farrugia L	F71433	371	39.42	04/10/2009
940	8673	3809	8034126	Farrugia L	F71433	371	- 39.42	13/12/2009
940	8678	161683	8035161	Pearson R	F71433	371	-33.7	13/12/2009
940	8678	161683	8035161	Pearson R	F71433	371	33.7	04/10/2009
941	8673	3809	8034126	Farrugia L	F71433	371	42.13	18/10/2009
941	8673	3809	8034126	Farrugia L	F71433	371	- 42.13	13/12/2009
941	8678	161683	8035161	Pearson R	F71433	371	40.63	18/10/2009
941	8678	161683	8035161	Pearson R	F71433	371	- 40.63	13/12/2009
942	8673	3809	8034126	Farrugia L	F71433	371	- 40.62	13/12/2009
942	8673	3809	8034126	Farrugia L	F71433	371	40.62	18/10/2009
942	8678	161683	8035161	Pearson R	F71433	371	39.42	18/10/2009
942	8678	161683	8035161	Pearson R	F71433	371	- 39.42	13/12/2009
943	8673	3809	8034126	Farrugia L	F71433	371	23	25/10/2009
943	8673	3809	8034126	Farrugia L	F71433	371	-23	13/12/2009
943	8678	161683	8035161	Pearson R	F71433	371	29.27	25/10/2009
943	8678	161683	8035161	Pearson R	F71433	371	- 29.27	13/12/2009
944	8673	3809	8034126	Farrugia L	F71433	371	40.63	01/11/2009
944	8673	3809	8034126	Farrugia L	F71433	371	- 40.63	13/12/2009
944	8678	161683	8035161	Pearson R	F71433	371	37.42	01/11/2009
944	8678	161683	8035161	Pearson R	F71433	371	- 37.42	13/12/2009

Figure 4: Extract of the Employee Time booking for Calibration Investigation :L Farugia & R Pearson

Figure 5: Copy of the Employee Time booking for Calibration Investigation – L Farugia

Figure 6: Copy of the Employee Time booking for Calibration Investigation – L Farugia

Report

Change Date

Booking Month

Run Report

Display this data in Excel

Year	Month	Day	Employee Name	Job Title	Rate	Hours	Amount	Start Date	End Date
2007	08	01	LA Saver S D	751423	273	88.83	130120000		
2007	08	02	LA Saver S D	751423	273	88.83	130190000		
2007	08	03	LA Saver S D	751423	273	88.83	130260000		
2007	08	04	LA Saver S D	751423	273	88.83	130330000		
2007	08	05	LA Saver S D	751423	273	88.83	130400000		
2007	08	06	LA Saver S D	751423	273	88.83	130470000		
2007	08	07	LA Saver S D	751423	273	88.83	130540000		
2007	08	08	LA Saver S D	751423	273	88.83	130610000		
2007	08	09	LA Saver S D	751423	273	88.83	130680000		
2007	08	10	LA Saver S D	751423	273	88.83	130750000		
2007	08	11	LA Saver S D	751423	273	88.83	130820000		
2007	08	12	LA Saver S D	751423	273	88.83	130890000		
2007	08	13	LA Saver S D	751423	273	88.83	130960000		
2007	08	14	LA Saver S D	751423	273	88.83	131030000		
2007	08	15	LA Saver S D	751423	273	88.83	131100000		
2007	08	16	LA Saver S D	751423	273	88.83	131170000		
2007	08	17	LA Saver S D	751423	273	88.83	131240000		
2007	08	18	LA Saver S D	751423	273	88.83	131310000		
2007	08	19	LA Saver S D	751423	273	88.83	131380000		
2007	08	20	LA Saver S D	751423	273	88.83	131450000		
2007	08	21	LA Saver S D	751423	273	88.83	131520000		
2007	08	22	LA Saver S D	751423	273	88.83	131590000		
2007	08	23	LA Saver S D	751423	273	88.83	131660000		
2007	08	24	LA Saver S D	751423	273	88.83	131730000		
2007	08	25	LA Saver S D	751423	273	88.83	131800000		
2007	08	26	LA Saver S D	751423	273	88.83	131870000		
2007	08	27	LA Saver S D	751423	273	88.83	131940000		
2007	08	28	LA Saver S D	751423	273	88.83	132010000		
2007	08	29	LA Saver S D	751423	273	88.83	132080000		
2007	08	30	LA Saver S D	751423	273	88.83	132150000		
2007	08	31	LA Saver S D	751423	273	88.83	132220000		
2008	08	01	LA Saver S D	751423	273	88.83	132290000		
2008	08	02	LA Saver S D	751423	273	88.83	132360000		
2008	08	03	LA Saver S D	751423	273	88.83	132430000		
2008	08	04	LA Saver S D	751423	273	88.83	132500000		
2008	08	05	LA Saver S D	751423	273	88.83	132570000		
2008	08	06	LA Saver S D	751423	273	88.83	132640000		
2008	08	07	LA Saver S D	751423	273	88.83	132710000		
2008	08	08	LA Saver S D	751423	273	88.83	132780000		
2008	08	09	LA Saver S D	751423	273	88.83	132850000		
2008	08	10	LA Saver S D	751423	273	88.83	132920000		
2008	08	11	LA Saver S D	751423	273	88.83	132990000		
2008	08	12	LA Saver S D	751423	273	88.83	133060000		
2008	08	13	LA Saver S D	751423	273	88.83	133130000		
2008	08	14	LA Saver S D	751423	273	88.83	133200000		
2008	08	15	LA Saver S D	751423	273	88.83	133270000		
2008	08	16	LA Saver S D	751423	273	88.83	133340000		
2008	08	17	LA Saver S D	751423	273	88.83	133410000		
2008	08	18	LA Saver S D	751423	273	88.83	133480000		
2008	08	19	LA Saver S D	751423	273	88.83	133550000		
2008	08	20	LA Saver S D	751423	273	88.83	133620000		
2008	08	21	LA Saver S D	751423	273	88.83	133690000		
2008	08	22	LA Saver S D	751423	273	88.83	133760000		
2008	08	23	LA Saver S D	751423	273	88.83	133830000		
2008	08	24	LA Saver S D	751423	273	88.83	133900000		
2008	08	25	LA Saver S D	751423	273	88.83	133970000		
2008	08	26	LA Saver S D	751423	273	88.83	134040000		
2008	08	27	LA Saver S D	751423	273	88.83	134110000		
2008	08	28	LA Saver S D	751423	273	88.83	134180000		
2008	08	29	LA Saver S D	751423	273	88.83	134250000		
2008	08	30	LA Saver S D	751423	273	88.83	134320000		
2008	08	31	LA Saver S D	751423	273	88.83	134390000		
2009	08	01	LA Saver S D	751423	273	88.83	134460000		
2009	08	02	LA Saver S D	751423	273	88.83	134530000		
2009	08	03	LA Saver S D	751423	273	88.83	134600000		
2009	08	04	LA Saver S D	751423	273	88.83	134670000		
2009	08	05	LA Saver S D	751423	273	88.83	134740000		
2009	08	06	LA Saver S D	751423	273	88.83	134810000		
2009	08	07	LA Saver S D	751423	273	88.83	134880000		
2009	08	08	LA Saver S D	751423	273	88.83	134950000		
2009	08	09	LA Saver S D	751423	273	88.83	135020000		
2009	08	10	LA Saver S D	751423	273	88.83	135090000		
2009	08	11	LA Saver S D	751423	273	88.83	135160000		
2009	08	12	LA Saver S D	751423	273	88.83	135230000		
2009	08	13	LA Saver S D	751423	273	88.83	135300000		
2009	08	14	LA Saver S D	751423	273	88.83	135370000		
2009	08	15	LA Saver S D	751423	273	88.83	135440000		
2009	08	16	LA Saver S D	751423	273	88.83	135510000		
2009	08	17	LA Saver S D	751423	273	88.83	135580000		
2009	08	18	LA Saver S D	751423	273	88.83	135650000		
2009	08	19	LA Saver S D	751423	273	88.83	135720000		
2009	08	20	LA Saver S D	751423	273	88.83	135790000		
2009	08	21	LA Saver S D	751423	273	88.83	135860000		
2009	08	22	LA Saver S D	751423	273	88.83	135930000		
2009	08	23	LA Saver S D	751423	273	88.83	136000000		
2009	08	24	LA Saver S D	751423	273	88.83	136070000		
2009	08	25	LA Saver S D	751423	273	88.83	136140000		
2009	08	26	LA Saver S D	751423	273	88.83	136210000		
2009	08	27	LA Saver S D	751423	273	88.83	136280000		
2009	08	28	LA Saver S D	751423	273	88.83	136350000		
2009	08	29	LA Saver S D	751423	273	88.83	136420000		
2009	08	30	LA Saver S D	751423	273	88.83	136490000		
2009	08	31	LA Saver S D	751423	273	88.83	136560000		

Figure 5: Copy's of the Employees Time bookings for Calibration Investigation- R Pearson

Additional work was undertaken by L Farugia in 2011 under internal R&D Open Innovation funding which then resulted in the Patent Application the time bookings are shown in figure 6 and Figure 7

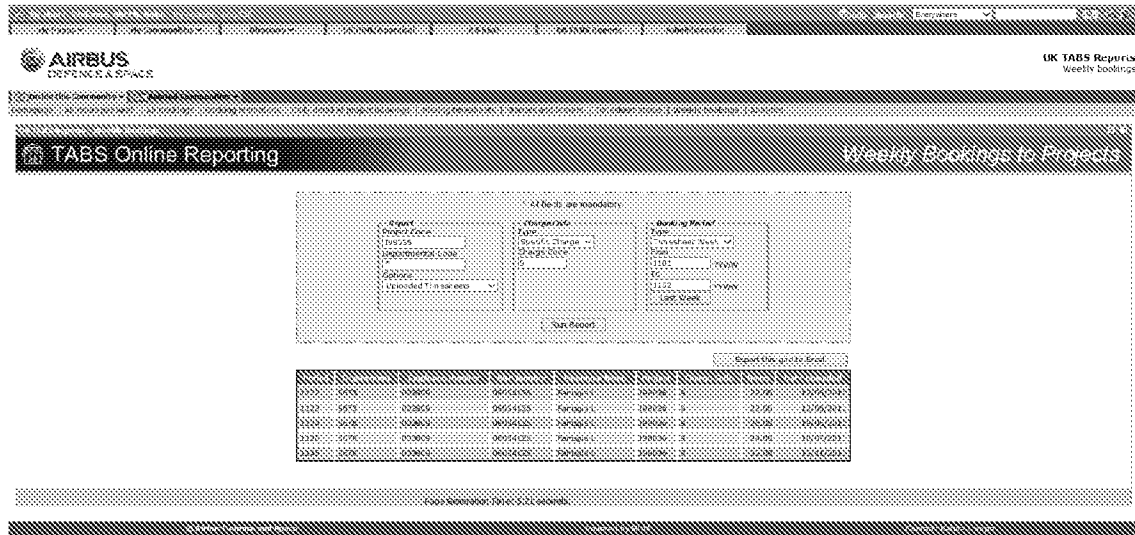


Figure 6: Copy of the Employees Time bookings for Open Innovation 2011 project reference 56/ASP.2.

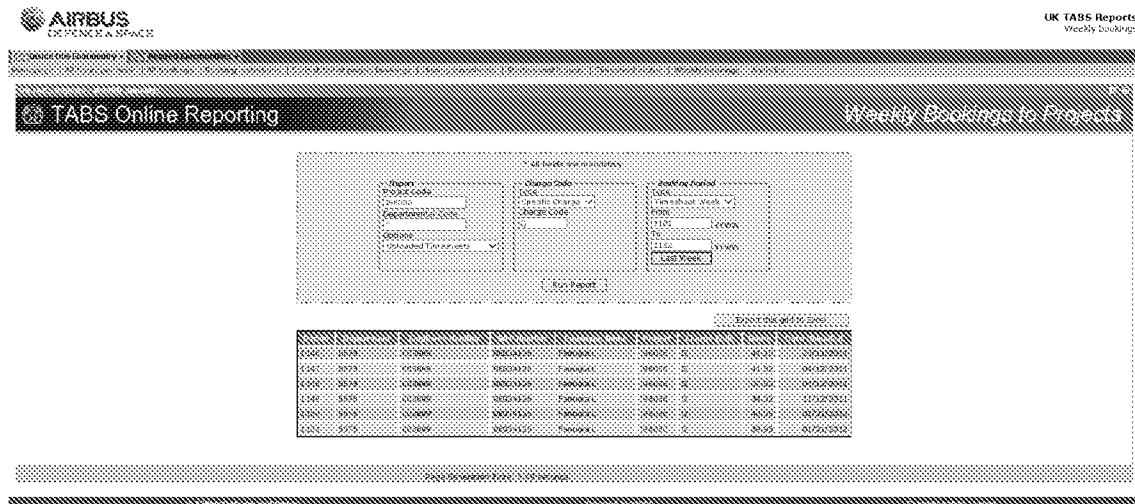


Figure 7: Copy of the Employees Time bookings for Open Innovation 2011 project reference 57/ASP.2.

Below is a screen copy Figure 8 showing e-mail correspondence between myself and Lewis Farugia in regard to this study and the patent application and an example e-mail Figure 9

From	Subject	Received	Size
FARUGIA, Lewis	RE: Your ref: 56/215 Char ref: 0448FC646115F1 [N-5-FID333270]	Thu 27/05/2011 12:55	9 KB
FARUGIA, Lewis	RE: Your ref: 56/215 Char ref: 0448FC646115F1 [N-5-FID333270]	Fri 23/05/2011 09:45	0 KB
FARUGIA, Lewis	RE: Your ref: 56/215 Char ref: 0448FC646115F1 [N-5-FID333270]	Fri 23/05/2011 09:45	0 KB
FARUGIA, Lewis	Response to 56/215 Char ref: 0448FC646115F1 [N-5-FID333270]	Thu 26/05/2011 10:52	6 KB
FARUGIA, Lewis	FW: Your ref: 56/215 Char ref: 0448FC646115F1 [N-5-FID333270]	Mon 23/05/2011 12:18	0 KB
FARUGIA, Lewis	Open Innovation project - communication	Fri 23/05/2011 09:45	0 KB
FARUGIA, Lewis	RE: 56/215 Char ref: 0448FC646115F1 [N-5-FID333270]	Thu 26/05/2011 10:52	6 KB
FARUGIA, Lewis	RE: 56/215 Char ref: 0448FC646115F1 [N-5-FID333270]	Thu 26/05/2011 10:52	6 KB

Figure 7: E-mail Archive related to relevant Patent correspondence with Lewis Farugia



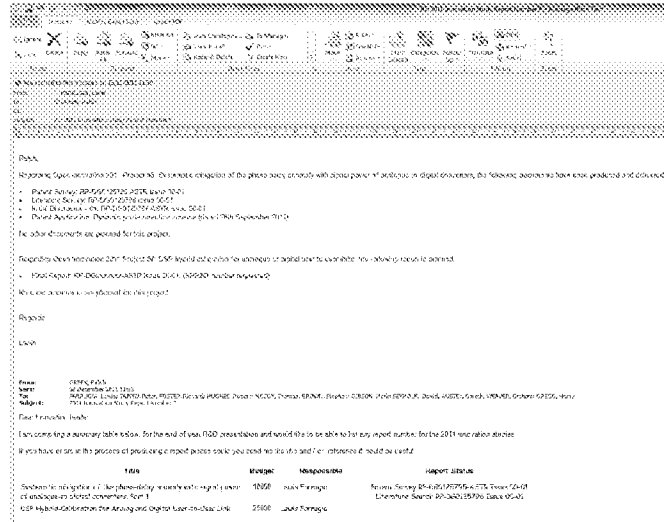
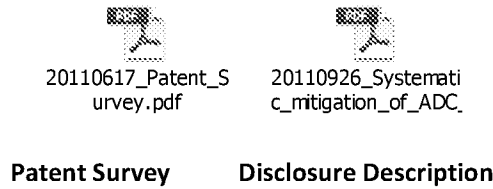


Figure 9: Example e-mail regarding Innovation Study on Patent topic



In my view the above information supports the fact that Astrium specifically funded the normal development work from which the invention arose by Lewis Farugia, Mark Gibson, Ryan Pearson

**CR Green** BSc(Hons), CEng,CPhys,FIET,MInstP,MIEEE

9<sup>th</sup> March 2017

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