VX4730
12-Channel D/A Module
Service Manual

Tektronix

02/14/92 9201-01-A

WARRANTY

This Tektronix, Inc. product is warranted against defects in materials and workmanship, and is warranted to meet the performance specifications as listed in the current catalog and/or data sheet for this product. This warranty applies for three (3) years following the date of shipment. Tektronix will, at its option, repair or replace, at no cost to the customer, this product should it prove to be defective during the warranty period, provided the defect or failure is not due to misuse or abuse of the product. The customer is responsible for shipment of the defective product to the Tektronix repair facility. NO OTHER WARRANTY IS EXPRESSED OR IMPLIED, INCLUDING WARRANTY FOR FITNESS OF PURPOSE. TEKTRONIX INC. SHALL, IN NO CASE, BE LIABLE FOR CONSEQUENTIAL DAMAGES.

Printed in U.S.A.

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WARNING

These servicing instructions are for use by qualified personnel only. To reduce the risk of electric shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.

VX4730
12-Channel D/A Module

Section 1
Introduction

The VX4730 12-Channel D/A Module (DAC) consists of twelve (12) independent single-ended 16-bit DACs (digital-to-analog converters), individually programmable from -16.3835 volts to +16.3835 volts in 0.5 millivolt steps. Monotonicity is guaranteed to 14 bits.

Each output channel of the DAC provides a minimum of 60 milliamperes of current, with all channels driven. In addition, any individual channel may provide up to ±16.3835 V into a 40 Ohm load. The collective current for all twelve channels cannot exceed 720 milliamperes.

The VX4730 incorporates extensive self test capabilities, with both visual and software indications of pass/fail status. The built-in self test determines that all twelve DAC channels are operational and that the programmed output voltages are accurate to within 3% of full scale.

During self test, each output is relay-isolated from the front panel connector to prevent possible damage to the Unit Under Test (UUT). A relay readback feature allows the closure status of each isolation relay to be determined. A self test failure of any of the twelve channels will cause the error LED to be lit and a discrete fault interrupt to be generated, indicating that an error message has been queued up.

Refer to the Operating Manual for information on programming the module.

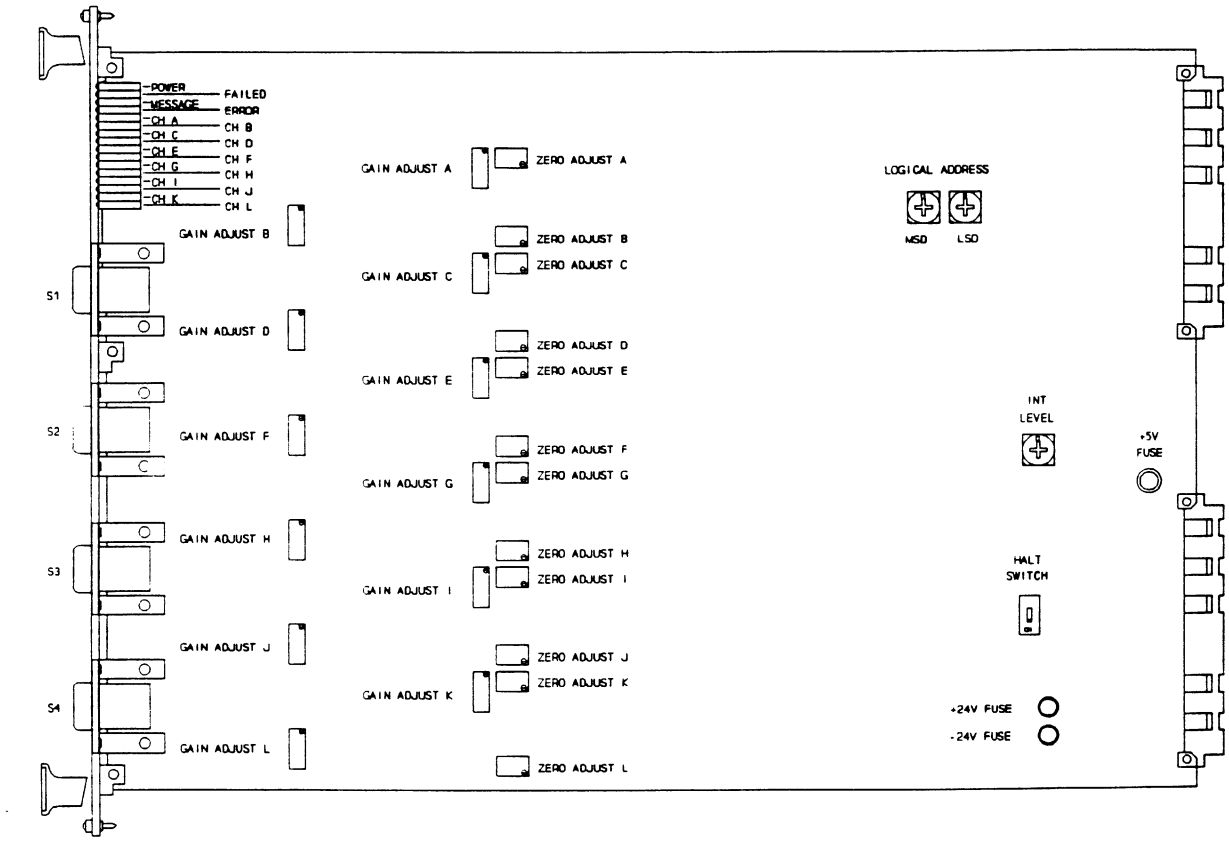

Figure 1: VX4730 Controls and Indicators

Section 2
Adjustment and Calibration

This module does not require any regular adjustment.

The VX4730 Module must be calibrated every twelve months for the module to meet its published accuracy specifications. Calibrate the module at the temperature at which it will be operating. If this is not feasible, or if the module will be operating under a wide temperature range, refer to the temperature drift specifications. Allow a ten minute warm-up period before performing the calibration.

When shipped, this module has been calibrated so that the absolute accuracy of the module is within 1.5 millivolts (0.5 mV calibration error plus one mV linearity error) of programmed voltage at room temperature (25°C).

Test Equipment Required

- 73A-850 Extender Card or equivalent
- 5½ digit digital volt meter (DVM) with a 100 V dc range absolute accuracy of 0.002% or better

Calibration Procedure

Each channel of this module must be individually calibrated. It is important to note the effects of cabling resistance versus load current and temperature on the measured module outputs. The resistance of Tek/CDS Cable Part No. 73A-732P is 34.4 ohms/kilometer which corresponds to 2.0 millivolts/meter voltage drop at 60 milliamperes output current.

Allow a ten minute warm-up period before performing the calibration.

1) There is one gain adjust and one zero offset adjust potentiometer for each channel. Labeled holes are provided in the module's EMC shield to access the potentiometers.

2) Repeat steps 3 thru 9 listed below for each DAC channel.

3) Connect the voltage input of the DVM to the output connector associated with the channel to be calibrated (see Appendix B for output connector pin definitions). If practical, a higher degree of absolute overall system accuracy can be obtained

if the readings are taken from the end of the terminated cable that will be used to drive the UUT load during normal operations.

4) Use the A 0<LF> command to reset all Digital/Analog outputs to 0.000 volts. If the module has been ordered with Option 1M (MATE TMA), use the CIIL commands:

```
RST DCS :CH0<CR><LF>
RST DCS :CH1<CR><LF>
...
RST DCS :CH11<CR><LF>
```

to reset all Digital/Analog outputs to 0.000 volts.

5) Use the CLS<LF> command to close all isolation relays and connect all DAC outputs to the module output connectors. If the module has been ordered with Option 1M (MATE TMA), use the CIIL commands:

```
CLS :CH0<CR><LF>
CLS :CH1<CR><LF>
...
CLS :CH11<CR><LF>
```

to connect all outputs to the output connector.

6) Adjust the zero offset adjust potentiometer until the DVM reads between +0.0001 volts and -0.0001 volts.

7) Use the A 16.382<LF> command to set all DACs to 16.382 volts. If the module has been ordered with Option 1M (MATE TMA), use the CIIL commands:

```
FNC DCS :CH0 SET VOLT +.1638200000E+02<CR><LF>
FNC DCS :CH1 SET VOLT +.1638200000E+02<CR><LF>
...
FNC DCS :CH11 SET VOLT +.1638200000E+02<CR><LF>
```

to set all outputs.

8) Adjust the gain adjust potentiometer of the channel being calibrated until the DVM reads between 16.3815 and 16.3825 volts.

9) Send the A -16.382<LF> command and verify that the resultant voltage level of the channel being calibrated is between -16.381 and -16.383.

If the module has been ordered with Option 1M (MATE TMA), use the CIIL commands:

FNC DCS :CH0 SETS VOLT -.1638200000E+02<CR><LF>
FNC DCS :CH1 SETS VOLT -.1638200000E+02<CR><LF>
...
FNC DCS :CH11 SETS VOLT -.1638200000E+02<CR><LF>

If the output voltage of the channel being calibrated does not read between -16.381 and -16.383, repeat steps 4 through 6 above to double check the zero offset calibration. If the readings are being taken from the end of a cable connected to the output connector rather than directly from the connector, an accuracy problem may result due to interference from external sources.

If the readings are being taken directly from the connector, and, after rechecking the zero offset the voltage outputs are still not symmetrical, a faulty part exists on this module. Contact Tektronix/CDS at 1-800-CDS-ATE1.

Section 3
Assembly And Disassembly

The VX4730 is shipped fully assembled. A schematic diagram that may also be used as a reference is included with this manual.

Section 4
Parts List

The following lists give the name and part number for all field replaceable parts of the VX4730. To order replacement parts, call your Tektronix representative.

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REFERENCE DESIGNATOR	CDS PART NUMBER	QTY.	PART DESCRIPTION	MFG. NUM.	MFG. PART NUMBER
FOR USE WITH KIT 1,2,3,4	45008-20418	8	SCREW LOCK ASSEMBLY FOR D CONNECTOR	0108	D-20418-2
FOR USE WITH HS81,92,1011,1121,1211,1321,21,32,41, 52,61,72 AND ALSO WITH VR1351,1361	47000-04880	14	HEAT SINK MOUNTING KIT TO-220	0204	4880
C01,051,06,1022,1023,1061,1111 1112,1161,1181,12,1222,1223,1241 1251,1253,13,1311,1312,1372,1381 18,222,223,24,25,28,311,312,332 333,341,342,37,422,423,432,433 511,512,532,533,54,57,59,623,624 65,711,712,732,733,78,802,822 823,832,833,85,87,911,912,932 933,98,99	20128-10006	66	CAP FXD CER .1UF 20% 50VDCW	0058	C322C104M5U5CA
C052,1182,1252,1271,1291,801,89	22022-20008	7	CAP FXD TA 22UF 10-20% 20-25VDCW	0106	199D226X9025CA1
C1001,1101,1201,1301,201,301,401 501,601,701,803,901	20128-10004	12	CAP FXD CER .001UF 10% STABLE 100VDCW	0058	CK05BX102K
C1002,1102,1202,1302,202,302,402 502,602,702,804,902	21528-68003	12	CAP FXD MICA 680PF 5% 300VDCW	0012	DM15-681J
C1011,1121,1211,1321,1351,1361 21,32,331,334,41,431,434,52,531 534,61,72,731,734,81,831,834,92 931,934	21627-10005	26	CAP FXD FILM .01UF 10% 50 VDC	0169	ECQ-V1H103JZ
C1021,1113,1221,1313,221,313,421 513,621,713,821,913	20129-22006	12	CAP FXD CER .22UF 10% STABLE 50 VDCW	0058	CK06BX224K
C1102,1302,302,502,702,902	40430-10020	0.50	TUBING TEFLON 20GA THIN WALL	0262	TTI-S20-1100-NAT
C1371,1374	20129-33006	2	CAP FXD CER .33UF 20% STABLE 50VDCW	0005	SR215E334MAA
C1373,1382	21018-47003	2	CAP FXD ELECT 47UF 30% -10% 100VDCW	0025	241-F-470M100XX
C56,66	21528-10002	2	CAP FXD MICA 10PF 5% 100VDCW	0012	DM15-100D
CR1241,34	32000-05260	2	DIODE ZENER 43V .5W 5%	0074	1N5260B
CR1251	32000-05221	1	DIODE ZENER 2.4V 500MW 5%	0074	1N5221B
CR1291,1341,1351,1371,1372,1373 1374,1375,1381,1382,1383,1384 1385,1386	32000-04001	14	DIODE SILICON 50V 1A 5%	0357	1N4001

REFERENCE DESIGNATOR	CDS PART NUMBER	QTY.	PART DESCRIPTION	MFG. NUM.	MFG. PART NUMBER
CR1376,79	32000-04148	2	DIODE SILICON 75V 1A 5%	0078	1N4148
DCL1	40408-14730	1	LABEL VX4730 DRW 03292 REV 910	0026	40408-14730
DCL2	40409-14730	1	LABEL VX4730 DRW 03293 REV 910	0026	40409-14730
DS001,101,103,104,105,106,201 202,203,204,205,206,301,302	32000-02303	14	DIODE LIGHT EMITTING GREEN WITH RESISTOR	0039	547-2303
DS002,102	32000-02003	2	DIODE LIGHT EMITTING RED WITH RESISTOR 0	0039	547-2003
E10,13,20,23,30,33,40,43	92301-40037	8	SCREW PHIL PNHD 4-40 X 3-8 ZINC SILVER	0137	4-40X3-8 PHIL PNHD
E11,14,21,24,31,34,41,44	92302-00440	8	WASHER STAR NUMBER 4 INTERNAL ZINC	0137	4 IN STAR WASH ZIN
E12,15,22,25,32,35,42,45	92303-00440	8	HEX MACHINE NUT 4-40 ZINC	0137	HEX MACH NUT 4-40
F1391,1392,79	42202-73040	3	FUSE MICRO 4AMP 125V FAST PLUG IN CLEAR CAP	0061	273 004
FP1	47006-14730	1	FACE PLATE VX4730 DRW 02351 REV 910	0026	47006-14730
FP10,11	92505-25005	2	WASHER WAVY 2.7MM	0026	92505-25005
FP10,11	92500-25005	2	SCREW 2.5MM PHIL CSK 5MM	0026	92500-25005
FP12,13	92501-25010	2	SCREW M2.5X10 CHEESEHEAD	0026	92501-25010
FP14	92502-25008	1	SCREW PHIL M 2.5 X 8 CSK BRITE ZINC	0137	PHIL M 2.5 X 8 CSK
FP15	92500-25008	1	SCREW M 2.5 X 8 SELF TAP	0266	21100-710
FP16	92520-00183	1	VME PCB-FRONT PANEL HOLDER	0266	60807-183
FP17	92500-25025	1	HEX NUT M2.5 ZINC	0266	21100-144
FP18,20	92500-25011	2	COLLAR SCREW M 2.5 X 11 SL NICKEL	0266	21100-379
FP19,21	92510-00464	2	SLEEVE CAPTIVE SCREW GRAY	0266	21100-464
FP2,22,4,8	40406-00140	1	EJECTOR HANDLE C-TOP VX1400	0266	20817-328

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REFERENCE DESIGNATOR	CDS PART NUMBER	QTY.	PART DESCRIPTION	MFG. NUM.	MFG. PART NUMBER
FP23,3,5,9	40406-00141	1	EJECTOR HANDLE C-BOTTOM VX1400	0266	20817-327
HS1011,1121,1211,1321,1351,1361 21,32,41,52,61,72,81,92	47000-06073	14	HEAT SINK FOR TO 220 PKG 20 DEGC W RSA	0204	6073-B
K1001,1101,1201,1301,20,30,40,50 60,70,80,90	83500-20016	12	RELAY DPDT 45 OHM	0013	DS2E-M-DC5V
L1391,1392	27051-00200	2	INDUCTOR WIDE-BAND FERRITE CHOKE	0042	VK 200 10-3B
L79	27051-50007	1	INDUCTOR 5 UH 5A .015 OHMS 50MHZ FR	0037	IHA-501
P1,2	45003-09600	2	CONNECTOR DIN 96 PIN MALE RT ANGLE SOLDER	0265	10-8457-096-002097
PCB	41140-47300	1	P.C. BOARD VERSION 8L 9201	0498	41140-47300
Q1341,1342	51100-03646	2	TRANSISTOR NPN HIGH SPEED SWITCH	0074	MPS3646
Q1371	33000-05061	1	SILICON CONTROLLED RECTIFIER .8 AMPS	0074	2N5061
Q691,692	51100-00300	2	TRANSISTOR VMOS N-FET	0102	VN0300L
Q693,694	51100-03906	2	TRANSISTOR PNP SWITCHING	0107	2N3906
R06,1081,1171,1181,1382,16,551 552,553	10117-18005	9	18K RES COMP 1-4W 5%	0087	R25J-18K-5%
R07,27,29	12008-33004	3	3.3K RES NETWORK SIP 5% 1.5W 9-PKG	0027	750-101-R3.3K
R1001,1022,1071,1101,1115,1191 1192,1193,1201,1222,1261,1262 1263,1273,1301,1315,1381,20,222 30,315,40,422,50,515,60,622,70 715,80,822,90,915	14024-10004	33	1K RES FILM 1-4W 1% 100PPM	0035	RN55D1001F
R1011,1116,1211,1316,21,316,41 516,61,716,81,916	10117-10001	12	1 OHM RES COMP 1-4W 5%	0087	R25J-1-5%
R1021,1113,1221,1313,221,313,421 513,621,713,821,921	14045-62504	12	6.25K RES FILM 1-8W .1% 5 PPM	0037	PTF56-6.25K-B-T16
R1023,1027,1114,1123,1223,1227 1242,1314,1321,223,227,314,321 34,423,427,514,521,623,627,693 694,714,721,823,827,911,914	14024-10005	28	10K RES FILM 1-4W 1% 100PPM	0035	RN55D1002F

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REFERENCE DESIGNATOR	CDS PART NUMBER	QTY.	PART DESCRIPTION	MFG. NUM.	MFG. PART NUMBER
R1024,1112,1224,1312,224,312,424 512,624,712,824,922	14045-10005	12	10K RES FILM 1-4W .1% 5 PPM	0037	PTF56-10K-B-T16
R1025,1111,1225,1311,225,311,425 511,625,711,825,923	15119-20003	12	200 OHM RES VAR WW 25TRN IW 50 PPM	0021	RT24C2W201
R1026,1124,1226,1324,226,324,426 524,626,724,826,924	15138-10005	12	10K RES VAR CER 25TRN 1-2W 100PPM	0021	3299W-1-103
R1028,1029,1121,1122,1228,1229 1322,1323,228,229,322,323,428 429,522,523,628,629,722,723,828 829,912,913	14023-18206	24	182K RES FILM 1-8W 1% 50 PPM	0037	RNC55H1823FS
R1041,14	12006-33004	2	3.3K RES NETWORK SIP 5% 1.1W 7-PKG	0027	750-81-R3.3K
R1082,1172,1241,1291,781,782,79	10117-47004	7	4.7K RES COMP 1-4W 5%	0087	R25J-4.7K-5%
R1251,1271,1272	14024-20003	3	200 OHM RES FILM 1-4W 1% 100PPM	0035	RN55D2000F
R1292	14024-82503	1	825 OHM RES FILM 1-4W 1% 100PPM	0035	RN55D8250F
R1341,1342	10117-20005	2	20K RES COMP 1-4W 5%	0087	R25J-20K-5%
R1343	10117-51004	1	5.1K RES COMP 1-4W 5%	0087	R25J-5.1K-5%
R1344,691,692	10117-33004	3	3.3K RES COMP 1-4W 5%	0087	R25J-3.3K-5%
R65	10117-10007	1	1M RES COMP 1-4W 5%	0087	R25J-1M-5%
R99	14024-10006	1	100K RES FILM 1-4W 1% 100PPM	0035	RN55D1003F
S1,2,3,4	45008-09000	4	RT ANGLE DE-9 SOCKET PC MOUNT	0164	DEU-9S-AA-F202
S1081	42050-10101	1	SWITCH DIP 1POS SPST	0093	JS-8794-01
S381,382	42050-10301	2	SWITCH DIP ROTARY HEX	0007	DRW-16C
S79	42050-10300	1	SWITCH DIP ROTARY BCD ENCODED	0007	DRW-10C
SH1	47007-74256	1	SHIELD FRONT 256 CARD DRW 01805 REV 900	0026	47007-74256
SH10,11,13,14,17,2,20,31,4,5,7,8	92500-25010	12	SCREW M 2.5 X 10 CSK OVAL PHIL NIK PL	0266	21100-500
SH12,3,6,9	92519-25019	4	STANDOFF HEX M2.5 X 19.5MM DRW 01801 REV 900	0026	92519-25019

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SH15,18,21,33	92201-19451	4	STANDOFF HEX M2.5 THRU X .538L DRW 01673 REV 920	0026	92201-19451
SH16,19,30,34	92500-25017	4	SCREW 2.5MM X 16MM 90 DEG CSK FLHD PHIL STAINLS	0420	DIN965M2.5X16
SH22	47007-74002	1	SHIELD BACK CONN MTG CONFIG -01816 REV 9004	0026	47007-74002
SH23,24,25,26,27,28,29,32	92519-25004	8	REAR SHIELD SPACER 73A DRW 01807 REV 890	0212	19501-A-0029
U00,10,11	73205-74279	3	IC TTL LS QUAD S-R LATCH	0107	74LS279
U01,02,12	77816-07432	3	IC HCT QUAD 2-INPUT OR GATE	0088	74HCT32
U031,1081,291	76606-07400	3	IC HCT QUAD 2-INPUT NAND GATE	0088	74HCT00
U032,04,1152,132,54	77206-07408	5	IC HCT QUAD 2-INPUT AND GATE	0092	74HCT08N
U05	79000-09311	1	IC TTL 1-OF-16 DIGITAL DECODER	0107	9311 OR 74154
U06,1041,14,96	73309-74244	4	IC HCT OCTAL BUFFER NON-INVERTING	0107	74HCT244
U07,16,18,94	73005-74574	4	IC HCT OCTAL TRISTATE LATCH NON-INVERT	0107	74HCT574
U08,292	77203-07430	2	IC TTL ALS 8-INPUT NAND GATE	0107	74ALS30
U09,19	73308-74645	2	IC TTL ALS OCTAL BUS TRANSCEIVER	0107	74ALS645-1
U1011,1121,1211,1321,21,32,41,52 61,72,81,92	61000-00675	12	OP AMP HIGH VOLTAGE	0078	LM675T
U1031,33,53,63,73,93	20100-00725	6	IC DUAL D-A CONVERTER 16BIT VOLTAGE OUTPUT	0023	DAC725KP
U1051,69	79008-74138	2	IC HCT 3-TO-8 LINE DECDR DEMULTIPLEXER	0107	74HCT138
U1061,1141,24,27	73005-74273	4	IC HCT OCTAL D-TYPE FLIP FLOP W RESET	0088	74HCT273N
U1071,1091,1161,1162	73005-07474	4	IC HCT DUAL D-TYPE FLIP FLOP	0092	74HCT74N
U1131,1132	79008-74238	2	IC HCT 3-TO-8 LINE DECDR DEMULTIPLEXER	0107	74HCT238

REFERENCE DESIGNATOR	CDS PART NUMBER	QTY.	PART DESCRIPTION	MFG. NUM.	MFG. PART NUMBER
U1151,97	77825-07432	2	IC TTL ALS QUAD 2-INPUT OR GATE	0107	74ALS32
U1171,98	73001-07431	2	IC LS DELAY ELEMENT	0107	74LS31
U1181	77203-07408	1	IC TTL ALS QUAD 2-INPUT AND GATE	0107	74ALS08
U1191,1281	74200-09602	2	IC TTL DUAL RETRIGGERABLE MONOSTABLE	0078	9602
U1241,34	73405-02803	2	IC HIGH-VLT-CUR DARLINGTON TRANS ARRAY	0531	ULN2803A
U1291,131	78403-07414	2	IC HCT HEX SCHMITT INVERTING BUFFER	0088	74HCT14
U1331,1332	61010-10311	2	VOLTAGE COMPARATOR	0078	LM311N
U17	79814-00439	1	PAL PROGRAMMED 5AC312 REV A 73A-SUPER 8	0000	
U25	79813-00269	1	PROGRAMMED PROM	0000	
U26	73003-74574	1	IC TTL ALS OC TRI LATCH NON INV TI ONLY	0107	74ALS574
U28,36,39	73308-74244	3	IC TTL ALS OCTAL BUFFER NON-INVERTING	0107	74ALS1244
U37	73308-74245	1	IC TTL ALS OCTAL BUS TRANSCEIVER	0107	74ALS245
U44	73003-74573	1	IC TTL ALS OCTAL D-TYPE EDGE TRIG FLIP-FLOP	0107	74ALS573
U46	79825-88002	1	IC SUPER 8 CPU ROMLESS 20 MHZ	0117	Z08800A20PSC
U47	79814-00186	1	PAL PROGRAMMED 18P8L REV B 73A-256 AND 342	0000	
U48	79814-00482	1	PAL PROGRAMMED 20L8 REV B 73A-SUPER 8	0000	
U49	71701-74682	1	IC TTL LS 8-BIT COMPARATOR	0107	74LS682
U59	73313-74760	1	IC TTL AS OCTAL BUFFER NON-INV	0107	74AS760
U64	12013-10004	1	1K RES NETWORK 1% .7W 15-PRG	0008	F16A102F
U65	79805-58256	1	IC CMOS 32K X 8 SRAM 120NS	0052	HM62256P-12

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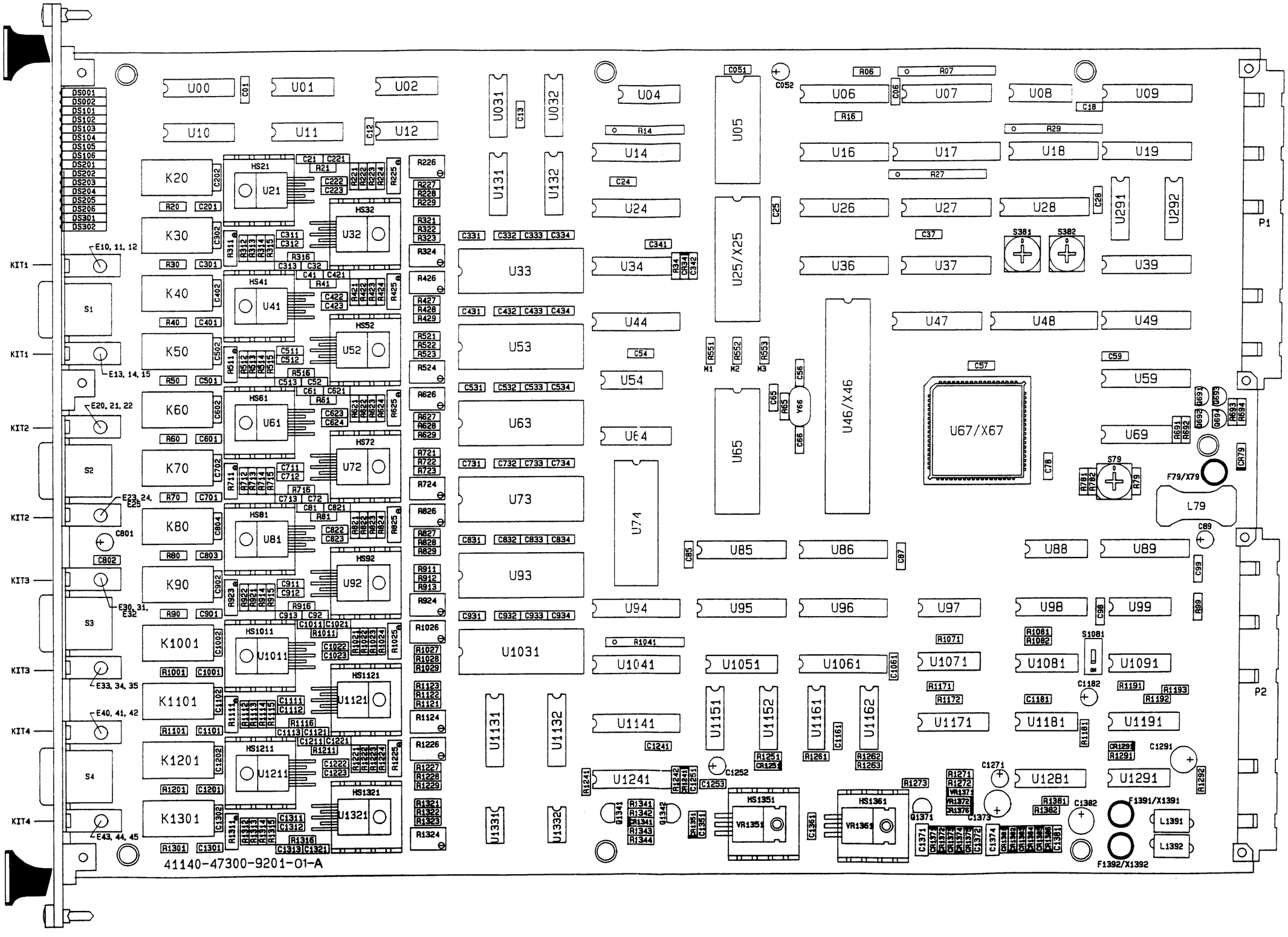
REFERENCE DESIGNATOR	CDS PART NUMBER	QTY.	PART DESCRIPTION	MFG. NUM.	MFG. PART NUMBER
U67	79814-00467	1	PAL PROGRAMMED EP1810 REV A	0000	
U74	81001-00506	1	IC CMOS ANALOG MULTIPLEXER 8-16 CHANNELS	0102	DG506ACJ
U85	73006-74573	1	IC TTL AS OCTAL D-TYPE LATCH	0107	74AS573
U86	76603-74645	1	IC TTL AS OCTAL BUS TRANSCEIVER	0107	74AS645
U88	76510-07410	1	IC TTL ALS TRIPLE 3-INPUT NAND GATE	0107	74ALS10
U89	79814-00185	1	PAL PROGRAMMED C16L8 REV D 73A-256 AND 342	0000	
U95	79814-00188	1	PAL PROGRAMMED EP310-2 REV A 73A-256 AND 342	0000	
U99	76602-07438	1	IC TTL S QUAD 2-INPUT NAND BUFFER W-OC	0107	74S38
VR1351	52000-07815	1	VOLTAGE REGULATOR 15 1.5A	0078	LM7815CT
VR1361	52000-07915	1	VOLTAGE REGULATOR -15V 1.5A	0074	MC7915CT
VR1371	32000-05228	1	DIODE ZENER 3.9V .5W 5%	0074	1N5228B
VR1372	32000-05243	1	DIODE ZENER 13V .5W 5%	0074	1N5243B
X1391,1392,79	42300-28105	3	FUSE SOCKET MICRO VERTICAL .025 LEADS .1 CNT	0061	281 005
X25	45012-28100	1	SOCKET 28-PIN DIP LOW PRO	0089	ICO-286-S8A-TG
X46	45010-48100	1	SOCKET 48-PIN DIP	0089	ICN-486-S5-G
X67	45010-80186	1	SOCKET 68 PIN PLCC	0243	QILE68P-410T
Y66	89500-20000	1	CRYSTAL 20.000 MHZ 50 PPM	0062	MP-1 20.000


DS001
DS002
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K1001
K1101
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HS32
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HS52
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