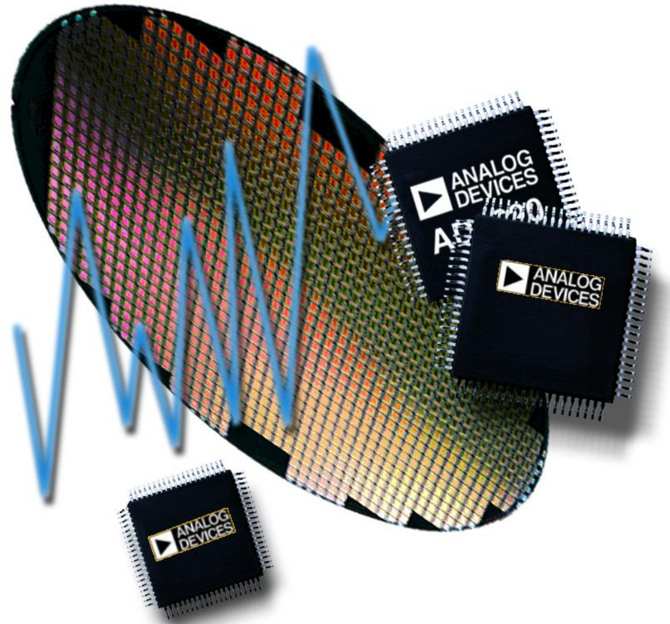

Reliability Report

Report Title: 0.5um CMOS Wafer Fabrication at ADI Limerick Fab Qualification

Report Number: 22087

Revision: C

Date: 3 May 2024

Summary

This report documents the reliability qualification requirements for the release of the 0.5um CMOS Wafer Fabrication Process at Analog Devices Limerick Wafer Fabrication Facility. The products listed below were selected to cover the technology being released.

The products are:

The AD2S1210 is a complete 10-bit to 16-bit resolution tracking resolver-to-digital converter, integrating an on-board programmable sinusoidal oscillator that provides sine wave excitation for resolvers.

The AD7699 is an 8-channel, 16-bit, charge redistribution successive approximation register (SAR) analog-to-digital converter (ADC) that operates from a single power supply, VDD.

The AD7401A is a second-order, sigma-delta (Σ-Δ) modulator that converts an analog input signal into a high speed, 1-bit data stream with on-chip digital isolation based on the Analog Devices, Inc., iCoupler® technology.

The AD2S1205 is a complete 12-bit resolution tracking resolver-to-digital converter that contains an on board programmable sinusoidal oscillator providing sine wave excitation for resolvers.

AECQ100 Qualification Test Methods and Summary

AEC Test Group	AEC Stress Test Name	Abbreviation	AEC Test#	Reference
Group A ACCELERATED ENVIRONMENT STRESS TESTS	Preconditioning	PC	A1	Table 2, and Table 6
	Temperature Humidity Bias or Biased-HAST	THB or HAST	A2	
	Autoclave or Unbiased HAST or Temperature Humidity (without Bias)	AC, UHST, or TH	A3	
	Temperature Cycle	TC	A4	
	Power Temperature Cycling	PTC	A5	
	High Temperature Storage Life	HTSL	A6	
Group B ACCELERATED LIFETIME SIMULATION TESTS	High Temperature Operating Life	HTOL	B1	Table 2, and Table 6
	Early Life Failure Rate	ELFR	B2	
	NVM Endurance, Data Retention, and Operational Life	EDR	B3	
Group C PACKAGE ASSEMBLY INTEGRITY TESTS	Wire Bond Shear	WBS	C1	• Test C2 (and C1 for Cu Wire) are shown in Table 4. • Tests C3-6 are qualified and controlled with inline monitors and may be viewed on-site at Analog Devices.
	Wire Bond Pull Strength	WBP	C2	
	Solderability	SD	C3	
	Physical Dimensions	PD	C4	
	Solder Ball Shear	SBS	C5	
	Lead Integrity	LI	C6	
Group D DIE FABRICATION RELIABILITY TESTS	Electromigration	EM	D1	Die Fabrication Reliability data may be viewed on-site at Analog Devices.
	Time Dependent Dielectric Breakdown	TDDB	D2	
	Hot Carrier Injection	HCI	D3	
	Negative Bias Temperature Instability	BTI	D4	
	Stress Migration	SM	D5	
Group E ELECTRICAL VERIFICATION TESTS	Pre- and Post-Stress Electrical Test	TEST	E1	Table 8, and Table 9
	Electrostatic Discharge Human Body Model	HBM	E2	
	Electrostatic Discharge Charged Device Model	CDM	E3	
	Latch-Up	LU	E4	
	Electrical Distributions	ED	E5	• For Tests E5, E6 and E7, ADI New Product Yield Analysis Testing Guidelines meet AEC Q100 requirements. • Results for Tests E7-E11 are available as applicable on a case–by-case basis. • Test E12 results may be viewed on-site at Analog Devices
	Fault Grading	FG	E6	
	Characterization	CHAR	E7	
	Electromagnetic Compatibility	EMC	E9	
	Short Circuit Characterization	SC	E10	
	Soft Error Rate	SER	E11	
	Lead (Pb) Free	LF	E12	
Group F DEFECT SCREENING TESTS	Process Average Test	PAT	F1	ADI New Product Yield Analysis Testing Guidelines meet AECQ100 Requirements.
	Statistical Bin/Yield Analysis	SBA	F2	
Group G CAVITY PACKAGE INTEGRITY TESTS	Mechanical Shock	MS	G1	< Applicable only for Cavity-Packages>
	Variable Frequency Vibration	VFV	G2	
	Constant Acceleration	CA	G3	
	Gross/Fine Leak	GFL	G4	
	Package Drop	DROP	G5	
	Lid Torque	LT	G6	
	Die Shear	DS	G7	
	Internal Water Vapor	IWV	G8	

Die/Fab Product Characteristics

Table 1: Die/Fab Product Characteristics- 0.5um CMOS

Product Characteristics	Products used for Substitution Data			
Generic/Root Part #	AD2S1210 / 8YX48B	AD7699 / 8YZ06A	AD7401A / 8YZ10A	AD2S1205 / 8YX49A
Die Id	8YX48 B	8YZ06 A	8YZ10 A	8YX49 A
Die Size (mm)	4.00 x 3.90	2.43 x 2.43	1.51 x 2.90	3.35 x 3.32
Wafer Fabrication Site	ADI-Limerick	ADI-Limerick	ADI-Limerick	ADI-Limerick
Wafer Fabrication Process	0.5um CMOS	0.5um CMOS	0.5um CMOS	0.5um CMOS
Die Substrate	Si	Si	Si	Si
Metallization / # Layers	AlCu(0.5%)/3	AlCu(0.5%)/3	AlCu(0.5%)/3	AlCu(0.5%)/3
Polyimide	No	No	No	No
Passivation	undoped-oxide/SiN	undoped-oxide/SiN	undoped-oxide/SiN	undoped-oxide/SiN

Die/Fab Test Results

Table 2: Die/Fab Test Results - 0.5um CMOS at ADI-Limerick

Test Name	AEC #	Spec	Conditions	Generic/Root Part #	Lot #	Fail/SS	eTest Temp
Early Life Failure Rate (ELFR)	B2	JESD22-A108 / JESD74	125°C, 48 Hours	AD2S1210 / 8YX48B	Q20663.1.EL1A_RES_EXP	0/800	RH
					Q20663.2.EL2_RES_EXP	0/800	RH
					Q20663.3.EL3_RES_EXP	0/800	RH
High Temperature Operating Life (HTOL)[1]	B1	JESD22-A108	125°C<Tj<135°C, Biased, 1,000 Hours	AD2S1210 / 8YX48B	Q20663.1.HO1_RES_EXP	0/77	RCH
					Q20663.2.HO2_RES_EXP	0/77	RCH
					Q20663.3.HO3_RES_EXP	0/77	RCH
High Temperature Operating Life (HTOL)[1]	B1	JESD22-A108	125°C<Tj<135°C, Biased, 1,000 Hours	AD7401 / 8YZ10A	Q20822.3.HO1_RES_EXP	0/77	RCH
					Q20822.2.HO2_RES_EXP	0/77	RCH
					Q20822.1.HO3_RES_EXP	0/77	RCH
High Temperature Operating Life (HTOL)[1]	NA	JESD22-A108	125°C<Tj<135°C, Biased, 1,000 Hours	AD7699 / 8YZ06A	Q21139.1.HO1_RES_EXP	0/77	R
					Q21139.2.HO2_RES_EXP	0/77	R
					Q21139.3.HO3_RES_EXP	0/77	R
High Temperature Storage Life (HTSL)	A6	JESD22-A103	150°C, 1,000 Hours	AD2S1210 / 8YX48B	Q20663.1.HS1_RES_EXP	0/77	RH
High Temperature Storage Life (HTSL)	A6	JESD22-A103	150°C, 1,000 Hours	AD7401 / 8YZ10A	Q20822.1.HS3_RES_EXP	0/77	RH
High Temperature Storage Life (HTSL)	NA	JESD22-A103	150°C, 1,000 Hours	AD7699 / 8YZ06A	Q21139.1.HS1_RES_EXP	0/77	R
Highly Accelerated Temperature and Humidity Stress Test (HAST)[1]	A2	JESD22-A110	130C 85%RH 33.3 psia, Biased, 96 Hours	AD2S1210 / 8YX48B	Q20663.1.HA1_RES_EXP	0/77	RH
					Q20663.2.HA2_RES_EXP	0/77	RH
					Q20663.3.HA3_RES_EXP	0/77	RH

Highly Accelerated Temperature and Humidity Stress Test (HAST)[1]	A2	JESD22-A110	130C 85%RH 33.3 psia, Biased, 96 Hours	AD7401 / 8YZ10A	Q20822.1.HA1_RES_EXP	0/77	RH
					Q20822.2.HA2_RES_EXP	0/77	RH
					Q20822.3.HA3_RES_EXP	0/77	RH
Highly Accelerated Temperature and Humidity Stress Test (HAST)[1]	NA	JESD22-A110	130C 85%RH 33.3 psia, Biased, 96 Hours	AD7699 / 8YZ06A	Q21139.1.HA1_RES_EXP	0/77	R
					Q21139.2.HA2_RES_EXP	0/77	R
					Q21139.3.HA3_RES_EXP	0/77	R
Unbiased HAST (UHST)[1]	A3	JESD22-A118	130C 85%RH 33.3 psia, 96 Hours	AD2S1210 / 8YX48B	Q20663.1.UH1_RES_EXP	0/77	R
					Q20663.2.UH2_RES_EXP	0/77	R
					Q20663.3.UH3_RES_EXP	0/77	R
Unbiased HAST (UHST)[1]	A3	JESD22-A118	130C 85%RH 33.3 psia, 96 Hours	AD7401 / 8YZ10A	Q20822.3.UH1_RES_EXP	0/77	R
					Q20822.2.UH2_RES_EXP	0/77	R
					Q20822.1.UH3_RES_EXP	0/77	R
Unbiased HAST (UHST)[1]	NA	JESD22-A118	130C 85%RH 33.3 psia, 96 Hours	AD7699 / 8YZ06A	Q21139.1.UH1_RES_EXP	0/77	R
					Q21139.2.UH2_RES_EXP	0/77	R
					Q21139.3.UH3_RES_EXP	0/77	R
Temperature Cycling (TC)[1]	A4	JESD22-A104	-65°C/+150°C, 500 Cycles	AD2S1210 / 8YX48B	Q20663.1.TC1_RES_EXP	0/77	H
					Q20663.2.TC2_RES_EXP	0/77	H
					Q20663.3.TC3_RES_EXP	0/77	H
Temperature Cycling (TC)[1]	NA	JESD22-A104	-65°C/+150°C, 1000 Cycles	AD2S1210-EP / 8YX48B	Q20794.1.TC1_RES	0/77	R
					Q20794.2.TC2_RES	0/77	R
					Q20794.3.TC3_RES	0/77	R
Temperature Cycling (TC)[1]	A4	JESD22-A104	-65°C/+150°C, 500 Cycles	AD7401 / 8YZ10A	Q20822.1.TC3_RES_EXP	0/77	H
					Q20822.2.TC2_RES_EXP	0/77	H
					Q20822.3.TC1_RES_EXP	0/77	H
Temperature Cycling (TC)[1]	NA	JESD22-A104	-65°C/+150°C, 500 Cycles	AD7699 / 8YZ06A	Q21139.1.TC1_RES_EXP	0/77	R
					Q21139.2.TC2_RES_EXP	0/77	R
					Q21139.3.TC3_RES_EXP	0/77	R

Low Temperature Storage (LTSL)	NA	JESD22-A1019	-55°C, 1000 Hours	AD2S1210-EP / 8YX48B	Q20794.1.LS1_RES	0/77	R
					Q20794.2.LS2_RES	0/77	R
					Q20794.3.LS3_RES	0/77	R

[1] These samples were subjected to preconditioning at MSL 3 with 3x reflow peak temp of 260°C prior to the start of the stress test.

Package/Assembly Product Characteristics

Table 3: Package/Assembly Product Characteristics - 20-LFCSP at AMKOR (AP3)

Product Characteristics	Product(s) to be qualified
Generic/Root Part #	AD7699 / 8YZ06A
Package	20-LFCSP
Body Size (mm)	4.00 x 4.00 x 0.75
Assembly Location	AMKOR (AP3)
MSL/Peak Reflow Temperature(°C)	3 / 260°C
Mold Compound	Sumitomo G700
Die Attach/Underfill/TIM	Ablestik 8290 conductive
Leadframe Material	Copper
Lead Finish	100Sn
Wire Bond Material/Diameter (mils)	2N Gold / 1.00

Table 4: Package/Assembly Product Characteristics - 48-LQFP at AMKOR (AP1)

Product Characteristics	Product(s) to be qualified
Generic/Root Part #	AD2S1210 - EP / 8YX48B
Package	48-LQFP
Body Size (mm)	7.00 x 7.00 x 1.40
Assembly Location	AMKOR (AP1)
MSL/Peak Reflow Temperature(°C)	3 / 260°C
Mold Compound	Sumitomo G631HQ
Die Attach/Underfill/TIM	Ablestik 3230 conductive
Leadframe Material	Copper
Lead Finish	NiPdAu
Wire Bond Material/Diameter (mils)	2N Gold / 1.00

Table 5: Package/Assembly Product Characteristics - 48-LQFP at STATS (SC3)

Product Characteristics	Product(s) to be qualified
Generic/Root Part #	AD2S1210 / 8YX48B
Package	48-LQFP
Body Size (mm)	7.00 x 7.00 x 1.40
Assembly Location	STATS (SC3)
MSL/Peak Reflow Temperature(°C)	3 / 260°C
Mold Compound	Sumitomo G700E
Die Attach/Underfill/TIM	Ablestik 8361J conductive
Leadframe Material	Copper
Lead Finish	100Sn
Wire Bond Material/Diameter (mils)	MKE R 2N Gold / 1.00

Table 6: Package/Assembly Product Characteristics - 16-SOICW at ASE (AET)

Product Characteristics	Product(s) to be qualified
Generic/Root Part #	AD7401A / 8YZ10A
Package	16-SOICW
Body Size (mm)	10.50 x 7.60 x 2.35
Assembly Location	ASE (AET)
MSL/Peak Reflow Temperature(°C)	3 / 260°C
Mold Compound	Sumitomo G700LY
Die Attach/Underfill/TIM	Ablestik 2025D non-conductive
Leadframe Material	Copper
Lead Finish	100Sn
Wire Bond Material/Diameter (mils)	Heraeus AW7 4N Gold / 1.30

Table 7: Package/Assembly Product Characteristics - 44-LQFP at STATS (SC3)

Product Characteristics	Product(s) to be qualified
Generic/Root Part #	AD7401A / 8YZ10A
Package	44-LQFP
Body Size (mm)	10.00 x 10.00 x 1.40
Assembly Location	STATS (SC3)
MSL/Peak Reflow Temperature(°C)	3 / 260°C
Mold Compound	Sumitomo G700E
Die Attach/Underfill/TIM	Ablestik 8361J conductive
Leadframe Material	Copper
Lead Finish	100Sn
Wire Bond Material/Diameter (mils)	MKE R 2N Gold / 1.00

Package/Assembly Test Results

Table 8: Package/Assembly Test Results - LFCSP at AMKOR (AP3)

Test Name	AEC #	Spec	Conditions	Generic/Root Part #	Lot #	Fail/ SS	eTest Temp
High Temperature Storage Life (HTSL)	NA	JESD22-A103	150°C, 1,000 Hours	AD7699	Q21139.1.HS1_RES_EXP	0/77	R
Highly Accelerated Temperature and Humidity Stress Test (HAST)[1]	NA	JESD22-A110	130C 85%RH 33.3 psia, Biased, 96 Hours	AD7699	Q21139.1.HA1_RES_EXP	0/77	R
					Q21139.2.HA2_RES_EXP	0/77	R
					Q21139.3.HA3_RES_EXP	0/77	R
Solder Heat Resistance (SHR)	NA	J-STD-020	MSL-3	AD7699	Q21139.1.SH1_RES_EXP	0/11	R
					Q21139.2.SH2_RES_EXP	0/11	R
					Q21139.3.SH3_RES_EXP	0/11	R
Temperature Cycling (TC)[1]	NA	JESD22-A104	-65°C/+150°C, 500 Cycles	AD7699	Q21139.1.TC1_RES_EXP	0/77	R
					Q21139.2.TC2_RES_EXP	0/77	R
					Q21139.3.TC3_RES_EXP	0/77	R
Unbiased HAST (UHST)[1]	NA	JESD22-A118	130C 85%RH 33.3 psia, 96 Hours	AD7699	Q21139.1.UH1_RES_EXP	0/77	R
					Q21139.2.UH2_RES_EXP	0/77	R
					Q21139.3.UH3_RES_EXP	0/77	R

[1] These samples were subjected to preconditioning at MSL 3 with 3x reflow peak temp of 260°C prior to the start of the stress test.

Table 9: Package/Assembly Test Results - LQFP at STATS (SC3)

Test Name	AEC #	Spec	Conditions	Generic/Root Part #	Lot #	Fail/ SS	eTest Temp
High Temperature Storage Life (HTSL)	A6	JESD22-A103	150°C, 1,000 Hours	AD2S1210 / 8YX48B	Q20663.1.HS1_RES_EXP	0/77	RH
Highly Accelerated Temperature and Humidity Stress Test (HAST)[1]	A2	JESD22-A110	130C 85%RH 33.3 psia, Biased, 96 Hours	AD2S1210 / 8YX48B	Q20663.1.HA1_RES_EXP	0/77	RH
					Q20663.2.HA2_RES_EXP	0/77	RH
					Q20663.3.HA3_RES_EXP	0/77	RH
Temperature Cycling (TC)[1]	A4	JESD22-A104	-65°C/+150°C, 500 Cycles	AD2S1210 / 8YX48B	Q20663.1.TC1_RES_EXP	0/77	H
					Q20663.2.TC2_RES_EXP	0/77	H
					Q20663.3.TC3_RES_EXP	0/77	H
Unbiased HAST (UHST)[1]	A3	JESD22-A118	130C 85%RH 33.3 psia, 96 Hours	AD2S1210 / 8YX48B	Q20663.1.UH1_RES_EXP	0/77	R
					Q20663.2.UH2_RES_EXP	0/77	R
					Q20663.3.UH3_RES_EXP	0/77	R
Solder Heat Resistance (SHR)	A1	J-STD-020	MSL - 3	AD2S1210 / 8YX48B	Q20663.1.SH1_RES_EXP	0/77	R
					Q20663.2.SH2_RES_EXP	0/77	R
					Q20663.3.SH3_RES_EXP	0/77	R
Wire Bond Pull – Post TC	C2	AEC-Q003	3 gF	AD2S1210 / 8YX48B	Q20663.1.WP1_RES_EXP	0/5	NA

[1] These samples were subjected to preconditioning at MSL 3 with 3x reflow peak temp of 260°C prior to the start of the stress test.

Table 10: Package/Assembly Test Results - LQFP at AMKOR (AP1)

Test Name	AEC #	Spec	Conditions	Generic/Root Part #	Lot #	Fail/SS	eTest Temp
Low Temperature Storage (LTS)	NA	JESD22-A119	-55°C, 1,000 Hours	AD2S1210-EP	Q20794.1.LS1_RES	0/77	R
					Q20794.2.LS2_RES	0/77	R
					Q20794.3.LS3_RES	0/77	R
Temperature Cycling (TC)[1]	NA	JESD22-A104	-65°C/+150°C, 1,000 Cycles	AD2S1210-EP	Q20794.1.TC1_RES	0/77	R
					Q20794.2.TC2_RES	0/77	R
					Q20794.3.TC3_RES	0/77	R

[1] These samples were subjected to preconditioning at MSL 3 with 3x reflow peak temp of 260°C prior to the start of the stress test.

Table 11: Package/Assembly Test Results - SOICW at ASE (AET)

Test Name	AEC #	Spec	Conditions	Generic/Root Part #	Lot #	Fail/SS	eTest Temp
High Temperature Storage Life (HTSL)	A6	JESD22-A103	150°C, 1,000 Hours	AD7401 / 8YZ10A	Q20822.1.HS3_RES_EXP	0/77	RH
Highly Accelerated Temperature and Humidity Stress Test (HAST)[1]	A2	JESD22-A110	130C 85%RH 33.3 psia, Biased, 96 Hours	AD7401 / 8YZ10A	Q20822.1.HA1_RES_EXP	0/77	RH
					Q20822.2.HA2_RES_EXP	0/77	RH
					Q20822.3.HA3_RES_EXP	0/77	RH
Unbiased HAST (UHST)[1]	A3	JESD22-A118	130C 85%RH 33.3 psia, 96 Hours	AD7401 / 8YZ10A	Q20822.3.UH1_RES_EXP	0/77	R
					Q20822.2.UH2_RES_EXP	0/77	R
					Q20822.1.UH3_RES_EXP	0/77	R
Temperature Cycling (TC)[1]	A4	JESD22-A104	-65°C/+150°C, 500 Cycles	AD7401 / 8YZ10A	Q20822.1.TC3_RES_EXP	0/77	H
					Q20822.2.TC2_RES_EXP	0/77	H
					Q20822.3.TC1_RES_EXP	0/77	H
Solder Heat Resistance (SHR)	A1	J-STD-020	MSL - 3	AD7401 / 8YZ10A	Q20822.1.SH3_RES_EXP	0/11	R
					Q20822.2.SH2_RES_EXP	0/11	R
					Q20822.3.SH1_RES_EXP	0/11	R

[1] These samples were subjected to preconditioning at MSL 3 with 3x reflow peak temp of 260°C prior to the start of the stress test.

ESD and Latch-Up Test Results

Table 12: ESD Test Result

ESD Model	Generic/Root Part #	Package	ESD Test Spec	RC Network	Highest Pass Level	Class	eTest Temp
FICDM	AD2S1210 / 8YX48B	48-LQFP	JS-002	1Ω, Cpkg	±500V	C2a	RH
HBM			JS-001	1.5kΩ, 100pF	±2500V	2	RH
FICDM	AD2S1210 EP / 8YX48B	48-LQFP	JS-002	1Ω, Cpkg	±1000V	C3	R
FICDM	AD7699 / 8YZ06A	20-LFCSP	JS-002	1Ω, Cpkg	±1500V	C3	RH
HBM			JS-001	1.5kΩ, 100pF	±2500V	2	RH
FICDM	AD7401A / 8YZ10A	16-SOICW	JS-002	1Ω, Cpkg	±1250V	C3	RH
HBM			JS001	1.5kΩ, 100pF	±3000V	2	RH
FICDM	AD2S1205 / 8YX49A	44-LQFP	JS-002	1Ω, Cpkg	±750V	C2b	RH
HBM			JS-001	1.5kΩ, 100pF	±4000V	3A	RH

Table 13: Latch Up Test Result

LU Test Spec	Generic/Root Part #	Passing Current	Passing Over-Voltage	Temperature (T_A)	Class	eTest Temp
JESD78	AD2S1210 / 8YX48B	+100mA, -100mA	+5.25, 5.25, 5.25V	125°C	II	RH
JESD78	AD7699 / 8YZ06A	+200mA, -200mA	+ 8.25V, 8.25V	25°C	I	R
JESD78	AD7401A / 8YZ10A	+200mA, -200mA	+ 8.25V, 8.25V	125°C	II	RH
JESD78	AD2S1205 / 8YX49A	+100mA, -100mA	+7.875, 7.875	125°C	II	RH

Approvals

Reliability Engineer: Danilo Juinio Jr.

Appendix

Wire Bond Pull Post TCT [WBP Data]

WBP_AD2S1210 _Q20663.1.WP1_RES_EXP										
Unit	**1**		**2**		**3**		**4**		**5**	
Ball	**Pull**	**Mode**	**Pull**	**Mode**	**Pull**	**Mode**	**Pull**	**Mode**	**Pull**	**Mode**
1	11.08	a-1	9.80	a-2	8.92	a-2	10.32	a-1	9.97	a-1
2	11.26	a-2	10.97	a-2	10.60	a-2	9.86	a-2	10.32	a-2
3	11.16	a-2	10.72	a-2	9.26	a-2	10.96	a-1	10.54	a-1
4	10.37	a-2	9.56	a-2	9.60	a-2	11.61	a-1	11.69	a-1
5	10.19	a-2	11.19	a-2	11.58	a-2	10.46	a-2	11.37	a-1
6	10.32	a-2	10.03	a-2	9.54	a-2	10.27	a-1	9.57	a-1
7	9.48	a-2	10.51	a-2	10.06	a-2	11.34	a-1	9.86	a-1
8	9.44	a-2	10.65	a-2	7.32	a-2	10.78	a-1	9.41	a-1
9	11.42	a-2	8.66	a-2	11.00	a-2	10.03	a-1	10.21	a-1
10	10.24	a-2	9.09	a-2	10.73	a-2	10.36	a-1	10.63	a-2
11	9.18	a-2	9.73	a-2	9.27	a-2	9.98	a-1	11.40	a-1
12	11.72	a-2	8.89	a-2	10.03	a-2	11.41	a-1	11.78	a-1
MIN	9.18		8.66		7.32		9.86		9.41	
MAX	11.72		11.19		11.58		11.61		11.78	
AVE	10.49		9.98		9.83		10.62		10.56	
STDEV	0.84		0.84		1.12		0.60		0.82	