ALTER TECHNOLOGY TÜV NORD
EUROPEAN COMPONENTS INITIATIVE (ECI)
PRESENTATION DAYS
SEPTEMBER 29TH – 30TH,2016

CONTENTS

- **VERY SHORT** INTRODUCTION TO ALTER TECHNOLOGY
- ECI PROJECTS UNDER **ATN DIRECT RESPONSIBILITY**
- **COLLABORATIONS** TO OTHER ECI ACTIVITIES
- **CONCLUSIONS**

ALTER TECHNOLOGY **TÜV NORD**

- 10,000 employees worldwide
- Wide range of expertise
- One of the leading international technology service providers
- Services extend far beyond traditional TÜV activities – now covering IT, **Aerospace**, Natural Resources and many others

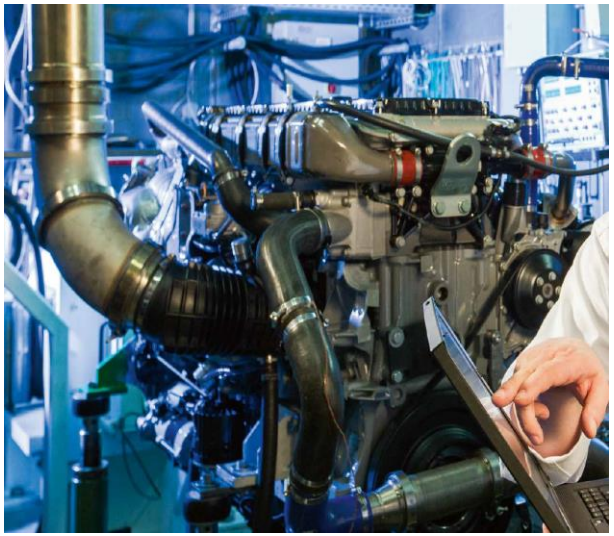
KEY FIGURES

	2014 € million	2013 € million
REVENUE	1,089.5	1,056.4
EBDIT (before non-operating items)	89.5	73.0
EBIT (before non-operating items)	58.8	43.7
EBT	49.2	34.5
EAT	29.4	19.0
TOTAL ASSETS	776.6	745.9

TÜV NORD GROUP MAIN FIELDS

ENERGY

IT



MOBILITY

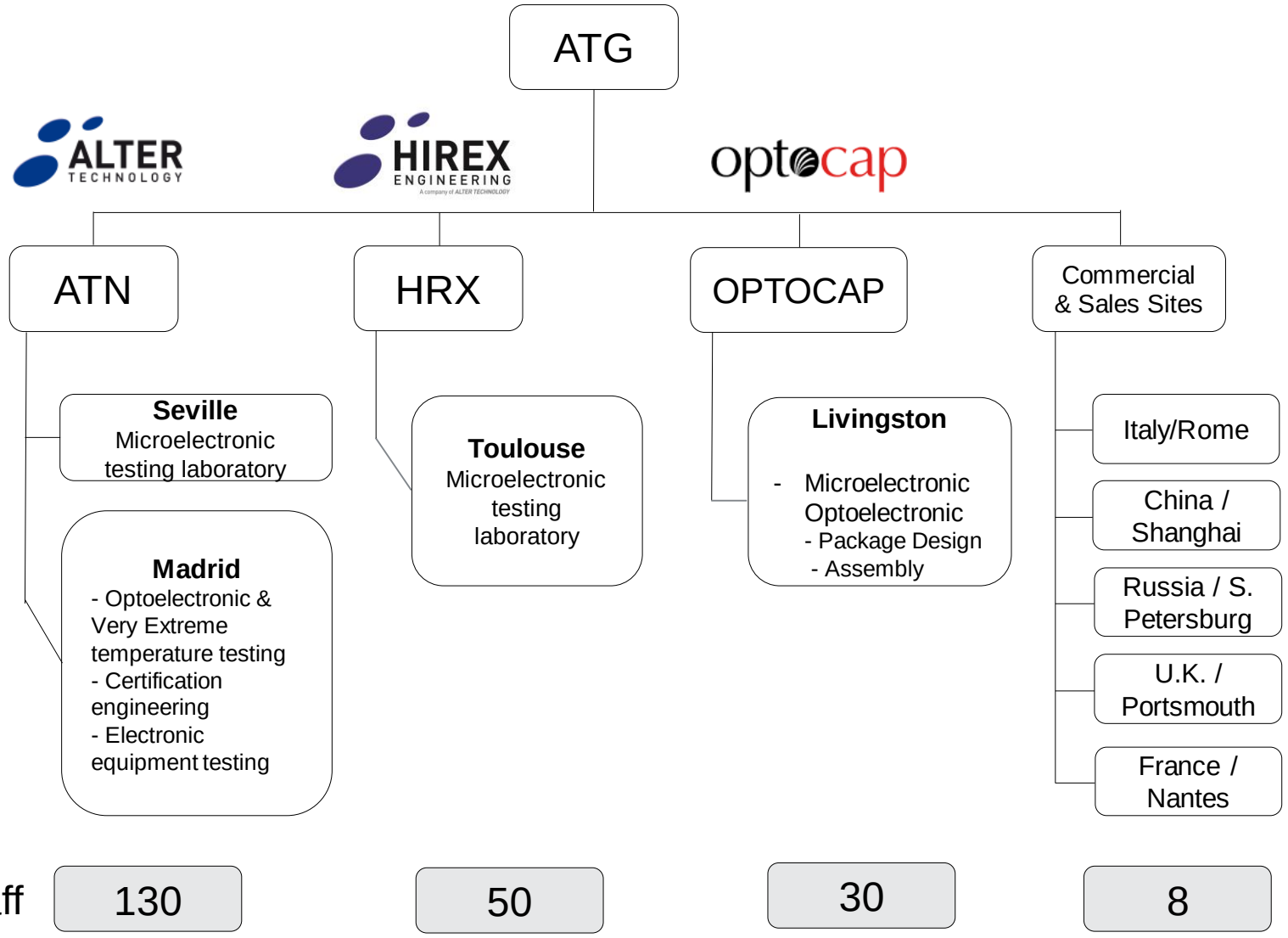
HEALTH AND NUTRITION

NATURAL RESOURCES

AEROSPACE & ELECTRONIC

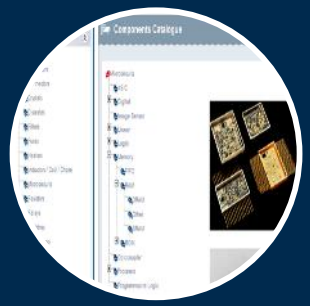
ALTER TECHNOLOGY TÜV NORD

SIMPLIFIED ORGANIZATION

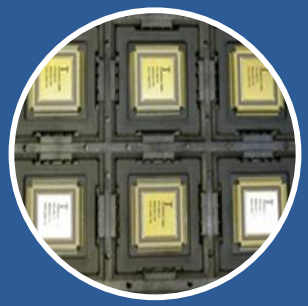


OBJECTIVE

- **To become a single solution provider** for all parts selection, design, procurement, testing and validation activities, including:



- Requirements Definition
- Parts selection



- Procurement
- Product Design
- Packaging

- Test benchs development
- Reliability Testing
- Failure Analysis
- Storage

R&D activities with ESA (TRP & ECI Projects)

Area	*Name*	*Summary*	*YEAR (Contract Signature)*	*Main Program*
Very Extreme Temperature Applications	**Characterization of Commecially available SiC JFET**	*Full characteerization of SiC JFET & SiC MOSFET to evaluate feasibiity for space application*	2012	ESA -TRP
ASICs Development	**ADC 16bits**	*Full development and evaluation of ADC 16bits for space application*	2013	ESA - ECI
Radiaton	**RADIATION CHARACTERISATION OF RT ANALOGUE MIXED SIGNAL TECHNOLOGY**	*TD & DD Radiation Characterization of Miixed Signal ASIC Technology*	2013	ESA -TRP
Very Extreme Temperature Applications	**CSP AND MCM-L (NON HERMETIC): LOW TCE HDI SUBSTRATES FOR FLIP-CHIP**	*Thermal characterization of new soldering tecquniques for high pin count devices*	2013	ESA -TRP
Very Extreme Temperature Applications	**Passive parts for extended temperature range**	*Upgrading of maxium rating criteria for resistors and capacitors with extended operating temperature for GaN related applications*	2013	ESA - ECI
Sensors	**Qualification of RUAG Angular Sensor**	*Complete ECSS qualification campaign of an hall effectc angular sensor*	2014	ESA - ECI
Very Extreme Temperature Applications	**Development and pre-evaluation of Silicon Capacitors**	*Evaluation of current available silicon capacitors to asses feasibility for space application*	2014	ESA -TRP
Very Extreme Temperature Applications	**Evaluation of SiC MOS structures**	*Detailed evaluation of different SiC MOS structures regarding foundry selection and oxidation processes*	2014	ESA -TRP
Optoelectronics	**Evaluation of Optical Switches**	*Detailed evaluation of low power optical switches for space application*	2016	ESA -TRP

ECI Project: 16 bits ADC

Motivation

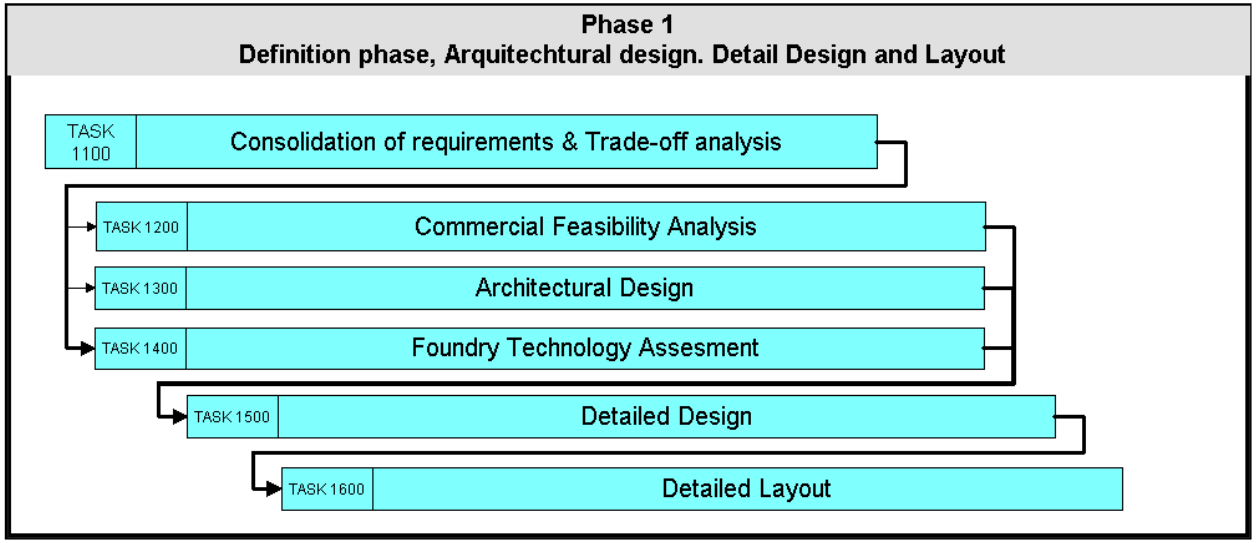
Today there is **no space suitable solution in Europe** for high speed (e.g. 20Msps) and **high resolution (16 bit) Analogue-to-Digital Converters (ADC)** to process and digitise analogue output signals from image sensors or other high resolution instruments. Such devices would enable new applications with higher performance. In addition it would **guarantee European independence** and it would reduce the dependence on COTS devices and their associated screening costs and time.

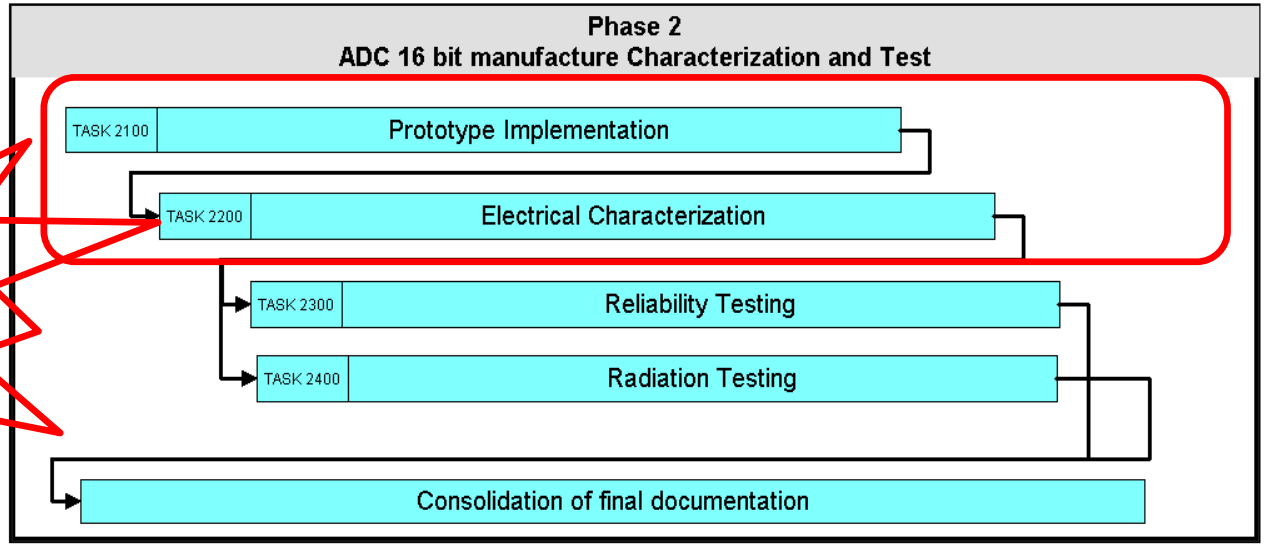
Contract

Contract ref.: ESA Contract 4000108445/13/NL/RA

Prime:	ALTER TECHNOLOGY (Spain)
Partners:	CNM – IMSE (Spain)
	OPTOCAP (UK)

ECI Project: 16 bits ADC

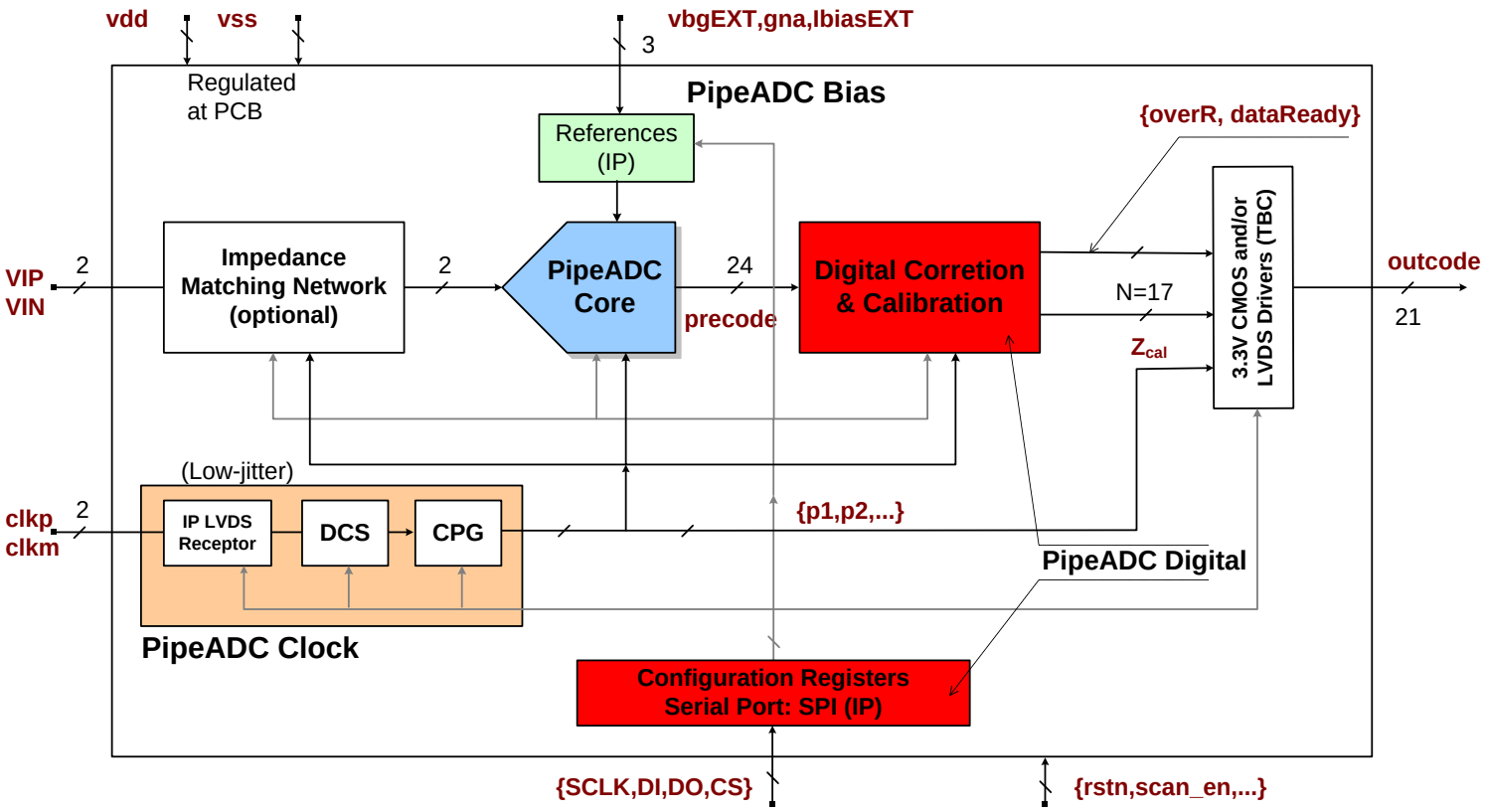




- 2 Iterations
- Assembly evaluation

ECI Project: 16 bits ADC

Detailed 16bADC ASIC Architecture



PRELIMINARY DATA SHEET: UPDATED COMPLIANCE MATRIX

Parameter	Specified Value			Unit	Comments
	ESA SoW	Contractual Proposal	Assumed hereinafter		
Number of digitized bits	16	**16-18**	**17-18**	bits	To reduce the quantization noise level well below the total error (see Sect. III.3)
Range of allowable sampling rates	from 0.1 to 20	**from 1 to 20 in 1 steps**	**~ 100**	Msps	Effective sampling below 20 Msps will be obtained through decimation (interpolation) and filtering of samples in the digital domain by an external DSP (see Sect. I.2)
Analogue input bandwidth	100	**1-100**	**1-100**	MHz	For f_{in}≤1MHz, input signal will be affected by flicker noise. Accuracy in this band will be jeopardized. (see Sect. I.2)
Analog input voltage Full-Scale-Range (differential)	2 to 4	**2.0**	**2.0**	Vpp	±0.5Vpk single-ended signals on a ~1V common mode.
Input impedance for signal and clock	> 100	**> 1 (unbuffered)** **> 100 (buffered)**	**> 1** **> 100**	kΩ	SC unbuffered input front-end (see Sect. III.3.2) Clock input
Power supply	3.3V or less compared with analogue input voltage	<= 3.3V	**1.8** **3.3**	V	Analogue and Digital Cores CMOS Digital I/O
Power consumption (Typical conditions)	< 100	**< 700**	**< 400**	mW	Only prototype Core is considered
DNL	-1 < DNL < 1.5	-1 < DNL < 1.5	-1 < DNL < 1.5	LSB(@16bits)	, f_{in}≤10MHz
INL	+/- 5	+/- 5	**+/- 2**	LSB(@16bits)	, f_{in}≤10MHz To be compatible with 14-b ENOB
THD	< -90	**< -86**	**< -89**	dB	, f_{in}≤10MHz To be compatible with 14-b ENOB

No modifications in performance specs from SRR

PRELIMINARY DATA SHEET: UPDATED COMPLIANCE MATRIX

Parameter	Specified Value			Unit	Comments
	ESA SoW	Contractual Proposal	Assumed hereinafter		
Qualification temperature range	-55 to + 125	-55 to + 125	-55 to + 125	°C	
Operational temperature range	-55 to + 125	-55 to + 125	-55 to + 125	°C	
Analog Input Protection	Yes	Yes	Yes		
Offset Error Adjustment	Yes	Yes	Yes		
Testability	Yes	Yes	Yes		
Radiation total dose	> 100	> 100	> 100	krad	See Sect. I.4.1
Latch up free	> 70	> 70	> 70	MeV.cm²/mg	See Sect. I.4.2
SEE performance	< 1	< 1	< 1	Bit/day	See Sect. I.4.3
SEFI free	> 70	> 70	> 70	MeV.cm²/mg	See Sect. I.4.4
Useful life tB	> 10	> 10	> 10	yrs	

No modifications in performance specs from SRR

PRELIMINARY DATA SHEET: UPDATED COMPLIANCE MATRIX

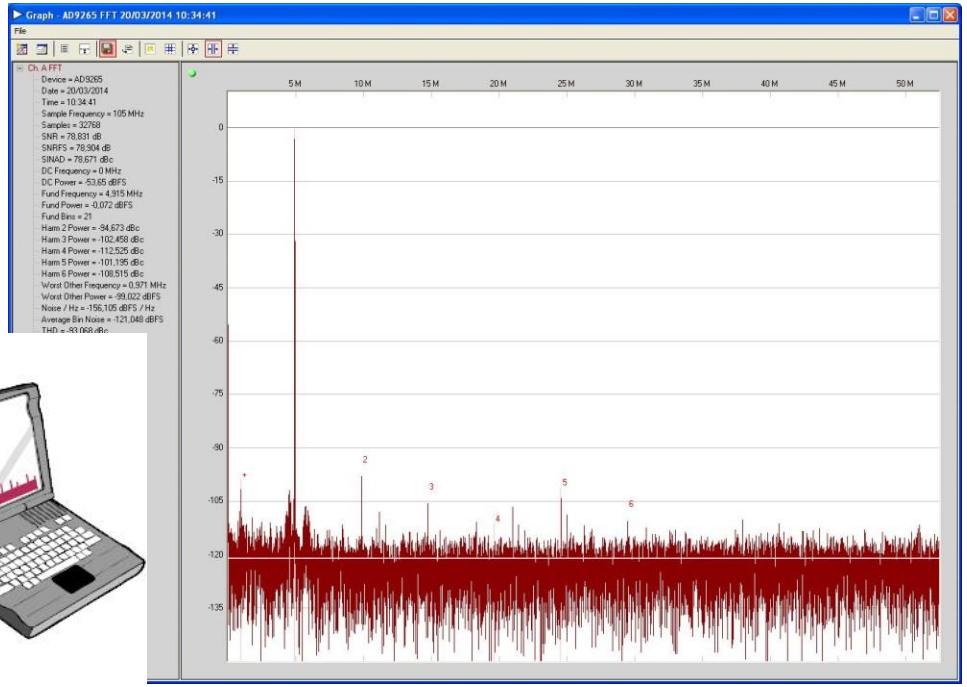
Parameter	Specified Value			Unit	Comments
	ESA SoW	Contractual Proposal	Assumed hereinafter		
SFDR	> 90	**> 86**	**> 90**	dBc	, f_{in}≤10MHz To be compatible with 14-b ENOB
NPR	> 80	**???**	**> 70**	dB	(Gaussian noise, -20dBFS), , f_{in}≤10MHz To be compatible with 14-b ENOB
SNR	> 92	**> 86 (SNDR)**	**> 89**	dB	, f_{in}≤10MHz To be compatible with 14-b ENOB
ENOB	15	**14**	**≥ 14** **≥ 12**	bits	, f_{in}≤10MHz (limited by thermal noise) , 10MHz<f_{in}≤100MHz (limited by jitter noise) (see Sect. III.3)
Jitter	-	-	**< 200**	fs (rms)	See Sect. III.3 and III.4.1
Lower frequency for flicker noise integration	-	-	**< 1.0**	MHz	Conservative threshold to be determined more precisely in the following WPs (see Sect. I.2)
Gain stability on temperature range	< 50	< 50	**< 200**	ppm/°C	The value of 50 ppm/°C only covers stability for the Bandgap behaviour. A more conservative limit must be set to leave room for internal references (see Sect. III.3.5, III.4.2 and III.4.3)
ADC gain adjust	Yes	**Yes / No**	**No**		Programmable gain must be set at an external front-end of the prototype (see Sect. I.2)
Digital output Demux option	Yes	Yes	No		Demux option is not considered since it would imply duplicating the output bus

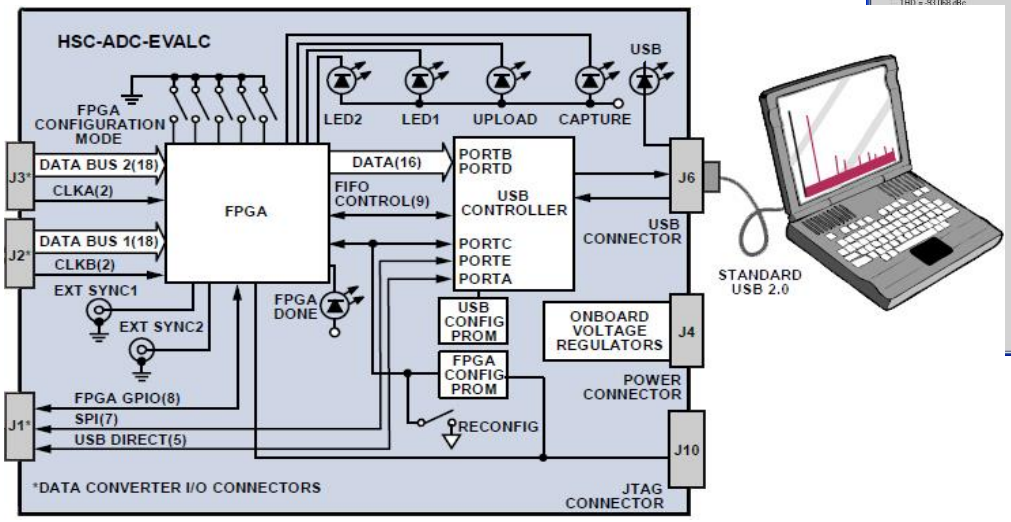
No modifications in performance specs from SRR

ECI Project: 16 bits ADC

VALIDATION PLAN (2/2)

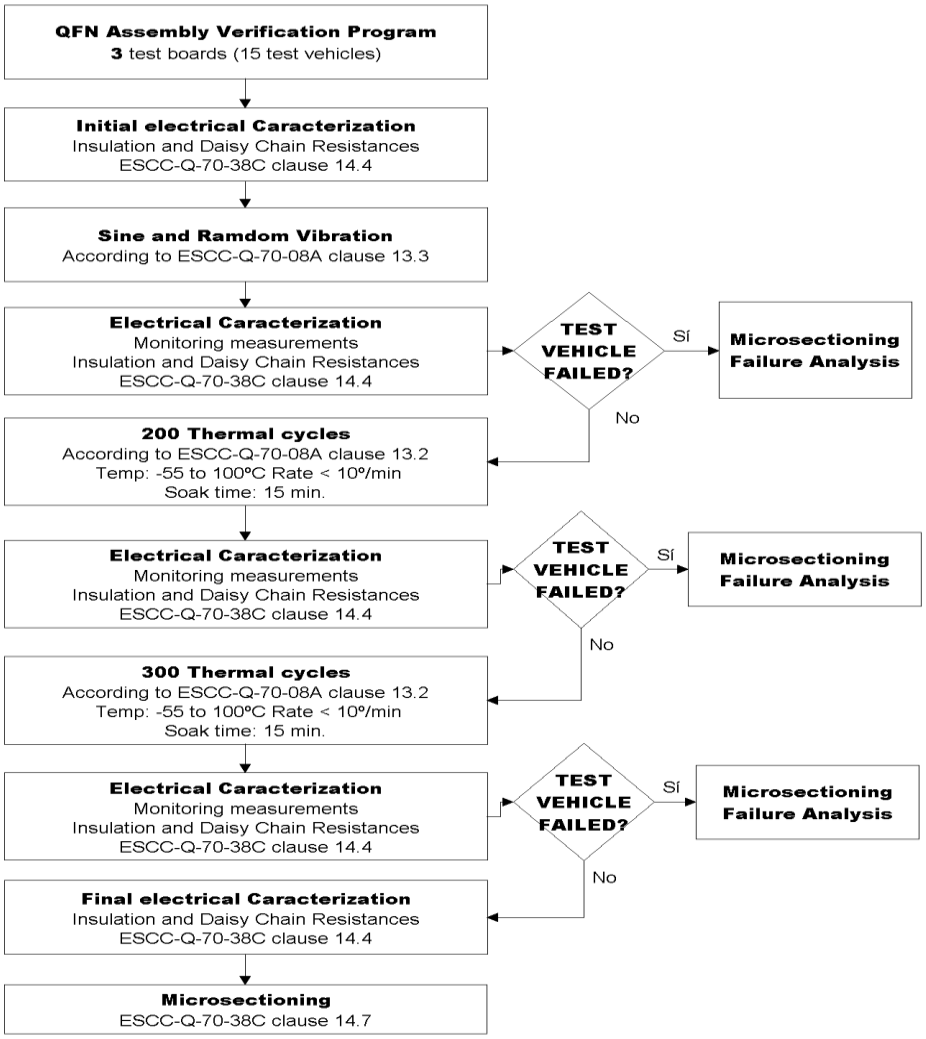
- Data Adquisition Board
  - A commercial High Speed Converter Evaluation Platform HSC-ADC-EVALC [66], from Analog Devices, is under evaluation to acquire and process digital signal
- Source and Signal Conditioning
  - Regulators, Filters, Low-jitter Master Clock



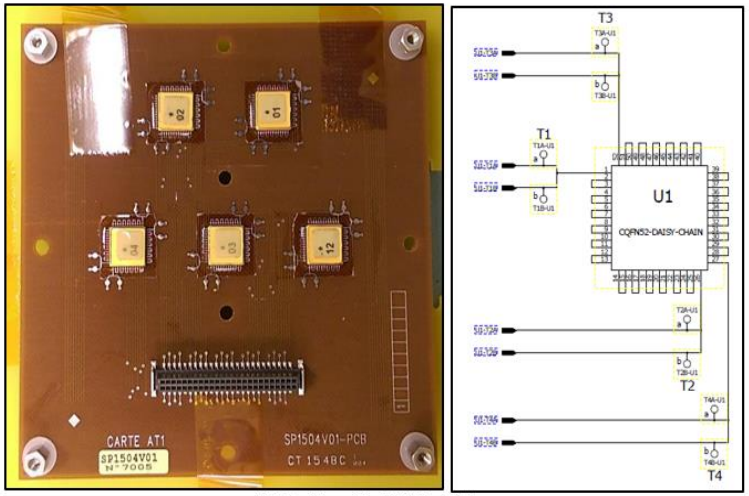


ECI Project: 16 bits ADC

PACKAGING ASSEMBLY QUALIFICATION



TB Serial Number	Manufacturing Process	
	Components U1 to U5	Repair of U5
7005	Vapor Phase	Hot Air
7006	Hot Air	Hot Air
7007	Hand Soldering	Hand Soldering



ATN-Test Board for QFN52 validation

PROJECT STATUS

- Wafer manufacturing (2nd design iteration) to be completed beginning October 2016
- Evaluation test board for reliability testing already available
- Backup solutions for package selection and / or packaging assembly evaluation in process
- Project to be completed beginning February 2017

ECI Project: Passive parts for very high temp application

Motivation

During the last decade, a growing number of applications demanding higher power electrical consumption have emerged in some industrial sectors such as in the military, automotive or space ones. **Consequently, electrical components with higher temperature range and rating voltage operation are needed**. In addition, the good thermal characteristics of Silicon Carbide (SiC) and Gallium Nitride (GaN) allow the fabrication of devices suitable for working in such extreme conditions. **In order to satisfy these demands, an evaluation of selected capacitors and resistors for future space SiC & GaN applications is presented.**

ECI Project: Passive parts for very high temp application

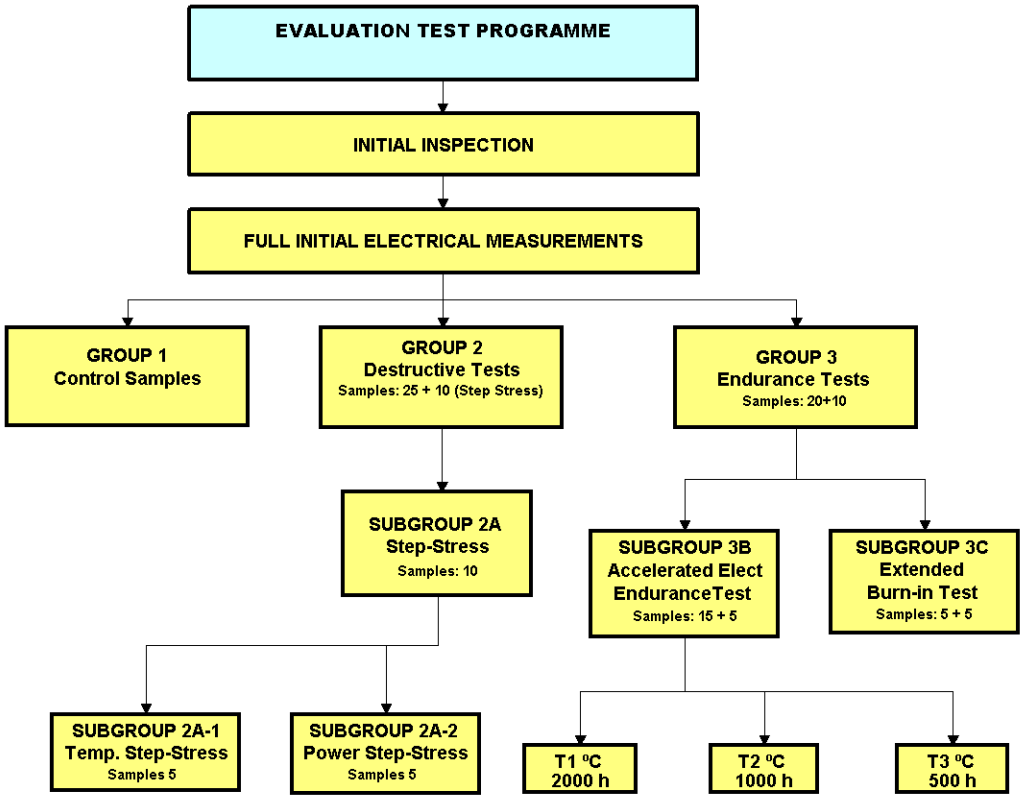
Parts Selection

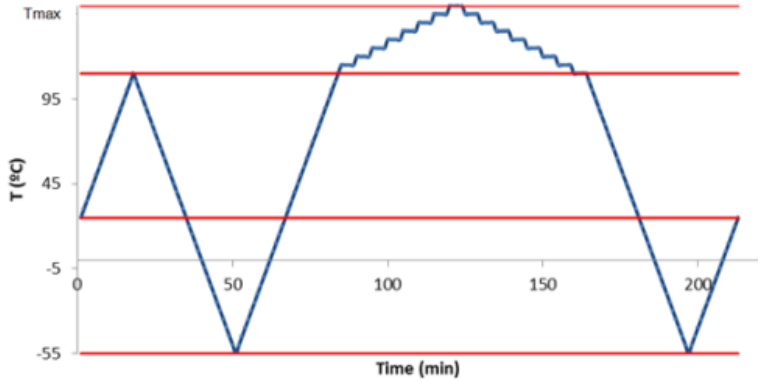
- Existing ESCC qualified parts
- NASA & JAXA Qualified parts
- Non Qualified European parts

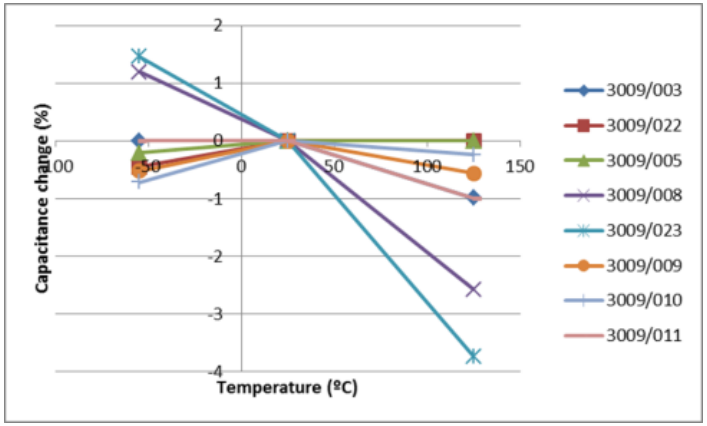
	Technology	Operating Temperature Range (ºC)
Capacitors	Chip Tantalum	-55 to + 175
	SMD Low ESR Tantalum	-55 to + 125
	Tantalum, chip in hermetic package	-55 to + 230
	High RF MLC Surface Mount	-55 to +125
	Multilayer Ceramic	-55 to + 150
Resistors	Thin Film wraparound , chip	-55 to + 215
	Z1-Foil, chip	-55 to + 240
	Ultra-High Precision Foil Wraparound Chip	-55 to + 225
	Thin film, chip	-55 to +155
	Thick Film Chip	-55 to + 155

ECI Project: Passive parts for very high temp application

PROPOSED TEST ACTIVITIES







TEST RESULTS / CAPACITORS

Capacitor	Datasheet info		Test Results					
	Rated Voltage Vr (V)	Tmax (°C)	Test 1 (150°C, 2000h)		Test 2 (150°C, 2000h)		Test 3 (170°C, 2000h)	
			Applied Voltage	Results (pass)	Applied Voltage	Results (pass)	Applied Voltage	Results (pass)
A	50	150	4xVr	3/3	5xVr	3/3	4xVr	3/3
B	50	150	4xVr	3/3	5xVr	2/3	4xVr	2/3
C	25 16 50 (@85°C)	125	Vr	2/3	1.2xVr	0/3	1.2xVr	0/3
D	63 35 16 (@85°C)	230	Vr	2/3	1.2xVr	0/3	1.2xVr	0/3
E	35 (@85°C)	175	Vr	3/3	1.2xVr	3/3	1.2xVr	1/3

TEST RESULTS / RESISTORS

Resistor	Datasheet info		Test Results					
	Rated Power (W)	Tmax (°C)	Test 1 (150°C, 2000h)		Test 2 (150°C, 2000h)		Test 3 (170°C, 2000h)	
			Power Applied (W)	Results (pass)	Power Applied (W)	Results (pass)	Power Applied (W)	Results (pass)
A	1 (@70°C)	155	0.62W	3/3	1.2W	3/3	0.62W	0/3
B	0.12 (@70°C)	225	0.16W	0/3	0.32W	0/3	0.16W	0/3
C	0.125 (@155°C)	155	0.16W	0/3	0.3W	0/3	0.16W	0/3
D	0.0375 (@215°C)	215	0.16W	2/3	0.32W	0/3	0.16W	0/3
E	0.0125 (@220°C)	225	0.16W	0/3	0.32W	0/3	0.16W	0/3

SUMMARY OF TEST RESULTS

Some technologies show very good performance when opeating beyond actual max. ratings.

Due to the low amount of cumulated testing time and number samples, it is not possible to derive any specific formal new reliability figures.

Potential candidates for delta qualification

	Manufacturer	Technology	Datasheet Tmax (°C)	Test Results (3pcs/part type per test)		
				Test 1 (150°C, 2000h)	Test 2 (150°C, 2000h)	Test 3 (170°C, 2000h)
Capacitors	A	Multilayer Ceramic	150	3 OK	3 OK	3 OK
	B	Multilayer Ceramic	150	3 OK	2 failures at 1700h, 1 OK	1 failure at 1000h, 2 OK
	B	Chip Tantalum	175	3 OK	3 OK	700h, 1900h, 1 OK
Resistors	C	Thick Film Chip	155	3 OK	3 OK	failures at 200h, 700h, 1000h
	D	Thin Film wraparound chip	215	1 failure at 700h, 2 OK	failures at 200h, 1000h, 2000h	failures at 400h, 700h, 700h

PROJECT OVERALL STATUS

- All technical activities already completed
- Contract closure documentation under preparation

OTHER **RUNNING** ECI PROJECTS WITH ATN SUPPORT

- European LVDS Driver Development and ESCC Evaluation and Qualification
- Contactless Angular Sensor (CAPS)
- Space validation of Rad-Hard Erbium Optical Fibre Amplifier at 1.55 µm

FINAL COMMENTS

- ALTER TECHNOLOGY is being supported several ECI projects either as prime or partner based on in house Design, packaging and Testing capabilities
- ECI is considered of the utmost importance to ensure proper technology development in front of future market demands.
- ALTER TECHNOLOGY is therefore fully committed to support all space community as a single solution provider that can handle state-of-the-art technologies in the field of hi-rel components

TÜV NORD GROUP

TÜV NORD DMT ALTER TECHNOLOGY GROUP TÜVIT

Thank you!!!

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