NASA/JPL
A/D CONVERTER
SELECTION GUIDE

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ELECTRONIC PARTS ENGINEERING OFFICE
514

Preface

The Analog-to-Digital, A/D, converter is one of the critical components sought by engineers designing electronic hardware for flight projects. The performance requirements for an A/D cover a wide spectrum: the three main features being the bit resolution, power and speed. In addition, each project has their radiation and reliability requirements that the selected A/D is expected to meet or exceed. Not one single A/D can satisfy all of the requirements. With the number of flight worthy suppliers dwindling, it behooves for us to pursue the evaluation of the COTS products as well for their possible infusion into the NASA programs.
The ensuing tables show status of selected A/D converters for their flight worthiness. They are grouped by bit resolution, from 8-bit converters to 24-bit parts. Shown are the salient features of each part followed by the status of their respective evaluation. Comments are welcome (send to shri.g.agarwal@jpl.nasa.gov).

8-Bit Analog to Digital Converters Status

Part Information	**Manufacturer**	**Maxim**	**FSC/SPT**	**Intersil**	**Intersil**	**ADI/Maxwell**
	Part No.	MX101	SPT7725	HI1276	HS9008	7684RP
	Process	Bipolar	Bipolar	Bipolar	CMOS	CMOS
	Power Supply	+5V, -5.2V	-5.2V	-5.2V	5V	5V
	Power Dissipation	7.5 W	2.2 W	2.8 W	400 mW	450 mW
	Analog Input Voltage	+/-250mV	0V to -2V	0V to -2V	0-5V	0-5V
	Digital Interface	Parallel	Parallel	Parallel	Parallel	Parallel
	Conversion rate/time	500 Msps	300 Msps	500 Msps	20 Msps	15 Msps
	NASA/JPL Usage	None	ARTP	None	Cassini	-
	Availability	Yes	Check w/ Fairchild	Yes	Being obsoleted	Yes
Test Results	**Construction Analysis**	Passed	Passed	No Data	Passed	No data
	Single Event Latchup	Destructively Failed	No Latchup, LET>100	No Latchup, LET>100	No Latchup	No Latchup, (per Maxwell)
	Total Ionizing Dose	No Data	>100 krads (High dose rate)	No Data	>100 krads	100krads, (Radpak)
	Reliability	No Data	Acceptable (Vendor Data)	No Data	Acceptable (JPL Data)	Acceptable (Vendor Data)
	Other	COB (Chip-on-board) Tech	N/A	N/A	N/A	N/A

Notes: LET units= MeV- cm^2/mg

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8-Bit Analog to Digital Converters Status (Continued)

Part Information	**Manufacturer**	**ADI**	**T.I. / BB**	**Lin Tech**	**National**
	Part No.	AD9280	ADS930	LTC1406	ADC1175
	Process	CMOS	CMOS	CMOS	CMOS
	Power Supply	+3V, +5V	+3V, +5V	+5V	+5V
	Power Dissipation	95 mW@3V	66 mW@3V	150 mW	60 mW
	Analog Input Voltage	0 to VDD	1V to 2V	+/-1V	0V to 4V
	Digital Interface	Parallel	Parallel	Parallel	Parallel
	Conversion rate/time	32 Msps	30 Msps	20 Msps	20 Msps
	NASA/JPL Usage	Eval for PUG	Eval for PUG	Eval for PUG	Eval for PUG
	Availability	Yes	Yes	Yes	Yes
Test Results	**Construction Analysis**	Not Planned	Passed	Not Planned	No Data
	Single Event Latchup	Failed Californium Test	Failed Californium Test	Failed Californium Test	Passed Californium
	Total Ionizing Dose	Not Planned	Not Planned	Not Planned	Planned
	Reliability	Not Planned	Not Planned	Not Planned	Available in Space Version
	Other				

Notes: LET units= MeV- cm^2/mg
PUG = Parts User Group

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8-Bit Analog to Digital Converters Status (Continued)

Part Information	**Manufacturer**	**Atmel**	**ADI**
	Part No.	TS8388B	AD7828
	Process	Bipolar	CMOS
	Power Supply	+5V, -5V	5V
	Power Dissipation	3.4 W	50 mW
	Analog Input Voltage	+/-1V	8-ch MUX
	Digital Interface	Parallel	Parallel
	Conversion rate/time	1 Gsps	2.5 us/channel
	NASA/JPL Usage	Radar (Note 2)	Electra (Note 2)
	Availability	Yes	Yes
Test Results	**Construction Analysis**	No Data	No Data
	Single Event Latchup	No Data	No Data
	Total Ionizing Dose	150krad (per Atmel)	No Data
	Reliability	Available as Grade 2	Available as Grade 2
	Other		

Notes: 1. LET units= MeV- cm^2/mg

2. Potential candidate

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10-Bit Analog to Digital Converters Status

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Part Information	**Manufacturer**	**ADI**	**ADI**	**FSC / SPT**	**National**
	Part No.	AD9200	AD876	SPT7855	ADC10321
	Process	CMOS	CMOS	CMOS	CMOS
	Power Supply	3V, 5V	+5V	+5V	+5V
	Power Dissipation	80 mW@3V	160 mW	150 mW (+ ref)	98 mW
	Analog Input Voltage	0 to VDD	2V	2V to 4V	1.3V to 4V
	Digital Interface	Parallel	Parallel	Parallel	Parallel
	Conversion rate/time	20 Msps	20 Msps	25 Msps	20 Msps
	NASA/JPL Usage	Eval for PUG	Eval for PUG	-	Eval for PUG
	Availability	Yes	Yes	Check with Fairchild	Yes
Test Results	**Construction Analysis**	Passed	Not Planned	Not Planned	Not Planned
	Single Event Latchup	Failed Californium test	Failed Californium test	Not Planned	Failed Californium test
	Total Ionizing Dose	Not Planned	Not Planned	Not Planned	Not Planned
	Reliability	Not Planned	Not Planned	Not Planned	Not Planned
	Other			Same process as 8-bit SPT7725	

Notes: PUG = Parts User Group

LET units = MeV-cm^2/mg

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12-Bit Analog to Digital Converters Status

Part Information	**Manufacturer**	**ADI**	**National**	**Maxim/Maxwell**	**MAXIM**	**Intersil**
	Part No.	9871XE	ADC12062	7672RP	MX674A	HI574A
	Process	RBCMOS	CMOS	CMOS	BiCMOS	CMOS/Bipolar[1]
	Power Supply	+5V, -5V	+5V	+5V, -12V	+5V, +/-15V	+/-15V, +5V
	Power Dissipation	1 W	75 mW	110 mW	150 mW	500 mW (15V) 385 mW (12V)
	Analog Input Voltage	+/- 1V	0 to Vcc	+5V, +10V, +/-5V	+/-5V, +/-10V, 0-10V, 0-20V	+/-5V, +/-10V 0-10V, 0-20V
	Digital Interface	Parallel	Parallel	Parallel	Parallel	Parallel
	Conversion rate/time	5 Msps	1 Msps	5 us	15 us	25 us
	NASA/JPL Usage	AIRS	DS1	Cassini,MARS	Cassini(?)	Cassini
	Availability	See note 2	Yes	Yes	Yes	Yes
Test Results	**Construction Analysis**	Passed	No Data	Passed	Passed	Passed
	Single Event Latchup	No Latchup	LET=12	No Latchup	No Latchup	No Latchup
	Total Ionizing Dose	>200 krads	No Data	10 krads - die (100krads in RADPAK)	2 krads (Low dose rate)	5 krads (?)
	Reliability	Planned	No Data	Acceptable	Acceptable	Acceptable
	Other	N/A	N/A	N/A	N/A	N/A

Notes: 1-14-05

LET units = MeV-cm^2/mg

1. Two die solution; digital CMOS and analog bipolar.
2. Available through JPL only as overage from custom build.

12-Bit Analog to Digital Converters Status (Continued)

Part Information	**Manufacturer**	**National**	**ADI**	**Lin Tech**	**Lin Tech**
	Part No.	LM12H458	9042	LTC1279	LTC1409
	Process	CMOS	Bipolar/SOI	CMOS	CMOS
	Power Supply	5V	5V	5V, +/- 5V	+/- 5V
	Power Dissipation	34 mW	595 mW	60 mW	80 mW (Nap: 4 mW Sleep: 10uW)
	Analog Input Voltage	0 to 5V	2.4V	0-5V, +/-2.5V	+/- 2.5V
	Digital Interface	Parallel	Parallel	Parallel	Parallel
	Conversion rate/time	8 MHz	41 Msps	600ksps	800 ksps
	NASA/JPL Usage	-	MTO (Note 2)	MARS	MER-
	Availability	Yes	Yes	Yes	Yes
Test Results	**Construction Analysis**	No Data	No Data	Passed	Note 3
	Single Event Latchup	Failed Californium test	No Latchup, (per ADI)	Note 3	Note 3
	Total Ionizing Dose	5 krads, (per National)	100krad (per ADI)	No Data	Note 3
	Reliability	Not planned	Space version	Upscreen	Upscreen
	Other	N/A	N/A	Commercial	Commercial

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Notes:

1. LET units = MeV-cm^2/mg
2. Potential candidate
3. Acceptable for Project

12-Bit Analog to Digital Converters Status (Continued)

Part Information	**Manufacturer**	**ADI**	**Honeywell**	**ADI**	**ADI**
	Part No.	AD1672	RH9225	AD6640	AD7890-10
	Process	CMOS	CMOS/SOI	Bipolar/SOI	CMOS
	Power Supply	5V	5V	5V	5V
	Power Dissipation	240 mW	240 mW	710 mW	50 mW
	Analog Input Voltage	2.5V,5V,+/-2.5V	4V p-p	2V p-p	+/-10V
					8-ch. Mux
	Digital Interface	Parallel	Parallel	Parallel	Parallel
	Conversion rate/time	3 Msps	20 Msps	65 Msps	5.9 uS
	NASA/JPL Usage	MRO	MSL, Prometheus eval	WSOA?	Electra (Note 3)
	Availability	Yes	Yes	Yes	Yes
Test Results	**Construction Analysis**	Note 2	No Data	No Data	No Data
	Single Event Latchup	No Latchup, LET>75	No Latchup, (per Honeywell)	No Latchup	No Data
	Total Ionizing Dose	Note 2	300krad (per Honeywell)	>100krad	No Data
	Reliability	Space version	Space version	Will require upscreen	Available as Grade 2
	Other	N/A	Notes 4, 5	Commercall	

Notes: 1-14-05

1. LET units = MeV-cm^2/mg
2. Acceptable for Project
3. Potential candidate
4. Chip for MSL, packaged part for Prometheus
5. Rad hard version of ADI AD9225 (ADI/Honeywell joint effort).

14-Bit Analog to Digital Converters Status

Part Information	**Manufacturer**	**Linear Tech**	**ADI/Maxwell**	**ADI**	**ADI/Maxwell**	**Raytheon**	**Northrop**
	Part No.	LTC1419/1419A	7872RP	AD6644	7871RP	AL2	3340?
	Process	CMOS	CMOS	Bipolar/SOI	CMOS	CMOS	CMOS
	Power Supply	+5V, -5V	+5V, -5V	5V	+/- 5V	5V	5V
	Power Dissipation	150 mW	50 mW	1.3W	50 mW	325 mW	150 mW
	Analog Input Voltage	+/- 2.5V	+/- 3V	+/-2V	+/- 3V	Diff/single ended	0 to 2.5V
	Digital Interface	Parallel	Serial	Parallel	Parallel	Parallel/Serial	Parallel
	Conversion rate/time	800 ksps	10-10.5 us	65 Msps	10-10.5 us	10 Msps	5 Msps
	NASA/JPL Usage	Rosetta? Galex, MARS, Cloudsat	MISR	Prometheus eval	None	Gifts, Prometheus eval	None
	Availability	Yes	Yes	Yes	Yes	Yes (Die)	Development
Test Results	**Construction Analysis**	Passed	Passed	Complete	No Data	Planned	No Data
	Single Event Latchup	No Latchup, LET>100	No Latchup	No Latchup	No Latchup, (per Maxwell)	No Latchup, (per Raytheon)	No Data
	Total Ionizing Dose	~50 krads, (European user)	4 krad (die) shielded in RAD-PAK^R	>100krad	30-100 krads, (per Maxwell)	300krads (per Raytheon)	50 krads, (NGC)
	Reliability	Upscreen	Acceptable	No Data	Acceptable, (per Maxwell)	Package die, screen and qualify	No Data
	Other	Commercial (Die Available)	N/A	Commercial	N/A	Rad hard by design	N/A

Notes: LET units = MeV- cm^2/mg

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14-Bit Analog to Digital Converters Status (Contd)

Part Information	**Manufacturer**	**Linear Tech**	**ADI**
	Part No.	LTC1417	AD6645
	Process	CMOS	Bipolar/SOI
	Power Supply	+5V, -5V	+5V
	Power Dissipation	150 mW	1.5 W
	Analog Input Voltage	+/- 2.5V	Differential
	Digital Interface	Serial	parallel
	Conversion rate/time	800 ksps	80/105 Msps
	NASA/JPL Usage	MRO, MIRI(Note 3)	MRO
	Availability	Yes	Yes
Test Results	**Construction Analysis**	Passed	No Data
	Single Event Latchup	No Latchup, LET>67	No Latchup
	Total Ionizing Dose	20 krads	>100krad
	Reliability	Upscreen	Upscreen
	Other	Commercial	Commercial (Note 2)

Notes: 1. LET units = MeV- cm^2/mg

2. ADI has plans to qualify for Space

3. Potential candidate

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16-Bit Analog to Digital Converters Status

Part Information	**Manufacturer**	**Datel**	**T.I. / Maxwell**	**T.I. / Maxwell**	**Linear Tech**
	Part No.	ADS937	7809LPTRP	7805LPTRP	LTC1604
	Process	Hybrid	CMOS (1)	CMOS	CMOS
	Power Supply	+5V, -5V, +15V, -15V	+5V	+5V	+5V, -5V
	Power Dissipation	1.1 W	150 mW	132 mW	220 mW (2)
	Analog Input Voltage	+/-5V, 0-10V	+/-10V, +/-5V, +/-3.33V, 0-10V, 0-5V, 0-4V	+/- 10V	+/-2.5V
	Digital Interface	Parallel	Serial	Parallel	Parallel
	Conversion rate/time	1 Msps	100 ksps	100 ksps	333 ksps
	NASA/JPL Usage	None	TES	GSFC, ACRIM	MRO, GSFC, Prometheus eval
	Availability	Yes	Yes	Yes	Yes
Test Results	**Construction Analysis**	Passed	Passed	No Data	Completed (3)
	Single Event Latchup	LET<10	LET=19.9 (Uses LPT)	V. low LET, (Uses LPT)	LET=55-70
	Total Ionizing Dose	25 krads (High dose rate)	10 krads - die, (100krads in RADPAK)	100 krads, (Radpak)	100 krads (30krads in nap/sleep modes)
	Reliability	No Data	Acceptable	Acceptable	Upscreen
	Other	N/A	N/A	N/A	Commercial

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Notes:

LET units = MeV-cm^2/mg

1. Ttwo die solution (A/D die and de-latch circuit as an ASIC die)
2. 7mW in Nap mode, 10uW in Sleep mode.
3. Metal thinning found but acceptable for MRO/OPNAVCAM.

16-Bit Analog to Digital Converters Status (Contd)

Part Information	**Manufacturer**	**ADI**	**ADI**	**Linear Tech**	**Linear Tech**
	Part No.	AD977A	AD7694	LTC1864	LTC1609
	Process	BiCMOS	CMOS	CMOS	CMOS
	Power Supply	+5V	+5V	+5V	+5V, -5V
	Power Dissipation	100 mW max	800 uA@100ksps	850 uA typ	65 mW typ
	Analog Input Voltage	Several (Unipolar and Bipolar)	Differential	Differential	Several (Unipolar and Bipolar)
	Digital Interface	Serial	Serial	Serial	Serial
	Conversion rate/time	200 ksps	250 ksps	250 ksps	200 ksps
	NASA/JPL Usage	OCO	OCO eval	MIRI/OCO eval	MIRI/OCO eval
	Availability	Yes	Yes	Yes	Yes
Test Results	**Construction Analysis**	Planned	Not Planned	No Data	No Data
	Single Event Latchup	LET>80	Very low LET	LET<8.45	LET=5.26
	Total Ionizing Dose	Planned	Not Planned	No Data	No Data
	Reliability	Upscreen			
	Other	Commercial	Commercial	Commercial	Commercial

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Notes:

LET units = MeV-cm^2/mg

24-Bit Analog to Digital Converters Status

Part Information	**Manufacturer**	**Intersil**	**ADI**	**T.I. / BB**	**Asahi Kasei (AKM)**
	Part No.	HI7190	AD7714-5, AD7714-3	ADS 1210	AK5394A
	Process	CMOS	CMOS	CMOS	CMOS
	Power Supply	+5V, -5V	+5V (-5), +3V (-3)	+5V	5V
	Power Dissipation	15 mW	5 mW (-5), 2.6 mW (-3)	26 mW	665 mW
	Analog Input Voltage	Diff., Prog.	Diff.,Prog.	Diff.,Prog.	Differential
	Digital Interface	Serial	Serial	Serial	Serial
	Conversion rate/time	Note 3	Note 3	Note 3	1-216 kHz (Note 3)
	NASA/JPL Usage	None	ST7	None	PUG Eval
	Availability	Yes	Yes	Yes	Yes
Test Results	**Construction Analysis**	Passed	Passed	Passed	No Data
	Single Event Latchup	No Data	LET=55 for AD7714-3	No Data	No Data
	Total Ionizing Dose	No Data	Planned	No Data	No Data
	Reliability	No Data	Upscreen	No Data	No Data
	Other	Commercial	Commercial	Commercial	Commercial

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Notes:

1. LET units = MeV-cm^2/mg
2. PUG = Parts User Group
3. Consult vendor data sheet for information on effective resolution vs conversion rate and gain setting for a given clock frequency.