APPLICATION	REVISIONS			
	REV	DESCRIPTION	REVIEWED	DATE
	–	Initial Revision.	D. TRIVETT	15/01/12
	A	Added paragraph to end of 3.4. Added paragraph 3.10.	D. TRIVETT	16/9/29
	B	Added to paragraph 3.1, including NOTE. Added Section 3.1.2. Added to paragraph 3.3. Added Section 3.11.	D. TRIVETT	16/11/30
	C	Added paragraph 3.12.	D. TRIVETT	17/06/22
	D	Revised paragraph 3.12.	D. TRIVETT	17/07/24
	E	Added paragraph 3.13. Revised paragraph 3.11. Added document in section 2.	D. TRIVETT	18/06/22
	F	Added Section 3.10.	A.LI-GREEN	18/09/17
	G	Added Section 3.15. Updated Appendix A.	A.LI-GREEN	20/06/09

GENERAL SPECIFICATION

CONTRACT NUMBER	REVISION STATUS
N/A	Active sheets: 1 through 11 All sheets are at revision G

CRANE AEROSPACE & ELECTRONICS

TOLERANCES ARE:
LINEAR .XX =
.XXX =
ANGULAR =

TITLE

ENGINEERING DRAWING REQUIREMENTS, INTERPRETATION AND CLARIFICATION OF

SIZE	SCALE	CAGE	DRAWING NO.	SHEET	REV.
A	None	08748	**48.00.20**	1 of 11	G

1 SCOPE

This specification establishes general and specific guidelines to aid in the interpretation and application of engineering drawings defining components, materials, or assemblies, whether purchased from suppliers or fabricated at Crane Aerospace & Electronics facilities.

1.1 Applicability

This document applies to engineering drawings controlled by the Lynnwood site of Crane Aerospace & Electronics (Crane). Other Crane sites may use these guidelines if it is beneficial to do so.

1.2 Conflicts

In the event of a conflict between this document and any engineering documents, the engineering documents take precedence. It is not the intent of this document to change or modify specific engineering requirements, but to provide clarification and interpretation of commonly used engineering drawing practices.

2 APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. The documents listed shall be of the issue in effect on the date of the most recent and applicable Crane Request for Quotation, if one exists, or the date of the most recent and applicable Crane Purchase Order.

SPECIFICATIONS AND STANDARDS

MILITARY

MIL-STD-130	Identification Marking of US Military Property
MIL-STD-100 (Cancelled)	Engineering Drawings

INDUSTRY

ASME Y14.24	Types and Applications of Engineering Drawings
ASME Y14.5	Dimensioning and Tolerancing

CRANE AGIS

40-002	Supplier Quality Assurance Requirements

CRANE EIS

0715-006	Material and Process Substitution Requirements

CRANE PROCESS SPECIFICATIONS

54.10.01	Identification Marking By Rubber Stamping, Screening, and Thermal Labels
54.10.03	Part Marking, Laser

3 REQUIREMENTS

The following areas are addressed in this specification. If further clarification of these or other items is required, the cognizant engineering authority within Crane shall be responsible for responding to specific questions. Questions originating at a supplier shall be communicated through the Crane Buyer or Supplier Liaison.

3.1 Part marking

Background: Many Crane engineering and procurement drawings will have a general reference to MIL-STD-130 marking requirements, such as “Part Mark per MIL-STD-130”. Some will have no reference to a particular marking method, but still call out a marking requirement.

Interpretation: If the drawing does not specify a particular marking method, any part marking method allowed by MIL-STD-130 may be used. If the drawing specifies a particular method, it is preferred to use that method. If

that method cannot be provided, a method that provides a similar level of data clarity, resistance to rubbing/smudging of the data, and chemical resistance to the method specified on the drawing may be selected if allowed by the referenced Crane Process Specification.

If the drawing specifies part marking but does not call out a part marking specification or method, the use of "Bag and Tag" marking as defined in 3.1.1 is allowed.

If the drawing states "Part Mark per MIL-STD-130", but no location is provided and the part is not marked at an upper level assembly by the supplier, the use of bag and tag marking is preferred. If the part is marked at an upper level assembly by supplier, it is not necessary to mark at the subassembly level.

If a drawing specifies multiple part marking methods which may include 54.10.01, 54.10.03 and/or MIL-STD-130 and/or laser etching, laser marking per 54.10.03 is preferred if the material to be marked is compatible with laser marking (see 54.10.03 Process Specification for material restrictions). Pressure vessel or highly stressed thin parts (e.g. springs and valves) should not be laser marked on their highly stressed areas.

NOTE: Laser marking of Chem Film over aluminum is prohibited.

NOTE: Laser marking of MU metal parts or their specialty heat treated parts is prohibited.

3.1.1 Bag and Tag Marking

When specified on the drawing, or when a part is too small or otherwise unsuitable for direct marking, the parts may be "Bagged and Tagged" in accordance with accepted industry practice. Parts shall be placed in a suitable bag or similar container, with a tag firmly attached that contains the following information:

- Part Number
- Manufacturer
- Quantity
- Date or Lot Code
- Additional information as specified

Parts that are serialized should be individually bagged. The tag marking shall remain legible throughout storage and handling until installed in the next higher assembly. Parts that are susceptible to handling damage shall be protected from such damage through the use of an appropriate container.

3.1.2 Serial Numbering

Where the serial number is in the format "X-S",

- X Indicates the unique product ID generated and tracked by the manufacturing system,
- S Indicates the sequence. The sequence shall not include leading zeros. The length of sequence is defined by the manufacturing work order.

3.2 Raw Material Dimensions

Dimensional sizes specified on Crane Aerospace Parts Lists and Materials Specifications are optimized for internal Crane Aerospace & Electronics use. Other dimensionally sized raw material that complies with all other specifications for the type of raw material being called out may be substituted provided the minimum tensile strength is equal to or greater than the material originally specified. A note allowing such substitution will also be added to the materials specification. If a raw material dimension is critical to the application, a statement to that effect shall appear on the drawing, and no substitution is allowed.

For example, if a 1 x 1 x 1 inch 303 stainless steel part is called out on the Crane Aerospace parts list, the supplier could substitute any size raw material that meets the specifications for 303 stainless steel as long as

the finished parts meet the final dimensional requirements, and the minimum tensile strength meets or exceeds the requirement specified in the Crane Materials Specification or referenced Military Specification, or Industry Standard.

3.3 Drawing Note "BREAK ALL SHARP EDGES"

BREAK ALL SHARP EDGES is defined to be:

A radius or chamfer that is up to one third of the material thickness and no greater than 0.02 inches, and at least 0.002 inch unless the material is less than 0.010 inch, in which case at least 0.001 inch radius or chamfer shall be maintained.

3.4 Name/Address Change (Including Source Acquisition or Supersession)

When a Source of Supply identified on an engineering drawing undergoes a name change, and the CAGE Code remains the same, the specification does not need to be revised just to reflect the name change. Name changes will be made at the next revision of the standard. The same is true for a plant address. As long as the CAGE Code remains unchanged, the source is considered to be unchanged.

When a Source is acquired by a new company and the name is subsequently changed to the acquiring company, evidence of the acquisition, such as a public statement on the company website or a press release of the acquisition along with a clarification from the Crane Supplier Liaison is required. A list of such supersessions shall be maintained by Crane Component Engineering as Appendix A of this specification, and made available to suppliers. New additions may be proposed by suppliers, but must be verified by Crane Component Engineering. Verified supersession records shall be added to the list prior to acceptance of affected parts, materials, or processes. The superseded suppliers list is dynamic and may change between revisions of this document. Please refer to the Component Engineering Sharepoint site on SiteLink for the latest version of the list.

3.5 Obsolete and/or Superseded Specifications Referenced On Drawings

When an industry or military specification or standard referenced on a drawing or parts list has become obsolete or replaced, the use of a superseding document referenced on the cancellation notice or supersession document is acceptable. If no superseding document is specified, the original document may continue to be used as long as all specified requirements can still be met. If no clear line of supersession is available for a particular obsolete document, the Crane buyer or Supplier Liaison shall be contacted to obtain clarification. Crane EIS 0715-006 contains a listing of approved supersession substitutions and may be used as a guideline for superseded specifications and material designations.

3.6 Preferred Packaging

Background: Suppliers use a variety of packaging methods and materials. Some are less labor intensive than others to open and gain access to the parts. Some packaging methods conform better to part handling on the production line where there is very little room to put parts that come in large boxes or with lots of packaging around each part.

Interpretation: All packaging has to insure parts are not damaged or contaminated in shipment. Suppliers should select packaging that has internal containers that can stack when the parts are taken out of the initial delivery box (exterior container).

NOTE: This is not a rejectable criterion by Crane Aerospace Receiving Inspection.

3.7 Certificate of Conformance

Background: Inconsistent delivery of parts with the proper set of certificates of conformance causes part delivery delays to the production line plus associated overhead to correct the problem. It may also negatively impact the supplier scorecard or other performance metrics.

Interpretation: The requirements for fabricators are specified in Supplier Quality Assurance Requirements AGIS 40-002, Section 8.5, Section C, and repeated here. Each certificate shall contain these items:

3.7.1 Part Number (Crane Aerospace P/N)

3.7.2 Purchase Order number

3.7.3 The revision of the drawing the part was built to, this shall match the revision that appears on the Purchase Order.

3.7.4 Quantity of parts in the shipment.

3.7.5 Serial number(s) of the parts in the shipment (where applicable.)

3.7.6 Sub-tier certifications for any materials, parts, and/or processes used to make the part or performed on the part provided or performed by any other supplier. All of these documents shall match the specific drawing requirements unless there is a documented supersession (see section 3.5).

3.7.7 Where any processing was performed internally it must be specifically called out on the supplier's certification form. These shall match the specific drawing requirements.

3.7.8 Certifications for cast products shall reference actual chemical and physical properties of the items being delivered.

Where applicable:

3.7.9 Off the shelf and industry standard parts certifications shall include the specified P/N on the certification. This P/N shall match the part number on the drawing or parts list or the Crane Aerospace drawing requirements for Part Number. For off the shelf items (normally specified on Specification Control Drawings), certification to either the manufacturer's part number or to the Crane part number is acceptable. For Source Control and other custom parts, the certification should include the Crane part number.

3.7.10 Separate Material and Process certs for off the shelf and industry standard parts are not required.

3.8 "Suggested" and "Approved" Sources of Supply on Engineering Procurement Drawings or Component Specifications

Background: The headings "Suggested" and "Approved" Sources of Supply as shown in some engineering procurement drawings were used to comply with the definitions of MIL-STD-100, "Engineering Drawing Practices", and are still recommended practice as shown in ASME Y14.24, the replacement industry standard.

Interpretation: Any time "Suggested" or "Approved" sources are listed on a parts standard or specification, the listed sources and their authorized distributors are the only sources approved by Crane Aerospace & Electronics for the procurement of those items. The sources listed under "Suggested" or "Approved" Sources of Supply are not necessarily the only possible sources for these items. They represent those sources which have been approved to-date by Crane Aerospace & Electronics Engineering. Procurement from an unlisted source requires approval by Crane Aerospace & Electronics Engineering. When approval is given, the affected drawing shall be revised to reflect the addition of the new source.

3.9 Vapor Degreasing with Trichloroethylene

Background: Trichloroethylene is no longer a preferred cleaning solvent due to health and environmental hazards. It is being withdrawn from the marketplace. Alternatives have been evaluated and qualified by Crane, but some legacy assemblies may still refer to this type of cleaning.

Interpretation: Where vapor degreasing or cleaning with Trichloroethylene is specified on a part drawing or within a process specification, Trichloroethylene replacement solvents, including Ensolv 5408, Vertrel SDG, Leksol AL, Novec 72DA and others, may be used in place of Trichloroethylene.

3.10 Dew Point Requirement when Heat Treating High Permeability Nickel-Iron alloys

Crane uses Nickel-Iron alloys in a variety of contexts for many reasons, including their high magnetic permeability, and strength and creep resistance at high temperatures and loads. Hydrogen embrittlement can diminish their strength to an unacceptable level, and cause components made of these alloys to fail catastrophically well below their specified limits. To diminish these effects, High Permeability Nickel-Iron alloys (such as MIL-N-14411 or Crane 573026) which undergo heat treatment are required to be soaked in an atmosphere of Dry Hydrogen with a dew point below -40°F. For this purpose, when the annealing cycle is specified on the engineering drawing, it must be ensured that the dew point in the oven reaches below -40°F before the component has cooled to 1100°F.

3.11 Shelf Life Materials

Some materials specifications have a selection labeled “Shelf Life”. This requirement is intended to document the initial shelf life of the material to insure that sufficient time remains of the manufacturer-specified shelf life to allow for consumption of the material with minimal waste or excess. The shelf life may be extended beyond the manufacturer’s labeled date through testing at Crane using accepted procedures. If a material is tested and meets all other specification requirements it is considered to be in accordance with the material specification.

3.12 Torque Callouts

Background: Some drawings do not include a tolerance on torque callouts. The torque callouts on drawings represent nominal torque tool settings. The default tolerance provided in this section will account for the tolerance associated with the setting the tool to the nominal tolerance.

Torque callouts on Crane drawings represent torque tool settings. Tolerances on torque callouts are tolerances on the actual setting of the torque value on tools.

If there is no tolerance on the torque callout on the drawing, the default tolerance is +/- 1 the unit of measurement of the torque callout on the drawing. For example, for torque callouts in in-lb, the default tolerance is +/- 1 in-lb, for torque callouts in in-oz., the default tolerance is +/- 1 in-oz., etc.

Calibration tolerances shall be +/-6% for torque screwdrivers and T-handles and +/-4% for torque wrenches.

3.13 DRAWING NOTE: “CAUTION: CRITICAL MACHINED PART. DO NOT CHEMICALLY ETCH PRIOR TO ANODIZE” is interpreted as follows:

The part has dimensionally critical features which takes precedence over the default requirements in the drawing title block that states “dimensions apply prior to finish.” Anodize builds up on the surfaces of the part which can change the part dimensionally therefore dimensions apply after anodize.

Etching per MIL-A-8625 for anodize preparation is allowed per the drawing note as long as the process does not significantly change the part dimensionally (.0003 in maximum material removal per anodize thickness requirements) nor create surface pitting in excess of that allowed by the specification.

3.14 Drawing Dimensions and Rounding

All dimensional limits specified on drawings are absolute. Dimensional limits, regardless of the number of decimal places, are used as if they were continued with zeros (ASME Y14.5, section 2.4).

Examples:

12.2	means	12.20.....0
12.0	means	12.00.....0
12.01	means	12.010.....0

Rounding of decimal is not allowed when taking measurements. One must read all the values as shown on the measurement equipment and compare that value with the dimension specified on the drawings. If the drawing dimension has fewer decimal places than the measurement equipment, then the drawing decimals will continue with zeros as described above. This rule assumes that the uncertainty of the measurement result is consistent with the requirements of the dimensional limits.

For example, if a drawing specified dimension range is 0.768 - 0.771, and a caliper reading of that part is 0.7713, then the part would be out of tolerance as 0.7713 > 0.7710.

3.15 PWB Ink Marking

Background: Some Crane PWB and PCB engineering drawings will specify to silkscreen legend markings with an ink that meets A-A-56032, Type II. Many manufacturers no longer use the epoxy based ink required by A-A-56032, Type II.

Interpretation: Per EIS 0715-006, inkjet printing using an ink that meets the performance criteria of A-A-56032, Type 2 non-conductive, permanent and fungus resistant shall also be acceptable.

TABLE I **APPENDIX A MANUFACTURERS SUPERSESSION TABLE**

This table is intended to capture a record of manufacturer and test facility name changes, mergers, and acquisitions for the purpose of maintaining control of the sources of supply for components and materials. Contact Component Engineering for additions or changes.

Superseded Manufacturer	CAGE	Product Type	New Manufacturer Name	CAGE	Year
Actel	0J4Z0	FPGA	Microsemi SoC	0J4Z0	2010
Advanced Power Technologies	0DY74	Power Discretes	Microsemi	34333	2006
Agilent Technologies	50434	Optoelectronics	Avago	50434	2005
Altera	67183	Programmable logic	Intel	34649	2015
American Microsystems Inc. (AMI)	3K298	Digital Ics	ON Semiconductor	31471	2008
Amkor Technology		Component Testing	Integra Technologies		2005
Amp	00779	Connectors, electrome-chanical hardware	Tyco Electronics (Now TE Connectivity)	00779	1999
Apex Microtechnology	60024	Power Linear Microcir-cuits	Cirrus Logic/ Apex Precision Power	60024	2007
Arnold Magnetics Technologies	95566	Torroid Cores	Micrometals, Inc.	12856	2010
ASIC Advantage	1MN37	ASICs	Microsemi ASIC Advantage	1MN37	2011
Atmel	1FN41	Memories, programmable logic	Microchip Technology	60991	2016
Avago Technologies	50434	Optoelectronics	Broadcom Limited	?	2016
AVX	6KUV2	Ceramic Capacitors	AVX	04222	2017
B.F. Goodrich Co.	03481	Hardware	Bollhoff, Inc.	3H464	2000

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Superseded Manufacturer	CAGE	Product Type	New Manufacturer Name	CAGE	Year
Bayer Chemicals AG		Molding Compound (Poly-carbonate)	Bayer MaterialScience AG		2003
Bayer MaterialScience AG		Molding Compound (Poly-carbonate)	Covestro		2015
BC Components	H0Z60	Passives	Vishay BC GMBH	D9539	2002
Berg Electronics	22526	Connectors	FCI Electronics	22526	1998
BKC Components	66891	Discrete semiconductors	Microsemi, Lawrence	43611	1998
Burr-Brown Semiconductor	13919	Analog Microcircuits	Texas Instruments	01295	2000
C & D Technologies	53719	Power Electronics	Murata Power Solutions	50721	2007
Calmark Corp	52094	Hardware	Pentair Technical Products (PEP), Inc.	61081	2007
Catalyst Semiconductor	70097	Digital Ics and Memories	ON Semiconductor	1MQ07	2009
CII	58614	Relays	Tyco Electronics	58614	2001
Cirrus Logic/ Apex Precision Power	60024	Power Linear Microcir-cuits	Apex Microtechnology	60024	2012
Cooper Industries	1UW16	Fuses, Circuit Protection, Electronics	Eaton Corp., Bussman	1UW16	2012
Corfin Industries, LLC	0ZG10	Lead refinishing services	Micross Components, LLC	0ZG10	2020
Crystal Semiconductor	0A384	Digital Ics	Cirrus Logic	3G3J7	1991
Dale	91637	Resistors	Vishay-Dale	91637	1988
Datel	50721	Power Electronics	Murata Power Solutions	50721	2004
Deutsch	11139	Connectors	TE Electronics (Tyco)	58614	2012
Eaton Aerospace (some prod-ucts)	81640	Small toggles and push-button switches	Labinal LLC (division of Safran)	81640	2014
Evox - Rifa	65964	Capacitors	Kemet	95275	2007
Fairchild Semi	07263	Linear, Digital, Discrete	ON Semiconductor	1MQ07	2016
FCI Electrical	1NJK8	Terminals	Burndy, LLC	1NJK8	2009
Fox Electronics	61429	Crystals, oscillators	Integrated Device Technologies	61772	2012
Freescale	04713	Complex microcircuits	NXP Semiconductors	18324	2015

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Superseded Manufacturer	CAGE	Product Type	New Manufacturer Name	CAGE	Year
General Semiconductor	14936	Discrete semiconductors	Vishay General Semi	14936	2001
Hamlin, Inc.	12617	Reed Switches and Sensors	Littelfuse	57924	2013
Harris Semi	3G472	Discrete semiconductors and microcircuits	Intersil	34371	1999
Harris Semi	3G472	Standard Logic Microcircuits	Texas Instruments	01295	1998
Hartman	74063	Relays	Tyco Electronics	74063	2001
HP Opto	28480	Optoelectronics	Avago	50434	2005
Hypertronics	50541	Connectors (Hypertac brand)	Smiths Interconnect	50541	2010
International Rectifier	59993	Discretes and Ics	Infineon	C6489	2015
International Rectifier Power Control Systems	59993	Some power discretes and control Ics	Vishay	18612	2007
Intersil (announced, final mid-2017)	34371	Analog	Renesas	SAN34	2017
J.W. Miller	76493	Magnetic Components	Bourns, Inc.	32997	2006
Laird Technologies	0ZNK1	Thermal Pads	Tape Innovations	430Y8	2014
Linear Technology (announced, final mid-2017)	64155	Linear Microcircuits	Analog Devices	24355	2017
Linfinity	34333	Linear microcircuits	Microsemi	34333	1999
Lucent Technologies	1CFA1	Power Electronics	Lineage Power	1TT19	2007
Micrel	60496	Microcircuits	Microchip Technology	60991	2015
Micro Networks	50507	ASICs	Spectrum Controls (part of API)	50507	2009
Microdot	98278	Connectors	Tyco Electronics/Microdot	98278	2000
Microsemi Corporation	Multi	Discretes and Ics	Microchip Technology	60991	2018
Motorola	04713	Microprocessors and DSP	Freescale Semiconductor	04713	2004
Motorola	04713	Discrete semiconductors and microcircuits	ON Semiconductor	1MQ07	1999
National Semiconductor	27014	Analog Ics	Texas Instruments	01295	2011

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Superseded Manufacturer	CAGE	Product Type	New Manufacturer Name	CAGE	Year
New England Semiconductor	43611	Discrete semiconductors	Microsemi, Lawrence	43611	2001
NXP (std products - announced divestiture)	18324	Standard products	Nexperia	TBD	2017
Omni-rel	69210	Power Discretes	International Rectifier	59993	2000
Philips Passive Components	56699	Resistors and Capacitors	Yageo	S7293	2000
Philips Semiconductors	18324	Discrete semiconductors and microcircuits	NXP Semiconductors	H1R01	2006
Power-One	0WH51	Power modules	Bel Fuse Inc.		2014
PPC Power Products	33178	Discrete semiconductors	Microsemi, Lawrence	43611	1997
QP Semiconductor	0C7V7	Military ICs	E2V Aerospace & Defense	0C7V7	2008
Raychem	06090	Interconnection Products	Tyco Electronics	06090	1999
Raytheon Integrated Circuits	07933	Mircocircuits/ASICs	Fairchild Semiconductor	07933	1997
Roederstein	4U402	Capacitors	Vishay	18612	1993
Semicon Components	11961	Discrete Semiconductors	Microsemi, Scottsdale	12954	1992
Sheffield Plastics	54D47	Molding Compound (Poly-carbonate)	Bayer Chemicals AG		1999
Signetics	18324	Discrete semiconductors and microcircuits	Philips Semiconductor	18324	1975
Silicon General (Linfinity)	34333	Linear microcircuits	Microsemi	34333	1999
Silicon Transistor Corp (NES)	07256	Discrete semiconductors	Microsemi, Lawrence	43611	2001
Siliconix	17856	Discrete semiconductors	Vishay	18612	1998
Spansion	4JUL4	Memories	Cypress	65786	2015
Spectrol	02111	Potentiometers	Vishay	18612	2000
Spectrum Microwave	50507	ASICs	API Technologies	50507	2011
Sprague	56289	Capacitors	Vishay	18612	1992
Sprague	56289	Diodes	Allegro MicroSystems	0CVK3	1990
Steward	83285	Magnetic Components	Laird	30817	2006
Supertex	59640	Analog, discrete	Microchip Technology	60991	2014
Sypris Test & Measurement		Component Testing	Tektronix Component Solutions		2009

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T.I.	01295	Military Memory Products, only	Austin Semiconductor	0EU86	1999
T.I. Controls	82647	Thermal switches, relays	Sensata	82647	2006
Tansitor	05079	Capacitors	Vishay	18612	2001
Techno Components	17826	Resistors	Vishay-Dale	91637	2006
Tektronix Component Solutions		Component Testing	Precision Test Solutions (PTS)		2013
Tyco Electronics	00779	All	TE Connectivity	00779	2011
Tyco Electronics (Lucent Power)	1CFA1	Power Electronics	Lineage Power	1TT19	2007
Unitrode Corp	12969	Discrete semiconductors	Microsemi, Lawrence	43611	1992
Unitrode Corp	12969	Linear Microcircuits	Texas Instruments	01295	1999
Valpey-Fisher	21821	Crystals, oscillators	CTS	75378	2012
Vitramon		Capacitors	Vishay	18612	1994
VTI	-	Sensors	Murata Manufacturing	-	2011
Wolfson Microelectronics	-	Digital Ics	Cirrus Logic	3G3J7	2014
Xicor	60395	Linear microciruits	Intersil	34371	2004
Zetex	K1196	Discrete Semiconductors	Zetex Diodes, Inc.	K1196	2008