REVISION HISTORY

LTR	DESCRIPTION	CLASS	DWN	ENGR	
A	INITIAL RELEASE	E			SEE JPL DATA MANAGEMENT SYSTEM FOR APPROVAL SIGNATURES AND DATES
B	CORRECTED R79 & R97. PREPARED FOR UNLIMITED RELEASE.	E			

Sheet Listing

10398534	
NEXT ASSEMBLY	USED ON
APPLICATION	

MATERIAL:

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

LINEAR TOLERANCES:

.XX ± .03
.XXX ± .010

ANGULAR TOLERANCE: ± 0.5°

SURFACE ROUGHNESS (MICROMETERS) √

DO NOT SCALE DRAWING
INTERPRET DIMENSIONING AND TOLERANCING PER ASME Y14.5-2009
INTERPRET DWG PER ASME Y14.100

CONTRACT NO _____

APPD _____ DATE _____

DWN	D Palmer
ENGR	C Shelton

SEE JPL DATA MANAGEMENT SYSTEM FOR APPROVAL SIGNATURES AND DATES.

JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CA 91109

SCHEMATIC, THIRTY METER TELESCOPE M1 ACTUATOR DRIVER

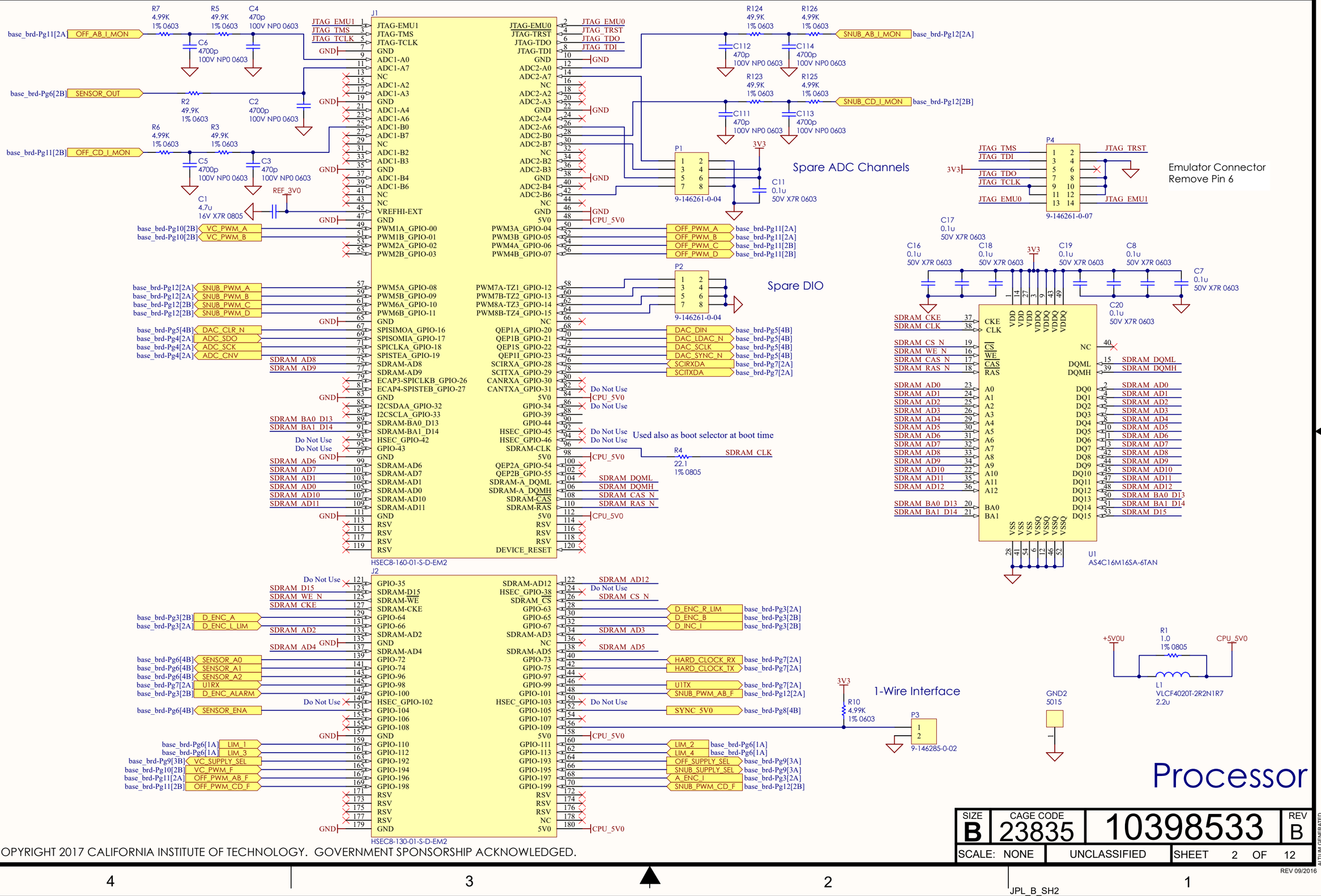
SIZE	CAGE CODE		REV
B	23835	10398533	B

SCALE: NONE | UNCLASSIFIED | SHEET 1 OF 12

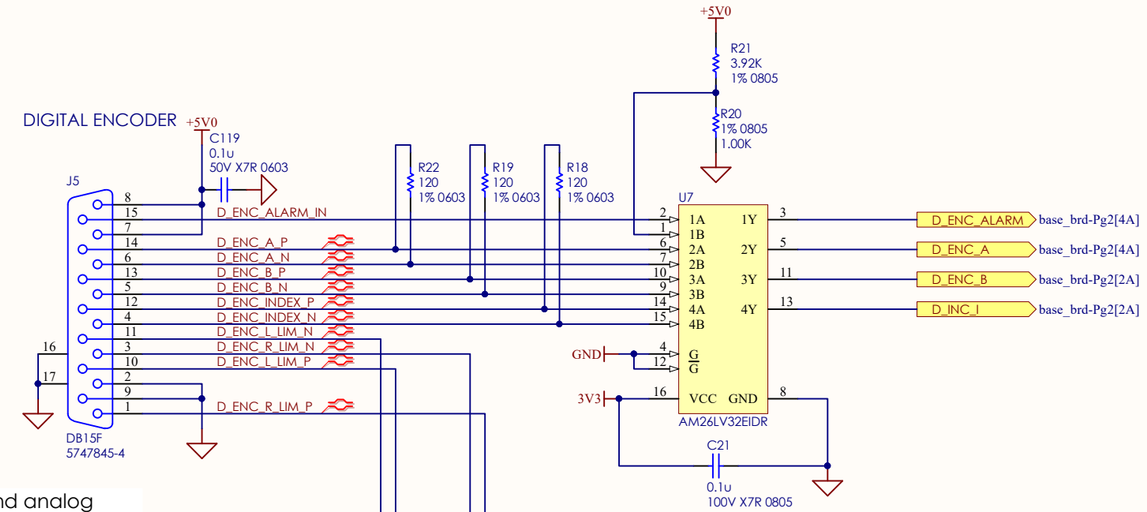
ALTIUM GENERATED

REV 09/2016

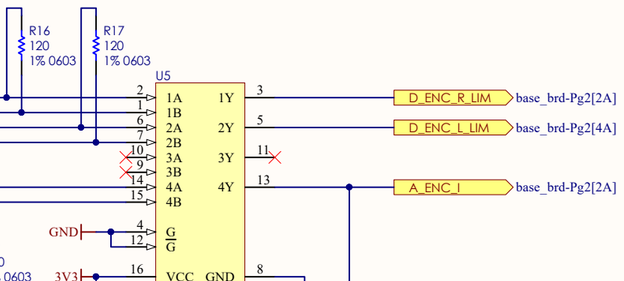
JPL_B_SH1


J1
HSEC8-160-01-S-D-EM2
J2
HSEC8-130-01-S-D-EM2
P1
9-146261-0-04
P2
9-146261-0-04
P3
9-146285-0-02
P4
9-146261-0-07
U1
AS4C16M16SA-6TAN
Spare ADC Channels
Spare DIO
Used also as boot selector at boot time
1-Wire Interface
Emulator Connector
Remove Pin 6
Processor
COPYRIGHT 2017 CALIFORNIA INSTITUTE OF TECHNOLOGY. GOVERNMENT SPONSORSHIP ACKNOWLEDGED.
SIZE B
CAGE CODE 23835
10398533
REV B
SCALE: NONE
UNCLASSIFIED
SHEET 2 OF 12
REV 09/2016
ALTIUM GENERATED
JPL_B_SH2

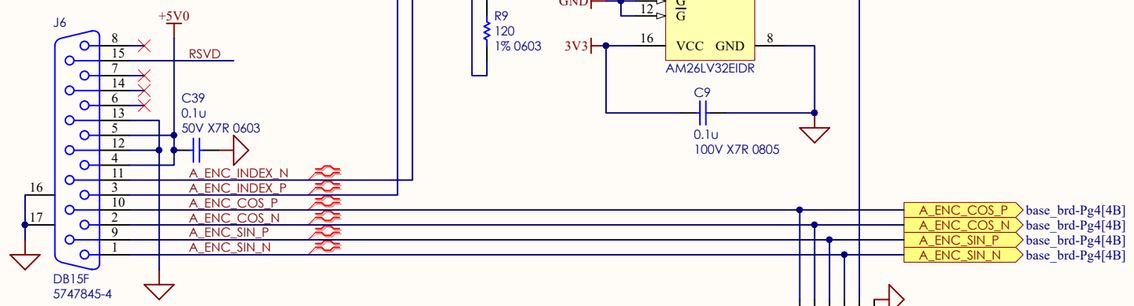
DIGITAL ENCODER



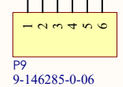
The digital and analog encoder inputs share no connections, can in principle be operated simultaneously.

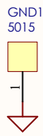


ANALOG ENCODER



Analog Encoder Test Points





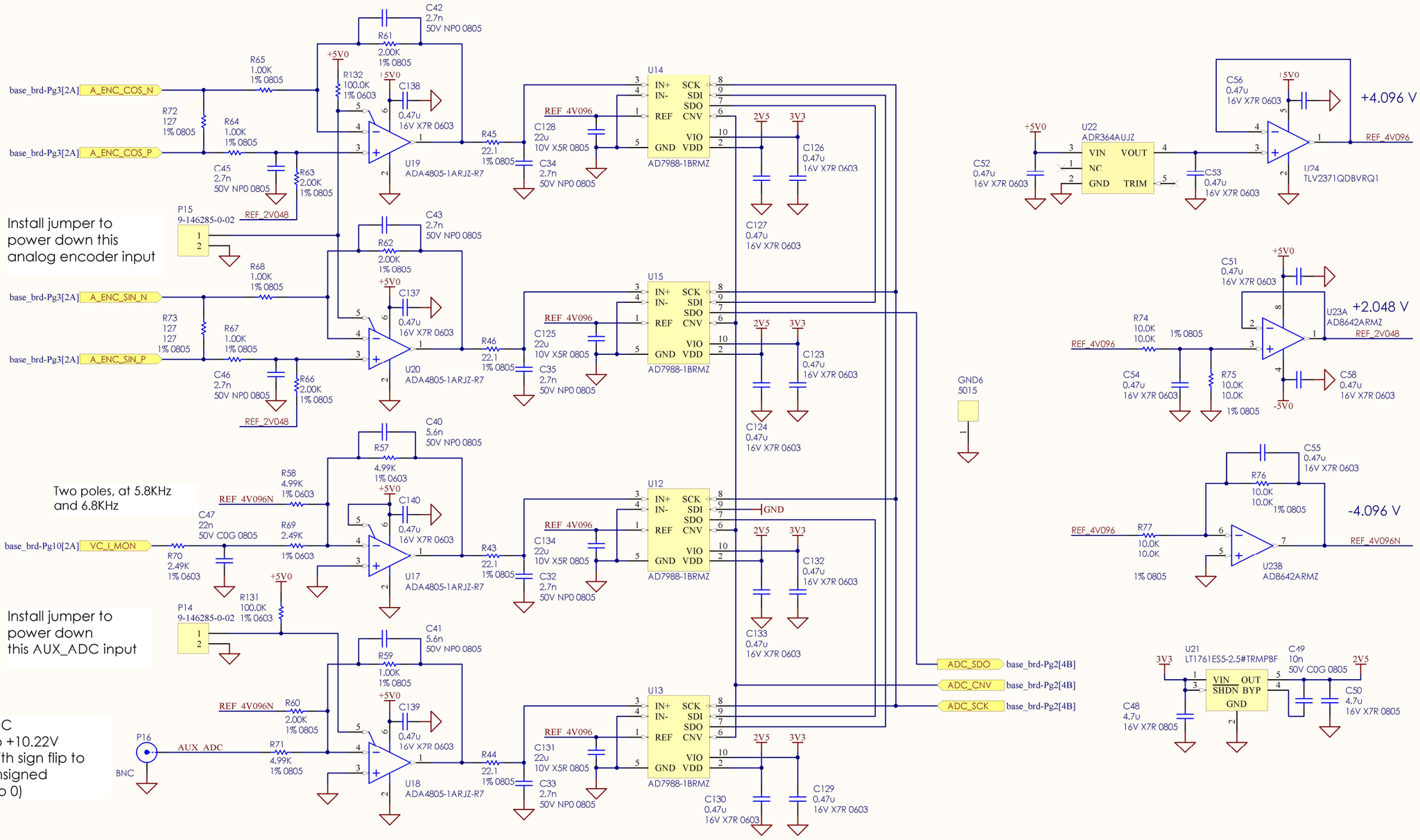
Encoders

SIZE	CAGE CODE		REV
B	23835	10398533	B
SCALE: NONE	UNCLASSIFIED	SHEET 3 OF 12	

ALTIUM GENERATED

REV 09/2016

JPL_B_SH2



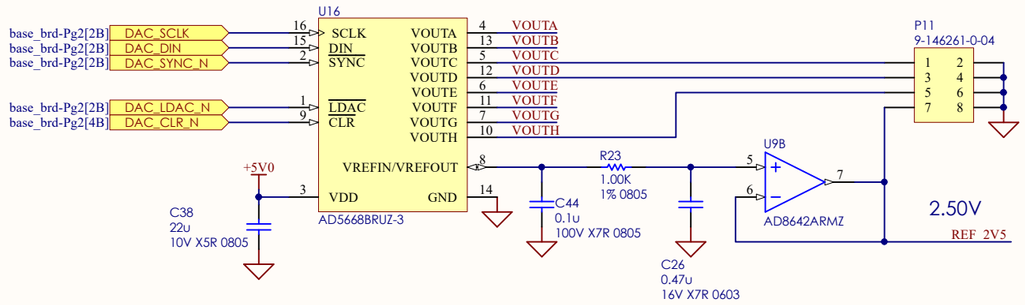
SIZE	CAGE CODE		REV
B	23835	10398533	B
SCALE: NONE	UNCLASSIFIED	SHEET 4 OF 12	

REV 09/2016

ALTIUM GENERATED

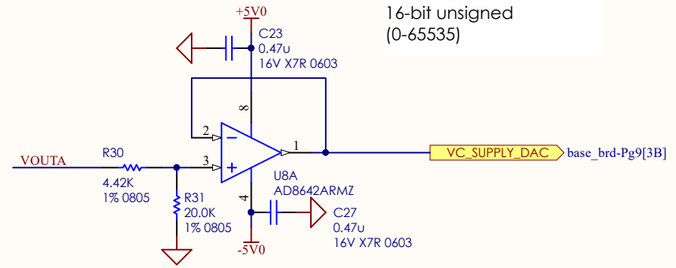
JPL_B_SH2

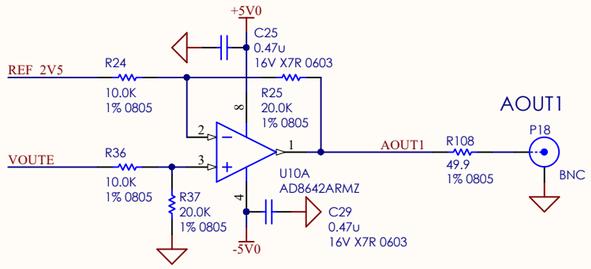
DAC
0.0 to 5.0V
16-bit unsigned
(0-65535)



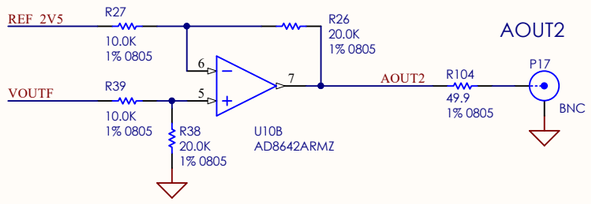
VC_SUPPLY_DAC,
OFF_SUPPLY_DAC
SNUB_SUPPLY_DAC

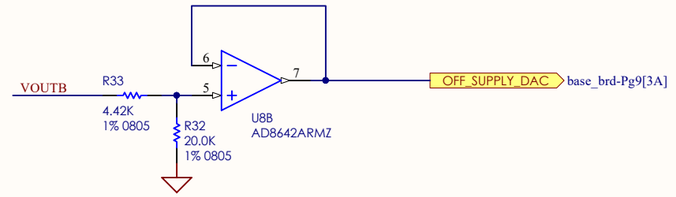
0 to +4.096V
16-bit unsigned
(0-65535)

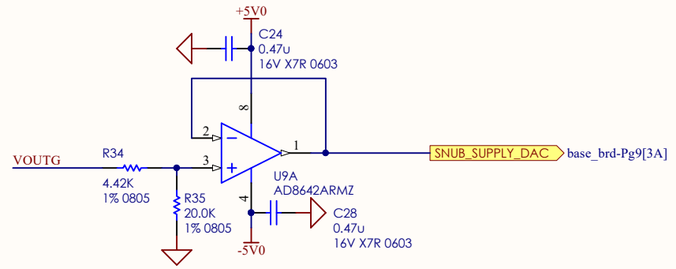


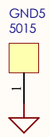


AOUT1, AOUT2
-5.0 to 5.0V
16-bit unsigned
(0-65535)



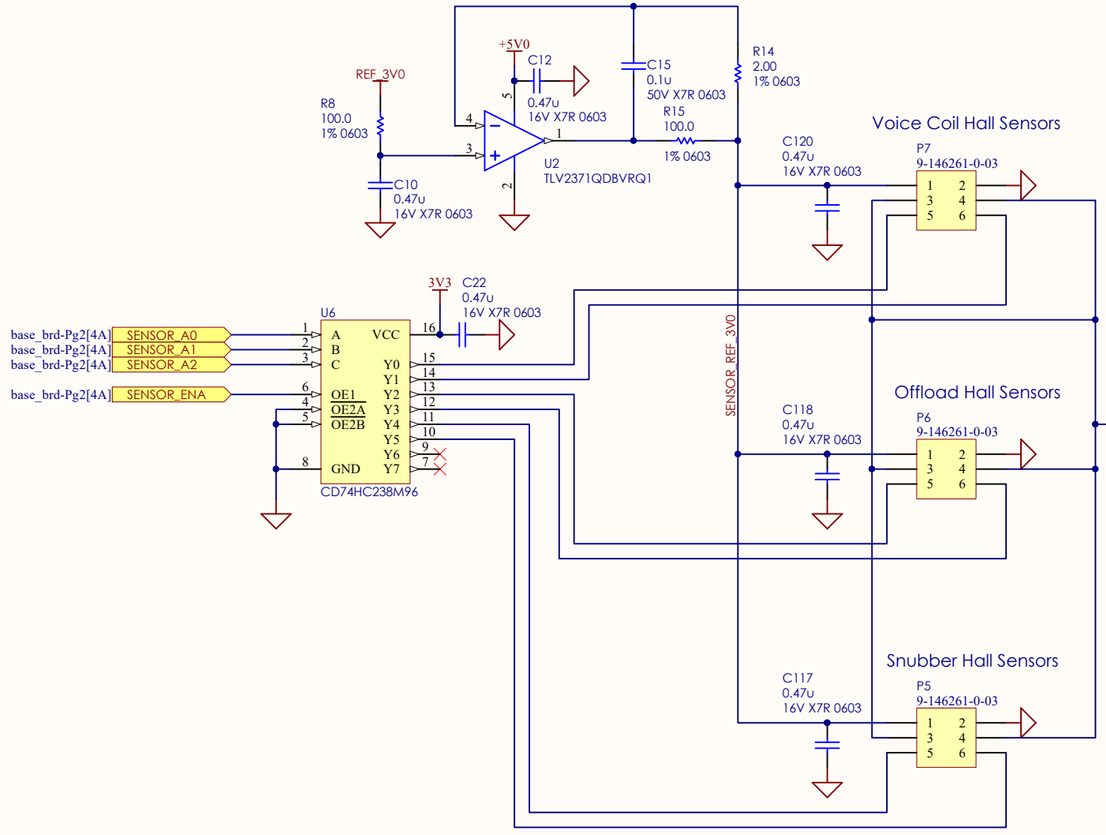






DAC

SIZE	CAGE CODE		REV
B	23835	10398533	B
SCALE: NONE	UNCLASSIFIED	SHEET 5 OF 12	



PINOUT FOR HALL SENSORS
Each connector supports one or two hall sensors. One (or no) sensor is enabled at a time.

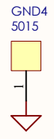
1 Vref, Vcc
2 GND
3 OUT1
4 OUT2
5 /SLEEP1
6 /SLEEP2

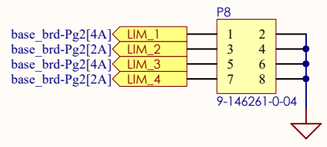
CONNECTOR FOR LEGACY LIMIT SWITCHES

Switches be SPST, connecting 1 to 2, 3 to 4, etc.

Normally-open or -closed operation is accomodated in software.

GPIO pins should be configured with a pull-up resistor internal to the C2x.





VC, OFFLOAD & SNUBBER HALL SENSORS

SIZE	CAGE CODE		REV
B	23835	10398533	B
SCALE: NONE	UNCLASSIFIED	SHEET 6 OF 12	

REV 09/2016

ALTIUM GENERATED

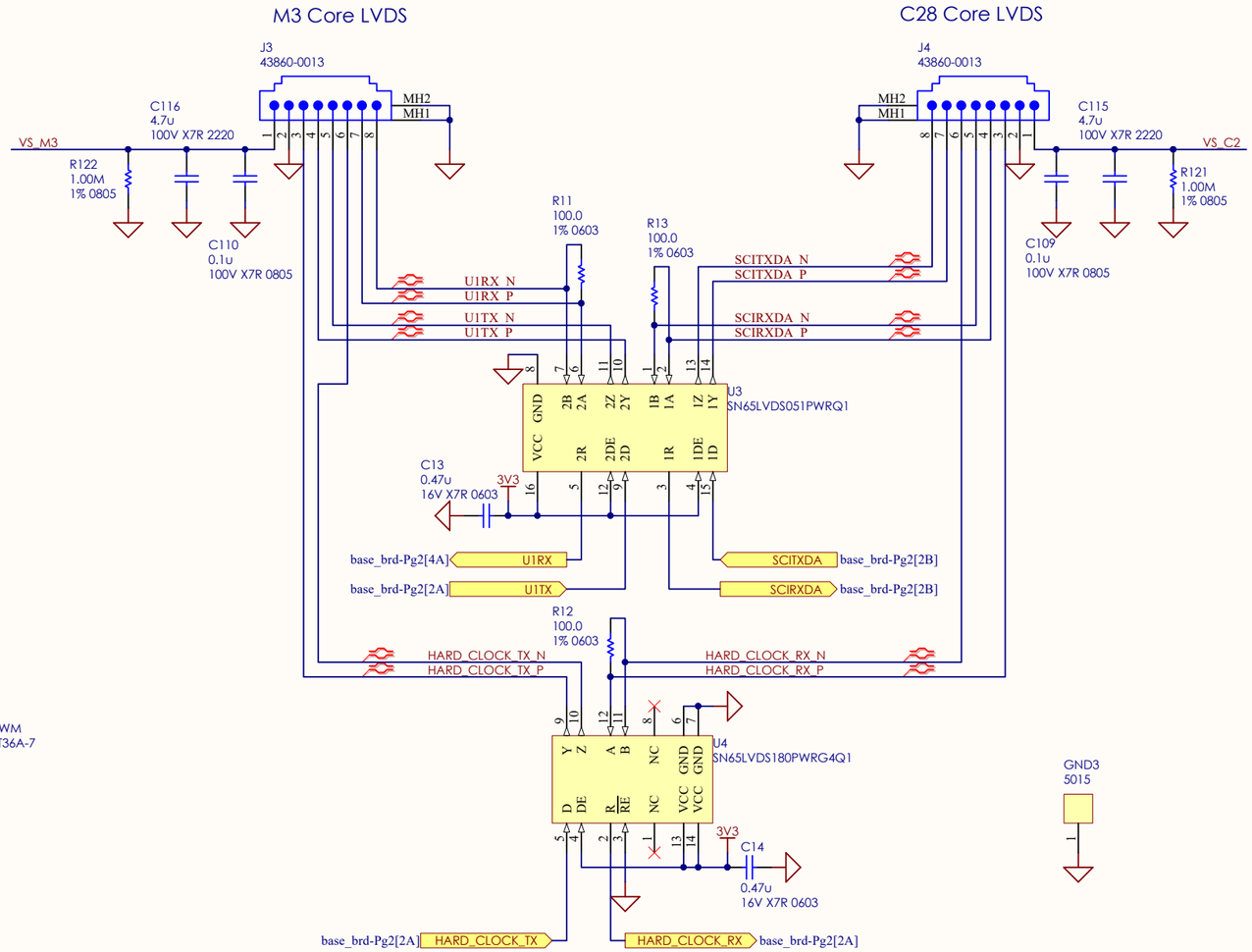
JPL_B_SH2

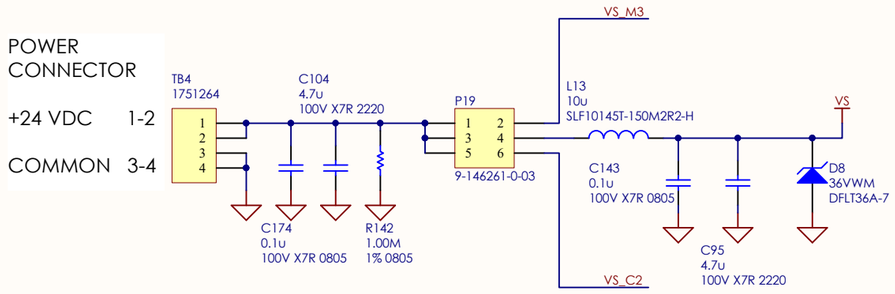
JUMPER OPTIONS FOR ROUTING POWER

Standalone (dual core)
3-4

Emulate Lower Segment Box
(M3 comm connector sends 24VDC)
1-2
3-4

Emulate Actuator Board
(C2 comm connector receives 24VDC)
4-6

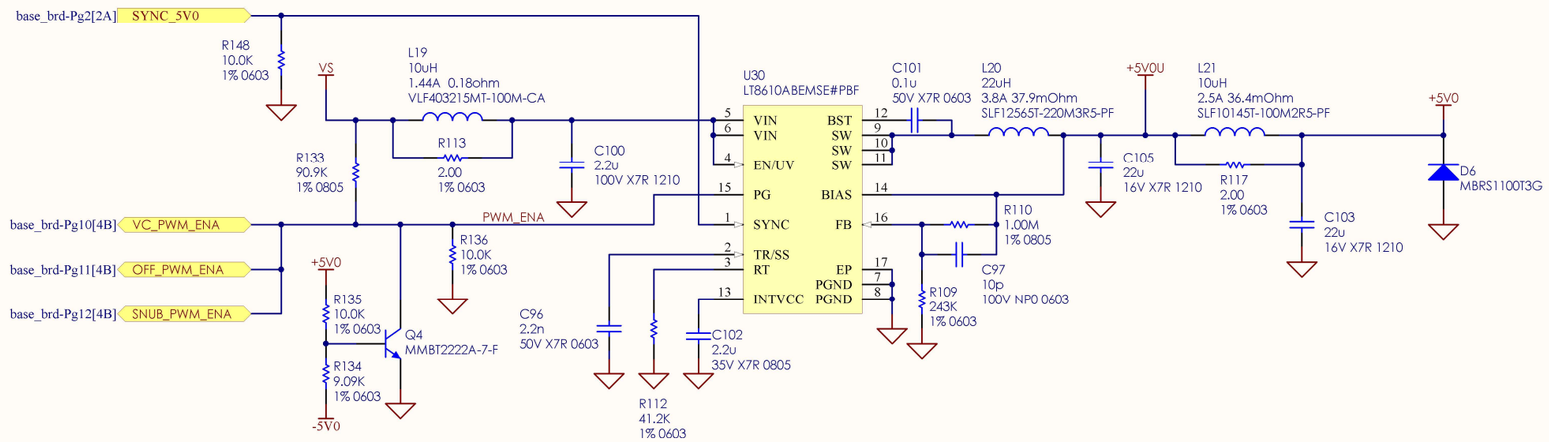




Comm and Power I/O

SIZE	CAGE CODE		REV
B	23835	10398533	B
SCALE: NONE	UNCLASSIFIED	SHEET 7 OF 12	

REV 09/2016



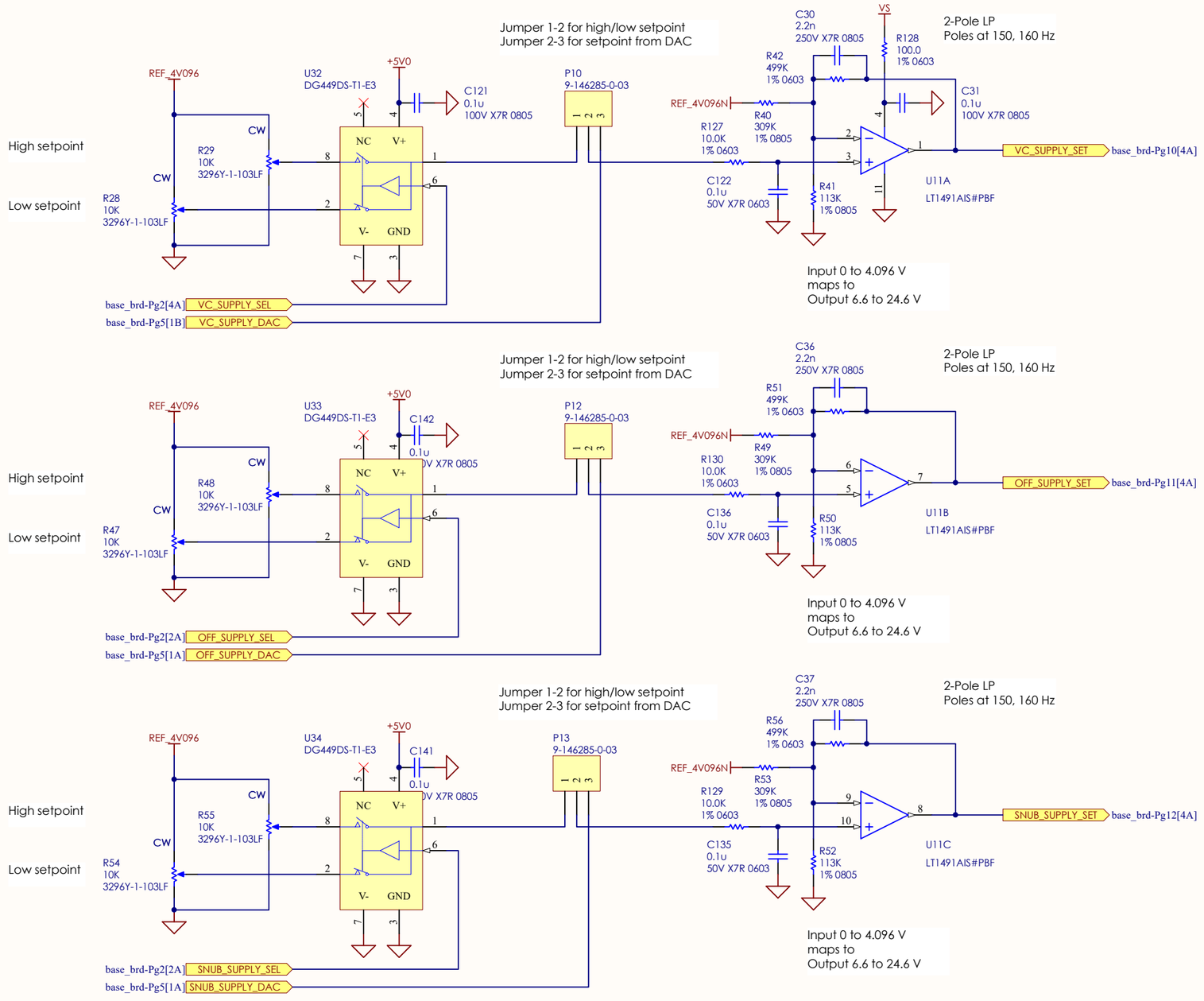
Power

SIZE	CAGE CODE		REV
B	23835	10398533	B
SCALE: NONE	UNCLASSIFIED	SHEET 8 OF 12	

REV 09/2016

ALTIUM GENERATED

JPL_B_SH2



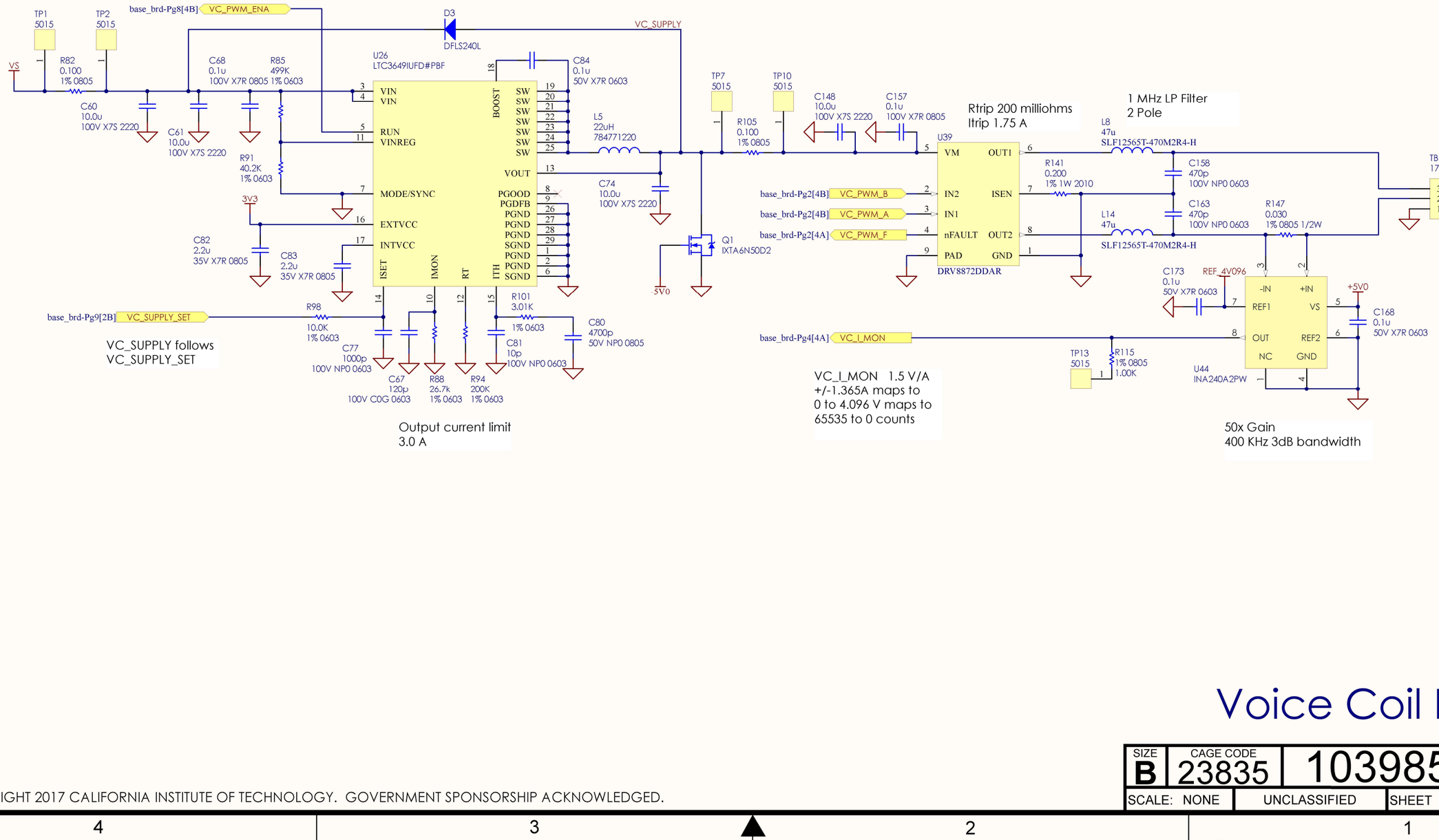
Motor Supply Control

SIZE	CAGE CODE		REV
B	23835	10398533	B
SCALE: NONE	UNCLASSIFIED	SHEET 9 OF 12	

REV 09/2016

ALTIUM GENERATED

JPL_B_SH2



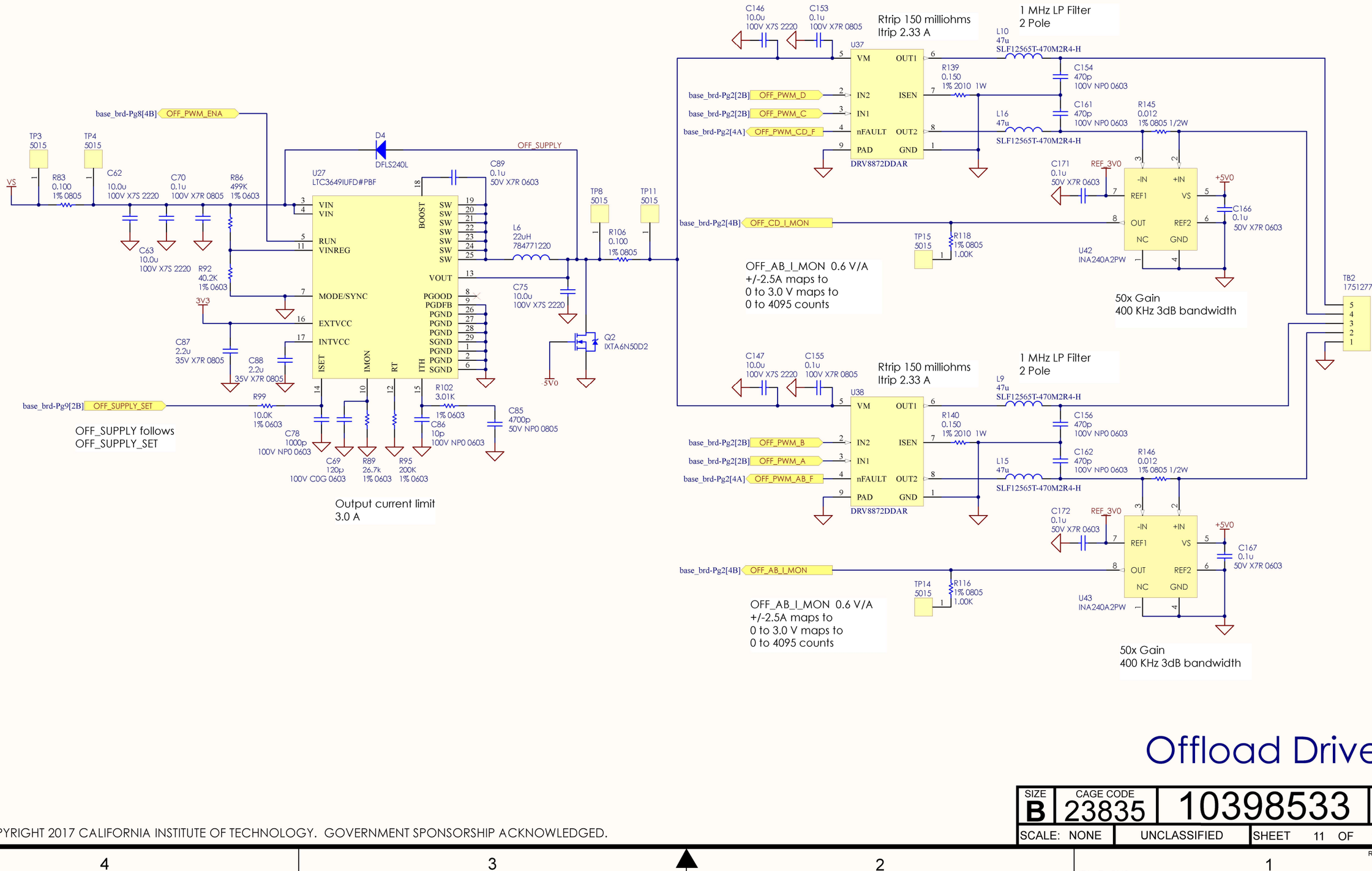
Voice Coil Driver

SIZE	CAGE CODE		REV
B	23835	10398533	B
SCALE: NONE	UNCLASSIFIED	SHEET 10 OF 12	

REV 09/2016

ALTIUM GENERATED

JPL_B_SH2



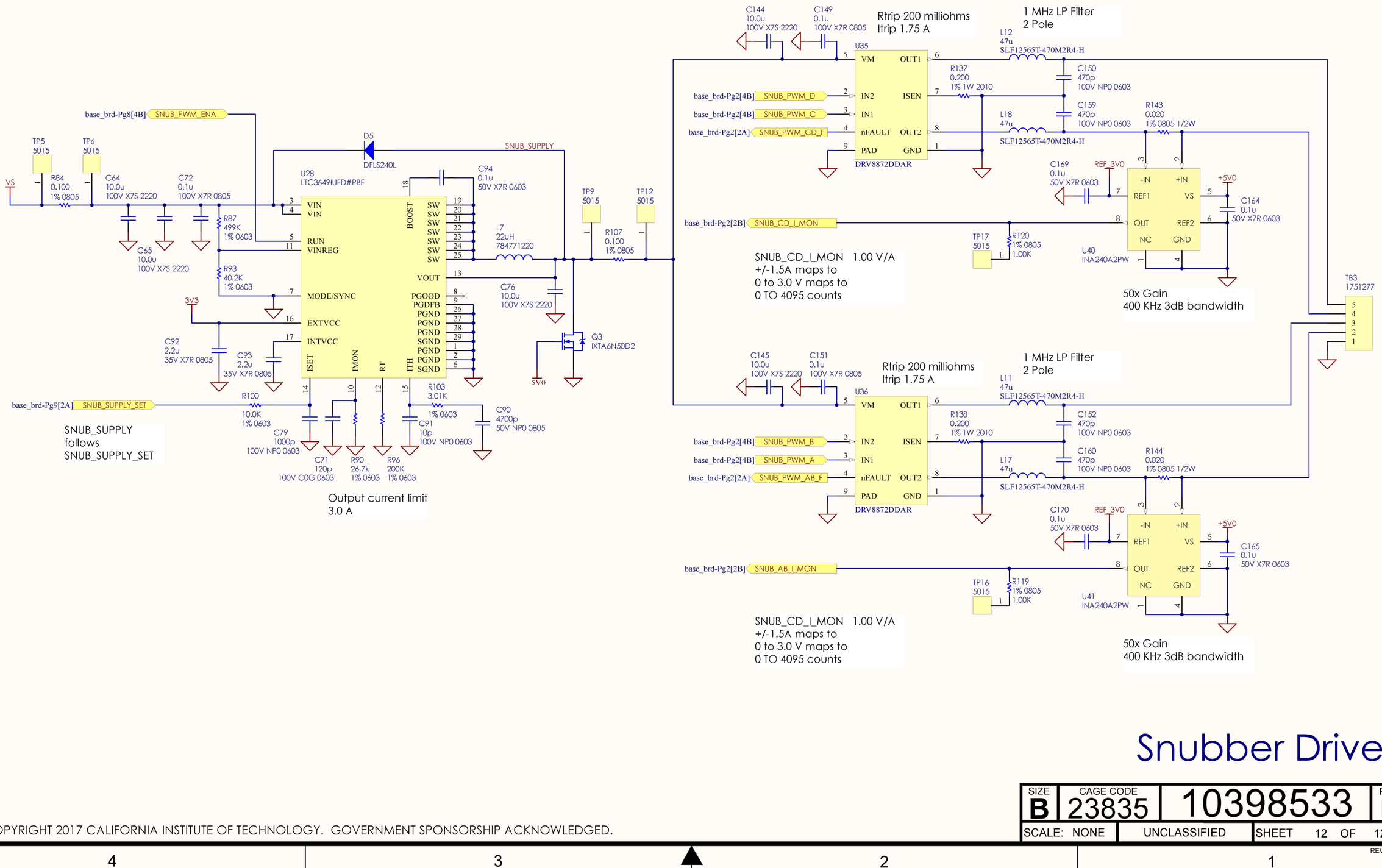
Offload Driver

SIZE	CAGE CODE		REV
B	23835	10398533	B
SCALE: NONE	UNCLASSIFIED	SHEET 11 OF 12	

REV 09/2016

ALTIUM GENERATED

JPL_B_SH2



Snubber Driver

SIZE	CAGE CODE		REV
B	23835	10398533	B
SCALE: NONE	UNCLASSIFIED	SHEET 12 OF 12	

REV 09/2016

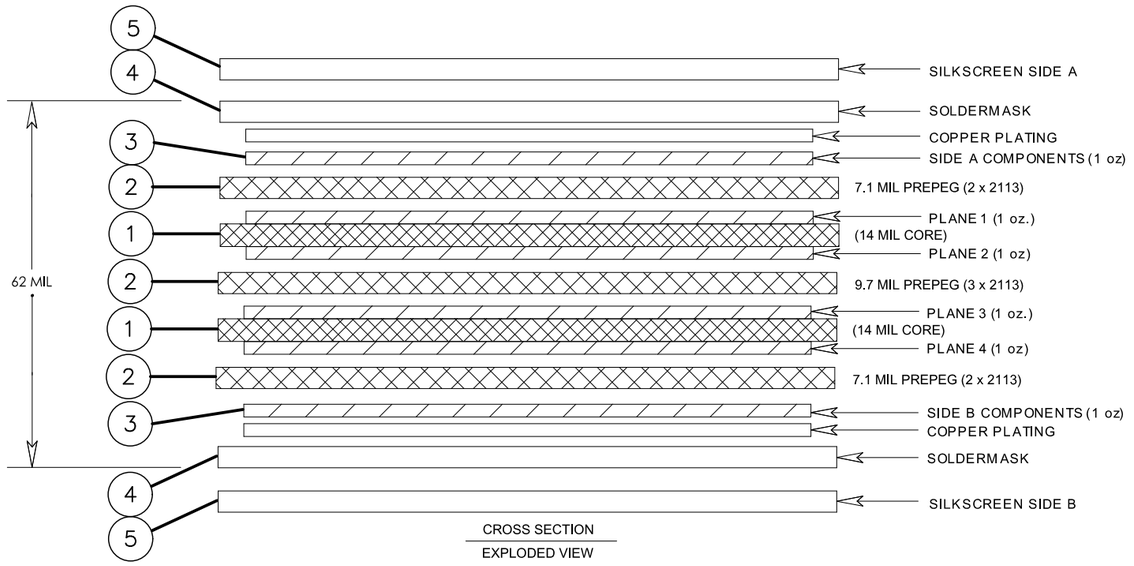
ALTIUM GENERATED

JPL_B_SH2

REVISION HISTORY												
LTR	DESCRIPTION	CLASS	DWN	CHK	STRUCT	MATL	THRM CONT			ENGR	DSGN SUPV	DATA MGT	RELEASE DATE
A	INITIAL RELEASE	E	SEE JPL DATA MANAGEMENT SYSTEM FOR APPROVAL SIGNATURES AND DATES										
B	CORRECTED R79 & R97. PREPARED FOR UNLIMITED RELEASE.	E											

11. ELECTRICAL TEST: CONTINUITY SHORT AND OPEN TESTING ON ALL AVAILABLE EXPOSED TERMINAL PADS USING IPC–D–356A NETLIST DATA. CONTINUITY TEST SHALL BE AT 5 OHMS MAX. SHORTS TESTING SHALL BE PERFORMED AT 250V. MINIMUM ISOLATION OF 20M OHMS.
10. BOW AND TWIST: SHALL NOT EXCEED .007 IN PER INCH
9. SILKSCREEN: BOTH SIDES WITH WHITE NON–CONDUCTIVE EPOXY INK. LANDS AND EXPOSED PLATED AREAS TO BE FREE OF INK.
8. SOLDER MASK: PHOTO–IMAGED LIQUID POLYMER, GREEN COLOR, ON BOTH SIDES OF BOARD IN ACCORDANCE WITH IPC–SM–840, TYPE B, CLASS 2, OVER BARE COPPER.
7. FABRICATION TOLERANCES: END PRODUCT TRACE WIDTHS AND LANDS SHALL NOT VARY MORE THAN THE SMALLER OF .002 IN OR 10% OF THE TRACE WIDTH FROM THE GERBER DATA.
6. ALL HOLES SPECIFIED IN THE DRILL CHART ARE FINISHED HOLE DIAMETERES. HOLE TOLERANCE +/– 0.002 IN FOR NON–PLATED HOLES AND +/– 0.003 IN FOR PLATED HOLES.
5. SURFACE FINISH TO BE ELECTROLESS NICKEL/IMMERSION GOLD (ENIG) PLATING PER IPC–6013. ALL PLATED HOLES AND CONDUCTIVE SURFACES SHALL BE PLATED WITH 0.001 IN COPPER MINIMUM. ALL Ni/Au PLATED AREA SHOULD HAVE MIMIMUM THICKNESS 0.0001 IN FOR Ni AND 0.000002 IN FOR Au.
4. MATERIAL: .062 IN (+/– 10%) THICK GLASS EPOXY, NATURAL COLOR, LAMINATED NEMA GRADE FR4.
3. FABRICATE AND INSPECT PER IPC–6012.
2. THIS DOCUMENT AND RELATED ARTWORK ARE COM–PUTER GENERATED. CHANGES ARE TO BE PERFORMED ON THE ORIGINAL DATABASE IN SECTION 383.
1. THE FINISHED PRINTED WIRING BOARD SHALL MEET THE REQUIREMENTS OF IPC–A–600–X (LATEST REVISION).

NOTES: UNLESS OTHERWISE SPECIFIED



CROSS SECTION
EXPLODED VIEW

PARTS LIST

QTY REQD		ITEM NO	REF DES	CAGE CODE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL OR NOTE
	AR	5			HYSOL SERIES M. CATALYST 20/A	INK, WHITE EPOXY	IPC–4781	9
	AR	4			LPI, SM P41	SOLDERMASK, PROBIMER 52	IPC–SM–840 CL A	8
	AR	3			3 CU E3	COPPER FOIL, 1 OZ.	IPC–4562	
	AR	2			P 26–E2116 TW RE VC	GLASS BASE EPOXY RESIN PREPREG, B–STAGE	IPC–4104/26	
	AR	1			L 26–0400–C1/C1	GLASS BASE EPOXY RESIN CU CLAD 1 OZ / 1 OZ	IPC–4104/26	

10398535	
NEXT ASSEMBLY	USED ON
APPLICATION	

MATERIAL:

MATERIAL PER SPECIFICATION

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
LINEAR TOLERANCES:

.XX ±.03
.XXX ±.010

ANGULAR TOLERANCES: ±0.5°

MACHINE FINISH

DO NOT SCALE DRAWING
INTERPRET DWG PER ASME Y14.100

CONTRACT NO

APPD DATE

DWN	
CHK	
STRUCT	
MATL	
THRM CONT	
ENGR	
DSGN SUPV	

SEE JPL DATA MANAGEMENT SYSTEM FOR APPROVAL SIGNATURES AND DATES

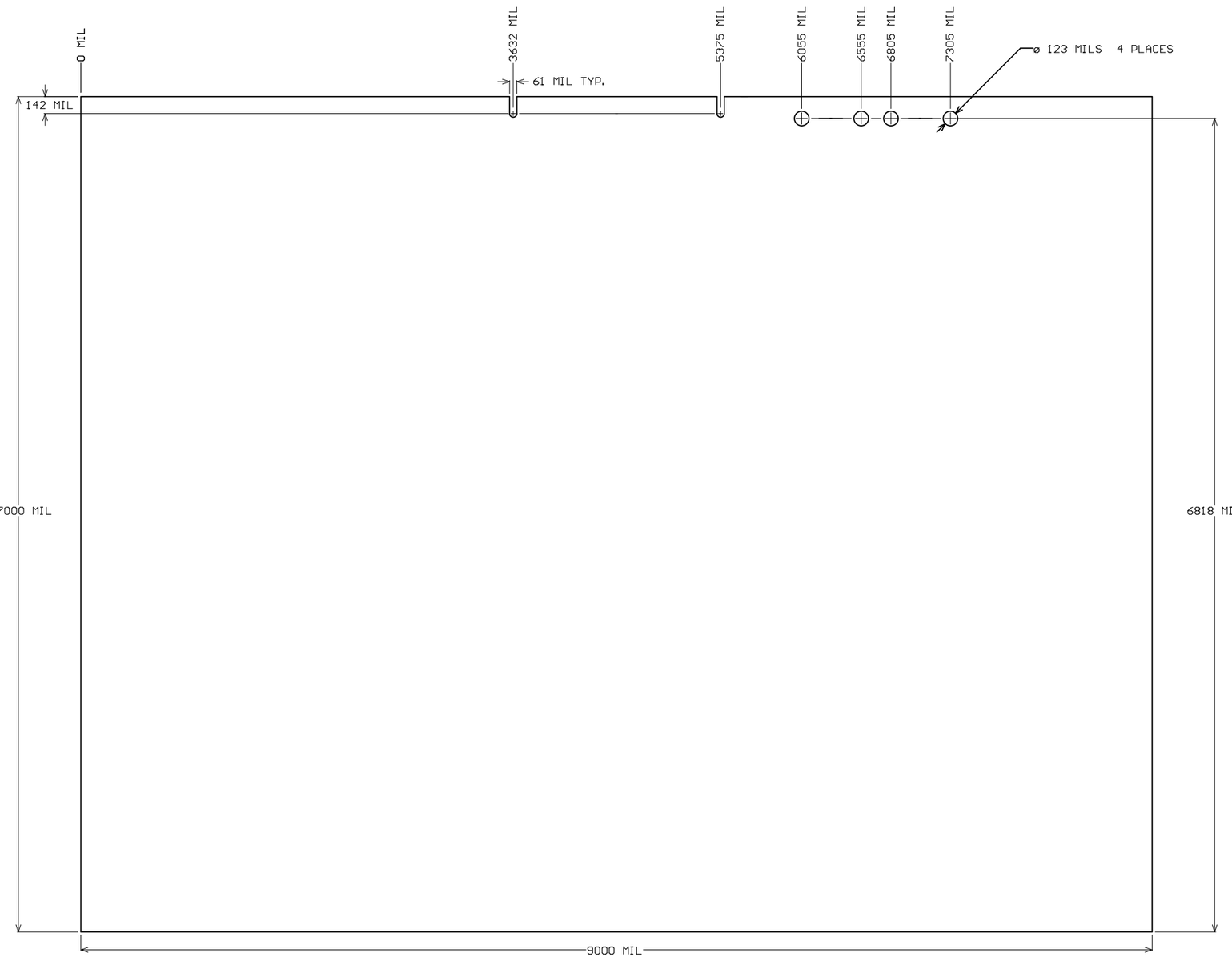
JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CA 91109

FABRICATION, THIRTY METER TELESCOPE M1 ACTUATOR DRIVER PWB

SIZE	CAGE CODE		REV
B	23835	10398534	B

SCALE: 1/1 | UNCLASSIFIED | SHEET 1 OF 16

REV 01/2013
DBASE NAME: ANSI_B–SH1/A5



DIMENSIONS

SIZE	CAGE CODE		REV
B	23835	10398534	B
SCALE: 1/1	UNCLASSIFIED	SHEET 2 OF 16	

REV 02/2013

DBASE NAME: ANSI_B-SH2/A5

TABLE A / ARTWORK FILE DESIGNATION

SN NO.	FILE:	LOGICAL LAYER	PHYSICAL LAYER	DESCRIPTION
4	10364583.GTP	-	OUTER LAYER 1	PASTE MASK SIDE A
5	10364583.GTO	-	OUTER LAYER 2	OVERLAY SIDE A
6	10364583.GTS	-	OUTER LAYER 3	SOLDER MASK SIDE A
7	10364583.GTL	COPPER SIDE A	OUTER LAYER COPPER	COMPONENTS SIDE A
8	10364583.GP1	COPPER LAYER 2	INNER LAYER	PLANE - GND
9	10364583.GP2	COPPER LAYER 3	INNER LAYER	PLANE - +5V SPLIT
10	10364583.GP3	COPPER LAYER 4	INNER LAYER	PLANE - REF_4V096
11	10364583.GP4	COPPER LAYER 5	INNER LAYER	PLANE - VS / 3V3 SPLIT
12	10364583.GBL	COPPER SIDE B	OUTER LAYER COPPER	COMPONENTS SIDE B
13	10364583.GBS	-	OUTER LAYER 4	SOLDER MASK SIDE B
14	10364583.GBO	-	OUTER LAYER 5	OVERLAY SIDE B
15	10364583.GBP	-	OUTER LAYER 6	PASTE MASK SIDE B
16	10364583.GD1	-	DRILL LOCATIONS	DRILL DRAWING

TABLE B / APERTURE SIZES

SH NO.	FILE:	APERTURE TYPE	EMBEDDED CODE
4	10364583.GTP	RS274-X STANDARD	YES
5	10364583.GTO		YES
6	10364583.GTS		YES
7	10364583.GTL		YES
8	10364583.GP1		YES
9	10364583.GP2		YES
10	10364583.GP3		YES
11	10364583.GP4		YES
12	10364583.GBL		YES
13	10364583.GBS		YES
14	10364583.GBO		YES
15	10364583.GBP		YES
16	10364583.GD1		YES

SIZE	CAGE CODE		REV
B	23835	10398534	B
SCALE: 1/1	UNCLASSIFIED	SHEET 3 OF 16	

REV 02/2013

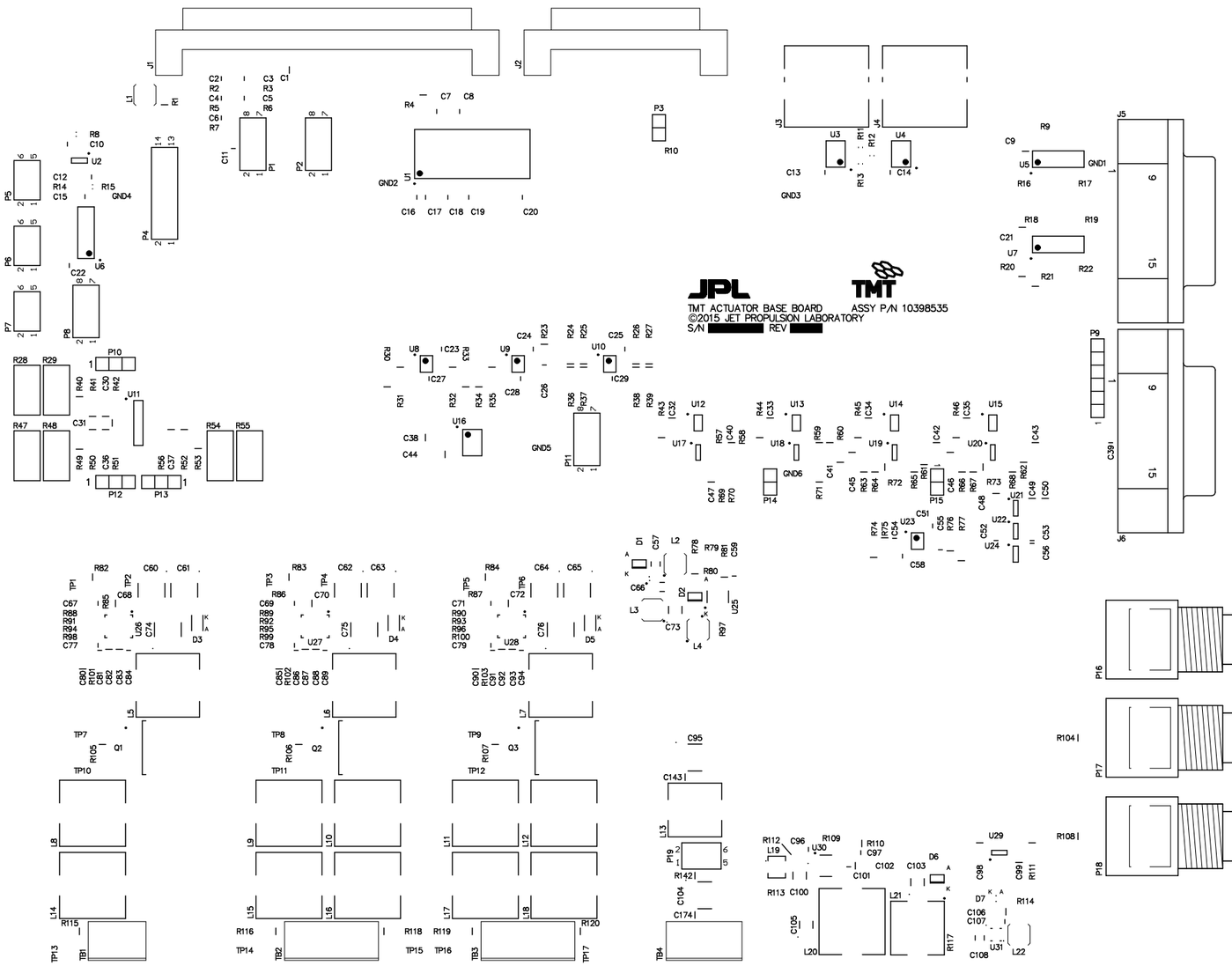
DBASE NAME: ANSI_B-SH2/A5

PASTEMASK – SIDE A

SIZE	CAGE CODE		REV
B	23835	10398534	B
SCALE: 1/1	UNCLASSIFIED	SHEET 4 OF 16	

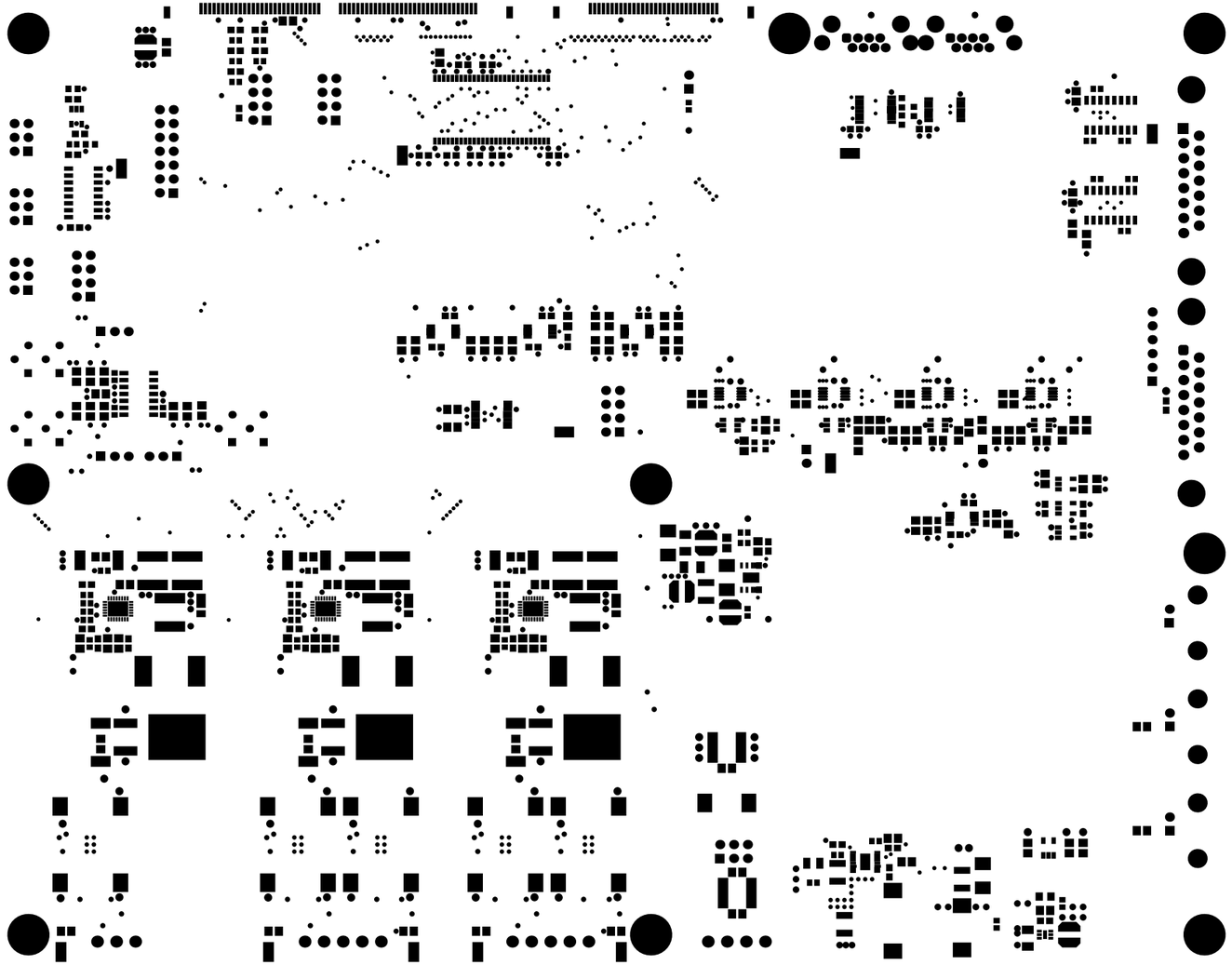
REV 02/2013

DBASE NAME: ANSI_B–SH2/A5



SILKSCREEN – SIDE A

SIZE	CAGE CODE		REV
B	23835	10398534	B
SCALE: 1/1	UNCLASSIFIED	SHEET 5 OF 16	

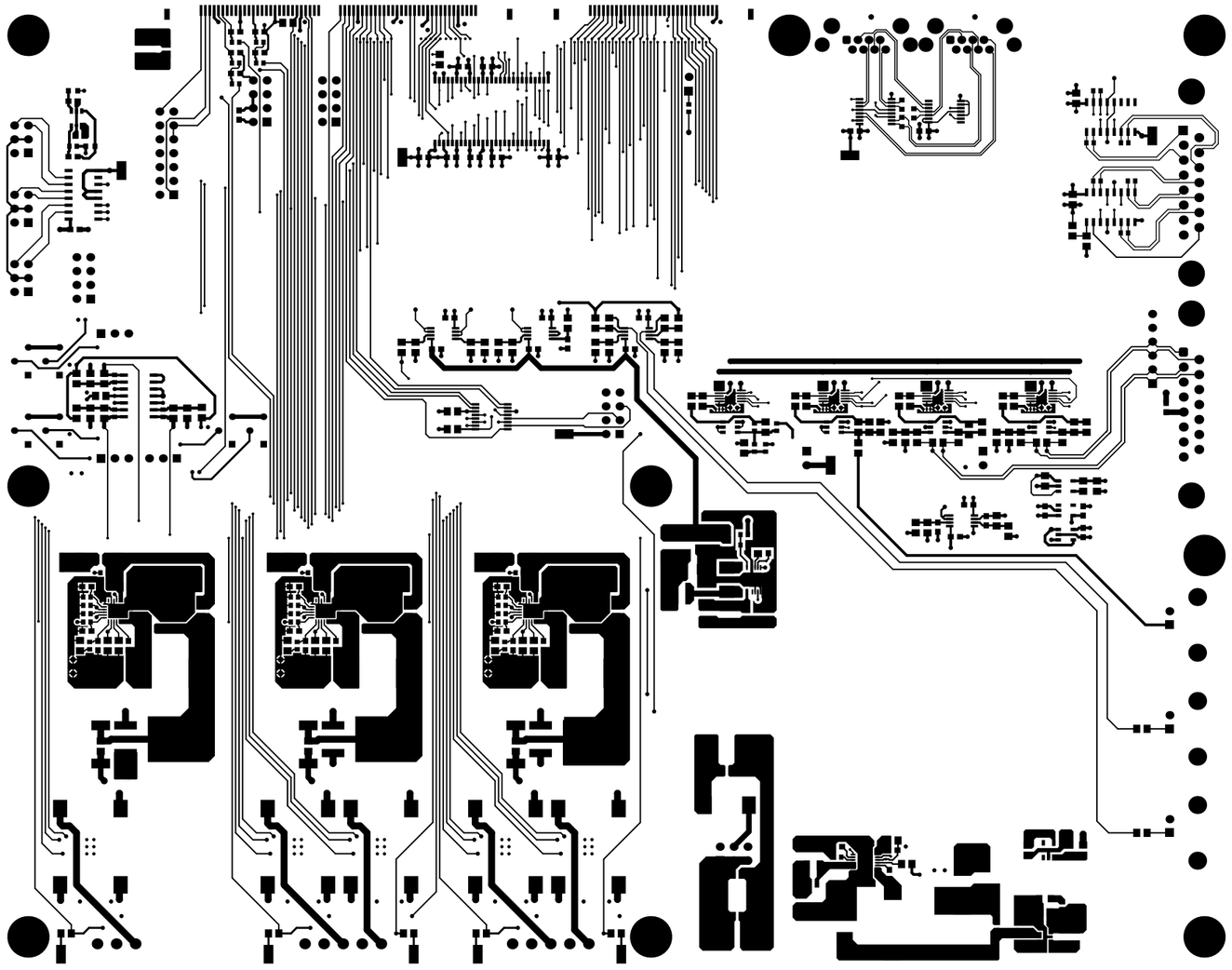


SOLDERMASK – SIDE A

SIZE	CAGE CODE		REV
B	23835	10398534	B
SCALE: 1/1	UNCLASSIFIED	SHEET 6 OF 16	

REV 02/2013

DBASE NAME: ANSI_B-SH2/A5

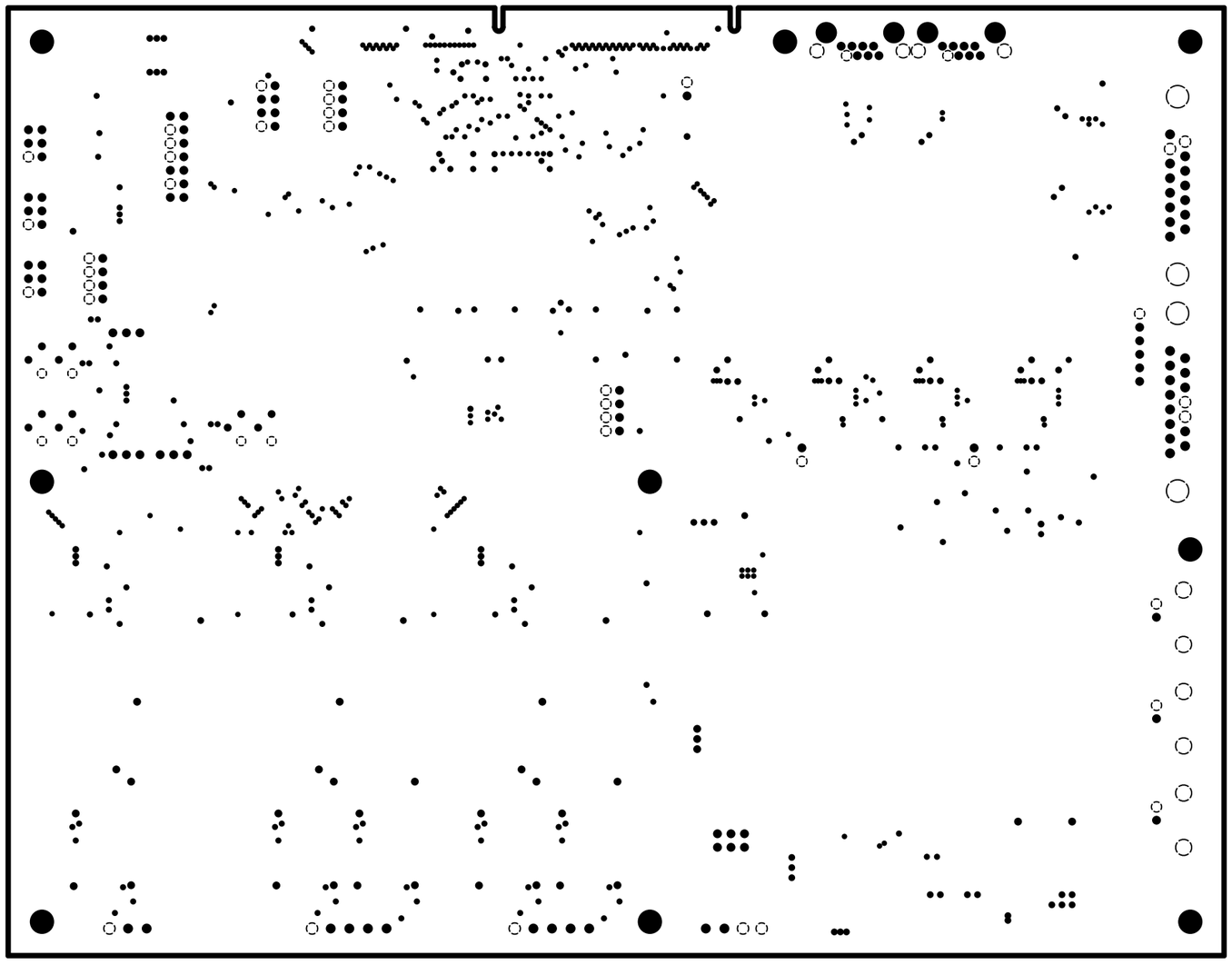


COPPER LAYER 1 – SIDE A

SIZE	CAGE CODE		REV
B	23835	10398534	B
SCALE: 1/1	UNCLASSIFIED	SHEET 7 OF 16	

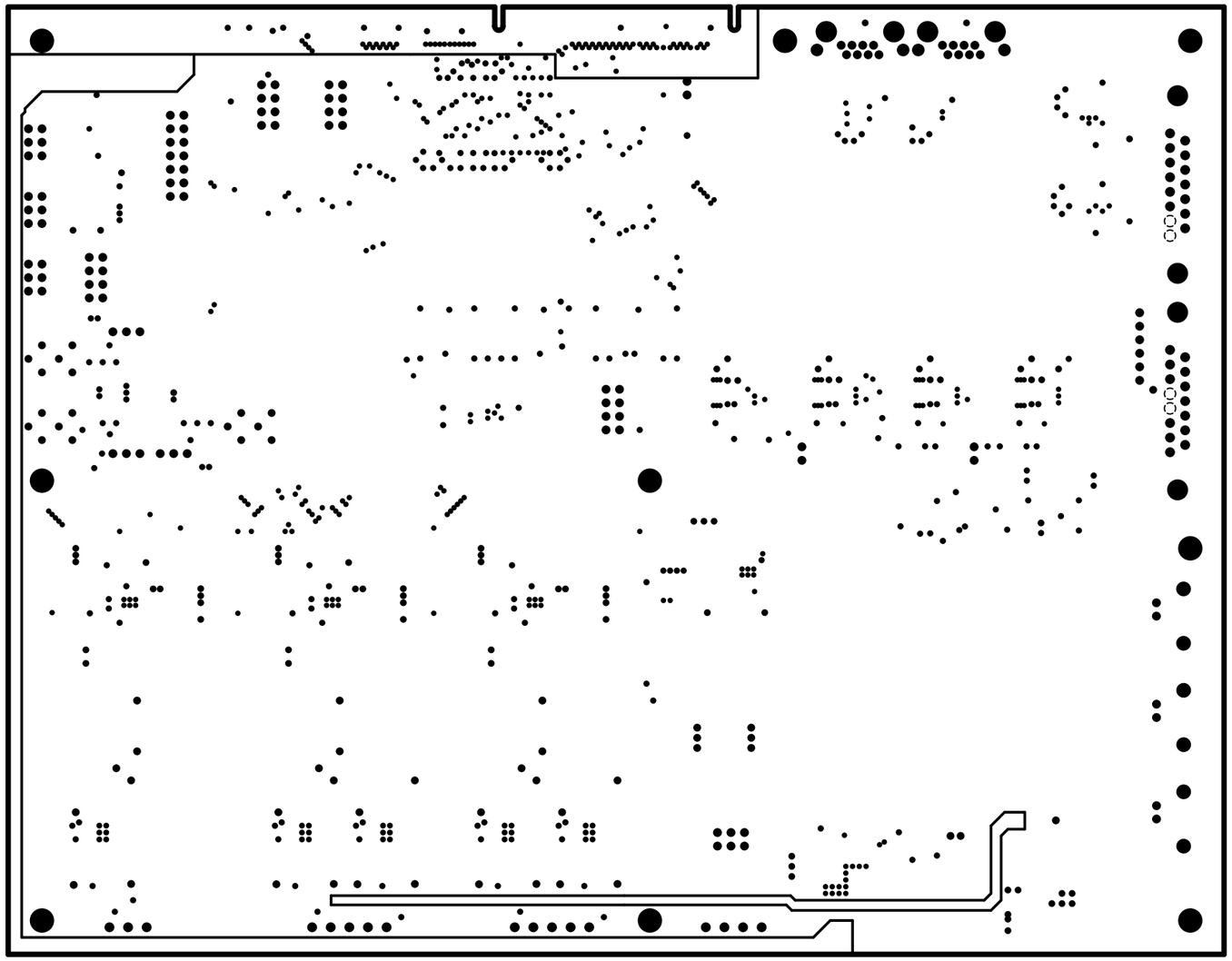
REV 02/2013

DBASE NAME: ANSI_B–SH2/A5



PLANE 1 – GND

SIZE	CAGE CODE		REV
B	23835	10398534	B
SCALE: 1/1	UNCLASSIFIED	SHEET 8 OF 16	

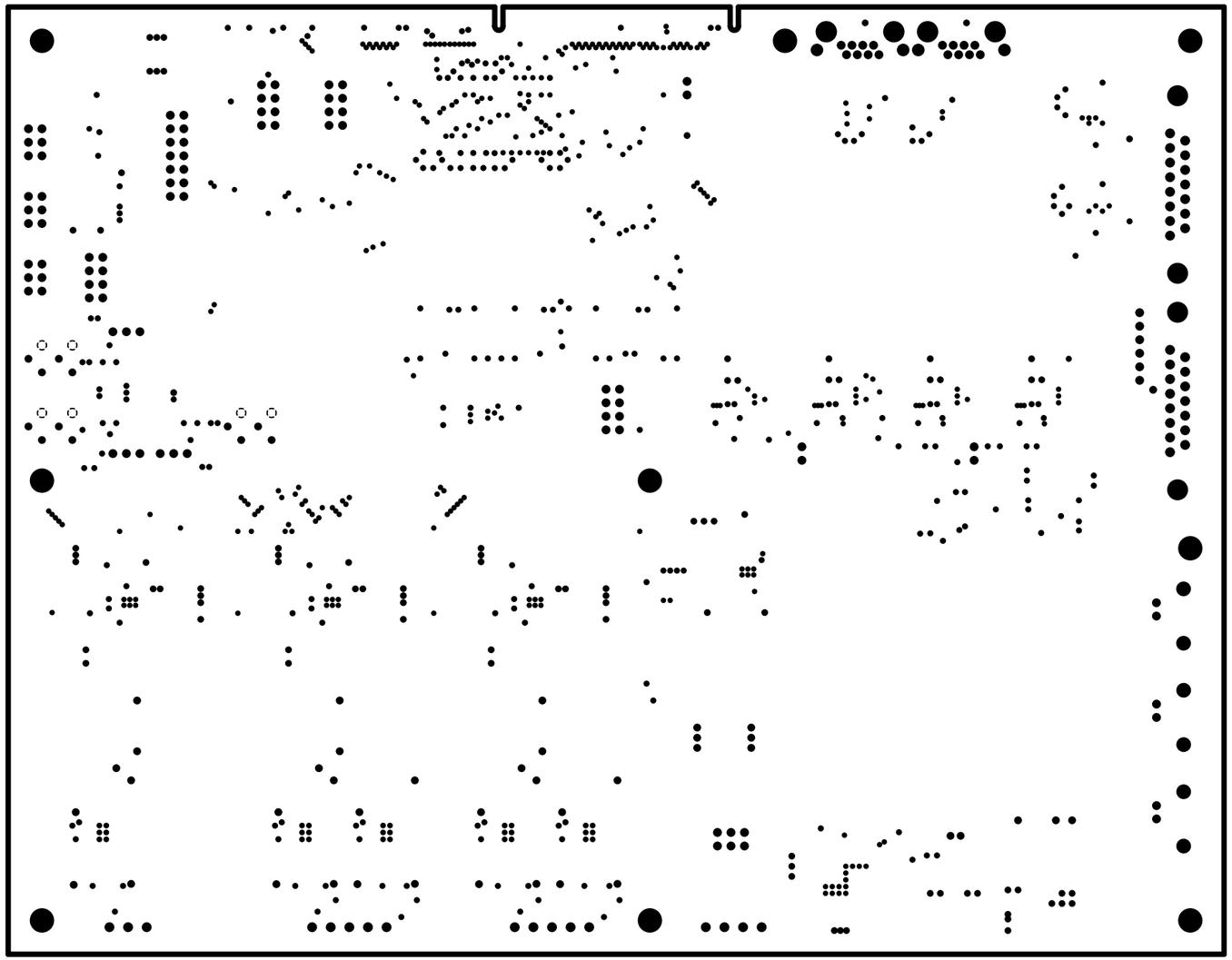


PLANE 2 – +5V SPLIT

SIZE	CAGE CODE		REV
B	23835	10398534	B
SCALE: 1/1	UNCLASSIFIED	SHEET 9 OF 16	

REV 02/2013

DBASE NAME: ANSI_B–SH2/A5

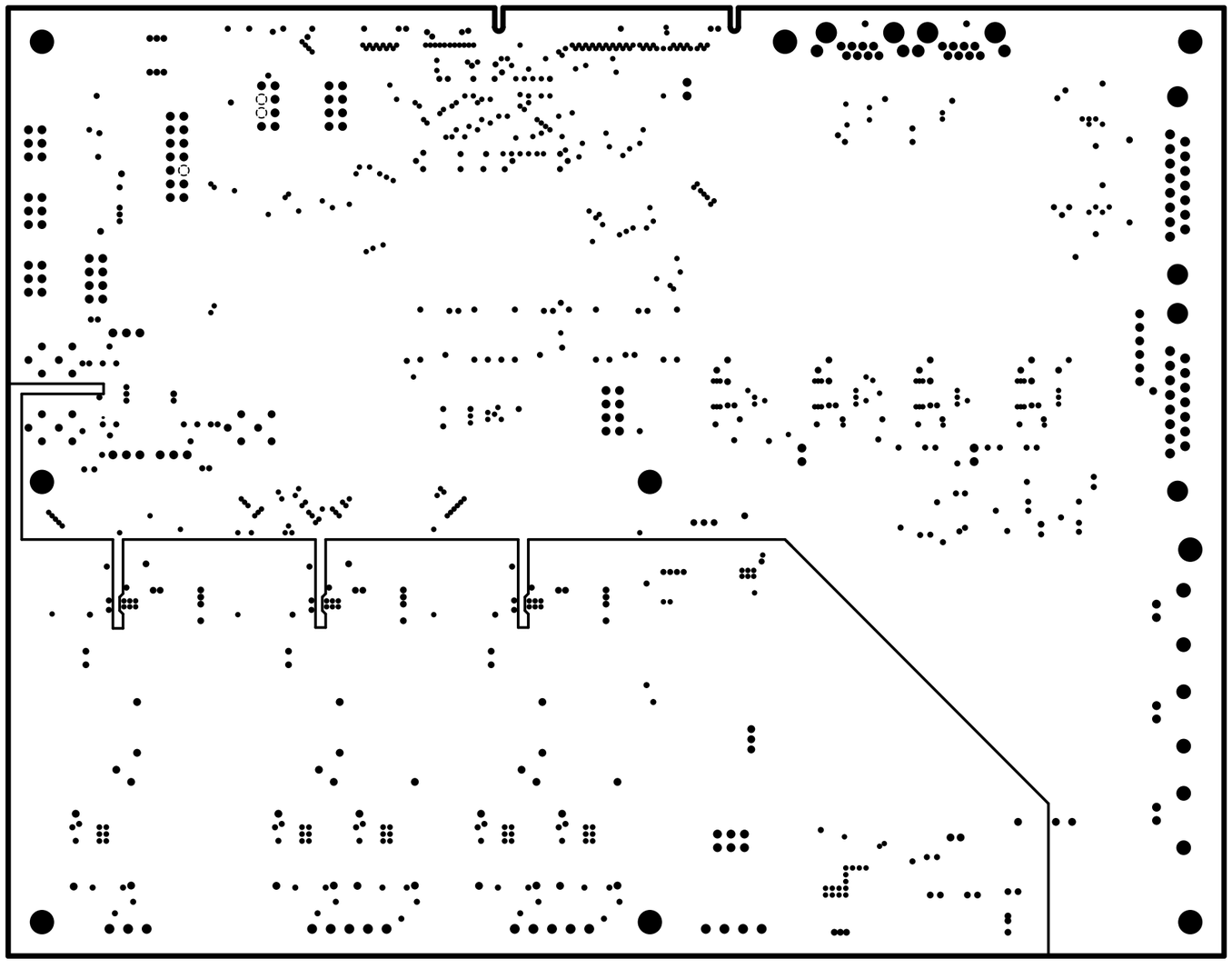


PLANE 3 – REF_4V096

SIZE	CAGE CODE		REV
B	23835	10398534	B
SCALE: 1/1	UNCLASSIFIED	SHEET 10 OF 16	

REV 02/2013

DBASE NAME: ANSI_B–SH2/A5

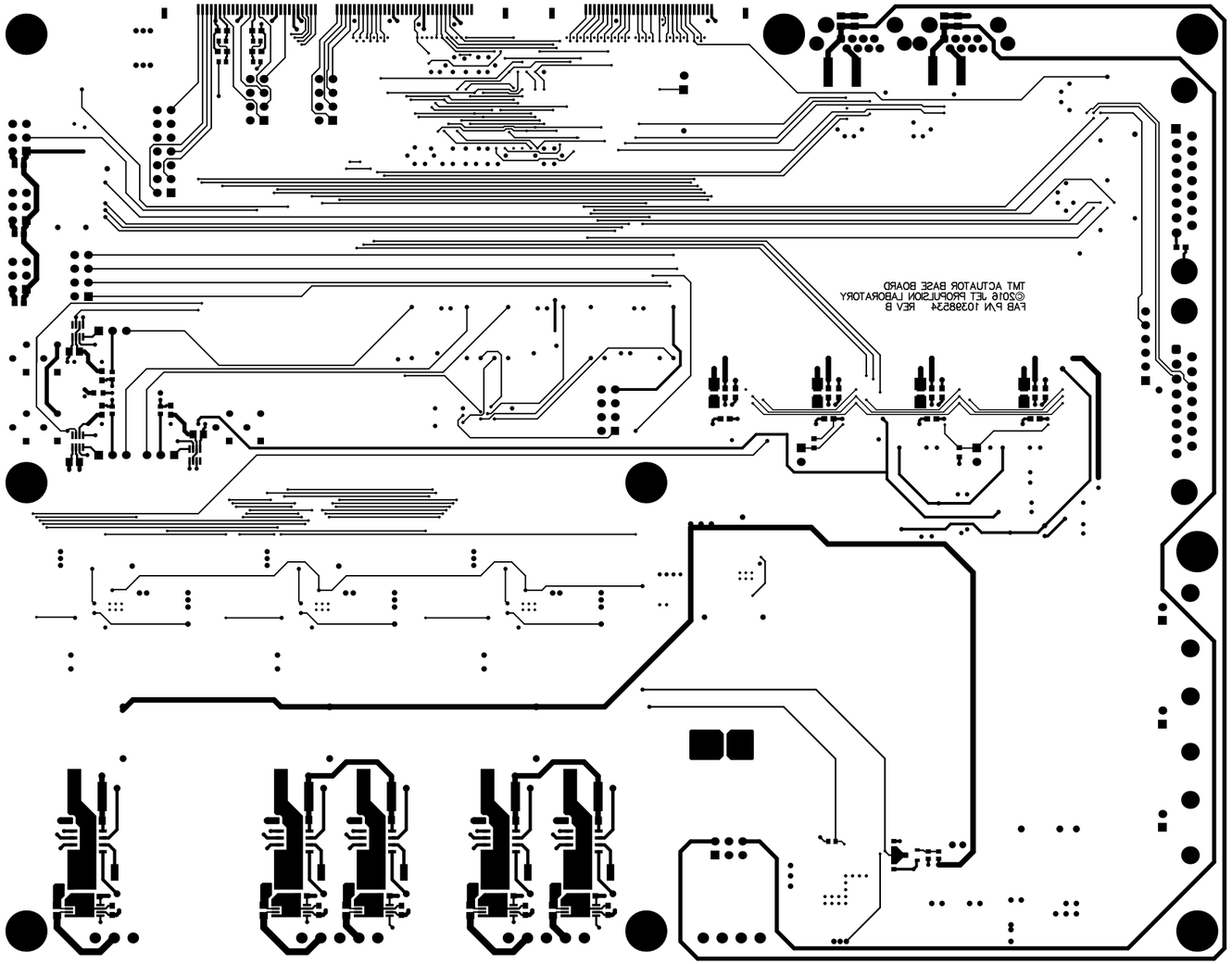


PLANE 4 – VS/3V3 SPLIT

SIZE	CAGE CODE		REV
B	23835	10398534	B
SCALE: 1/1	UNCLASSIFIED	SHEET 11 OF 16	

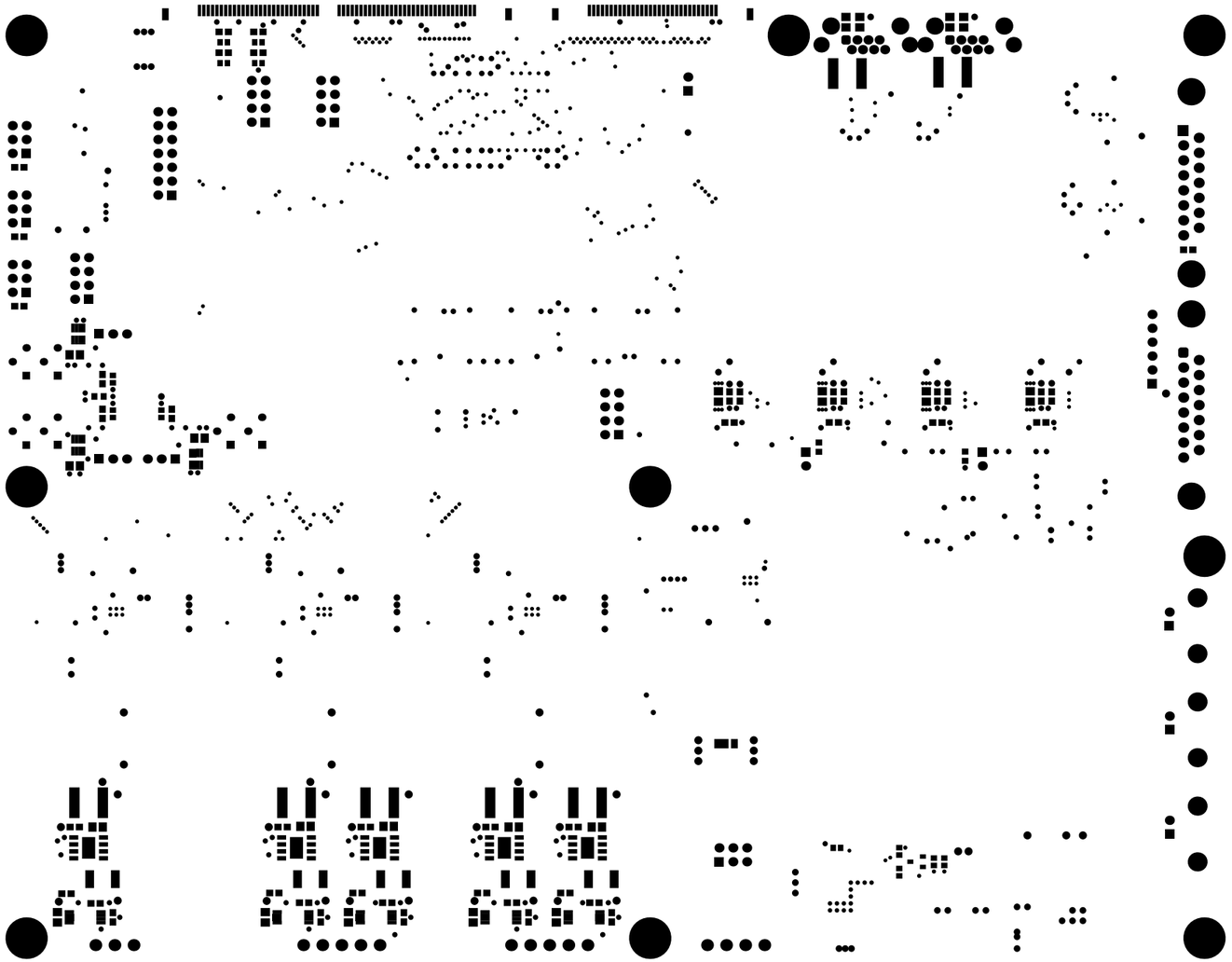
REV 02/2013

DBASE NAME: ANSI_B–SH2/A5



COPPER LAYER 2 – SIDE B

SIZE	CAGE CODE		REV
B	23835	10398534	B
SCALE: 1/1	UNCLASSIFIED	SHEET 12 OF 16	

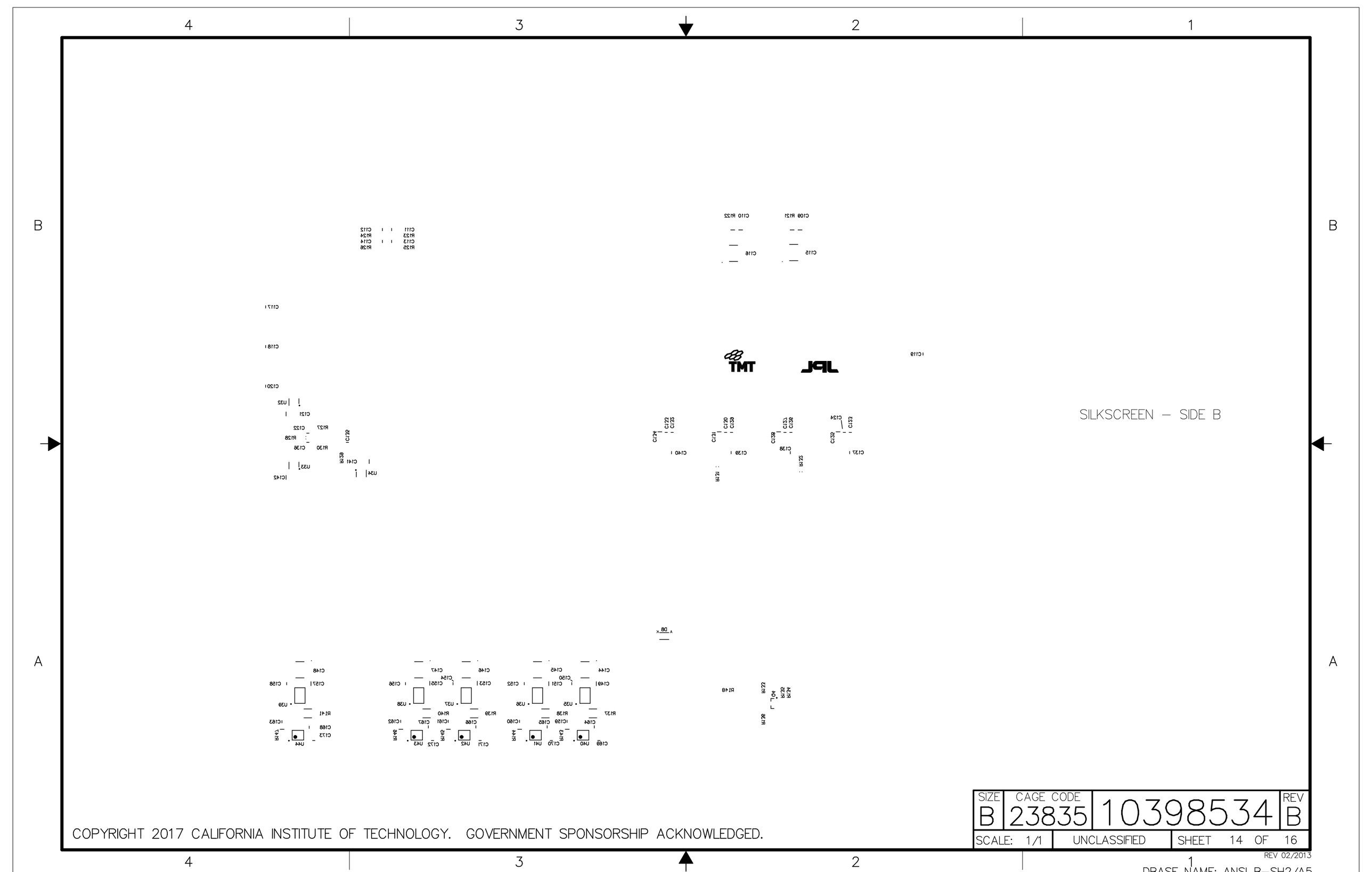


SOLDERMASK – SIDE B

SIZE	CAGE CODE		REV
B	23835	10398534	B
SCALE: 1/1	UNCLASSIFIED	SHEET 13 OF 16	

REV 02/2013

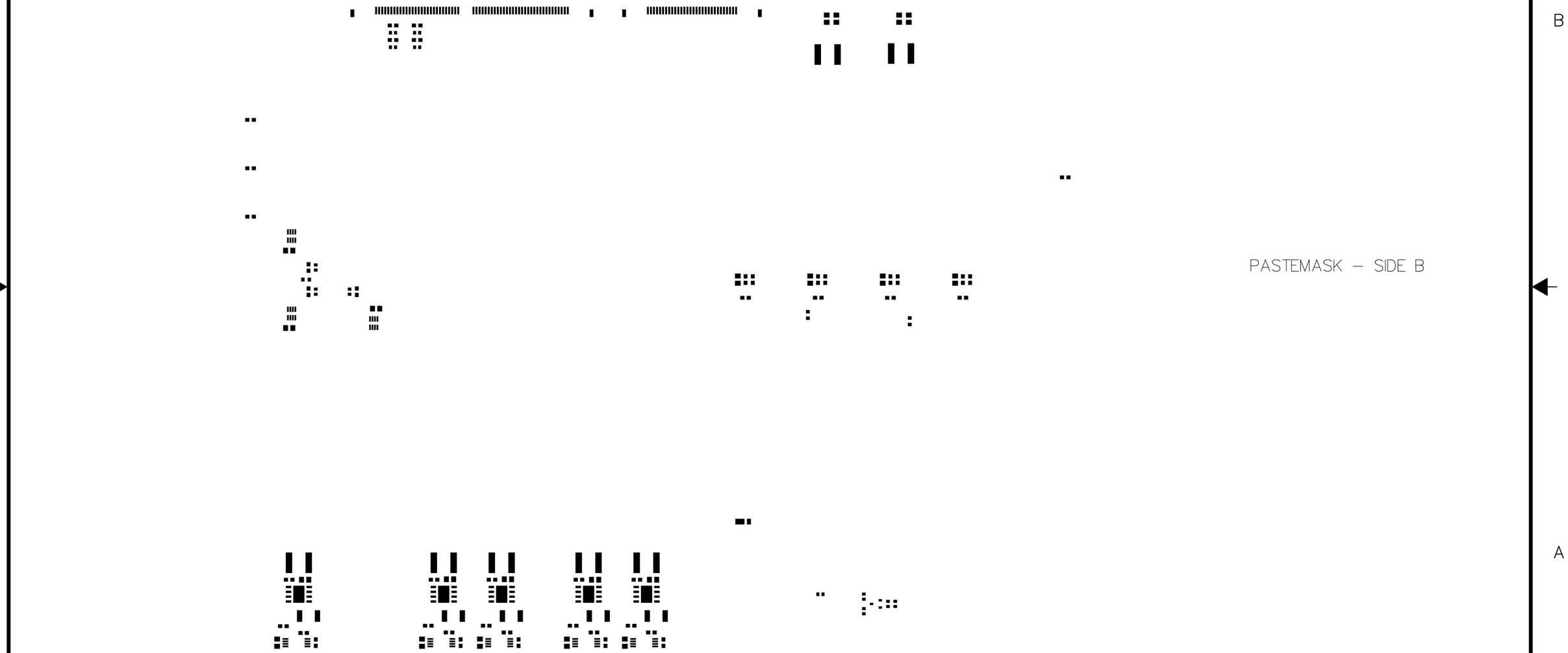
DBASE NAME: ANSI_B–SH2/A5



SIZE	CAGE CODE		REV
B	23835	10398534	B
SCALE: 1/1	UNCLASSIFIED	SHEET 14 OF 16	

REV 02/2013

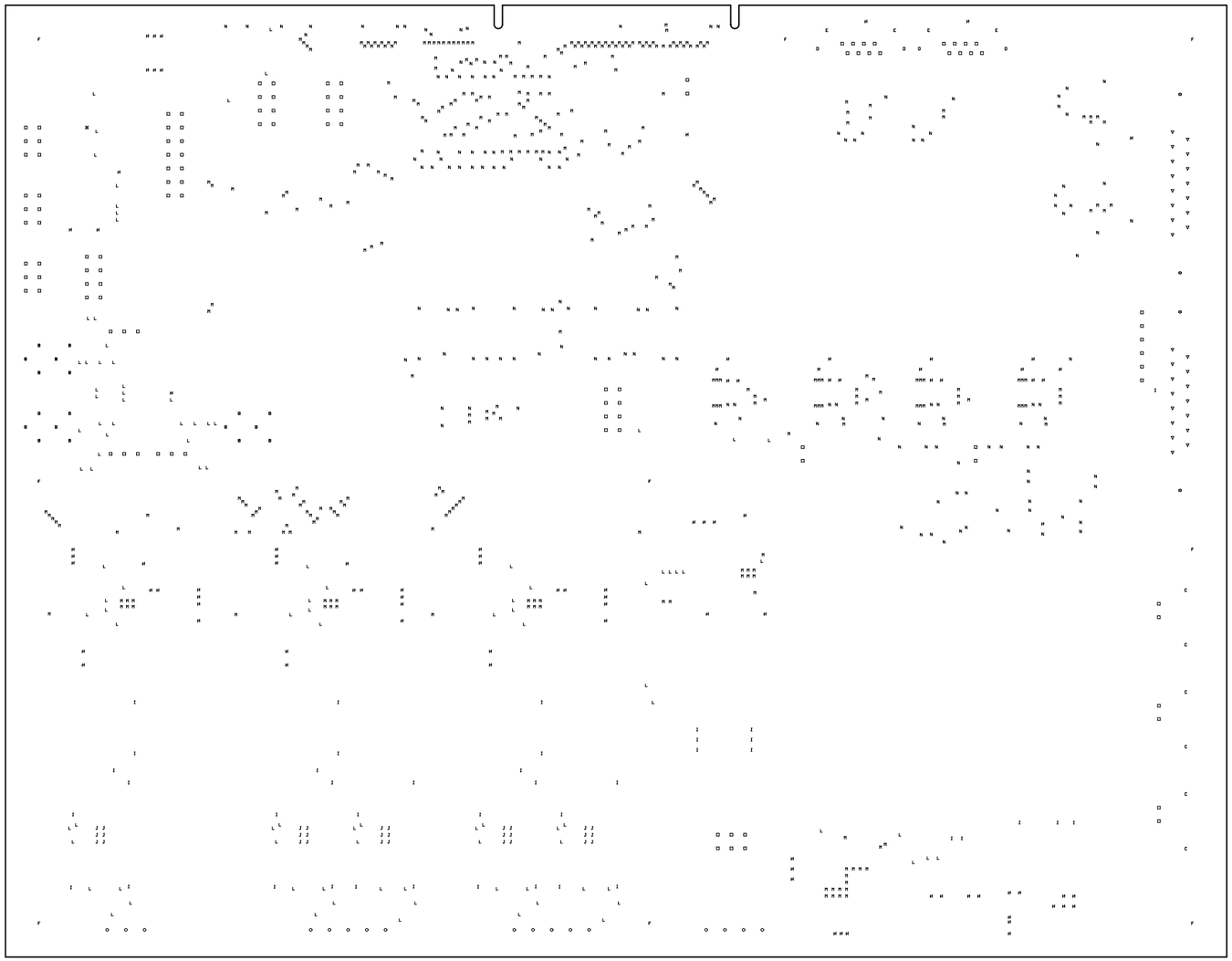
DBASE NAME: ANSI_B–SH2/A5



SIZE	CAGE CODE		REV
B	23835	10398534	B
SCALE: 1/1	UNCLASSIFIED	SHEET 15 OF 16	

REV 02/2013

DBASE NAME: ANSI_B–SH2/A5



DRILL DRAWING

Symbol	Hit Count	Finished Hole Size	Plated	Hole Type
⌑	1	12.00mil (0.305mm)	PTH	Round
D	4	62.99mil (1.600mm)	PTH	Round
⌖	4	125.00mil (3.175mm)	PTH	Round
E	4	127.95mil (3.250mm)	NPTH	Round
C	6	78.74mil (2.000mm)	PTH	Round
F	9	150.00mil (3.810mm)	PTH	Round
O	17	43.31mil (1.100mm)	PTH	Round
B	18	27.56mil (0.700mm)	PTH	Round
J	30	12.99mil (0.330mm)	PTH	Round
▽	30	42.91mil (1.090mm)	PTH	Round
I	41	28.00mil (0.711mm)	PTH	Round
H	93	20.00mil (0.508mm)	PTH	Round
L	106	15.00mil (0.381mm)	PTH	Round
□	113	35.43mil (0.900mm)	PTH	Round
N	157	16.00mil (0.406mm)	PTH	Round
M	354	10.00mil (0.254mm)	PTH	Round
	987 Total			

SIZE	CAGE CODE		REV
B	23835	10398534	B
SCALE: 1/1	UNCLASSIFIED	SHEET 16 OF 16	

REV 02/2013

DBASE NAME: ANSI_B-SH2/A5

REVISION HISTORY

LTR	DESCRIPTION	CLASS	DWN	CHK	STRUCT	MATL	THRM CONT			ENGR	DSGN SUPV	DATA MGT	RELEASE DATE
A	INITIAL RELEASE	E	SEE JPL DATA MANAGEMENT SYSTEM FOR APPROVAL SIGNATURES AND DATES										
B	CORRECTED R79 & R97. PREPARED FOR UNLIMITED RELEASE.	E											

NOTES: UNLESS OTHERWISE SPECIFIED

1. WORKMANSHIP STANDARDS AND ACCEPTABILITY REQUIREMENTS SHALL MEET IPC–A–610 (LATEST VERSION)
2. THIS DOCUMENT AND RELATED ARTWORK ARE COMPUTER GENERATED. CHANGES ARE TO BE PERFORMED ON THE ORIGINAL DATABASE IN SECTION 383.

△3 SOLDER COMPONENTS USING LEAD FREE SOLDER, ITEM 3.

4 CLEAN SOLDER FLUX FROM BOARD SO THERE IS NO DISCERNABLE RESIDUE.

△5 MARK OR INK STAMP REVISION LETTER AND SERIAL NUMBER USING INK, ITEM 2. CHARACTERS TO BE 50mil HIGH MINIMUM.

6. FOR ELECTRONIC PARTS LIST SEE PL10398535 REV B.
7. FOR SCHEMATIC DIAGRAM SEE JPL DRAWING 10398533.
8. THIS PRINTED WIRING BOARD ASSEMBLY CONSISTS OF BOTH SMT AND THROUGH–HOLE TECHNOLOGY.

SEE SEPARATE PARTS LIST

PARTS LIST

QTY REQD	ITEM NO	REF DES	CAGE CODE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL OR NOTE
AR	3			Sn96.5/Ag3.0/ Cu0.5	SOLDER	J–STD–005A	△3
AR	2			HYSOL SERIES M CATALYST 20A	INK, WHITE EPOXY		△5
1	1			10398534–1	PRINTED WIRING BOARD		REV B

NEXT ASSEMBLY | USED ON

APPLICATION

MATERIAL:

MATERIAL PER SPECIFICATION

THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
LINEAR TOLERANCES:
.XX ±.03
.XXX ±.010
ANGULAR TOLERANCES: ±0.5°
MACHINE FINISH √
DO NOT SCALE DRAWING
INTERPRET DWG PER ASME Y14.100

CONTRACT NO

APPD DATE

DWN	SEE JPL DATA MANAGEMENT SYSTEM FOR APPROVAL SIGNATURES AND DATES
CHK	
STRUCT	
MATL	
THRM CONT	
ENGR	
DSGN SUPV	

JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CA 91109

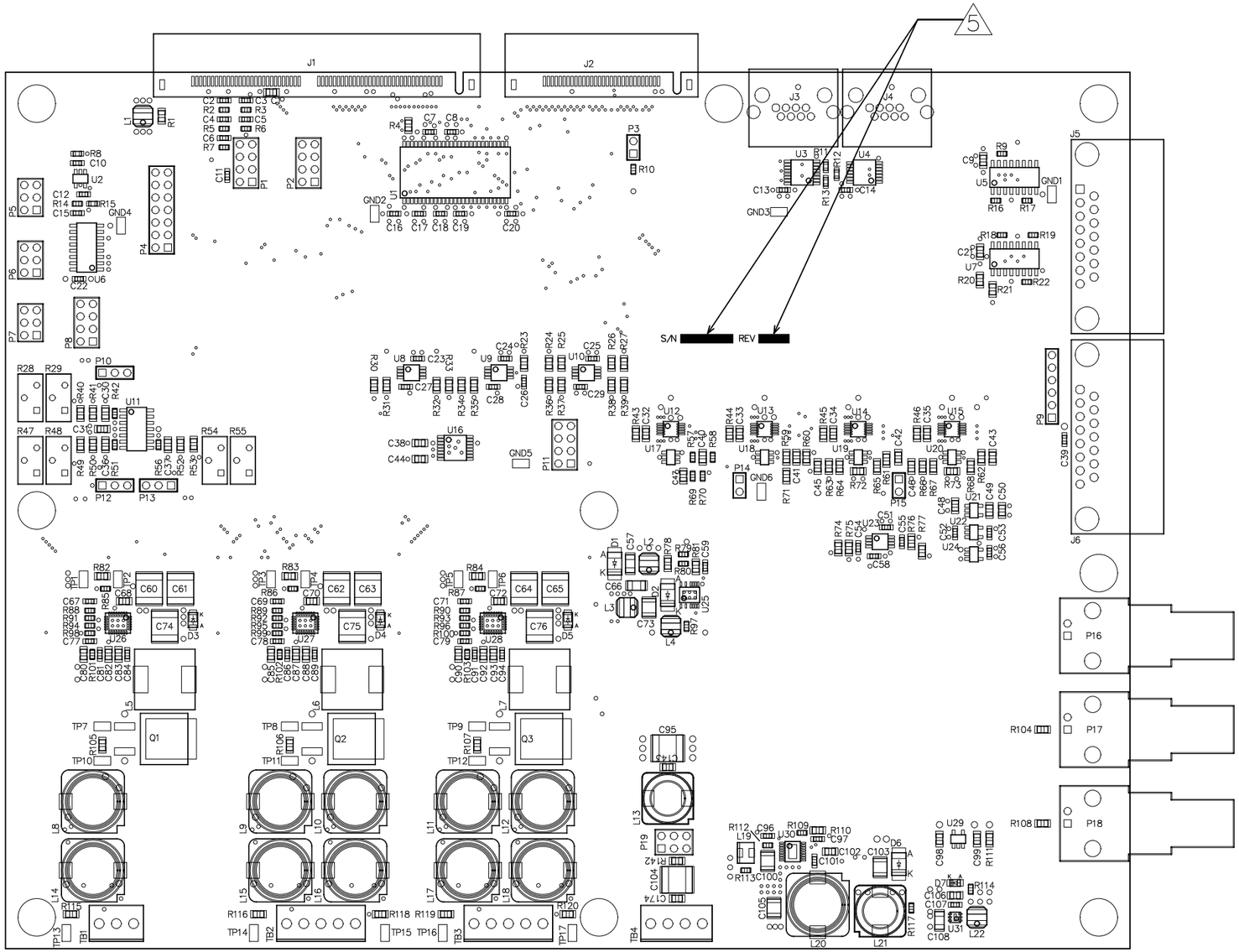
ASSEMBLY, THIRTY METER TELESCOPE M1 ACTUATOR DRIVER PWA

SIZE	CAGE CODE		REV
B	23835	10398535	B

SCALE: 1/1 | UNCLASSIFIED | SHEET 1 OF 3

REV 01/2013

DBASE NAME: ANSI_B–SH1/A5

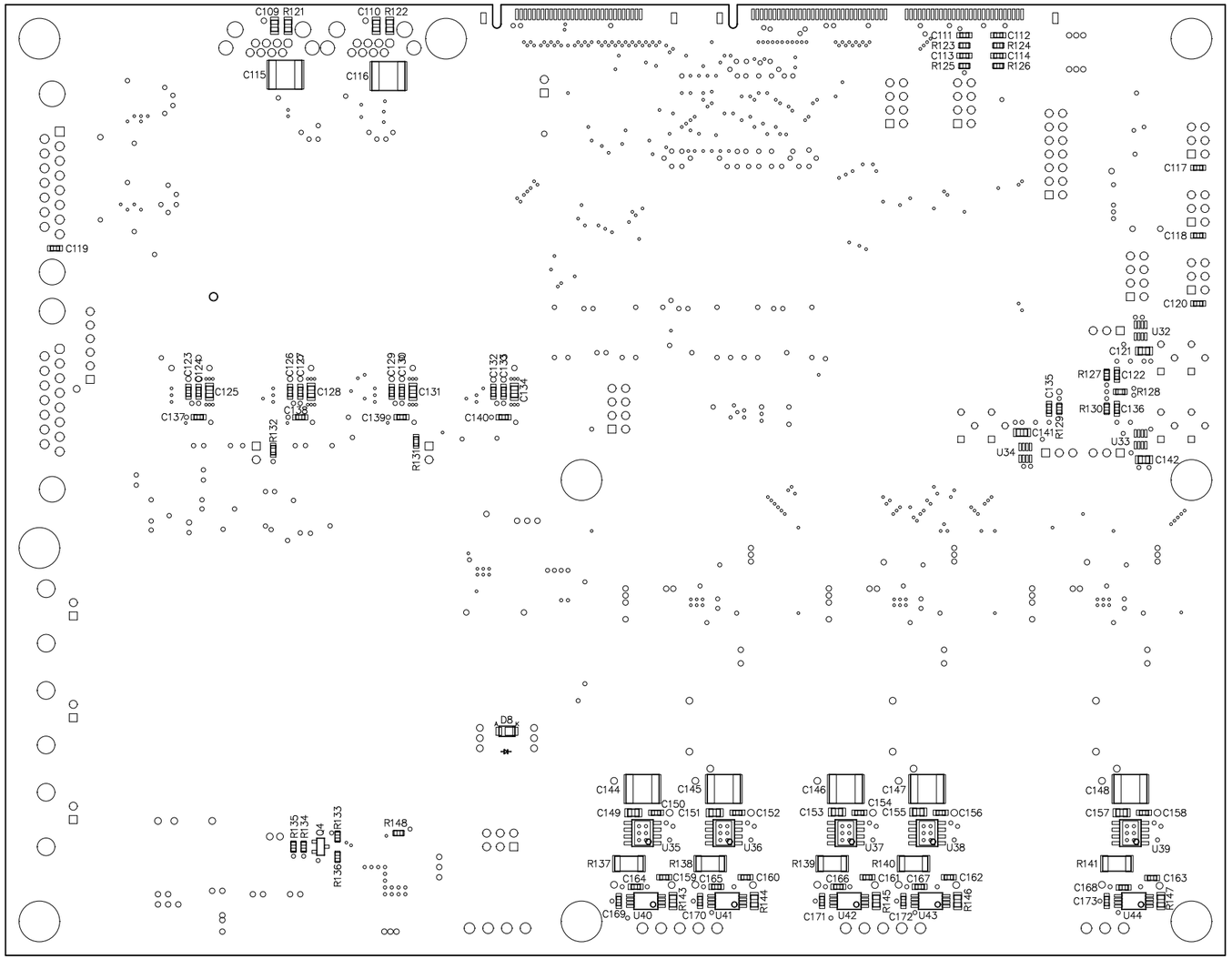


TOP ASSEMBLY

SIZE	CAGE CODE		REV
B	23835	10398535	B
SCALE: 1/1	UNCLASSIFIED	SHEET 2 OF 3	

REV 02/2013

DBASE NAME: ANSI_B-SH2/A5



BOTTOM ASSEMBLY

SIZE	CAGE CODE		REV
B	23835	10398535	B
SCALE: 1/1	UNCLASSIFIED	SHEET 3 OF 3	

REV 02/2013

DBASE NAME: ANSI_B-SH2/A5

Bill of Materials: Bill of Materials For Thirty Meter Telescope M1 Actuator Driver, Rev B

Source Data From: base brd.PrjPCB
Project: base brd.PrjPCB
Report Date: 12/18/2016 9:33:41 PM
Print Date: 9/7/2017 3:10:58 PM

Item	Quantity	Designator	Description	Footprint	Manufacturer	ManufacturerPN	Supplier	SupplierPN	Notes
4.	1	C47	CAP CER 0.022UF 50V 5% C0G 0805	CAPCP1608X09N	TDK	CGA4J2C0G1H223J125AA	Digi-Key	445-6949-1-ND	
5.	29	C7, C8, C11, C15, C16, C17, C18, C19, C20, C39, C84, C89, C94, C101, C107, C119, C122, C135, C136, C164, C165, C166, C167, C168, C169, C170, C171, C172, C173	CAP CER 0.1UF 50V 10% X7R 0603	CAPCP1608X09N	TDK	CGA3E2X7R1H104K080AE	Digi-Key	445-15957-1-ND	
6.	19	C9, C21, C31, C44, C68, C70, C72, C109, C110, C121, C141, C142, C143, C149, C151, C153, C155, C157, C174	CAP CER 0.1UF 100V 10% X7R 0805	CAPCP2012X14N	TDK	CGA4J2X7R2A104M125AE	Digi-Key	445-15962-1-ND	
7.	34	C10, C12, C13, C14, C22, C23, C24, C25, C26, C27, C28, C29, C51, C52, C53, C54, C55, C56, C58, C117, C118, C120, C123, C124, C126, C127, C129, C130, C132, C133, C137, C138, C139, C140	CAP CER .47UF 16V X7R 0603	CAPCP1608X09N	Murata	GCM188R71C474KA55D	Digi-Key	490-4775-1-ND	
8.	7	C82, C83, C87, C88, C92, C93, C102	CAP CER 2.2UF 35V 10% X7R 0805	CAPCP2012X14N	TDK	CGA4J1X7R1V225K125AE	Digi-Key	445-8787-1-ND	
9.	2	C73, C100	CAP CER 2.2UF 100V X7R 1210	CAPCP3225X28N	Murata	GRM32ER72A225KA35L	Digi-Key	490-3385-1-ND	
10.	6	C1, C48, C50, C98, C99, C106	CAP CER 4.7UF 16V 10% X7R 0805	CAPCP2012X14N	TDK	CGA4J3X7R1C475K125AE	Digi-Key	445-8788-1-ND	
11.	4	C95, C104, C115, C116	CAP CER 4.7UF 100V 10% X7R 2220	CAPCP5850X26N	Murata	GRM55ER72A475KA01L	Digi-Key	490-1934-1-ND	
12.	4	C81, C86, C91, C97	CAP CER 10PF 100V 5% NP0 0603	CAPCP1608X09N	Murata	GCM1885C2A100JA16D	Digi-Key	490-4770-1-ND	
13.	2	C66, C108	CAP CER 10UF 35V 10% X7R 1206	CAPCP3316X19N	TDK	C3216X7R1V106K160AC	Digi-Key	445-14799-1-ND	
14.	14	C60, C61, C62, C63, C64, C65, C74, C75, C76, C144, C145, C146, C147, C148	CAP CER 10UF 100V 10% X7S 2220	CAPCP5850X26N	TDK	CGA9N3X7S2A106K230KE	Digi-Key	445-8768-1-ND	
15.	5	C38, C125, C128, C131, C134	CAP CER 22UF 10V 20% X5R 0805	CAPCP2012X14N	TDK	C2012X5R1A226M125AB	Digi-Key	445-7665-1-ND	
16.	2	C103, C105	CAP CER 22UF 16V 10% X7R 1210	CAPCP3225X28N	TDK	C3225X7R1C226K250AC	Digi-Key	445-3945-1-ND	
17.	1	C57	CAP CER 22UF 35V 20% X5R 1206	CAPCP3316X19N	TDK	C3216X5R1V226M160AC	Digi-Key	445-8045-1-ND	
18.	3	C67, C69, C71	CAP CER 120PF 100V 5% C0G 0603	CAPCP1608X09N	TDK	CGA3E2C0G2A121J080AA	Digi-Key	445-5725-1-ND	
19.	4	C3, C4, C111, C112	CAP CER 470PF 100V 5% NP0 0603	CAPCP1608X09N	TDK	CGA3E2C0G2A471J080AA	Digi-Key	445-5732-1-ND	
20.	10	C150, C152, C154, C156, C158, C159, C160, C161, C162, C163	CAP CER 470PF 100V NP0 0603	CAPCP1608X09N	Murata	GCM1885C2A471JA16D	Digi-Key	490-4949-1-ND	
21.	3	C77, C78, C79	CAP CER 1000PF 100V 5% NP0 0603	CAPCP1608X09N	Murata	GRM1885C2A102JA01D	Digi-Key	490-3281-1-ND	
22.	1	C96	CAP CER 2200PF 50V 10% X7R 0603	CAPCP1608X09N	TDK	CGA3E2X7R1H222K080AA	Digi-Key	445-5660-1-ND	
23.	3	C30, C36, C37	CAP CER 2200PF 250V 10% X7R 0805	CAPCP2012X09N	TDK	C2012X7R2E222K085AA	Digi-Key	445-2278-1-ND	
24.	8	C32, C33, C34, C35, C42, C43, C45, C46	CAP CER 2700PF 50V 5% NP0 0805	CAPCP2012X07N	Murata	GRM2165C1H272JA01D	Digi-Key	490-1630-1-ND	
25.	3	C80, C85, C90	CAP CER 4700PF 50V 5% NP0 0805	CAPCP2012X14N	Murata	GCM2165C1H472JA16D	Digi-Key	490-4973-1-ND	
26.	5	C2, C5, C6, C113, C114	CAP CER 4700PF 100V 5% NP0 0603	CAPCP1608X09N	TDK	CGA3E1C0G2A472J080AC	Digi-Key	445-172684-1-ND	
27.	2	C40, C41	CAP CER 5600PF 50V 5% NP0 0805	CAPCP2012X09N	Murata	GRM2195C1H562JA01D	Digi-Key	490-1636-1-ND	
28.	1	C49	CAP CER 10000PF 50V 5% C0G 0805	CAPCP2012X09N	Murata	GRM2195C1H103JA01D	Digi-Key	490-1642-1-ND	
29.	1	TB1	CONN 3-position screw terminal block	1751251	Phoenix Contact	1751251	Digi-Key	277-5749-ND	
30.	1	TB4	CONN 4-position screw terminal block	1751264	Phoenix Contact	1751264	Digi-Key	277-5744-ND	
31.	2	TB2, TB3	CONN 5-position screw terminal block	1751277	Phoenix Contact	1751277	Digi-Key	277-5727-ND	
32.	1	J2	CONN 60-pin edge mount high-speed edge card	HSEC8-130-01-X-D-EM2-TI	Samtec	HSEC8-130-01-S-D-EM2	Samtec	HSEC8-130-01-S-D-EM2	
33.	1	J1	CONN 120-pin edge mount high-speed edge card	HSEC8-160-01-X-D-EM2-TI	Samtec	HSEC8-160-01-S-D-EM2	Samtec	HSEC8-160-01-S-D-EM2	
34.	2	J5, J6	CONN D-SUB RECPT 15POS R/A SOLDER	5747845	TE Connectivity	5747845-4	Digi-Key	A32121-ND	
35.	3	P3, P14, P15	CONN HEADR BRKWAY .100 02POS STR	9-146285-0-02	TE Connectivity	9-146285-0-02	Digi-Key	A32700-02-ND	
36.	4	P5, P6, P7, P19	CONN HEADR BRKWAY .100 03POS 2ROW STR	9-146261-0-03	TE Connectivity	9-146261-0-03	Digi-Key	A34268-03-ND	
37.	3	P10, P12, P13	CONN HEADR BRKWAY .100 03POS STR	9-146285-0-03	TE Connectivity	9-146285-0-03	Digi-Key	A32700-03-ND	
38.	4	P1, P2, P8, P11	CONN HEADR BRKWAY .100 04POS 2ROW STR	9-146261-0-04	TE Connectivity	9-146261-0-04	Digi-Key	A34268-04-ND	
39.	1	P9	CONN HEADR BRKWAY .100 06POS STR	9-146285-0-06	TE Connectivity	9-146285-0-06	Digi-Key	A32700-06-ND	
40.	1	P4	CONN HEADR BRKWAY .100 07POS 2ROW STR	9-146261-0-07	TE Connectivity	9-146261-0-07	Digi-Key	A34268-07-ND	
41.	2	J3, J4	CONN MODULAR JACK 8-8 R/A SHIELD	43860-0013	Molex	43860-0013	Digi-Key	WM5435-ND	
42.	3	P16, P17, P18	CONN right-angle PCB mount BNC	5227161-7	TE Connectivity	5227161-7	Digi-Key	A32260-ND	
43.	1	D7	DIODE LED GREEN 0805	DIOC2012X09N	Stanley Electric	PG1112H-TR	Digi-Key	404-1021-1-ND	
44.	3	D3, D4, D5	DIODE SCHOTTKY 2A 40V PWRDI 123	POWERDI-123	Diodes Inc	DFLS240L-7	Digi-Key	DFLS240LDICT-ND	
45.	3	D1, D2, D6	DIODE SCHOTTKY 100V 1A	DO-214AC - MBRS1100T3G	ON Semiconductor	MBRS1100T3G	Digi-Key	MBRS1100T3GOSCT-ND	
46.	1	D8	DIODE TVS 36VWM POWERDI123	POWERDI-123	Diodes Inc	DFLT36A-7	Digi-Key	DFLT36ADICT-ND	
47.	1	U6	IC 3-TO-8 DECOD/DEMUX 16-SSOP	TI-D-16 N	Texas Instruments	CD74HC238M96	Digi-Key	296-24353-1-ND	
48.	4	U17, U18, U19, U20	IC Amplifier 1 Circuit Rail-to-Rail SOT-23-6	RJ-6 N	Analog Devices	ADA4805-1ARJZ-R7	Digi-Key	ADA4805-1ARJZ-R7CT-ND	
49.	3	U26, U27, U28	IC Buck Switching Regulator 4A 28-WFQFN Exposed Pad	LT-UFD-28_N	Linear Technology	LTC3649IUFD#PBF	Digi-Key	LTC3649IUFD#PBF-ND	
50.	1	U25	IC Buck-Boost Switching Regulator	LT-MSE-16(12)	LT	LTC7138EMSE#PBF	Digi-Key	LTC7138EMSE#PBF-ND	
51.	5	U40, U41, U42, U43, U44	IC Current Sense Amplifier	PW0008A	TI	INA240A2PW	Digi-Key	INA240A2PW-ND	
52.	1	U4	IC, 1/1 Transceiver Full LVDS 14-TSSOP	TI-PW-14 N	Texas Instruments	SN65LVDS180PWRG4Q1	Digi-Key	296-23882-1-ND	
53.	1	U3	IC, 2/2 Transceiver Full LVDS 16-TSSOP	TI-PW-16 N	Texas Instruments	SN65LVDS051PWRQ1	Digi-Key	296-16948-1-ND	
54.	1	U29	IC, 3.00V precision voltage reference	UJ-5_N	Analog Devices	ADR363BUJZ-REEL7	Digi-Key	ADR363BUJZ-REEL7CT-ND	
55.	1	U30	IC, 3.5 A Synchronous Step-Down Regulator, 16-pin SOP (MSE-16-EDP)	LT-MSE-16	Linear Technology	LT8610ABEMSE#PBF	Digi-Key	LT8610ABEMSE#PBF-ND	
56.	1	U22	IC, 4.096V precision voltage referernce	UJ-5 N	Analog Devices	ADR364AUJZ-REEL7	Digi-Key	ADR364AUJZ-REEL7CT-ND	
57.	1	U16	IC, 16 Bit Digital to Analog Converter 8 16-TSSOP	RU-16 N	Analog Devices	AD5668BRUZ-3	Digi-Key	AD5668BRUZ-3-ND	

58.	4	U12, U13, U14, U15	IC, single 16-Bit PulSAR analog-to-digital converter with SPI interface, 100KSPS	RM-10_N	Analog Devices	AD7988-1BRMZ	Digi-Key	AD7988-1BRMZ-ND	
59.	5	U35, U36, U37, U38, U39	IC DRIVER DC MOTOR 3.6A 8SOIC	DDA008H	TI	DRV8872DDAR	Digi-Key	296-42661-1-ND	
60.	1	U21	IC IV REG LDO 2.5V 0.1A LDO	RJ-5 N	Linear Technology	LT1761ES5-2.5#TRMPBF	Digi-Key	LT1761ES5-2.5#TRMPBFCT-ND	
61.	4	U8, U9, U10, U23	IC J-FET Amplifier 2 Circuit Rail-to-Rail 8-MSOP	RM-8 N	Analog Devices	AD8642ARMZ	Digi-Key	AD8642ARMZ-ND	
62.	2	U2, U24	IC OPAMP GP 3MHZ RRIO SOT-23-5	TI-DBV-5 N	TI	TLV2371QDBVRQ1	Digi-Key	296-23540-1-ND	
63.	2	U5, U7	IC quad differential line receiver	TI-D-16_N	Texas Instruments	AM26LV32EIDR	Digi-Key	296-24694-1-ND	
64.	1	U11	IC QUAD OPAMP, RRIO, 44 V, SOIC-14	LT-S-14_N	Linear Technology	LT1491AIS#PBF	Digi-Key	LT1491AIS#PBF-ND	
65.	1	U31	IC REG BUCK 3.3V 1A 6-WDFN Exposed Pad	TI-DRV-6	Texas Instruments	TPS62291DRVT	Digi-Key	296-23330-1-ND	
66.	1	U1	IC SDRAM 16MX16 166MHZ 54TSOP	TSOP80P1180X120-54N	Alliance	AS4C16M16SA-6TAN	Digi-Key	1450-1251-ND	
67.	3	U32, U33, U34	IC SWITCH SPDT 45 Ohm SOT-23-8	SOT23-8	Vishay	DG449DS-T1-E3	Digi-Key	DG449DS-T1-E3CT-ND	
68.	2	L1, L22	IND 2.2µH Shielded 1.72A 59 mOhm	VLCF4020	TDK	VLCF4020T-2R2N1R7	Digi-Key	445-3182-1-ND	
69.	1	L19	IND 10UH 1.44A 180 MOHM	IND_VLF403215	TDK	VLF403215MT-100M-CA	Digi-Key	445-17152-1-ND	
70.	1	L21	IND 10UH 2.5A 36.4 mOhm	IND_TDK_SLF10145T	TDK	SLF10145T-100M2R5-PF	Digi-Key	445-1975-1-ND	
71.	1	L13	IND 15UH 2.2A 56.6 MOHM	IND TDK SLF10145T	TDK	SLF10145T-150M2R2-H	Digi-Key	445-3827-1-ND	
72.	3	L2, L3, L4	IND POWER 100UH .33A SMD	VLCF4028	TDK	VLCF4028T-101MR33-2	Digi-Key	445-6542-1-ND	
73.	1	L20	INDUCTOR 22µH Shielded 3.8A 37.9 mOhm	IND TDK SLF12565ST	TDK	SLF12565T-220M3R5-PF	Digi-Key	445-173079-1-ND	
74.	10	L8, L9, L10, L11, L12, L14, L15, L16, L17, L18	INDUCTOR 47µH Shielded 2.4A 69.36 mOhm	IND TDK SLF12565ST	TDK	SLF12565T-470M2R4-H	Digi-Key	445-3847-1-ND	
75.	3	L5, L6, L7	INDUCTOR POWER 22UH 3.2A 40mOhm SMD	IND_WE_PDA-1260	Wurth	784771220	Digi-Key	732-6773-1-ND	
76.	1	R1	RES 1.0 OHM 1/8W 1% 0805	RESC2012N	Panasonic	ERJ-6RQF1R0V	Digi-Key	P1.0DCT-ND	
77.	12	R20, R23, R59, R64, R65, R67, R68, R115, R116, R118, R119, R120	RES 1.00K OHM 1/8W 1% 0805 SMD	RESC2012N	Panasonic	ERJ-6ENF1001V	Digi-Key	P1.00KCCT-ND	
78.	5	R60, R61, R62, R63, R66	RES 2.00K OHM 1/8W 1% 0805 SMD	RESC2012N	Panasonic	ERJ-6ENF2001V	Digi-Key	P2.00KCCT-ND	
79.	1	R21	RES 3.92K OHM 1/8W 1% 0805 SMD	RESC2012N	Panasonic	ERJ-6ENF3921V	Digi-Key	P3.92KCCT-ND	
80.	3	R30, R33, R34	RES 4.42K OHM 1/8W 1% 0805 SMD	RESC2012N	Panasonic	ERJ-6ENF4421V	Digi-Key	P4.42KCCT-ND	
81.	1	R78	RES 4.7 OHM 1/8W 1% 0805 SMD	RESC2012N	Panasonic	ERJ-6RQF4R7V	Digi-Key	P4.7DCT-ND	
82.	1	R71	RES 4.99K OHM 1/8W 1% 0805 SMD	RESC2012N	Panasonic	ERJ-6ENF4991V	Digi-Key	P4.99KCCT-ND	
83.	1	R97	RES 4.99 OHM 0.1W 1% 0603 SMD	RESC1608X06N	Vishay	CRCW06034R99FKEA	Digi-Key	541-4.99HHCT-ND	
84.	8	R24, R27, R36, R39, R74, R75, R76, R77	RES 10.0K OHM 1/8W 1% 0805 SMD	RESC2012N	Panasonic	ERJ-6ENF1002V	Digi-Key	P10.0KCCT-ND	
85.	1	R111	RES 10.0 OHM 1/8W 1% 0805 SMD	RESC2012N	Panasonic	ERJ-6ENF10R0V	Digi-Key	P10.0CCT-ND	
86.	7	R25, R26, R31, R32, R35, R37, R38	RES 20.0K OHM 1/8W 1% 0805 SMD	RESC2012N	Panasonic	ERJ-6ENF2002V	Digi-Key	P20.0KCCT-ND	
87.	5	R4, R43, R44, R45, R46	RES 22.1 OHM 1/8W 1% 0805 SMD	RESC2012N	Panasonic	ERJ-6ENF22R1V	Digi-Key	P22.1CCT-ND	
88.	2	R104, R108	RES 49.9 OHM 1/8W 1% 0805 SMD	RESC2012N	Panasonic	ERJ-6ENF49R9V	Digi-Key	P49.9CCT-ND	
89.	2	R131, R132	RES 100K OHM 1/10W 1% 0603 SMD	RESC1608N	Yageo	RC0603FR-07100KL	Digi-Key	311-100KHRCT-ND	
90.	3	R41, R50, R52	RES 113K OHM 1/8W 1% 0805 SMD	RESC2012N	Panasonic	ERJ-6ENF1133V	Digi-Key	P113KCCT-ND	
91.	2	R72, R73	RES 127 OHM 1% 1/8W 0805	RESC2012N	Panasonic	ERJ-6ENF1270V	Digi-Key	P127CCT-ND	
92.	3	R40, R49, R53	RES 309K OHM 1/8W 1% 0805 SMD	RESC2012N	Panasonic	ERJ-6ENF3093V	Digi-Key	P309KCCT-ND	
93.	2	R145, R146	RES SMD 0.012 OHM 1% 1/2W 0805	RESC2012N	Panasonic	ERJ-6BWFR012V	Digi-Key	P.012AQCT-ND	
94.	2	R143, R144	RES SMD 0.02 OHM 1% 1/2W 0805	RESC2012N	Panasonic	ERJ-6BWFR020V	Digi-Key	P.02AQCT-ND	
95.	1	R147	RES SMD 0.03 OHM 1% 1/2W 0805	RESC2012N	Panasonic	ERJ-6BWFR030V	Digi-Key	P.03AQCT-ND	
96.	6	R82, R83, R84, R105, R106, R107	RES SMD 0.1 OHM 1% 1/2W 0805	RESC2012N	Panasonic	ERJ-6BWFR100V	Digi-Key	P17589CT-ND	
97.	2	R139, R140	RES SMD 0.15 OHM 1% 1W 2010	RESC5125X09N	Vishay Dale	WSL2010R1500FEA18	Digi-Key	WSLF-.15CT-ND	
98.	3	R137, R138, R141	RES SMD 0.2 OHM 1% 1W 2010	RESC5125X09N	Vishay Dale	WSL2010R2000FEA18	Digi-Key	WSLF-.20CT-ND	
99.	4	R110, R121, R122, R142	RES SMD 1M OHM 1% 1/8W 0805	RESC2012N	Panasonic	ERJ-6ENF1004V	Digi-Key	P1.00MCCT-ND	
100.	3	R14, R113, R117	RES SMD 2 OHM 1% 1/4W 0603	RESC1608X06N	Panasonic	ERJ-3BQF2R0V	Digi-Key	P17377CT-ND	
101.	2	R69, R70	RES SMD 2.49K OHM 1% 1/10W 0603	RESC1608X06N	Panasonic	ERJ-3EKF2491V	Digi-Key	P2.49KHCT-ND	
102.	3	R101, R102, R103	RES SMD 3.16K OHM 1% 1/10W 0603	RESC1608X06N	Panasonic	ERJ-3EKF3011V	Digi-Key	P3.01KHCT-ND	
103.	7	R6, R7, R10, R57, R58, R125, R126	RES SMD 4.99K OHM 1% 1/10W 0603	RESC1608X06N	Panasonic	ERJ-3EKF4991V	Digi-Key	P4.99KHCT-ND	
104.	1	R134	RES SMD 9.09K OHM 1% 1/10W 0603	RESC1608X06N	Panasonic	ERJ-3EKF9091V	Digi-Key	P9.09KHCT-ND	
105.	11	R79, R80, R98, R99, R100, R127, R129, R130, R135, R136, R148	RES SMD 10K OHM 1% 1/10W 0603	RESC1608X06N	Panasonic	ERJ-3EKF1002V	Digi-Key	P10.0KHCT-ND	
106.	3	R88, R89, R90	RES SMD 26.7K OHM 1% 1/10W 0603	RESC1608X06N	Panasonic	ERJ-3EKF2672V	Digi-Key	P26.7KHCT-ND	
107.	3	R91, R92, R93	RES SMD 40.2K OHM 1% 1/10W 0603	RESC1608X06N	Panasonic	ERJ-3EKF4022V	Digi-Key	P40.2KHCT-ND	
108.	1	R112	RES SMD 41.2K OHM 1% 1/10W 0603	RESC1608X06N	Panasonic	ERJ-3EKF4122V	Digi-Key	P41.2KHCT-ND	
109.	5	R2, R3, R5, R123, R124	RES SMD 49.9K OHM 1% 1/10W 0603	RESC1608X06N	Panasonic	ERJ-3EKF4992V	Digi-Key	P49.9KHCT-ND	
110.	1	R133	RES SMD 90.9K OHM 1% 1/10W 0603	RESC1608X06N	Panasonic	ERJ-3EKF9092V	Digi-Key	P90.9KHCT-ND	
111.	6	R8, R11, R12, R13, R15, R128	RES SMD 100 OHM 1% 1/10W 0603	RESC1608N	Yageo	RC0603FR-07100L	Digi-Key	311-100HRCT-ND	
112.	6	R9, R16, R17, R18, R19, R22	RES SMD 120 OHM 1% 1/10W 0603	RESC1608X06N	Panasonic	ERJ-PA3F1200V	Digi-Key	P120BYCT-ND	Do Not Install
113.	1	R81	RES SMD 150K OHM 1% 1/8W 0805	RESC2012N	Panasonic	ERJ-6ENF1503V	Digi-Key	P150KCCT-ND	
114.	3	R94, R95, R96	RES SMD 200K OHM 1% 1/10W 0603	RESC1608X06N	Panasonic	ERJ-3EKF2003V	Digi-Key	P200KHCT-ND	
115.	1	R109	RES SMD 243K OHM 1% 1/10W 0603	RESC1608X06N	Panasonic	ERJ-3EKF2433V	Digi-Key	P243KHCT-ND	
116.	6	R42, R51, R56, R85, R86, R87	RES SMD 499K OHM 1% 1/10W 0603	RESC1608X06N	Panasonic	ERJ-3EKF4993V	Digi-Key	P499KHCT-ND	
117.	1	R114	RES SMD 499 OHM 1% 1/10W 0603	RESC1608X06N	Panasonic	ERJ-3EKF4990V	Digi-Key	P499HCT-ND	
118.	23	GND1, GND2, GND3, GND4, GND5, GND6, TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17	TEST POINT MINIATURE SMT	TP-5015	Keystone	5015	Digi-Key	5015KCT-ND	
119.	3	Q1, Q2, Q3	TRANS MOSFET N-CH 500V 6A D2PAK	TO263AA	IXYS	IXTA6N50D2	Digi-Key	IXTA6N50D2-ND	
120.	1	Q4	TRANS NPN 40V 0.6A SMD SOT23-3	TO-236AB	Diodes, Inc	MMBT2222A-7-F	Digi-Key	MMBT2222A-FDICT-ND	
121.	6	R28, R29, R47, R48, R54, R55	TRIMMER 10K OHM 0.5W PC PIN	3296Y	Bourns	3296Y-1-103LF	Digi-Key	3296Y-103LF-ND	