

**EUROPEAN SPACE AGENCY
CONTRACT REPORT**

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SUMMARY REPORT

**Technical Support and maintenance of ESA
microprocessors**

Call-off Order 4

**CONTRACT :Design and Verification of Validation
Techniques for On-Board Microprocessors,
18533/04/NL/JD,**

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1 INTRODUCTION

This document summarizes the work performed under the contact: Design and Verification of Validation Techniques for On-Board Microprocessors, 18533/04/NL/JD, Call-off order 4. The objective of the work was to provide support for ERC32 and LEON2 to the European Space Agency and its contractors.

2 OVERVIEW

The processors of the ERC32 processor family are in use in numerous ESA space projects and consequently require a continued technical support. The LEON2-FT processor is under development as a product and will be commercialised by ATMEL. The LEON2-FT core is also used by European space companies to design new onboard integrated systems in the frame of ESA contracts. LEON2-FT is a new design and some improvements have been requested by the space user community. The LEON2-FT design also requires changes with respect to some known design errors. These improvements and changes need also to be validated and need to be maintained under configuration control.

The purpose of the call-off order 4 was to provide technical support for the ERC32 and the LEON2 processor, help to identify the causes of eventual problems, and to implement necessary improvements and to validate them. In addition support has also been provided for the RTEMS operating system. Repositories for LEON2-FT and RTEMS has been maintained giving proper configuration control

The work was performed during the period from June 2006 to March 2007.

The main tasks were:

- To provide functional technical support to the Agency and its Contractors for the ERC32 processor family and the LEON2-FT processor
- To provide the technical support to the Agency and its Contractors for the identification and the fixes of bugs in the LEON2-FT processor
- To make the necessary modifications/improvements to the VHDL model of LEON2-FT IP (Intellectual Property) core as required by the Agency and its Contractors
- To make the necessary updates of the relevant LEON2-FT documentation as required by the fixes and the modifications/improvements to the LEON2-FT processor
- To maintain the repository for the various versions of the model of the LEON2-FT
- To maintain and update the RTEMS kernel for the ERC32 processor and the LEON2-FT and validate the new versions
- To control and monitor the technical support described above

3 WORK PERFORMED UNDER CALL-OFF ORDER 4

The following main items has been performed under the call-off order 4:

- Support to the Agency and the following companies:
 - ATMEL
 - Astrium
 - Saab Space
 - Tidorum

- Update and verification of the LEON2-FT 1.0.9.16 (-r79) model as follows:
 - Improved memory protection scheme. Test bench extended to cover the new functionality.
 - Asynchronous assertion of BRDYN. Delayed assertion of BRDYN in test bench in combination with waveform inspection.
 - Use of BRDYN for prom area. Delayed assertion of BRDYN in test bench in combination with waveform inspection.
 - Extending the timers to 32-bits. Waveform inspection.
 - Added 4 additional external interrupts. Test bench extended to cover the new functionality.
 - Removed 16-bit memory option. Inspection of configuration file (device.vhd)
 - Option to freeze AHB trace buffer on debug mode entry: Waveform inspection.
 - Updating of test benches.
 - Merging of ESA-provided modifications. Not verified.
 - Removal of power-down dead-lock possibility. Not verified, only validated on FPGA.
 - Version number change. Manual inspection (config.vhd)
- Update and verification of the LEON2-FT 1.0.9.16.1 (-r85) model as follows:
 - Implemented new 8-bit memory EDAC scheme. Verified by extending the test bench and PROM models.
 - Memory controller support for 8-bit PROM write with EDAC enabled. Verified by dedicated memory controller test bench from GRLIB/LEON3.
 - Corrected the missing address lead-out on I/O area read cycle. Verified by dedicated memory controller test bench from GRLIB/LEON3
 - Changes not affecting the AT697 configuration. Verified by external test benches from GRLIB/LEON3
- The following LEON2-FT releases has been done:

Release	Date
LEON2-FT 1.0.9.16 (-r67)	2006-10-17
LEON2-FT 1.0.9.16 (-r79)	2006-11-14
LEON2-FT 1.0.9.16.1 (-r85)	2007-02-13

- Update of the LEON2-FT documentation
- Validation of the AT697 PCI interface

4 DOCUMENTS ISSUED

Title	Reference/Revision	Date
Call-off order 1 Progress report # 1	REP-2006-1201, iss 3	2006-12-13
LEON2 Modifications for AT697	Revision 1.2	2007-02-14
Verification and validation of the LEON2FT-1.0.9.16.1	Revision 1.1	2007-04-11



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5 SUPPORT HOURS PER MONTH

First reported period June 2006 to November 2006

2006

							Time Senior	Time	Time
June							Eng. / Man.	Engineer	Total
DATE	COMPANY	ITEM/Subject	GR ref	Comp. Ref	Esa Ref	Doc. Ref			
2006-06-01	ESA	Updating of LEON2FT validation tests	JG	-	A. Pouponnot	Email -> L. Messina	8	0	8
2006-06-02	ESA	Analysis of LEON2/SWARM bug list	JG	-	A. Pouponnot	Email	1		1
2006-06-03	Atmel	Atmel I/O bus email questions	JG	N. Renaud	A. Pouponnot	Email	1		1
Total							10	0	10

2006

							Time Senior	Time	Time
July							Eng. / Man.	Engineer	Total
DATE	COMPANY	ITEM/Subject	GR ref	Comp. Ref	Esa Ref	Doc. Ref			
2006-07-30	ESA	Specification of LEON2FT modifications	JG	-	A. Pouponnot	LEON2FT modifications for the AT697F	28		28
Total							28	0	28

2006

							Time Senior	Time	Time
August							Eng. / Man.	Engineer	Total
DATE	COMPANY	ITEM/Subject	GR ref	Comp. Ref	Esa Ref	Doc. Ref			
2006-08-03	ESA	LEON2FT Manual updates	JG	-	A. Pouponnot	Email	2	0	2
2006-08-15	ESA	LEON2 Write-protection clarifications	JG	-	A. Pouponnot	Email	2		2
2006-08-15	ESA	Email questions from Luciana regarding DSU/tracing	JG	-	L. Messina	Email	1		1
2006-08-16	ESA	Email question AT697 memory map	JG	-	A. Pouponnot	Email	1		1
2006-08-17	ESA	Email/phone support for AT697 memory map	JG	-	A. Pouponnot	Email	3		3
2006-08-20	Tidorum	Review of 'TidoRum' LEON cache analysis	JG	-	A. Pouponnot	Email	4		4
2006-08-23	ESA/Atmel	2x Teleconf write protection ESA/Atmel	JG	N. Renaud	A. Pouponnot	--	3		3
2006-08-24	ESA	Review ESA propped Write protection	JG	-	A. Pouponnot	Email	1		1
2006-08-25	ESA	Review ESA propped Write protection	JG	-	A. Pouponnot	Email	1		1
Total							18	0	18

2006

							Time Senior	Time	Time
September							Eng. / Man.	Engineer	Total
DATE	COMPANY	ITEM/Subject	GR ref	Comp. Ref	Esa Ref	Doc. Ref			
2006-09-18	ESA	Email support for AT697 power-down issue	JG	-	A. Pouponnot	Email	1		1
Total							1	0	1



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2006

October							Time Senior	Time	Time
DATE	COMPANY	ITEM/Subject	GR ref	Comp. Ref	Esa Ref	Doc. Ref	Eng. / Man.	Engineer	Total
2006-10-19	Astrium/Saab	Astrium/Saab AT697E SDRAM problem analysis	JG	T. Bedos, H. Corin	A. Pouponnot	--	3	0	3
2006-10-25	ESA	LEON2FT updates	JG	-	A. Pouponnot	LEON2 1.0.9.16-R79	8		8
2006-10-26	ESA	LEON2FT updates	JG	-	A. Pouponnot	LEON2 1.0.9.16-R79	5		5
2006-10-26	Astrium/Saab	Astrium/Saab AT697E SDRAM problem teleconf	JG	T. Bedos, H. Corin	A. Pouponnot	--	2		2
2006-10-27	Astrium/Saab	Astrium/Saab AT697E SDRAM problem analysis	JG	T. Bedos, H. Corin	A. Pouponnot	--	6		6
2006-10-28	ESA	LEON2FT updates	JG	-	A. Pouponnot	LEON2 1.0.9.16-R79	10		10
2006-10-29	ESA	LEON2FT updates	JG	-	A. Pouponnot	LEON2 1.0.9.16-R79	10		10
2006-10-30	ESA	LEON2FT updates	JG	-	A. Pouponnot	LEON2 1.0.9.16-R79	10		10
2006-10-31	ESA	LEON2FT updates	JG	-	A. Pouponnot	LEON2 1.0.9.16-R79	10		10
Total							64	0	64

2006

November							Time Senior	Time	Time
DATE	COMPANY	ITEM/Subject	GR ref	Comp. Ref	Esa Ref	Doc. Ref	Eng. / Man.	Engineer	Total
2006-11-01	ESA	LEON2FT updates	JG	-	A. Pouponnot	LEON2 1.0.9.16-R79	8	0	8
2006-11-02	ESA	LEON2FT updates	JG	-	A. Pouponnot	LEON2 1.0.9.16-R79	8		8
2006-11-03	ESA	LEON2FT updates	JG	-	A. Pouponnot	LEON2 1.0.9.16-R79	8		8
2006-11-04	ESA	LEON2FT updates	JG	-	A. Pouponnot	LEON2 1.0.9.16-R79	6		6
2006-11-05	ESA	LEON2FT updates	JG	-	A. Pouponnot	LEON2 1.0.9.16-R79	6		6
2006-11-06	ESA	LEON2FT updates	JG	-	A. Pouponnot	LEON2 1.0.9.16-R79	10		10
2006-11-07	ESA	LEON2FT updates	JG	-	A. Pouponnot	LEON2 1.0.9.16-R79	9		9
2006-11-08	ESA	LEON2FT updates	JG	-	A. Pouponnot	LEON2 1.0.9.16-R79	10		10
2006-11-09	ESA	LEON2FT updates	JG	-	A. Pouponnot	LEON2 1.0.9.16-R79	8		8
2006-11-09	ESA	ESA/ATMEL teleconf	JG	-	A. Pouponnot	LEON2 1.0.9.16-R79	2		2
2006-11-10	ESA	LEON2FT updates	JG	-	A. Pouponnot	LEON2 1.0.9.16-R79	8		8
2006-11-10	Astrium	Astrium AT697 email questions	JG	T. Bedos	A. Pouponnot	Email	1		1
2006-11-11	ESA	LEON2FT updates	JG	-	A. Pouponnot	LEON2 1.0.9.16-R79	9		9
2006-11-12	ESA	LEON2FT updates	JG	-	A. Pouponnot	LEON2 1.0.9.16-R79	8		8
2006-11-13	ESA	LEON2FT updates	JG	-	A. Pouponnot	LEON2 1.0.9.16-R79	8		8
Total							109	0	109



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2006

							Time Senior	Time	Time
December							Eng. / Man.	Engineer	Total
DATE	COMPANY	ITEM/Subject	GR ref	Comp. Ref	Esa Ref	Doc. Ref			
2006-12-06	ESA	Progress report #1	PD	-	A. Pouponnot	REP-2006-1201	2	0	2
2006-12-20	Atmel/ESA	Atmel/ESA teleconf, Jaguar board investigation	JG	N. Renaud	A. Pouponnot	-	1	0	1
2006-12-20	ESA	Analysis of new 8-bit EDAC scheme for AT697	JG	-	A. Pouponnot	-	3	0	3
Total							6	0	6

2007

							Time Senior	Time	Time
January							Eng. / Man.	Engineer	Total
DATE	COMPANY	ITEM/Subject	GR ref	Comp. Ref	Esa Ref	Doc. Ref			
2007-01-10 – 2007-02-05	ESA	Modifications of AT697E memory controller	JG/MI	-	A. Pouponnot	LEON2 1.0.9.16-R84	40	40	80
Total							40	40	80

2007

							Time Senior	Time	Time
February							Eng. / Man.	Engineer	Total
DATE	COMPANY	ITEM/Subject	GR ref	Comp. Ref	Esa Ref	Doc. Ref			
2007-02-01		AT697E tete-conf ESA/ATMEL, Model update and PCI validation	JG	N. Renaud	A. Pouponnot	-	2		2
2007-02-12		LEON2FT VHDL model verification	JG	-	A. Pouponnot	LEON2 1.0.9.16-R85	8		8
2007-02-13		LEON2FT model verification and documentation	JG	-	A. Pouponnot	LEON2 1.0.9.16-R85	10		10
2007-02-19	2007-02-23	AT697F PCI validation	JG/JF	-	A. Pouponnot	Validation Report	5	40	45
Total							25	40	65

2007

							Time Senior	Time	Time
March							Eng. / Man.	Engineer	Total
DATE	COMPANY	ITEM/Subject	GR ref	Comp. Ref	Esa Ref	Doc. Ref			
2007-03-05		Validation report	JG	-	A. Pouponnot	Validation Report	8		8
2007-03-08		AT697E tete-conf ESA/ATMEL, AT697E errata sheet update	JG	N. Renaud	A. Pouponnot	-	1		1
2007-03-19		Updating of LEON2FT docs with ESA comments	JG	-	A. Pouponnot	LEON2 1.0.9.16-R85	2		2
2007-03-28		Summary report	PD	-	A. Pouponnot	REP-2007-0301	2		2
Total							13	0	13