Gemini Near Infrared Coronagraphic Imager
Dual Array Controller
GEMINI SDN3003

MKIR# NICI –800-202-01
Rev 0.1 (prerelease)
Last Modified 2/11/2002

Table of Contents

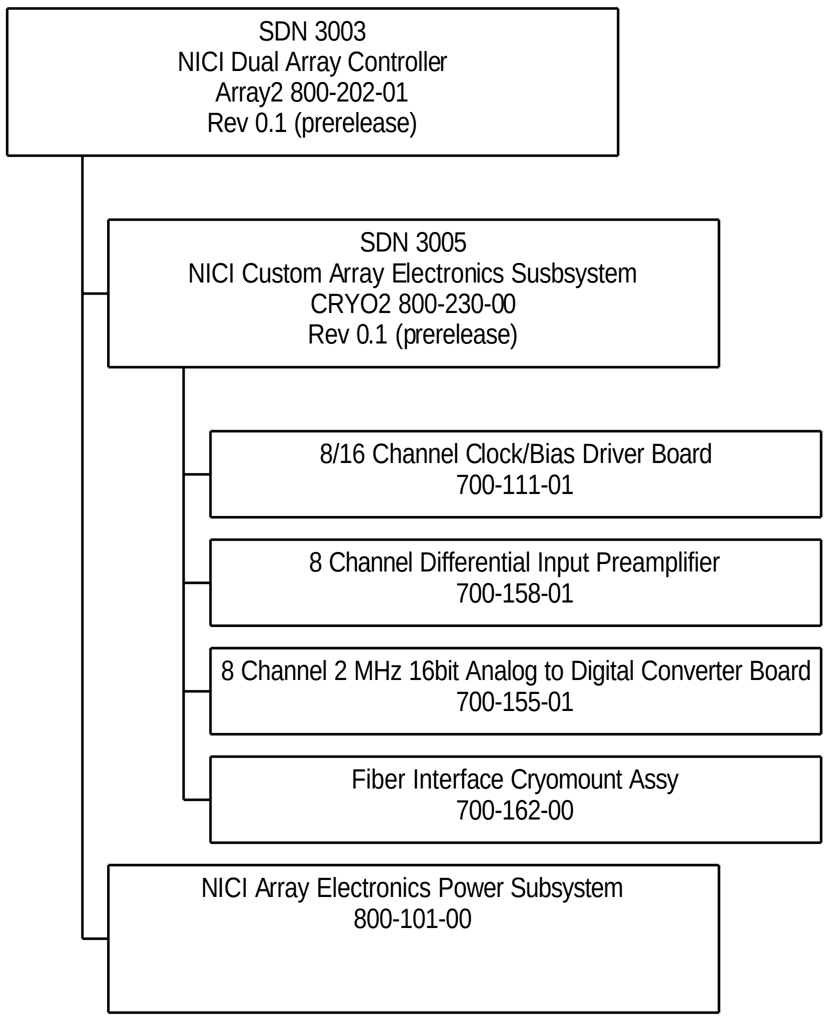
1 NICI Dual Array Controller, 800-202-01

1.1 Overview

1.1.1 Purpose

This document provides a subsystem level description of the array control portion of the Gemini NICI instrument. The system will use a Redstar3 design configured for dual AladdinIII control. This document has been created to account for configuration and implementation details specific to NICI that may not already be covered by the Redstar3 Array Controller documents.

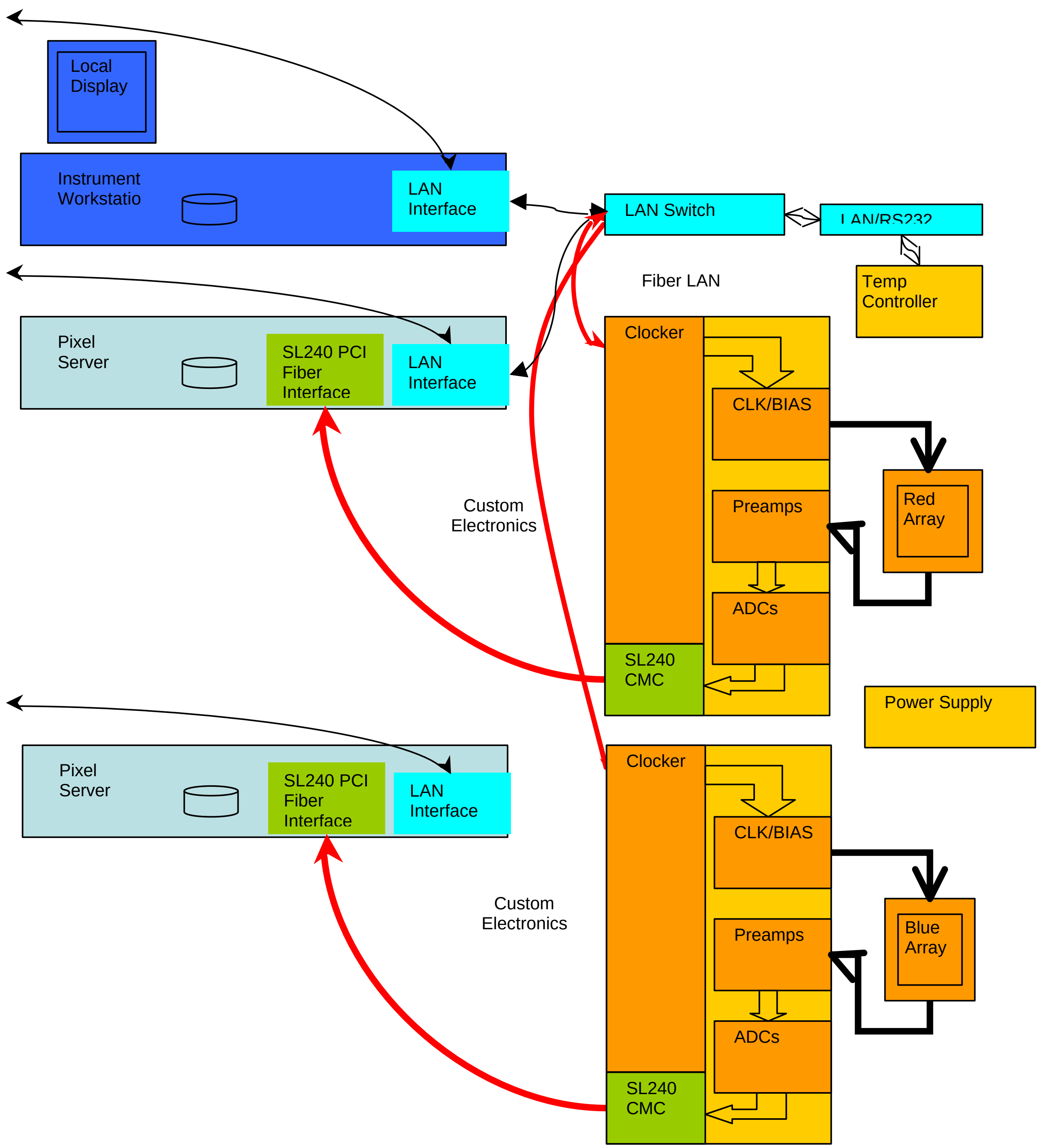
1.2 Subsystem Document Tree



1.3 Technical Specifications Dual array REDSTAR3

- PCI based Computer Control and Data Acquisition
  - 3 ‘Thinserver’ platforms
  - Rackmount, rugged low profile form factors
  - 1 Instrument Workstation
  - 2 Pixel Servers (1 per array)
    - Compaq Proliant DL360
    - Dual 1.2GHz Pentium 3 CPUs
    - Red Hat LINUX OS
    - Built in RAID
    - Systran SL240 2.5Gbps (247MByte/sec) FibreXtreme PCI interface
- Custom ‘Cryostat Mounted’ Readout Electronics, SDN 3005, 800-230-00
  - 32/16 channel analog clock signal drivers
  - 32 low noise preamplifiers
  - 32 individual 2Mhz 16bit Analog to Digital Converters
  - Systran SL240 2.5Gbps (247MByte/sec) FibreXtreme FPDP interface
  - 2 Embedded Brightstar Engineering IPengine1’s
    - 48Mhz PowerPC
    - Altera FPGA
    - ELINUX OS
    - 10BT Ethernet
- Cryostat electronics
  - Integrated array mount/fanout/configuration assembly
  - Cryostat cable assemblies
    - Thermal clamp/light tight feedthroughs
- Low Noise Agilent Switching Power Supply
  - Rackmount, modular
  - Front panel indicators
  - +5VDC,+15VDC, -15VDC for each array
  - Over current, voltage protection

1.4 Block Diagram



1.5 Functional Description

The user can interface with the system via the X User Interface (XUI) and Instrument Control programs running in the Instrument Workstation. This subsystem communicates with embedded clock generator via a fiber isolated 10BT link to the cryostat mounted electronics subsystem. The embedded clock (located on a vendor CPU+FPGA board) outputs digital clocks down a backplane and converted to analog voltage levels by clock/bias driver boards. The clocks and biases are fed out to the cryostat through custom cables, hermetic connector interface assemblies, through light tight feedthroughs and to the array mount assembly. The each of the 32 outputs from each array is then fed back via a similar path to a preamplifier followed by an analog to digital converter circuit. The outputs of the ADC's are then multiplexed down another backplane to another embedded CPU+FPGA board. This board interfaces with a vendor supplied 2.5Gbps FPDP fiber interface board. The pixel data is passed over this high speed link to Pixel Server platforms which perform preliminary processing steps and either locally store or pass data on to the DHS.

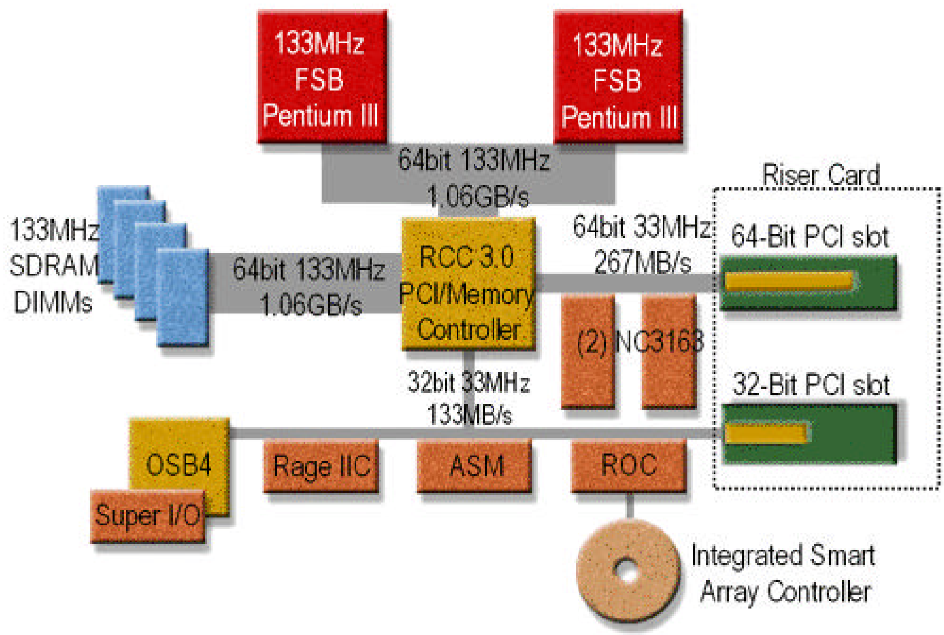
1.5.1 Thin Servers

To keep the system symmetric and lower maintenance, Redstar3 has currently standardized on a generic PC form factor intended for the Internet Service Provider marker. This form factor is known as a "Thin Server" which indicates a rackmount, high density PC/PCI platform. For a dual Aladdin III system, 3 thin servers will be used for the functions of Instrument Workstation and Pixel Server. In each case (plus or minus disk capacity) the platforms be of identical hardware. The choice of PC platforms (vs. VME, SPARC) is a deliberate attempt to be able to leverage future advancements and the price/performance ratios found in the PC market. We have baselined a particular platform for development and testing, a Compaq Proliant DL360. See the attached Appenndix for detailed vendor information.

1.5.1.1 Compaq Proliant DL360

1.5.1.1.1 Photo (Replace with Actual)

1.5.1.1.2 Block Diagram



- Processors: Dual Intel Pentium III FC PGA2 processor 1.26 GHz
- Memory Standard: 128 MB (PC133MHz Registered ECC SDRAM memory)
- Maximum: 4 GB
- Network Controller: Two Compaq NC3163 Fast Ethernet NIC (embedded) PCI 10/100 WOL (Wake On LAN)
- Expansion Slots I/O (2 Total) PCI Voltage :
  - 64-bit /33 MHz PCI 1 5 Volt or universal cards
  - 32-bit /33 MHz PCI 1 5 Volt or universal cards
- Storage Controller: Integrated Smart Array Controller
- Note: This controller is embedded on the system board.
- Storage Diskette Drives 1.44 MB
- CD-ROM 24x IDE CD-ROM Drive (Low-profile)
- Maximum Internal Storage 145.6 GB (internal drive cage) (2 x 72.8 GB Wide Ultra3, 1" drives)
- Inter faces:
  - Serial 1
  - Pointing Device (Mouse) 1
  - Graphics 1
  - Hot Plug Keyboard 1
  - External SCSI (for tape only) 1
  - Network RJ-45 2
- Graphics: Integrated ATI RAGE IIC Video Controller with 4-MB Video Memory
- Form Factor: Rack (1U), (1.75-in/4.45 cm)

1.5.2 Systran SL240 PCI, 2.5Gbps interface board

1.5.2.1.1 SL240 PCI Photo

1.5.2.1.2 Specifications

- Programmable bi-directional boards provide configuration flexibility
- Minimizes implementation cost and enhances throughput by using a simple protocol
- Two media options available Long wavelength and Short wavelength laser
- End-to-end throughput of up to 247 MB/s without frame checksums
- Built-in data synchronization with minimal on overall data throughput
- Integrated interrupt controller to report transaction completion, or buffer space
- Loop operation with out-of-band arbitration point-to-point operation
- Watchdog timer for failover operation
- Proven 8B/10B encoding for data transmission
- Memory: 1 MB receive buffer, 4 KB transmit
- 64-bit operation is backward compatible 33 MHz
- Status LED that reports link stability
- Hardware Compatibility:
    - PCI Local Bus
    - Specification, Rev. 2.1
    - Physical Dimensions:
    - 4.725" x 4.200" (120.015 mm x 106.680 mm)
    - 50um or 62.5 core fiber
    - ~ 0.25lbs
    - Power dissipation 8.2W average
        - +5VDC, 0.9 Amps av., 1.3 Amps peak
        - +3.3VDC, 1.1 Amps av. and peak

1.5.3 High Level Array Control System Functional Requirements

Must operate two 4 quadrant Aladdin type III style arrays
Reference Document: SDN 3003 NICI Dual Array Controller

Must allow synchronization of readouts of the two arrays to 1 millisecond.
'Quick Answer': The Clocking FPGA circuitry located on the FCRYO2 board will start exposures when in an ARM state and after receiving an optocoupled TTL level TRIGGER signal. Clocking will be synchronized to within 140nsec.
Reference Document: FCRYO2 700-2##-##

Single subarray mode minimum size 8x16 placed anywhere in the array and reflected to all four quadrants.
Global reset
Single sampled readout mode
Double correlated sampled readout mode
Multiple NDR noise reduction sampling mode
'Quick Answer': The Clocking FPGA circuitry located on the FCRYO2 board allows for flexible clocking encompassing these requirements. .

Reference Document: FCRYO2 700-2##-##

Connect to Gemini through a Socket for remote control
State set and state read commands
Populate the FITS header and ship the data to the DHS
Must operate in a standalone mode or under Gemini control in a remote mode
Must provide an image display in standalone mode
Must provide local storage for standalone mode
Reference Document: SDN 3003 NICI Dual Array Controller

Must time stamp frames using Gemini supplied time board*
'Quick Answer': NICI will use a MKIR supplied time board located in the Pixel Servers
Reference Document: SDN 3003 NICI Dual Array Controller
Must have macro capability in stand alone mode
Reference Document: SDN 3003 NICI Dual Array Controller

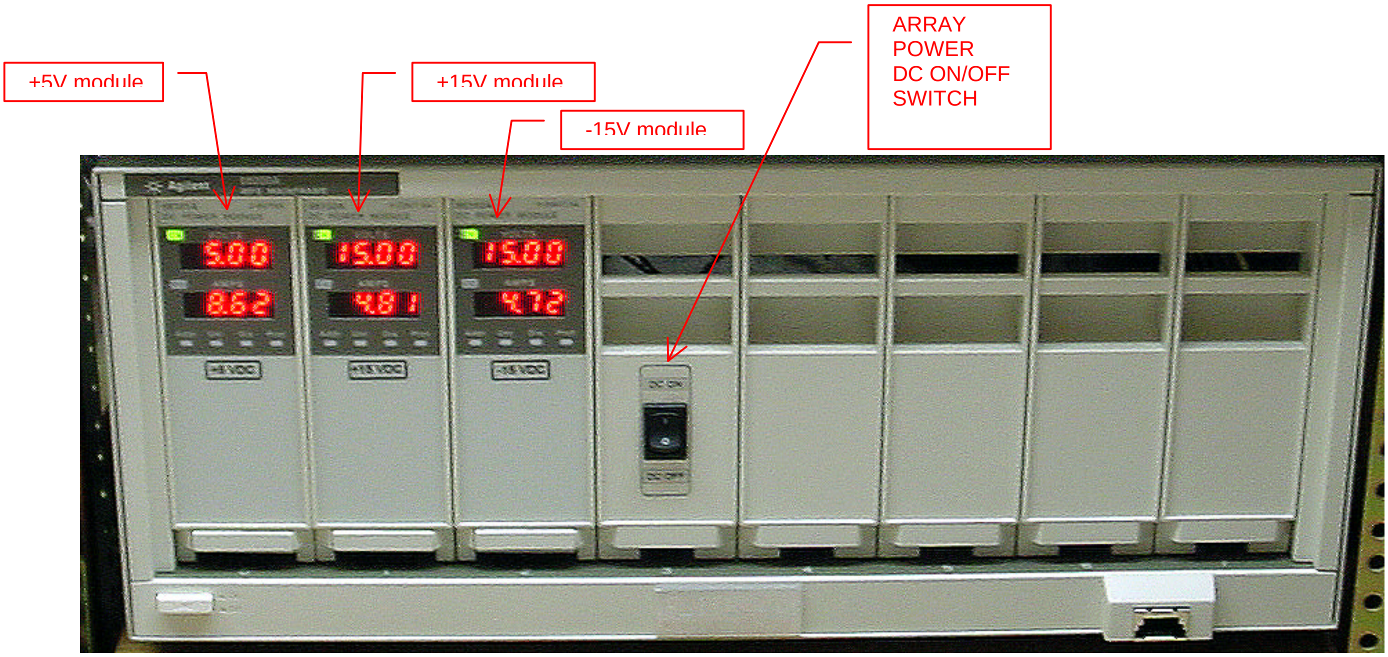
1.5.4 High Level Array Control System Performance Requirements

Read noise - the controller should not increase the device noise by more than 10%
'Quick Answer': 'The gain is fixed at X5 and the bandwidth is limited to ~2.9Mhz with resulting calculated noise (with a 1K souce impedance) is equal to 53.2uV. For the +/-2.5V input range of the ADCs' one bit (LSB) is equal to 76uV so the preamplifier contributes less than 1 LSB.'
Reference Document: PREAMP8 700-158-01
'Quick Answer': The previous generation array controllers using the same analog and ADC circuitry has been able to achieve the read noise requirement on 6 different Aladdin arrays on 3 different telescopes (SUBARU, IRTF, NRL/NO Flagstaff).
A/D resolution – adequate to get two bits on the noise
'Quick Answer': The gain is fixed at X5. From experience, the e/ADU ratio averages ~10e/ADU at this setting, leaving ~ 4bits of resolution on the noise from single Fowler pair readout of the Aladdin III.
Reference Document: PREAMP8 700-158-01
Full frame coadd rate - 2 Hz required (10 Hz goal)
Full frame to disk rate – 2 Hz required (10 Hz goal)
'Quick Answer': As of 3/15/2002, testing has that shown data processing and storage rates have achieved the 2 Hz requirement and 10Hz goal for both coaddition and storage.
Display frame rate stand alone mode – .5 sec to display frame desired.
'Quick Answer': As of 3/15/2002, no testing has been performed.

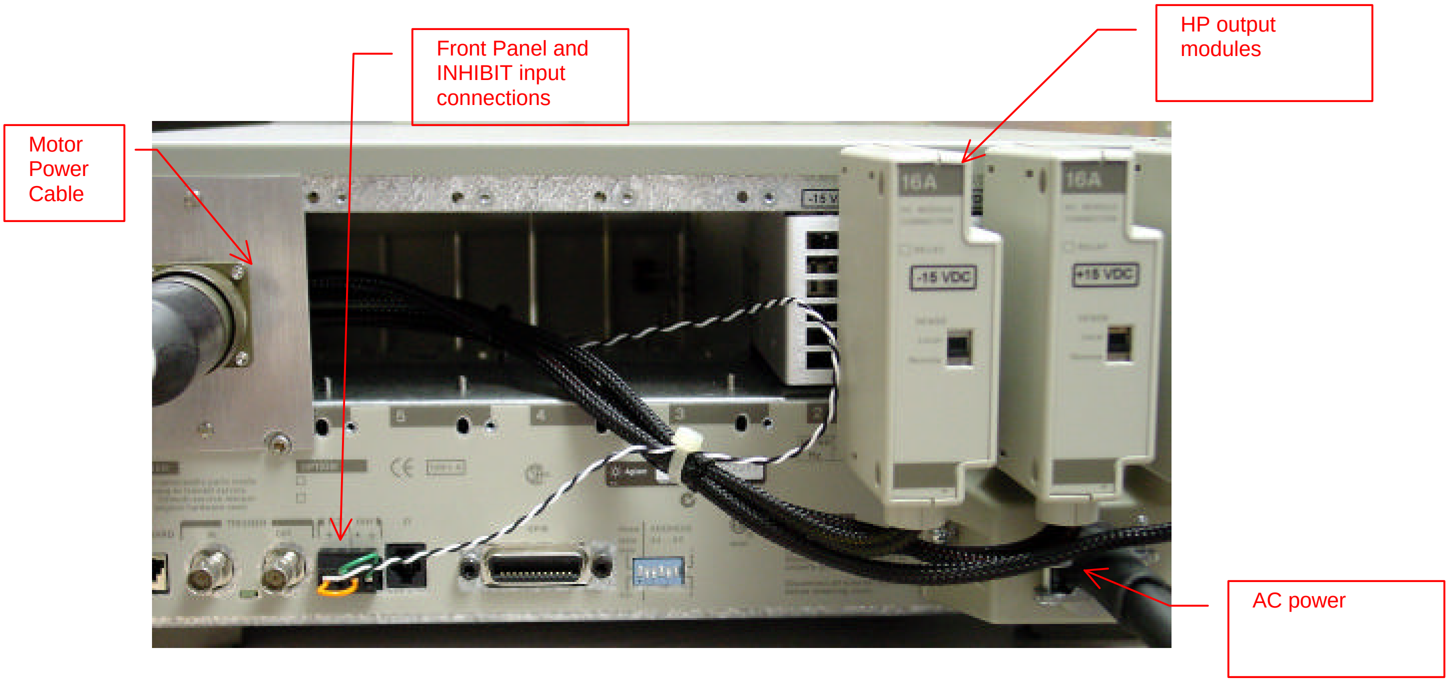
1.6 Power Supply

A specially modified HP 66000 series system power supply supplies the power for the Cryostat Mounted Electronics.

1.6.1 Power Supply Chassis Photo



1.6.2 Power Supply Chassis Rear View Photo



1.6.3 HP Output Module + AC power Installation/Removal

Due to the size of the power supply chassis and shipping crate, the output power modules and AC connector must be removed for shipping. To reinstall the connections, complete the following procedure.

1.6.4 AC Power Connection

After confirming that the silver strain relief is loose enough to back the plastic shell off the end of the cable, connect the BLACK wire to LINE, GREEN to EARTH and WHITE to NEUTRAL. Attach the plastic shell and tighten the strain relief clamp.

1.6.5 HP Output Module Connections

A cable harness that connects the three plastic HP output modules to the 16 pin panel mount ARRAY POWER connector must be installed. The ARRAY POWER connector should be installed using chassis holes on the left side of the HP chassis. The 3 output modules (labeled -15VDC, +15VDC,and +5VDC) should be connected to their respective connectors.

1.7 System Grounding

1.7.1 Plan Description

The grounding plan for the instrument is handled at five levels. The first is at the cryostat mounted electronics level. Separate analog and digital ground planes are used on all of the cryostat electronics boards and the backplane. A single point connection between them is unavoidably made at the analog to digital converters because the devices themselves are manufactured with an internal connection between the two potentials. The fact that there are multiple ADCs in the system places the best point for a single point ground at these connection points. This configuration dictates that the power supplies must have floating outputs. Previous experience has shown that there can also be substantial coupling capacitance between the power supply chassis and the outputs, so isolation is also often necessary.

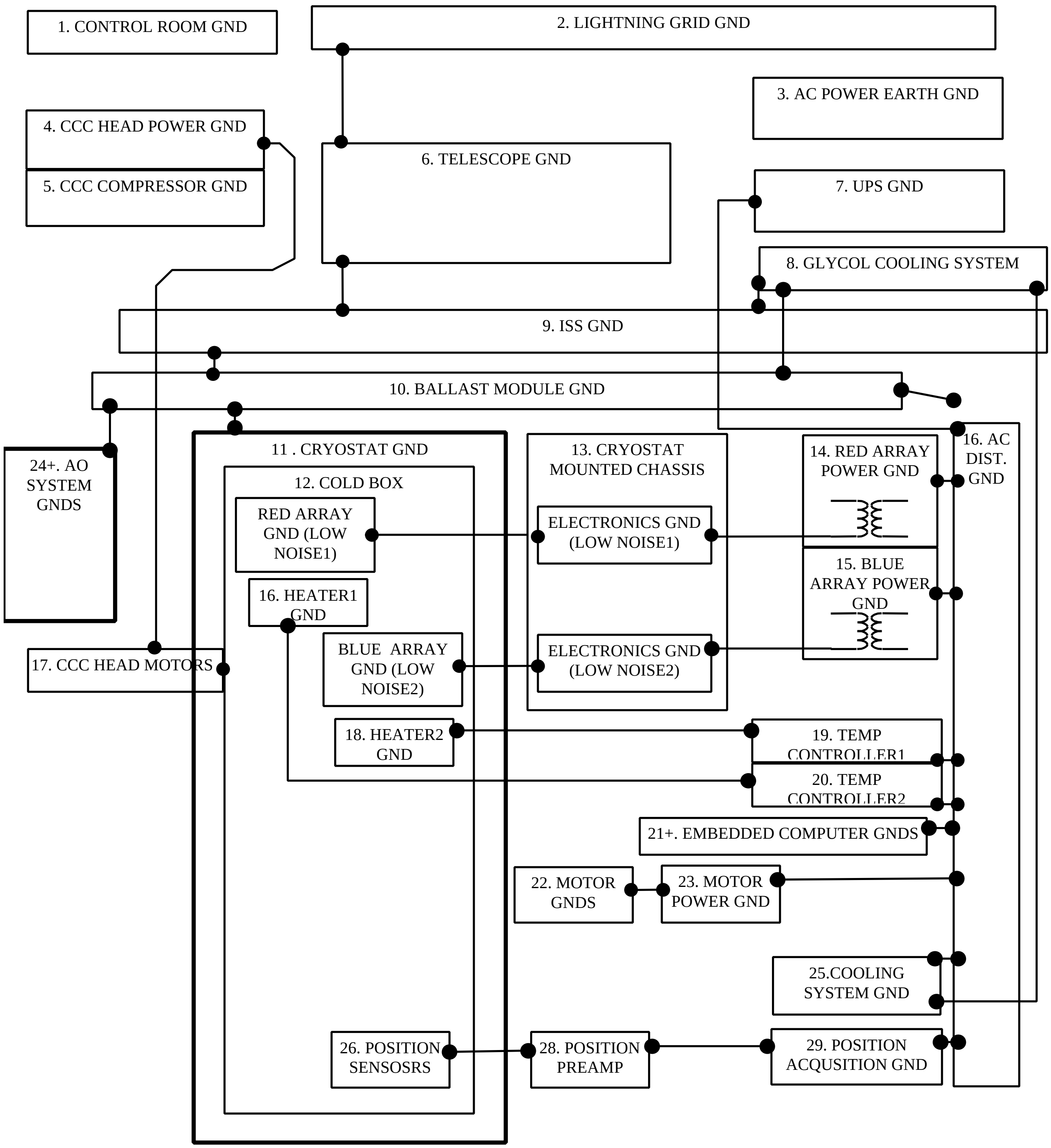
The second level of grounding is accomplished with the fiber optic link between the Embedded Computers (Instrument Workstation and Pixel Servers) and the cryostat mounted electronics. This complete optical isolation is intended to keep the high current and high frequency power distortion generated by the computer systems away from the low noise array electronics.

Each array electronics subsystem will have its own independent ground (that can be alternatively shorted to the other). This third level of grounding is intended to minimize crosstalk between the readout of the two arrays. The dual independent power supply systems support this configuration.

Another area of concern is the fourth level of ground isolation that between the closed cycle cooler system and the cryostat mounted electronics. The closed cycle cooler will not be electrically isolated from the cryostat vacuum jacket, so the two array wiring inside will be isolated.

The fifth level of the system grounding plan is illustrated in the following figure. It is an attempt to identify all of the different ground potential points in the facility that may affect the performance of the instrument. The diagram provides a starting point to identify and fix grounding problems.

1.7.2 System Ground Diagram

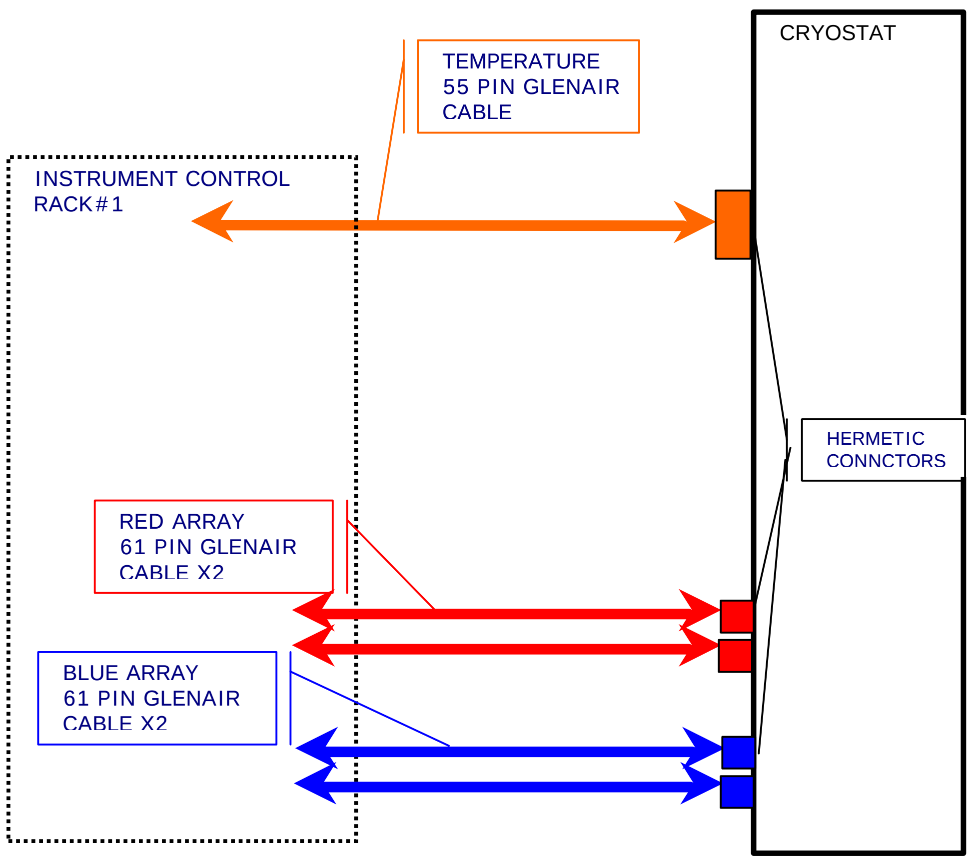


1.8 Connections and Cabling

1.8.1 Controller to Cryostat External Cabling

Qty	Name	Manufacturer's Part	# conductors	Type of signals	Length	Connectors
1	Temperature Cable	Glenair 55pin	55	Low level/noise and heater power	15ft	cylindrical
4	Array Cables	Glenair 61 pin ABC56145 rA	61	Critical Low noise	~3ft	cylindrical

1.8.2 Diagram



1.8.3 Array Cabling

Connection to the arrays are made via Glenair custom 61 pin cables specifically designed for low noise, high shielding operation. See the Appendix for the spreadsheet of array signal mapping and connections.

ALLADIN 2 pinout (SB0152 ROIC PCHANNEL OUTPUTS)					700-150			700-151					xxx					700-149					600-010				700-148					Backplane		
socket Yamaichi IC51-1244-410-1					Array Fanout			Config bd	J1,2,3,4= 2mm P1,2=96 pin				Thermal feedthrough		COLD	WARM		61 pin Bd	J1,2=34 pin headers				61 pin CABLES	conn=MS	conn=MS3116-E		60 pin Bd			J1,2=34 pin headers				
pin num	signal name	high level	low level		signal	conn	pin	signal	conn	pin	conn	pin	signal		pin	pin	Cu?	signal	conn	pin	pin	bd#	signal	cable#	pin	cond/shld	signal	pin	bd#	conn	pin	signal	slot#	pin
1	Q1_VGGCL	VDETCOM	-5	clk	q1_VGGCL	J1	1	VGGCL_T	J1	1	P1	A2,B2	VGGCL_T	JH1_T	4	3		VGGCL_T	J1	3	a	1	VGGCL_T	T-Q1&2	a	cond	VGGCL_T	a	1	J1	3	VGGCL_T	slot_7	C17
2	Q1_VDDCL	-1.2	VDDUC	clk	q1_VDDCL	J1	3	VDDCL_T	J1	3	P1	A27,B27	VDDCL_T	JH2_T	20	19		VDDCL_T	J2	19	LL	1	VDDCL_T	T-Q1&2	LL	shield	VDDCL_T	LL	1	J2	19	VDDCL_T	slot_1	C17
3	Q1_VDDUC	-4.0 to -3.5		bias	q1_VDDUC	J1	5	VDDUC_T	J1	5	P1	C27	VDDUC_T	JH2_T	19	20		VDDUC_T	J2	20	KK	1	VDDUC_T	T-Q1&2	KK	cond	VDDUC_T	KK	1	J2	20	VDDUC_T	slot_7	C28
4	Q1_PHISS	VpROW&COL	VnROW	clk	q1_PSS	J1	7	PSS_T	J1	7	P1	A28,B28	PSS_T	JH2_T	22	21		PSS_T	J2	21	AA	1	PSS_T	T-Q1&2	AA	shield	PSS_T	AA	1	J2	21	PSS_T	slot_7	C31
5	Q1_PHIS1	VpROW&COL	VnROW	clk	q1_PS1	J1	9	PS1_T	J1	9	P1	C28	PS1_T	JH2_T	22	21		PS1_T	J2	22	z	1	PS1_T	T-Q1&2	z	cond	PS1_T	z	1	J2	22	PS1_T	slot_1	C19
6	Q1_PHIS2	VpROW&COL	VnROW	clk	q1_PS2	J1	11	PS2_T	J1	11	P1	A29,B29	PS2_T	JH2_T	24	23		PS2_T	J2	23	i	1	PS2_T	T-Q1&2	i	shield	PS2_T	i	1	J2	23	PS2_T	slot_1	C21
7	Q1_PHIROE	VpROW&COL	VnROW	clk	q1_PROE	J1	13	PROE_T	J1	13	P1	C29	PROE_T	JH2_T	23	24		PROE_T	J2	24	h	1	PROE_T	T-Q1&2	h	cond	PROE_T	h	1	J2	24	PROE_T	slot_1	C23
8	Q1_PHIDES	VpROW&COL	VnROW	clk	q1_PDES	J1	15	PDES_T	J1	15	P1	A30,B30	PDES_T	JH2_T	26	25		PDES_T	J2	25	H	1	PDES_T	T-Q1&2	H	shield	PDES_T	H	1	J2	25	PDES_T	slot_1	C25
9	Q1_PHIFS	VpROW&COL	VnCOL	clk	q1_PFS	J1	17	PFS_T	J1	17	P1	C30	PFS_T	JH2_T	25	26		PFS_T	J2	26	G	1	PFS_T	T-Q1&2	G	cond	PFS_T	G	1	J2	26	PFS_T	slot_1	C27
10	Q1_PHIF1	VpROW&COL	VnCOL	clk	q1_PF1	J1	19	PF1_T	J1	19	P1	A31,B31	PF1_T	JH2_T	28	27		PF1_T	J2	27	K	1	PF1_T	T-Q1&2	K	shield	PF1_T	K	1	J2	27	PF1_T	slot_1	C29
11	Q1_PHIF2	VpROW&COL	VnCOL	clk	q1_PF2	J1	21	PF2_T	J1	21	P1	C31	PF2_T	JH2_T	27	28		PF2_T	J2	28	J	1	PF2_T	T-Q1&2	J	cond	PF2_T	J	1	J2	28	PF2_T	slot_1	C31
12	Q1_VnROW	-6.0 to -5.6		bias	q1_VNROW	J1	23	VNROW_T	J1	23	P1	A32,B32	VNROW_T	JH2_T	30	29		VNROW_T	J2	29	k	1	VNROW_T	T-Q1&2	k	shield	VNROW_T	k	1	J2	29	VNROW_T	slot_7	C30
13	Q1_VnCOL	-6.0 to -3.5		bias	q1_VNCOL	J1	25	VNCOL_T	J1	25	P1	C32	VNCOL_T	JH2_T	29	30		VNCOL_T	J2	30	j	1	VNCOL_T	T-Q1&2	j	cond	VNCOL_T	j	1	J2	30	VNCOL_T	slot_7	C29
14	Q1_Vp	0.0 to -0.5		bias	q1_VP	J1	27	VP_T	J1	27	P1	A1,B1	VP_T	JH1_T	2	1	Cu	VP_T	J1	1	Z	1	VP_T	T-Q1&2	Z	cond	VP_T	Z	1	J1	1	VP_T	AGND1	A12S?
15	VSS	0		bias	q1_VSSCM	J1	29	VSSCM_T	J1	29	P1	C2	VSSCM_T	JH1_T	3	4		VSSCM_T	J2	4	u	1	VSSCM_T	T-Q1&2	u	shield	VSSCM_T	u	1	J2	4	VSSCM_T	AGND7	A22s?
16	VSUB	0 gnd		bias	AGND	J1	31	AGND	J1	31	P1	C1	AGND_T	JH1_T	1	2	Cu	AGND_T	J1	2	Y	1	AGND_T	T-Q1&2	Y	shield	AGND_T	Y	1	J1	2	AGND_T	AGND2	A2s?
17	VSS	0		bias	q3_VSSCM	J1	33	VSSCM_B	J1	33	P2	C2	VSSCM_B	JH1_B	3	4		VSSCM_B	J1	4	u	2	VSSCM_B	B-Q3&4	u	shield	VSSCM_B	u	2	J1	4	VSSCM_B	AGND6	A12s?
18	Q3_Vp	0.0 to -0.5		bias	q3_VP	J1	35	VP_B	J1	35	P2	A1,B1	VP_B	JH1_B	1	2	Cu	VP_B	J1	2	Y	2	VP_B	B-Q3&4	Y	Y	VP_B	Y	2	J1	2	VP_B	AGND4	A2s?
19	Q3_VnCOL	-6.0 to -3.5		bias	q3_VNCOL	J1	37	VNCOL_B	J1	37	P2	C32	VNCOL_B	JH2_B	29	30		VNCOL_B	J2	30	j	2	VNCOL_B	B-Q3&4	j	cond	VNCOL_B	j	2	J2	30	VNCOL_B	slot_14	C29
20	Q3_VnROW	-6.0 to -5.6		bias	q3_VNROW	J1	39	VNROW_B	J1	39	P2	A32,B32	VNROW_B	JH2_B	30	29		VNROW_B	J2	29	k	2	VNROW_B	B-Q3&4	k	shield	VNROW_B	k	2	J2	29	VNROW_B	slot_14	C30
21	Q3_PHIF2	VpROW&COL	VnCOL	clk	q3_PF2	J1	41	PF2_B	J1	41	P2	C31	PF2_B	JH2_B	27	28		PF2_B	J2	28	J	2	PF2_B	B-Q3&4	J	cond	PF2_B	J	2	J2	28	PF2_B	slot_8	C31
22	Q3_PHIF1	VpROW&COL	VnCOL	clk	q3_PF1	J1	43	PF1_B	J1	43	P2	A31,B31	PF1_B	JH2_B	28	27		PF1_B	J2	27	K	2	PF1_B	B-Q3&4	K	shield	PF1_B	K	2	J2	27	PF1_B	slot_8	C29
23	Q3_PHIFS	VpROW&COL	VnCOL	clk	q3_PFS	J1	45	PFS_B	J1	45	P2	C30	PFS_B	JH2_B	25	26		PFS_B	J2	26	G	2	PFS_B	B-Q3&4	G	cond	PFS_B	G	2	J2	26	PFS_B	slot_8	C27
24	Q3_PHIDES	VpROW&COL	VnROW	clk	q3_PDES	J1	47	PDES_B	J1	47	P2	A30,B30	PDES_B	JH2_B	26	25		PDES_B	J2	25	H	2	PDES_B	B-Q3&4	H	shield	PDES_B	H	2	J2	25	PDES_B	slot_8	C25
25	Q3_PHIROE	VpROW&COL	VnROW	clk	q3_PROE	J1	49	PROE_B	J1	49	P2	C29	PROE_B	JH2_B	23	24		PROE_B	J2	24	h	2	PROE_B	B-Q3&4	h	cond	PROE_B	h	2	J2	24	PROE_B	slot_8	C23
26	Q3_PHIS2	VpROW&COL	VnROW	clk	q3_PS2	J1	51	PS2_B	J1	51	P2	A29,B29	PS2_B	JH2_B	24	23		PS2_B	J2	23	i	2	PS2_B	B-Q3&4	i	shield	PS2_B	i	2	J2	23	PS2_B	slot_8	C21
27	Q3_PHIS1	VpROW&COL	VnROW	clk	q3_PS1	J1	53	PS1_B	J1	53	P2	C28	PS1_B	JH2_B	21	22		PS1_B	J2	22	z	2	PS1_B	B-Q3&4	z	cond	PS1_B	z	2	J2	22	PS1_B	slot_8	C19
28	Q3_PHISS	VpROW&COL	VnROW	clk	q3_PSS	J1	55	PSS_B	J1	55	P2	A28,B28	PSS_B	JH2_B	22	21		PSS_B	J2	21	AA	2	PSS_B	B-Q3&4	AA	shield	PSS_B	AA	2	J2	21	PSS_B	slot_14	C31
29	Q3_VDDUC	-4.0 to -3.5		bias	q3_VDDUC	J1	57	VDDUC_B	J1	57	P2	C27	VDDUC_B	JH2_B	19	20		VDDUC_B	J2	20	KK	2	VDDUC_B	B-Q3&4	KK	cond	VDDUC_B	KK	2	J2	20	VDDUC_B	slot_14	C28
30	Q3_VDDCL	-1.2	VDDUC	clk	q3_VDDCL	J1	59	VDDCL_B	J1	59	P2	A27,B27	VDDCL_B	JH2_B	20	19		VDDCL_B	J2	19	LL	2	VDDCL_B	B-Q3&4	LL	shield	VDDCL_B	LL	2	J2	19	VDDCL_B	slot_8	C17
31	Q3_VGGCL	VDETCOM	-5	clk	q3_VGGCL	J1	60	VGGCL_B	J1	60	P2	A2,B2	VGGCL_B	JH1_B	4	3		VGGCL_B	J1	3	a	2	VGGCL_B	B-Q3&4	a	cond	VGGCL_B	a	2	J1	3	VGGCL_B	slot_14	C17
32	Q3_TEND				q3_TEND	J2	1	Q3_TEND	J2	1	P2	C15	Q3_TEND	JH1_B	29	30		Q3_TEND	J1	30	nc	2					Q3_TEND	nc	2	J1	30	Q3_TEND		
33	Q3_VRSTG	-3.5	-5.6	clk	q3_VRSTG	J2	3	VRSTG_B	J2	3	P2	C3	VRSTG_B	JH1_B	5	6		VRSTG_B	J1	6	FF	2	VRSTG_B	B-Q3&4	FF	cond	VRSTG_B	FF	2	J1	6	VRSTG_B	slot_14	C23
34	Q3_VROWOFF	0.0 to -0.7			q3_VROWOFF	J2	5	VROWOFF_B	J2	5	P2	A4,B4	VROWOFF_B	JH1_B	8	7		VROWOFF_B	J1	7	t	2	VROWOFF_B	B-Q3&4	t	shield	VROWOFF_B	t	2	J1	7	VROWOFF_B	AGND5	A22s?
35	Q3_IREF	-1.5 to -2.5		Isource	q3_IREF	J2	7	VIREF_B	J2	7	P2	C4	VIREF_B	JH1_B	7	8		VIREF_B	J1	8	s	2	VIREF_B	B-Q3&4	s	cond	VIREF_B	s	2	J1	8	VIREF_B	slot_14	C25
36	Q3_VROWON	-6.0 to -5.6			q3_VROWON	J2	9	VROWON_B	J2	9	P2	A3,B3	VROWON_B	JH1_B	6	5		VROWON_B	J1	5	GG	2	VROWON_B	B-Q3&4	GG	shield	VROWON_B	GG	2	J1	5	VROWON_B	slot_14	C19
37	Q3_VRSTR	-3.5	-5.6	clk	q3_VRSTR	J2	11	VRSTR_B	J2	11	P2	A5,B5	VRSTR_B	JH1_B	10	9		VRSTR_B	J1	9	MM	2	VRSTR_B	B-Q3&4	MM	cond	VRSTR_B	MM	2	J1	9	VRSTR_B	slot_14	C21
38	Q3_OUT1			output	q3_OUT1	J2	13	Q3OUT1+	J2	13	P2	C6	Q3OUT1+	JH1_B	11	12		Q3OUT1+	J1	12	DD	2	Q3OUT1+	B-Q3&4	DD	cond	Q3OUT1+	DD	2	J1	12	Q3OUT1+	slot_13	C3
39	Q3_OUT2			output	q3_OUT2	J2	15	Q3OUT2+	J2	15	P2	C7	Q3OUT2+	JH1_B	13	14		Q3OUT2+	J1	14	W	2	Q3OUT2+	B-Q3&4	W	cond	Q3OUT2+	W	2	J1	14	Q3OUT2+	slot_13	C5
40	Q3_OUT3			output	q3_OUT3	J2	17	Q3OUT3+	J2	17	P2	C8	Q3OUT3+	JH1_B	15	16		Q3OUT3+	J1	16	g	2	Q3OUT3+	B-Q3&4	g	cond	Q3OUT3+	g	2	J1	16	Q3OUT3+	slot_13	C7
41	Q3_OUT4			output	q3_OUT4	J2	19	Q3OUT4+	J2	19	P2	C9	Q3OUT4+	JH1_B	17	18		Q3OUT4+	J1	18	U	2	Q3OUT4+	B-Q3&4	U	cond	Q3OUT4+	U	2	J1	18	Q3OUT4+	slot_13	C9
42	Q3_OUT5			output	q3_OUT5	J2	21	Q3OUT5+	J2	21	P2	C10	Q3OUT5+	JH1_B	19	20		Q3OUT5+	J1	20	S	2	Q3OUT5+	B-Q3&4	S	cond	Q3OUT5+	S	2	J1	20	Q3OUT5+	slot_13	C11
43	Q3_OUT6			output	q3_OUT6	J2	23	Q3OUT6+	J2	23	P2	C11	Q3OUT6+	JH1_B	21	22		Q3OUT6+	J1	22	n	2	Q3OUT6+	B-Q3&4	n	cond	Q3OUT6+	n	2	J1	22	Q3OUT6+	slot_13	C13
44	Q3_OUT7			output	q3_OUT7	J2	25	Q3OUT7+	J2	25	P2	C12	Q3OUT7+	JH1_B	23	24		Q3OUT7+	J1	24	BB	2	Q3OUT7+	B-Q3&4	BB	cond	Q3OUT7+	BB	2	J1	24	Q3OUT7+	slot_13	C15
45	Q3_OUT8			output	q3_OUT8	J2	27	Q3OUT8+	J2	27	P2	C13	Q3OUT8+	JH1_B	25	26		Q3OUT8+	J1	26	P	2	Q3OUT8+	B-Q3&4	P	cond	Q3OUT8+	P	2	J1	26	Q3OUT8+	slot_13	C17
46	Q3_VDDOUT	-1.0 to -1.3		bias	q3_VDDOUT	J2	29	VDDOUT_B	J2	29	P2	C14	VDDOUT_B	JH1&2	27_1	28_2	_Cu	VDDOUT_B	J1&2	28_2	N_A	2	VDDOUT_B	B-Q3&4	N_A	c_s	VDDOUT_B	N_A	2	J1&2	28_2	VDDOUT_B	slot_14	C26
47	Q3_VDETCOM	-2.8 to-3.4		bias	q3_VDETCOM	J2	31	VDETCOM	J2	31	P2	A18,B18	VDETCOM_B	JH2_B	2	1	Cu	VDETCOM_B	J2	1	B	2	VDETCOM_B	B-Q3&4	B	cond	VDETCOM_B	B	2	J2	1	VDETCOM_B	slot_14	C27
48	Q4_VDDOUT	-1.0 to -1.3		bias	q3_VDDOUT	J2	33	VDDOUT_B	J2	33	P2	*	*	*	*	*		*	*	*	*	*	*	B-Q3&4	*	*	*	*	*	*	*	*		
49	Q4_OUT8			output	q4_OUT8	J2	35	Q4OUT8+	J2	35	P2	C19	Q4OUT8+	JH2_B	3	4		Q4OUT8+	J2	4	b	2	Q4OUT8+	B-Q3&4	b	cond	Q4OUT8+	b	2	J2	4	Q4OUT8+	slot_10	C17
50	Q4_OUT7			output	q4_OUT7	J2	37	Q4OUT7+	J2	37	P2	C20	Q4OUT7+	JH2_B	5	6		Q4OUT7+	J2	6	v		Q4OUT7+	B-Q3&4	v	cond	Q4OUT7+	v		J2	6	Q4OUT7+	slot_10	C15
51	Q4_OUT6			output	q4_OUT6	J2	39	Q4OUT6+	J2	39	P2	C21	Q4OUT6+	JH2_B	7	8		Q4OUT6+	J2	8	d		Q4OUT6+	B-Q3&4	d	cond	Q4OUT6+	d		J2	8	Q4OUT6+	slot_10	C13
52	Q4_OUT5			output	q4_OUT5	J2	41	Q4OUT5+	J2	41	P2	C22	Q4OUT5+	JH2_B	9	10		Q4OUT5+	J2	10	HH		Q4OUT5+	B-Q3&4	HH	cond	Q4OUT5+	HH		J2	10	Q4OUT5+	slot_10	C11
53	Q4_OUT4			output	q4_OUT4	J2	43	Q4OUT4+	J2	43	P2	C23	Q4OUT4+	JH2_B	11	12		Q4OUT4+	J2	12	x		Q4OUT4+	B-Q3&4	x	cond	Q4OUT4+	x		J2	12	Q4OUT4+	slot_10	C9
54	Q4_OUT3			output	q4_OUT3	J2	45	Q4OUT3+	J2	45	P2	C24	Q4OUT3+	JH2_B	13	14		Q4OUT3+	J2	14	C		Q4OUT3+	B-Q3&4	C	cond	Q4OUT3+	C		J2	13	Q4OUT3+	slot_10	C7
55	Q4_OUT2			output	q4_OUT2	J2	47	Q4OUT2+	J2	47	P2	C25	Q4OUT2+	JH2_B	15	16		Q4OUT2+	J2	16	f		Q4OUT2+	B-Q3&4	f	cond	Q4OUT2+	f		J2	16	Q4OUT2+	slot_10	C5
56	Q4_OUT1			output	q4_OUT1	J2	49	Q4OUT1+	J2	49	P2	C26	Q4OUT1+	JH2_B	17	18		Q4OUT1+	J2	18	E		Q4OUT1+	B-Q3&4	E	cond	Q4OUT1+	E		J2	18	Q4OUT1+	slot_10	C3
57	Q4_VRSTR	-3.5	-5.6	clk	q4_VRSTR	J2	51	VRSTR_B	J2	51	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
58	Q4_VROWON	-6.0 to -5.6			q4_VROWON	J2	53	VROWON_B	J2	53	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
59	Q4_IREF	-1.5 to -2.5		Isource	q4_IREF	J2	55	VIREF_B	J2	55	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
60	Q4_VROWOFF	0.0 to -0.7			q4_VROWOFF	J2	57	VROWOFF_B	J2	57	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
61	Q4_VRSTG	-3.5	-5.6	clk	q4_VRSTG	J2	59	VRSTG_B	J2	59	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
62	Q4_TEND				q4_TEND	J2	60	Q4_TEND	J2	60	P2	C17	Q4_TEND	JH2_B	33	34		Q4_TEND	J2	34	NC						Q4_TEND	NC		J2	34	Q4_TEND		
63	Q4_VGGCL	VDETCOM	-5	clk	q4_VGGCL	J3	1	VGGCL_B	J3	1	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
64	Q4_VDDCL	-1.2	VDDUC	clk	q4_VDDCL	J3	3	VDDCL_B	J3	3	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
65	Q4_VDDUC	-4.0 to -3.5		bias	Q4_VDDUC	J3	5	VDDUC_B	J3	5	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
66	Q4_PHISS	VpROW&COL	VnROW	clk	q4_PSS	J3	7	PSS_B	J3	7	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
67	Q4_PHIS1	VpROW&COL	VnROW	clk	q4_PS1	J3	9	PS1_B	J3	9	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
68	Q4_PHIS2	VpROW&COL	VnROW	clk	q4_PS2	J3	11	PS2_B	J3	11	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
69	Q4_PHIROE	VpROW&COL	VnROW	clk	q4_PROE	J3	13	PROE_B	J3	13	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
70	Q4_PHIDES	VpROW&COL	VnROW	clk	q4_PDES	J3	15	PDES_B	J3	15	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
71	Q4_PHIFS	VpROW&COL	VnCOL	clk	q4_PFS	J3	17	PFS_B	J3	17	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
72	Q4_PHIF1	VpROW&COL	VnCOL	clk	q4_PF1	J3	19	PF1_B	J3	19	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
73	Q4_PHIF2	VpROW&COL	VnCOL	clk	q4_PF2	J3	21	PF2_B	J3	21	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
74	Q4_VnROW	-6.0 to -5.6		bias	q4_VNROW	J3	23	VNROW_B	J3	23	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
75	Q4_VnCOL	-6.0 to -3.5		bias	q4_VNCOL	J3	25	VNCOL_B	J3	25	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
76	Q4_VP	0.0 to -0.5		bias	q4_VP	J3	27	VP_B	J3	27	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
77	VSS	0		bias	q4_VSSCM	J3	29	VSSCM_B	J3	29	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
78	VSUB	0 gnd		bias	AGND	J3	31	AGND	J3	31	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
79	VSS	0		bias	q2_VSSCM	J3	33	VSSCM_T	J3	33	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
80	Q2_Vp	0.0 to -0.5		bias	q2_VP	J3	35	VP_T	J3	35	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
81	Q2_VnCOL	-6.0 to -3.5		bias	q2_VNCOL	J3	37	VNCOL_T	J3	37	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
82	Q2_VnROW	-6.0 to -5.6		bias	q2_VNROW	J3	39	VNROW_T	J3	39	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
83	Q2_PHIF2	VpROW&COL	VnCOL	clk	q2_PF2	J3	41	PF2_T	J3	41	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
84	Q2_PHIF1	VpROW&COL	VnCOL	clk	q2_PF1	J3	43	PF1_T	J3	43	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
85	Q2_PHIFS	VpROW&COL	VnCOL	clk	q2_PFS	J3	45	PFS_T	J3	45	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
86	Q2_PHIDES	VpROW&COL	VnROW	clk	q2_PDES	J3	47	PDES_T	J3	47	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
87	Q2_PHIROE	VpROW&COL	VnROW	clk	q2_PROE	J3	49	PROE_T	J3	49	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
88	Q2_PHIS2	VpROW&COL	VnROW	clk	q2_PHIS2	J3	51	PS2_T	J3	51	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
89	Q2_PHIS1	VpROW&COL	VnROW	clk	q2_PS1	J3	53	PS1_T	J3	53	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		

90	Q2_PHISS	VpROW&COL	VnROW	clk	q2_PSS	J3	55	PSS_T	J3	55	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
91	Q2_VDDUC	-4.0 to -3.5		bias	q2_VDDUC	J3	57	VDDUC_T	J3	57	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
92	Q2_VDDCL	-1.2	VDDUC	clk	q2_VDDCL	J3	59	VDDCL_T	J3	59	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
93	Q2_VGGCL	VDETCOM	-5	clk	q2_VGGCL	J3	60	VDDCL_T	J3	60	P2	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
94	Q2_TEND				q2_TEND	J4	1	Q2TEND	J4	1	P1	C17	Q2TEND	JH1_T	33	34		Q2TEND									Q2TEND					Q2TEND		
95	Q2_VRSTG	-3.5	-5.6	clk	q2_VRSTG	J4	3	VRSTG_T	J4	3	P1	C3	VRSTG_T	JH1_T	5	6		VRSTG_T	J1	6	FF	1	VRSTG_T	T-Q1&2	FF	cond	VRSTG_T	FF	1	J1	6	VRSTG_T	slot_7	C23
96	Q2_VROWOFF	0.0 to -0.7			q2_VROWOFF	J4	5	VROWOFF_T	J4	5	P1	A4,B4	VROWOFF_T	JH1_T	5	5		VROWOFF_T	J1	5	t	1	VROWOFF_T	T-Q1&2	t	shield	VROWOFF_T	t	1	J1	5	VROWOFF_T	AGND3	
97	Q2_IREF	-1.5 to -2.5		Isource	q2_IREF	J4	7	VIREF_T	J4	7	P1	C4	VIREF_T	JH1_T	7	8		VIREF_T	J1	8	s	1	VIREF_T	T-Q1&2	s	cond	VIREF_T	s	1	J1	8	VIREF_T	slot_7	C25
98	Q2_VROWON	-6.0 to -5.6			q2_VROWON	J4	9	VROWON_T	J4	9	P1	A3,B3	VROWON_T	JH1_T	8	7		VROWON_T	J1	7	GG	1	VROWON_T	T-Q1&2	GG	shield	VROWON_T	GG	1	J1	7	VROWON_T	slot_7	C19
99	Q2_VRSTR	-3.5	-5.6	clk	q2_VRSTR	J4	11	VRSTR_T	J4	11	P1	A5,B5	VRSTR_T	JH1_T	10	9		VRSTR_T	J1	9	MM	1	VRSTR_T	T-Q1&2	MM	shield	VRSTR_T	MM	1	J1	9	VRSTR_T	slot_7	C21
100	Q2_OUT1			output	q2_OUT1	J4	13	Q2OUT1+	J4	13	P1	C26	Q2OUT1+	JH2_T	17	18		Q2OUT1+	J2	18	E	1	Q2OUT1+	T-Q1&2	E	cond	Q2OUT1+	E	1	J2	18	Q2OUT1+	slot_3	C3
101	Q2_OUT2			output	q2_OUT2	J4	15	Q2OUT2+	J4	15	P1	C25	Q2OUT2+	JH2_T	15	16		Q2OUT2+	J2	16	f	1	Q2OUT2+	T-Q1&2	f	cond	Q2OUT2+	f	1	J2	16	Q2OUT2+	slot_3	C5
102	Q2_OUT3			output	q2_OUT3	J4	17	Q2OUT3+	J4	17	P1	C24	Q2OUT3+	JH2_T	13	14		Q2OUT3+	J2	14	C	1	Q2OUT3+	T-Q1&2	C	cond	Q2OUT3+	C	1	J2	14	Q2OUT3+	slot_3	C7
103	Q2_OUT4			output	q2_OUT4	J4	19	Q2OUT4+	J4	19	P1	C23	Q2OUT4+	JH2_T	11	12		Q2OUT4+	J2	12	x	1	Q2OUT4+	T-Q1&2	x	cond	Q2OUT4+	x	1	J2	12	Q2OUT4+	slot_3	C9
104	Q2_OUT5			output	q2_OUT5	J4	21	Q2OUT5+	J4	21	P1	C22	Q2OUT5+	JH2_T	9	10		Q2OUT5+	J2	10	HH	1	Q2OUT5+	T-Q1&2	HH	cond	Q2OUT5+	HH	1	J2	10	Q2OUT5+	slot_3	C11
105	Q2_OUT6			output	q2_OUT6	J4	23	Q2OUT6+	J4	23	P1	C21	Q2OUT6+	JH2_T	7	8		Q2OUT6+	J2	8	d	1	Q2OUT6+	T-Q1&2	d	cond	Q2OUT6+	d	1	J2	8	Q2OUT6+	slot_3	C13
106	Q2_OUT7			output	q2_OUT7	J4	25	Q2OUT7+	J4	25	P1	C20	Q2OUT7+	JH2_T	5	6		Q2OUT7+	J2	6	v	1	Q2OUT7+	T-Q1&2	v	cond	Q2OUT7+	v	1	J2	6	Q2OUT7+	slot_3	C15
107	Q2_OUT8			output	q2_OUT8	J4	27	Q2OUT8+	J4	27	P1	C19	Q2OUT8+	JH2_T	3	4		Q2OUT8+	J2	4	b	1	Q2OUT8+	T-Q1&2	b	cond	Q2OUT8+	b	1	J2	4	Q2OUT8+	slot_3	C17
108	Q2_VDDOUT	-1.0 to -1.3		bias	q2_VDDOUT	J4	29	VDDOUT_T	J4	29	P1	C14,?C18	VDDOUT_T	JH1&2	27_1	28_2	_Cu	VDDOUT_T	J1&2	28_2	N_A	1	VDDOUT_T	T-Q1&2	N_A	c_s	VDDOUT_T	N_A	1	J1&2	28_2	VDDOUT_T	slot_7	C26
109	VDETCOM	-2.8 to-3.4		bias	VDETCOM	J4	31	VDETCOM	J4	31	P1	A18,B18	VDETCOM	JH2_T	2	1	Cu	VDETCOM	J2	1	B	1	VDETCOM	T-Q1&2	B	cond	VDETCOM	B	1	J2	1	VDETCOM	slot_7	C27
110	Q1_VDDOUT	-1.0 to -1.3		bias	q1_VDDOUT	J4	33	VDDOUT_T	J4	33	P1	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
111	Q1_OUT8			output	q1_OUT8	J4	35	Q1OUT8+	J4	35	P1	C13	Q1OUT8+	JH1_T	25	26		Q1OUT8+	J1	26	P	1	Q1OUT8+	T-Q1&2	P	cond	Q1OUT8+	P	1	J1	26	Q1OUT8+	slot_6	C17
112	Q1_OUT7			output	q1_OUT7	J4	37	Q1OUT7+	J4	37	P1	C12	Q1OUT7+	JH1_T	23	24		Q1OUT7+	J1	24	BB	1	Q1OUT7+	T-Q1&2	BB	cond	Q1OUT7+	BB	1	J1	24	Q1OUT7+	slot_6	C15
113	Q1_OUT6			output	q1_OUT6	J4	39	Q1OUT6+	J4	39	P1	C11	Q1OUT6+	JH1_T	21	22		Q1OUT6+	J1	22	n	1	Q1OUT6+	T-Q1&2	n	cond	Q1OUT6+	n	1	J1	22	Q1OUT6+	slot_6	C13
114	Q1_OUT5			output	q1_OUT5	J4	41	Q1OUT5+	J4	41	P1	C10	Q1OUT5+	JH1_T	19	20		Q1OUT5+	J1	20	S	1	Q1OUT5+	T-Q1&2	S	cond	Q1OUT5+	S	1	J1	20	Q1OUT5+	slot_6	C11
115	Q1_OUT4			output	q1_OUT4	J4	43	Q1OUT4+	J4	43	P1	C9	Q1OUT4+	JH1_T	17	18		Q1OUT4+	J1	18	U	1	Q1OUT4+	T-Q1&2	U	cond	Q1OUT4+	U	1	J1	18	Q1OUT4+	slot_6	C9
116	Q1_OUT3			output	q1_OUT3	J4	45	Q1OUT3+	J4	45	P1	C8	Q1OUT3+	JH1_T	15	16		Q1OUT3+	J1	16	q	1	Q1OUT3+	T-Q1&2	q	cond	Q1OUT3+	q	1	J1	16	Q1OUT3+	slot_6	C7
117	Q1_OUT2			output	q1_OUT2	J4	47	Q1OUT2+	J4	47	P1	C7	Q1OUT2+	JH1_T	13	14		Q1OUT2+	J1	14	W	1	Q1OUT2+	T-Q1&2	W	cond	Q1OUT2+	W	1	J1	14	Q1OUT2+	slot_6	C5
118	Q1_OUT1			output	q1_OUT1	J4	49	Q1OUT1+	J4	49	P1	C6	Q1OUT1+	JH1_T	11	12		Q1OUT1+	J1	12	DD	1	Q1OUT1+	T-Q1&2	DD	cond	Q1OUT1+	DD	1	J1	12	Q1OUT1+	slot_6	C3
119	Q1_VRSTR	-3.5	-5.6	clk	q1_VRSTR	J4	51	VRSTR_T	J4	51	P1	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
120	Q1_VROWON	-6.0 to -5.6			q1_VROWON	J4	53	VROWON_T	J4	53	P1	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
121	Q1_IREF	-1.5 to -2.5		Isource	q1_IREF	J4	55	VIREF_T	J4	55	P1	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
122	Q1_VROWOFF	0.0 to -0.7			q1_VROWOFF	J4	57	VROWOFF_T	J4	57	P1	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
123	Q1_VRSTG	-3.5	-5.6	clk	q1_VRSTG	J4	59	VRSTG_T	J4	59	P1	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
124	Q1_TEND				q1_TEND	J4	60	Q1TEND	J4	60	P1	C15	Q1TEND	JH1_T	30	29		Q1TEND	J1	29	PP	1	Q1TEND	T-Q1&2	PP	PP	Q1TEND	PP	1	J1	29	Q1TEND		

TECHNOLOGY BRIEF

June 2000

Compaq Computer Corporation

ISSD Technology Communications

CONTENTS

Compaq™ ProLiant™ DL360 Server Technology

Ultra-Dense Servers for Rack Environments

ABSTRACT

Rapid growth of application service providers (ASPs) and Internet service providers (ISPs) fuels demand for ultra-dense servers in rack environments. Through innovative mechanical and electrical design, Compaq has developed a high-performance 1U server ideal for dedicated applications or web hosting. The highly modular *Compaq ProLiant* DL360 server is a total, high-density solution for any computing environment, from the data center to remote locations. Compaq provides multiple deployment option kits for rapid, high-volume installation of ProLiant DL360 servers in Compaq 9000-Series and 7000-Series racks, in telecommunication (Telco) racks, in standard third-party racks, and as desktop/stackable units. Compaq also provides written guidelines for deploying the server most effectively using each option.

This field brief explains the technology innovations that significantly increase serviceability and enable easy installation of up to 42 full-featured ProLiant DL360 servers in a standard 42U rack.

Please direct comments regarding this communication to the ISSD Technology Communications Group at this internet address: TechCom@compaq.com

NOTICE

Compaq ProLiant DL360 Server Technology
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INTRODUCTION

The e-commerce explosion is forcing businesses to upgrade their enterprise computing systems to remain competitive. As a result, many are outsourcing some or all their computing needs to application service providers (ASPs) and Internet service providers (ISPs). Growth of the ASP and ISP markets is spurring demand for high-performance, highly serviceable, ultra-dense servers that can be deployed rapidly in large numbers.

Compaq developed the concept of high-density servers for rack deployment and has done more density development than any other server manufacturer. The *Compaq ProLiant* server line includes a range of servers optimized for density. For example, the 3U Compaq ProLiant 1850R server and its successor the ProLiant DL380 server have become mainstays in rack environments worldwide.

1U: *1.65 inches (4.19 centimeters)*

Reducing the geometry of the server chassis to less than 3U while providing the required functionality posed enormous technological challenges. Nonetheless, Compaq engineers have developed a full-featured ProLiant server that provides the performance that ASPs, ISPs, and enterprises require — in an ultra-dense, 1U form factor. The Compaq ProLiant DL360 server supports up to two 800-MHz processors, up to 4 GB of system memory, two hot-plug hard drives, two standard-length (12.283-inch) PCI slots, a CD-ROM drive, and a floppy disk drive. Compaq also provides rail mounting kits and best practices guidelines that enable customers to rapidly deploy large numbers of servers and to mount up to 42 ProLiant DL360 servers in a standard 42U rack.

This brief explains technical obstacles Compaq overcame to produce a reliable, high-performance 1U server that can be installed and serviced virtually tool free. It describes the technology and innovative mechanical and electrical design Compaq developed for overcoming these obstacles. It explains how the ProLiant DL360 server meets the needs of customers requiring ultra-high density in rack environments: for fully configured servers; for high quality and performance; for thermal integrity; and for simple, efficient deployment and system management. It also identifies critical design elements customers should consider when selecting servers for dense rack environments.

UNIQUE MECHANICAL AND ELECTRICAL DESIGN

Compaq's goal of meeting customer needs while significantly reducing the height of the server created multiple engineering challenges:

- Fitting all required components into a 1U chassis compatible with standard racks and a wide variety of customer environments
- Adequately cooling powerful processors, high-rpm drives, and other components within such limited space
- Adequately cooling up to 42 ProLiant DL360 systems mounted in a standard 42U rack
- Making the server highly serviceable
- Providing efficient system management and cable management

Designing a full-featured 1U server therefore required rethinking the essential components and the entire layout of the server. In meeting that challenge, Compaq engineers also laid the groundwork for future development of the ProLiant DL360 server.

1U Geometry

Three initial design goals of the ProLiant DL360 server controlled the server geometry:

- The height of the server was to be 1U (1.65 inches, or 4.19 centimeters).
- The server had to accommodate all components needed to provide all functionality required by the target customers.
- The chassis and component design had to permit easy installation and removal of key components such as processors, DIMMs, PCI cards, and hard drives.

DIMM: *dual inline memory module*

PCI: *peripheral component interface*

The ProLiant DL360 server fits into standard racks with ample space for air intake and exhaust. The interior chassis layout accommodates two processors, four DIMMs, and two standard-length PCI cards across the width of the server in the rear and two hot-plug hard drives, a floppy drive, and a CD-ROM drive across the front of the server (Figure 1). Components were designed and positioned in the chassis for efficient space utilization and air-flow control, as well as for the required functionality.

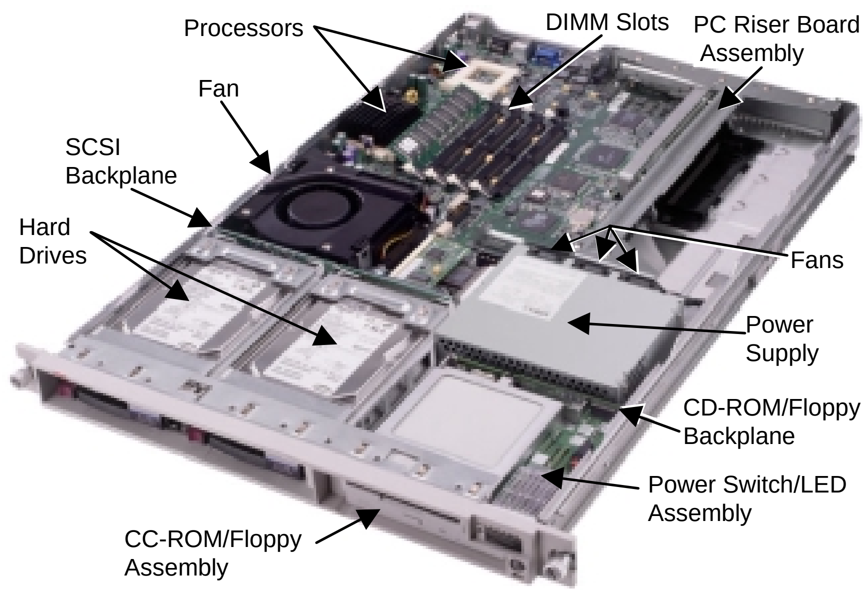
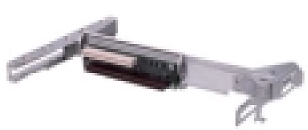


Figure 1. Interior layout of ProLiant DL360 server



PCI riser board assembly

Selecting a processor with a Flip Chip Pin Grid Array (FC-PGA) package rather than a larger, cartridge package made space for two processors in the 1U chassis. Compaq simplified insertion of DIMMs in the tight space by using angled DIMM slots and designing processor heat fins of graduated height. Another unique feature of the ProLiant DL360 server is the PCI riser board assembly. This lightweight, yet rigid metal frame connects directly to the system board and contains edge connectors for two standard-length PCI cards. The assembly lifts out easily for inserting or removing PCI cards and snaps securely back into place when the latch is closed.

For the low-profile CD-ROM/floppy drive module in the ProLiant DL360 server, Compaq used small form-factor products initially developed for Compaq portable computers. An ejector slot on the front of the ProLiant DL360 server makes it simple to remove the module for maintenance or security. For customers who do not need floppy drives and CD-ROM drives, the ProLiant DL360 server comes with a bezel blank to cover the CD-ROM/floppy drive bay. If drives are not installed in the bay, it must be covered to maintain thermal integrity while the server is operating.

Unique Thermal Design

The most difficult obstacle Compaq overcame in designing the 1U server was devising a way to cool server components adequately in such a densely packed chassis. Careful study of the problem reveals several important considerations:

- Incorporating fans that can move an adequate volume of air through the server
- Providing sufficient vents and air gaps to pull adequate cool air into the server
- Controlling the flow of air to move cool air over heated components and to prevent hot spots from developing as a result of warm air recirculation
- Preventing obstruction of air flow by components and cables
- Providing sufficient openings to exhaust hot air efficiently
- Cooling multiple servers adequately when they are densely configured in racks

Compaq engineers employed many design techniques to ensure efficient cooling of the ProLiant DL360 server. They also used extensive computer simulations and developed physical model validation tests to evaluate the initial thermal design and to improve it.

The internal design of the server creates two major air flow regions, one on the left side of the server and the other on the right side (Figure 2). The left side contains the components that generate the most heat and are therefore most susceptible to thermal issues in any server: the hard drives, processors, and memory modules. These components are cooled by a single pressure-blower fan that pulls a large volume of cool air in through vents in the front of the server, over the hard drives, and down through the fan. Compaq engineers planned the fan rotation pattern and custom designed the fan case to incorporate rear fins that direct air blowing from the fan into paths over the DIMMs, the front processor, and the rear processor.

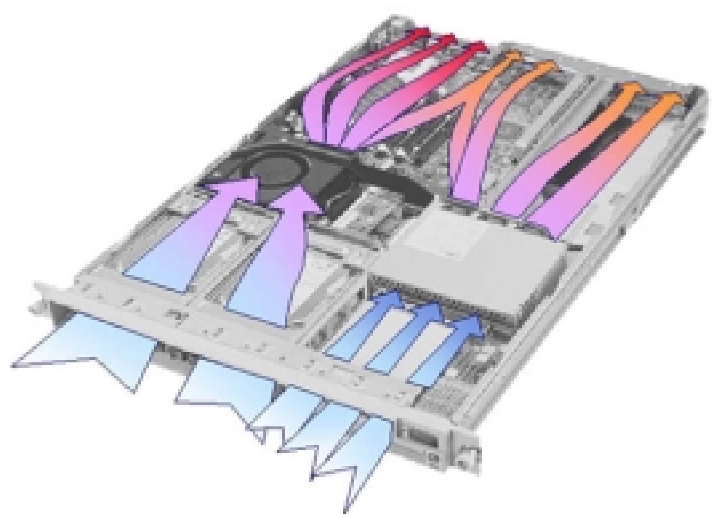


Figure 2. Air flow through the ProLiant DL360 server

The right side of the server contains the CD-ROM/floppy drive assembly, the power supply, and the PCI expansion slots. Three smaller fans attached to the back of the power supply pull cool air in from the front of the server, through the floppy drive, CD-ROM drive, and power supply, and push the air to the back of the server. The three fans are positioned so that one blows air toward the left side of the PCI riser board assembly where a 32-bit PCI card can be installed; the other two blow air toward the right side of the PCI riser board assembly where a 64-bit PCI card can be installed.

By positioning all fans near the middle of the ProLiant DL360 server, Compaq maximized thermal performance and minimized fan noise. Compaq engineers strategically placed other components within the chassis and added baffles and curved surfaces to direct air flow and prevent eddies of warm air. The rear processor, for example, is offset rather than directly aligned with the front processor. This placement allows cool air to flow past both processors and all the DIMMs.

The fans push warm air out through custom-designed louvers at the back of the top access panel (Figure 3) and through numerous vents in the rear panel. The sloping louvers allow warm air to vent out the top panel without being trapped by another server immediately above it. Connectors are strategically positioned low on the rear panel so that they will not block the flow of warm air venting out the back.

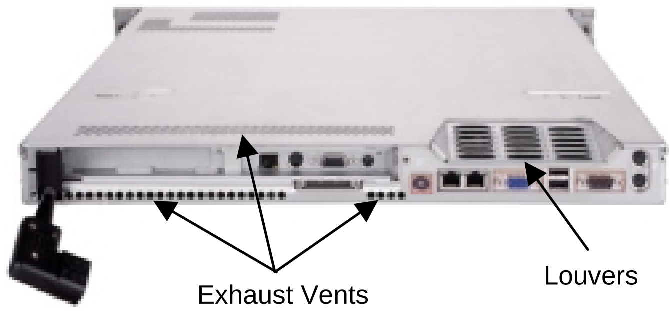
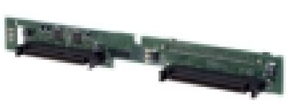


Figure 3. Warm air exhausts efficiently from the ProLiant DL360 server through custom-designed louvers in the top access panel and numerous vents in the rear panel.

Thermal safeguards prevent the ProLiant DL360 server from overheating, even in the event that a fan should fail. Each fan in the server has its own status signal, which is monitored by the server; and temperature sensors are strategically placed throughout the system board. Upon detection of a fan failure, the server will go through a predefined procedure that includes displaying a message, logging an entry in the system management log, and performing a graceful self-restart or self-shutdown. If the health driver is loaded on the server and a fan failure is detected, the server may resume operation after multiple verification proofs that the fan failure detection was either a false or intermittent signal. This functionality prevents potentially unnecessary system failures. If the health driver is not loaded and the pressure-blower fan fails, the server will continue operation until a predefined temperature trip point is reached. At that point, the server will start the shut-down process.

Virtually No Internal Cables



SCSI backplane

LED: *light-emitting diode*

Even a good server ventilation plan can be defeated if cables or other components block air flow. Therefore, minimizing internal cables was a major design goal for the ProLiant DL360 server. Use of two I/O backplanes (Figure 1) virtually eliminates internal cables in the server. The SCSI backplane connects with the system board, and the hard drives connect directly to the SCSI backplane. The CD-ROM/floppy drive assembly, the external power button, and the LED array connect to a second backplane.

The pop-out PCI riser board assembly connects directly to the system board through an edge connector. A latch holds the riser board assembly securely in place. A dual-channel SCSI RAID-on-a-Chip (ROC) array controller is integrated on the system board. One channel supports the two internal Wide Ultra2 hot-plug drives. The other channel supports the external SCSI tape connector.

An internal ribbon cable connecting the CD-ROM/floppy drive assembly to the system board lies flat under the power supply. The power supply engages directly to the system board through a single right-angled connector.

A short internal cable provides an interface from the keyboard, mouse, and power supply to the optional Compaq Remote Insight Lights-Out Edition. This configuration eliminates the need for an external keyboard/mouse cable and an external AC adapter, which greatly improves external cable management.

Placing the power supply/fan unit near the center of the server requires use of a power cable inside the chassis. To manage that cable in the tight space without blocking air flow or PCI option cards, Compaq engineers secured the power cable along the inside edge of the chassis.

Tool-Free Serviceability

For customers deploying hundreds or thousands of servers, ease of deployment and serviceability are critical factors. Knowing that, Compaq engineers designed the ProLiant DL360 server for quick, tool-free configuration and easy, in-rack service.

Two front thumbscrews secure the ProLiant DL360 server to a rack. A right-angled power cord and an effective cable management system reduce cable clutter. The chassis features a tool-free entry, quick-release, top access panel; slide-in and latching components; quick-release latches; simple thumbscrews; and easily visible LED status indicators.

The fact that the ProLiant DL360 server has virtually no internal cables makes the unit very easy to service. There are no cables in the way, and there is no risk of connecting cables in the wrong places.

The system board slides into place in the chassis and is secured with a single thumbscrew. Two backplanes provide direct edge connections for hard drives, the CD-ROM/floppy drive assembly, the power button, and an LED module. A shipping/ejector key serves a double purpose: as a locking pin to secure the CD-ROM/floppy module in place and as the means of ejecting the module for service. Simply pushing the shipping/ejector key into the ejector port pops out the module for quick replacement or to remove it for security purposes. PCI cards slide easily into edge connectors on either side of the PCI riser board assembly. This drop-in assembly features a lock/release lever for quick and secure installation or removal of PCI cards. A lever mounted on the side of the power supply closes easily to hold the power supply securely in place and provide tool-free installation or removal. Hot-plug drives with an easy release lever can be removed or upgraded one at a time, without powering off the server.

An LED unit on the front of the ProLiant DL360 server (Figure 4) identifies system status as indicated in Table 1.

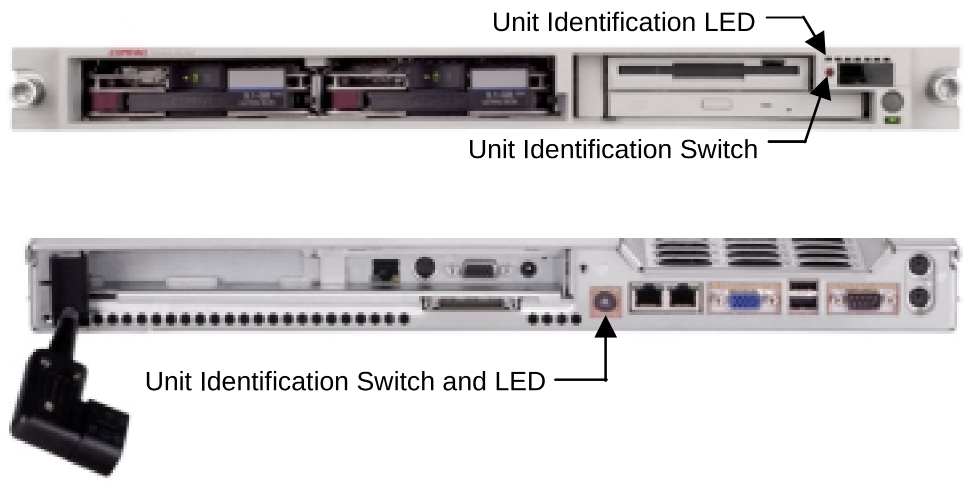


Figure 4. Front (top) and rear (bottom) panels of the ProLiant DL360 server

A unique feature of the ProLiant DL360 server is a Unit Identification switch and LED on the front and back of each ProLiant DL360 server (Figure 4). A push of a Unit Identification switch illuminates a blue LED on the front and back of the server simultaneously. For example, a technician can push the Unit Identification switch on the front of a rack-mounted server, walk around the row of racks, and then find that server immediately from the rear because the blue LED on the server's back panel is easily distinguishable from other LEDs and blinking lights in a rack full of servers. As soon as the technician's task is complete, another push of the Unit Identification switch turns off the front and rear blue LEDs and unmarks the server. The front and rear Unit Identification switches are equally useful in marking servers for immediate action or for attention later.

NIC: network interface controller

Table 1: LED Status Indicators on the ProLiant DL360 Server

LED No.[1]	LED Color	Status
1	Green/Amber	Power on/Standby
2	Green	Disk drive activity
3	Green	Integrated NIC2 link
4	Green	Integrated NIC2 active
5	Green	Integrated NIC1 link
6	Green	Integrated NIC 1 active
7	Blue	Unit identification

[1] *These numbers indicate the relative position of the individual LEDs from right to left on the LED module.*

TOTAL SOLUTION FOR ANY COMPUTING ENVIRONMENT

Compaq has a unique understanding of rack technology and has outpaced all competition in developing high-density servers. After initiating the concept of rack density products three years ago with the introduction of the ProLiant 850R server, Compaq continued to invest in developing this segment with second and third generation products such as the ProLiant 1850R and the ProLiant DL380 servers. In response to customer requests, Compaq expanded the high-density server line to include the most dense, full-featured server on the market: the ProLiant DL360 server.

In planning the ProLiant DL360 server, Compaq viewed the rack as a system composed of three major components: server, rack mounting options, and written guidelines for effective deployment. Compaq formed a team to focus specifically on addressing all customer rack issues and to develop a complete rack system for rapid, high-volume deployment. As a result, the ProLiant DL360 server is a total, high-density solution for any computing environment.

Telco: *telecommunications*

The server supports the Microsoft Windows NT 4.0, Microsoft Windows 2000, Novell NetWare 5.1, SCO UnixWare 7.1.1, and Linux operating systems. It ships with pre-installed server rails and a standard fast-deployment rack rail and cable tray solution. Compaq engineers also designed three other rack-mounting solutions (a sliding rail and cable management solution option, a Telco rack option, and a third-party rack option) plus a desktop/stackable option for installing the server as a free-standing unit. Also available are two power distribution unit (PDU) option kits for rapid rack deployment: One contains vertical-mount PDU brackets for use with low-voltage cables that ship standard with the ProLiant DL360 server. The other contains vertical-mount PDU brackets and high-voltage cables to support up to 22 servers in high-voltage environments. Use of two kits containing high-voltage cables facilitates rapid deployment of up to 42 ProLiant DL360 servers in a standard 42U rack.

Compaq also developed best practices guidelines for high-volume rack deployment. For specific Compaq recommendations for rack mounting ProLiant DL360 servers, see the following documents, which are available at this World Wide Web address: http://www.compaq.com/support/techpubs/whitepapers/index.html

- *Compaq Ultra-Dense Server Deployment Solutions Overview*, document number 1237-0300A-WWEN
- *Compaq Ultra-Dense Server Deployment in Compaq Racks*, document number 128H-0400A-WWEN
- *Compaq Ultra-Dense Server Deployment in Telecommunications (Telco) Racks*, document number 12CZ-0400A-WWEN
- *Compaq Ultra-Dense Server Deployment in Third-party Cabinet Racks*, document number 12CU-0400A-WWEN

Rear view of ProLiant DL360 server installed with standard fixed rack rails

Fixed Rack Rails

The ProLiant DL360 server ships standard with spring-loaded fixed rack rails designed for quick, tool-free installation in Compaq 9000-Series and 7000-Series racks. The fixed rails allow partial extension of the server; but servicing components besides the hot-plug drives and the CD-ROM/floppy drive assembly requires removing the server to a bench. The tool-free design makes removing the server quick and easy.

One thumbscrew secures a fixed cable tray to the back of the server, and another thumbscrew secures the tray to the rack rail. Removing a ProLiant DL360 server from the rack simply requires unscrewing the thumbscrew securing the fixed cable tray to the back of the server, unplugging the rear cables, and sliding the server out of the rack. The bundled cables remain in place, held securely by the cable tray.

To gain maximum benefit from this solution, refer to the document *Compaq Ultra-Dense Server Deployment in Compaq Racks*.

Slide Rails and Cable Management Solution

Rear view of ProLiant DL360 server installed with slide rails and cable management solution option kit

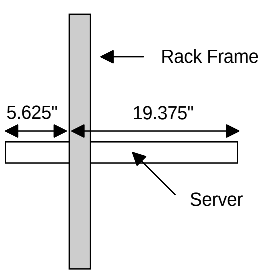
For full in-rack serviceability, Compaq offers an option kit with ball-bearing slide rails. Use of the slide rails requires removing the factory-installed fixed server rails from the ProLiant DL360 server and replacing them with the server rails provided in the option kit. Once the optional server rails have been installed on the server, installing the slide rails and mounting the ProLiant DL360 server in the rack are tool free.

For this solution, Compaq designed a new, tool-free cable management system (Figure 5) that is installed with three thumbscrews. This solution allows full extension of the server on the slide rail assembly without detaching the cables. The cable management system secures and supports the bundled rear cables in a way that allows easy access to rear connectors and prevents the cables from blocking air flow out the back of the server.

To gain maximum benefit from this solution, refer to the document *Compaq Ultra-Dense Server Deployment in Compaq Racks.*

Figure 5. When installed with the Compaq slide rails and cable management solution (left), ProLiant DL360 servers can be fully extended for in-rack service (right).

Telco Rack Option



ProLiant DL360 server in Telco rack

Compaq offers a Telco brackets option kit for mounting the ProLiant DL360 server in standard Telco racks. Installing the Telco rack brackets requires removing the factory-installed fixed server rails from the ProLiant DL360 server. Once the Telco brackets are installed, mounting the ProLiant DL360 server in the Telco rack is tool free.

The Telco rack brackets in this option kit can be adjusted to mount the ProLiant DL360 server in 19-inch Telco racks with rack frame widths of 3 to 5 inches. Once mounted in a Telco rack, the ProLiant DL360 server extends forward 5.625 inches and backward 19.375 inches from the front mounting edge of the rack frame.

To gain maximum benefit from this solution, refer to the document *Compaq Ultra-Dense Server Deployment in Telecommunications (Telco) Racks.*

For Telco rack installation, it should be noted that the ProLiant DL360 Server does not support a 48-volt power supply.

Third-Party Rack Rails

Compaq also offers an option kit with adjustable-depth rack rails that allow mounting the ProLiant DL360 server in third-party racks. These rails will adjust to support rack depths of 22 to 33 inches. These rails also support all mounting screw sizes defined in the industry rack standard (EIA).

To gain maximum benefit from this solution, refer to the document *Compaq Ultra-Dense Server Deployment in Third-Party Cabinet Racks*.

Desktop/Stackable Option

Stacked ProLiant DL360 servers

For customers wishing to deploy free-standing ProLiant DL360 servers, Compaq designed a desktop option consisting of a hood that the server chassis slides into readily. The structural integrity of the ProLiant DL360 chassis and hood, rubber feet on the bottom edge of the hood, and associated indentations in the top of the hood allow one unit to stack securely atop another. Compaq recommends stacking no more than six free-standing ProLiant DL360 servers in this fashion.

Stacked ProLiant DL360 servers can be serviced without dismantling the stack. The hot-plug drives and the CD-ROM/floppy drive assembly can be serviced from the front of the server. To service other components, a technician can easily slide the chassis out of the hood and place the chassis on a bench.

SYSTEM MANAGEABILITY

Today, Information Technology (IT) administrators are challenged by the business demand for continuous uptime of business-critical servers. As server deployments grow in volume and demands continue for greater density at remote sites and in large data centers, administrators require an easy and effective way to centrally manage all their servers.

The ProLiant DL360 server supports an optional card, Compaq Remote Insight Lights-Out Edition, that takes advantage of Internet browser technology to provide central administration of servers. The Remote Insight Lights-Out Edition has its own integrated hardware components (processor, memory, NIC interface, virtual power button) that allow full access and control of the server, regardless of the state of the operating system or server hardware. Through firmware support of integrated remote graphics console, Compaq Remote Insight Lights-Out Edition provides seamless access to the server in full graphics mode with keyboard and mouse control, without requiring installation of any software on the host server and management client. The Remote Insight Lights-Out Edition also supports virtual floppy drive functionality that allows the host server to boot remotely from a floppy diskette in a network client and enables remote installation of operating system and ROM updates. The graphical remote console, virtual floppy drive, and rich set of troubleshooting features of the Remote Insight Lights-Out Edition allow the IT administrator to access and manage all ProLiant DL360 servers installed in the data center or at a remote site, from a single browser client — including remote installation of drivers and ROM updates. By enabling faster response to downtime events, the Remote Insight Lights-Out Edition allows IT administrators to further reduce downtime and lost business revenue.

The ProLiant DL360 server provides a short, internal cable connection from the system board to the Remote Insight Lights-Out Edition. This one internal cable eliminates the need for the external keyboard/mouse cable and the external AC adapter that are required for normal operation of the Remote Insight Lights-Out Edition in other ProLiant servers. This simplifies cabling in racks when deploying ProLiant DL360 servers for maximum density.

When installed in a server, the Remote Insight Lights-Out Edition eliminates the requirement for equipping that server with a keyboard, mouse, and monitor. Deploying "headless" servers increases server density in rack environments significantly and reduces hardware costs. It allows deployment of up to 42 ProLiant DL360 servers in a single, standard 42U rack.

For more information about Compaq intelligent manageability and Compaq Remote Insight Lights-Out Edition, visit the following World Wide Web address:
http://www.compaq.com/lights-out

PROLIANT DL360 SERVER ARCHITECTURE

A key component of Compaq's business strategy is partnering with other major hardware and software vendors to provide the best possible value in industry-standard computing solutions to meet each customer's specific needs. For this platform Compaq evaluated chip sets from various manufacturers and chose to use a chip set developed by ServerWorks (formerly Reliance Computer Corp.).

In 1995 ServerWorks had shared with Compaq its original chip set design, claiming that through its highly parallel system architecture, the chip set would provide top performance at significantly reduced cost. Recognizing the potential benefits of ServerWorks' approach to chip set design, Compaq partnered with the company and licensed to ServerWorks the Compaq PCI-to-ISA bridge (south bridge) chip set, called OSB. Working with ServerWorks hardware engineers, Compaq helped define the features of the Champion 1.0 chip set. Compaq also did much of the debugging and simulation work for the chip set. The Compaq OSB core logic continues to be an integral part of every ServerWorks chip set sold to any independent hardware vendor, and Compaq has remained ServerWorks' lead design and validation partner.

By working so closely with ServerWorks in the development of its chip sets, Compaq has been in a unique position to evaluate them. As a result of that insight, Compaq uses ServerWorks chip sets strategically in the ProLiant server product line to achieve optimum value (functionality, cost, and performance) for customers.

Processor/Memory Subsystem

The ProLiant DL360 server is based on ServerWorks' third-generation chip set, ServerSet III (formerly known as Champion 3.0 LE). The implementation of the chip set in the ProLiant DL360 server supports up to two Intel Pentium III processors. The system bus provides a maximum peak bandwidth of 1.06 GB/s (Figure 6).

At introduction, the ProLiant DL360 server will be available in two models:

- Supporting two 800-MHz Pentium III processors with an integrated 256-KB full-speed Level 2 (L2) cache and running on a 64-bit, 133-MHz system bus
- Supporting a single 550-MHz Pentium III processor with an integrated 256-KB dual-speed L2 cache and running on a 64-bit,100-MHz system bus

The processors in the ProLiant DL360 server are FC-PGA processors that use Socket 370, which includes a lever to seat and lock the processor securely in the socket.

SDRAM: *synchronous dynamic random access memory*

The ServerSet III chip set uses low-latency PC133 registered error checking and correcting SDRAM (3.3V, 133 MHz).[2] Integrated voltage regulators provide the required voltages for both processors and chip set. The PCI/memory controller (north bridge) supports up to four double-sided DIMMs for a maximum system memory capacity of 4 GB (using 1-GB DIMMS). The server ships standard with a single 128-MB SDRAM module in one of four DIMM sockets. Memory can be upgraded one slot at a time, and the DIMMs do not have to be identical in capacity.

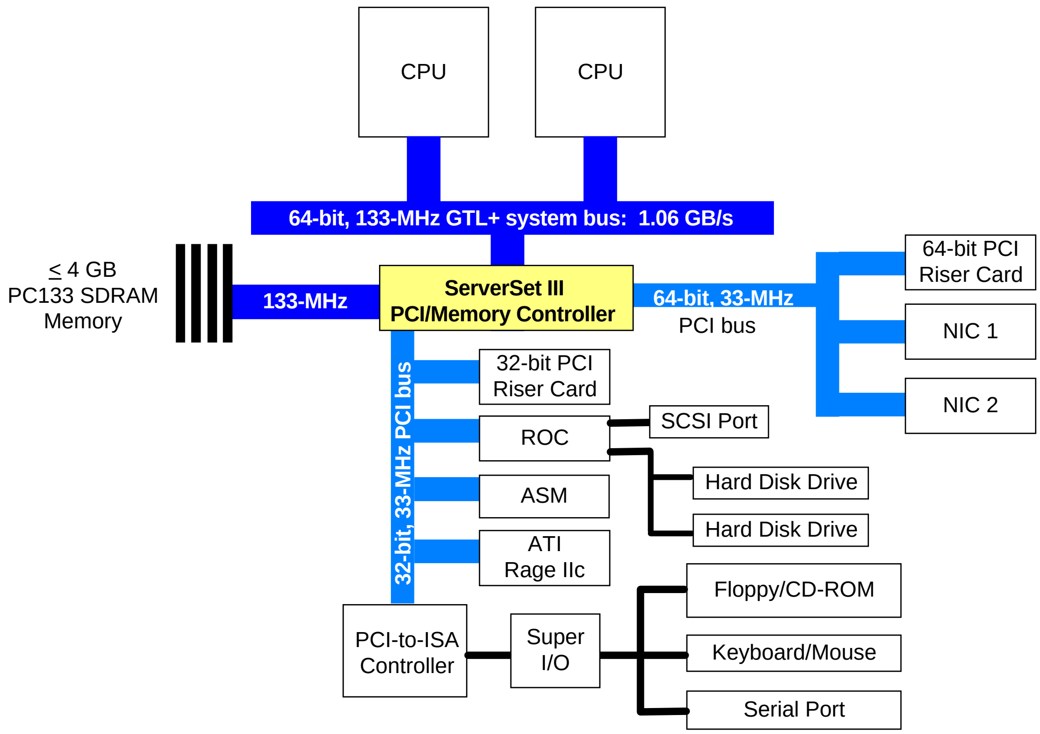


Figure 6. Block diagram of ProLiant DL360 server

I/O Subsystem

The ProLiant DL360 server is fully compliant with PCI Specification 2.2. The ServerSet III chip set supports dual-peer PCI buses: one 64-bit, 33-MHz PCI bus and one 32-bit, 33-MHz PCI bus. One PCI slot is implemented on each bus. If installed, the optional Compaq Remote Insight Board-Lights Out Edition card must reside in the 32-bit PCI slot, since it needs to intercept video traffic, and all embedded functions reside on the 32-bit PCI bus.

The ProLiant DL360 server can support two 1-inch LVDS SCSI hot-plug hard drives in Compaq drive carriers. An integrated dual-channel, Wide Ultra2 RAID-on-a-Chip (ROC) array controller provides low-cost drive mirroring capability. The ROC supports an 8-MB read cache but no write cache.

For customers desiring a Smart Array/SCSI controller with write cache for internal storage, Compaq provides an internal cable to bypass the ROC array controller. Via a connector on a 64-bit PCI SCSI adapter card and an edge connector on the system board, this cable connects the array controller through the SCSI bus and the SCSI backplane to the internal hard drives. When the cable is plugged into a 64-bit PCI SCSI adapter card and into the system board, it automatically opens a switch connecting the ROC to the SCSI bus, thereby bypassing the ROC and making the Compaq

[2] *In ProLiant DL 360 servers with a single 550-MHz processor, the PC133 memory will run at 100 MHz, not at 133 MHz.*

Smart Array Controller the SCSI bus master (Figure 7). External storage support is attained through use of a Compaq fibre channel or SCSI array controller in either PCI slot.

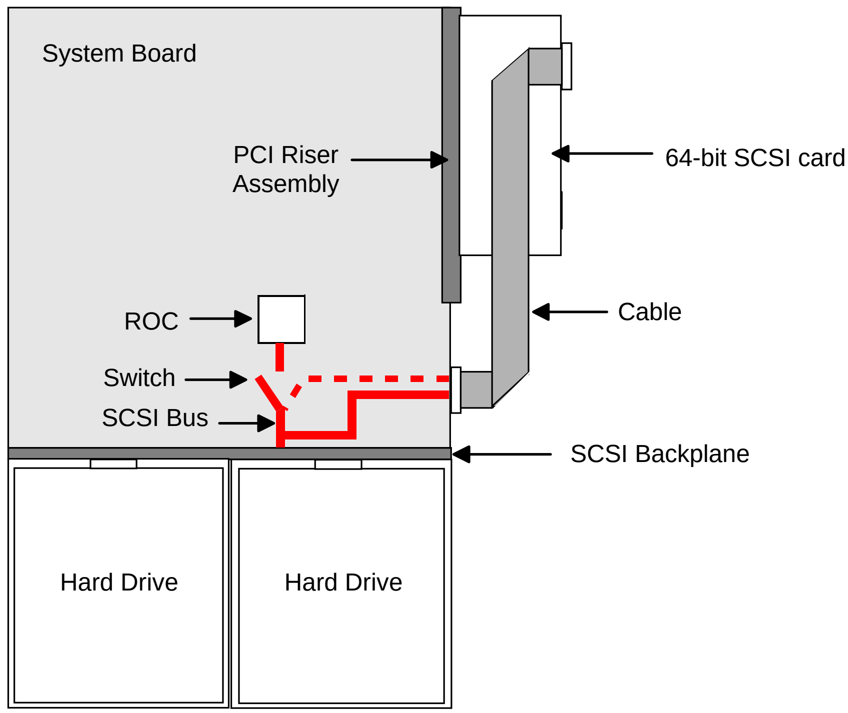


Figure 7. Installing the internal cable between a 64-bit SCSI array controller and the ProLiant DL360 system board bypasses the integrated ROC array controller.

A PCI-to-ISA bridge connected to the conventional PCI bus supports a 1.44-MB floppy drive, a low-profile IDE CD-ROM drive, the LED array, and the power switch.

SGRAM: *synchronous graphic random access memory*

VHDCI: *very high density cable interconnect*

The ProLiant DL360 server supports two integrated 10/100 Fast Ethernet Wake-on LAN network interface controllers and a Rage IIc video controller with 4 MB of SGRAM. The server provides external ports for mouse and keyboard, one serial port, a video port, two network ports, and one VHDCI SCSI tape port.

Future developments are definitely planned for the ProLiant DL360 I/O subsystem. For example, when they become available, the ProLiant DL360 server will support 15,000-rpm and 36.4-GB hard drives.

Power Subsystem

Since the primary design goal for the ProLiant DL360 server was to provide a reliable, economical, ultra-dense server, the server contains a single, modular power supply. The main power circuitry supports the system board, hard disk drives, CD-ROM/floppy drives, and the PCI slots. The auxiliary power circuitry supports the optional Remote Insight Lights-Out Edition. This power supply provides total peak output of 190 watts.

CONCLUSION

The Compaq ProLiant DL360 server provides a total, high-density solution for any computing environment, from the data center to remote locations. This robust, ultra-dense server is highly scalable, supporting:

- from one 550-MHz Pentium III processor running on a 64-bit,100-MHz system bus to two 800-MHz Pentium III processors on a 64-bit, 133-MHz system bus
- from 128 MB to 4 GB of system memory
- from one 9-GB drive to two 18-GB hot-plug drives

Its unique mechanical and electrical design makes the ProLiant DL360 server a compact, thermally and acoustically efficient, dependable, and highly serviceable work horse that can be installed and serviced virtually tool free. Multiple deployment option kits provide for rapid, high-volume installation in Compaq 9000-Series and 7000-Series racks, in Telco racks, in standard third-party racks, and as stackable free-standing units. Installation of an optional Remote Insight Lights-Out Edition board enables administering ProLiant DL360 servers 24x7 from a laptop or PC anywhere in the world. Again, Compaq is outpacing the industry with new innovation in the density server segment.

Rev 1.0

Array Mount

Cryogenic mount for Raytheon 1024 x 1024 InSb

5.1 Array Mount - Cryogenic mount for Raytheon 1024 x 1024 InSb

5.1.1 Overview

The array mount is a mechanical and electronic assembly that provides for cryogenic thermal control, isolation, array signal configuration and array signal contacts for the Raytheon 1024 x 1024 InSb array.

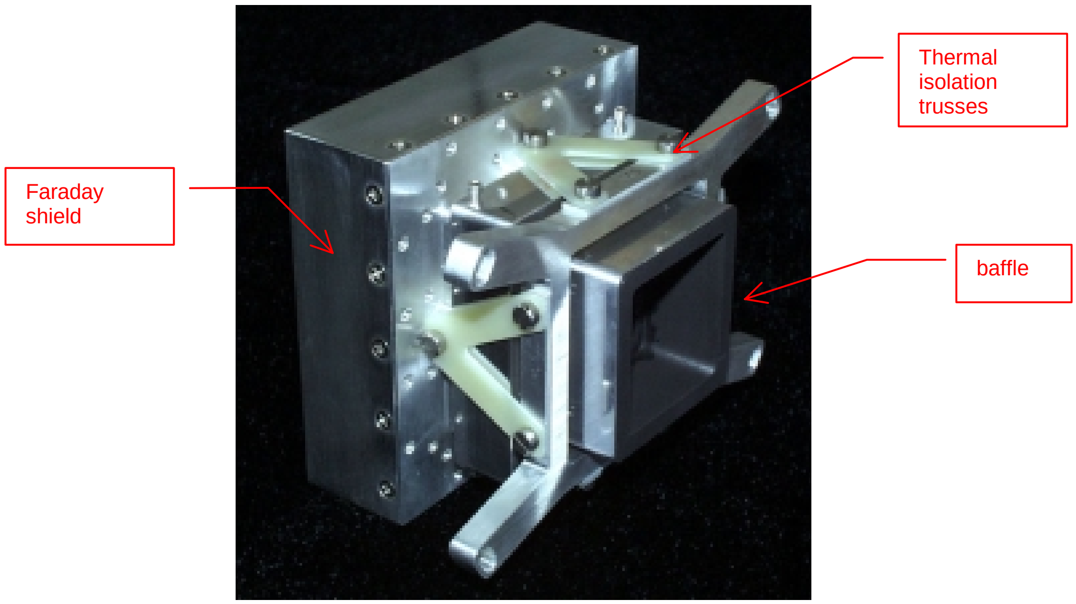
5.1.1.1 Technical Specifications Array Mount

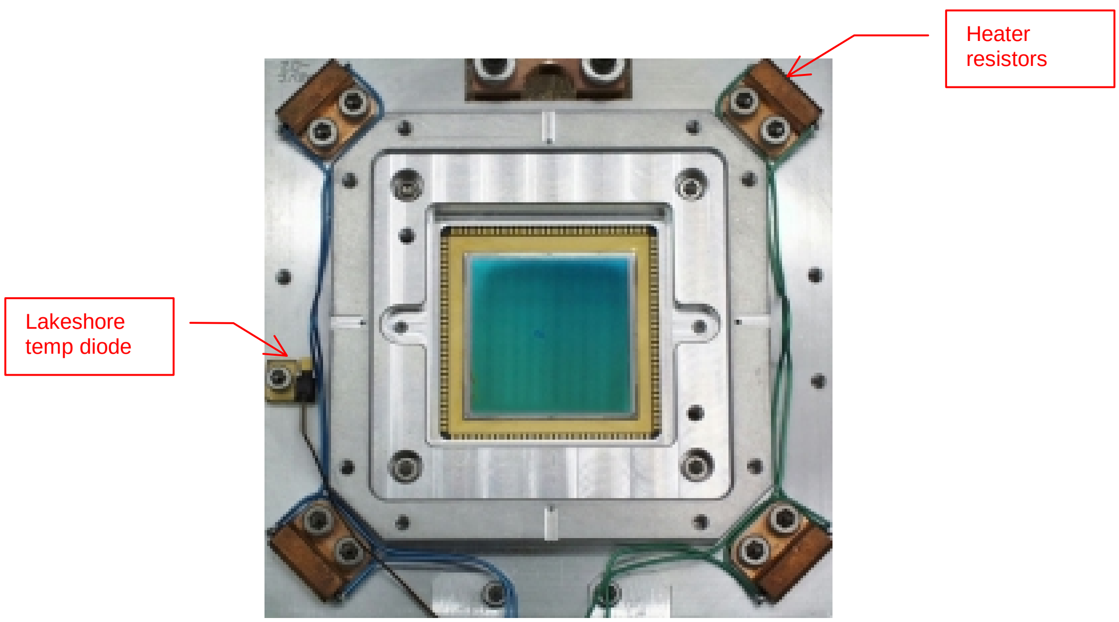
- 4 Heater resistors
- Lakeshore temperature sensor
- Mount light tight to <.1 e/s dark current
- Enclosed Faraday shield
- Low temperature baffle
- Cryo-ribbon cable connections
- Array socket and fanout PCB
- Array signal configuration PCB

Mechancial Specifications

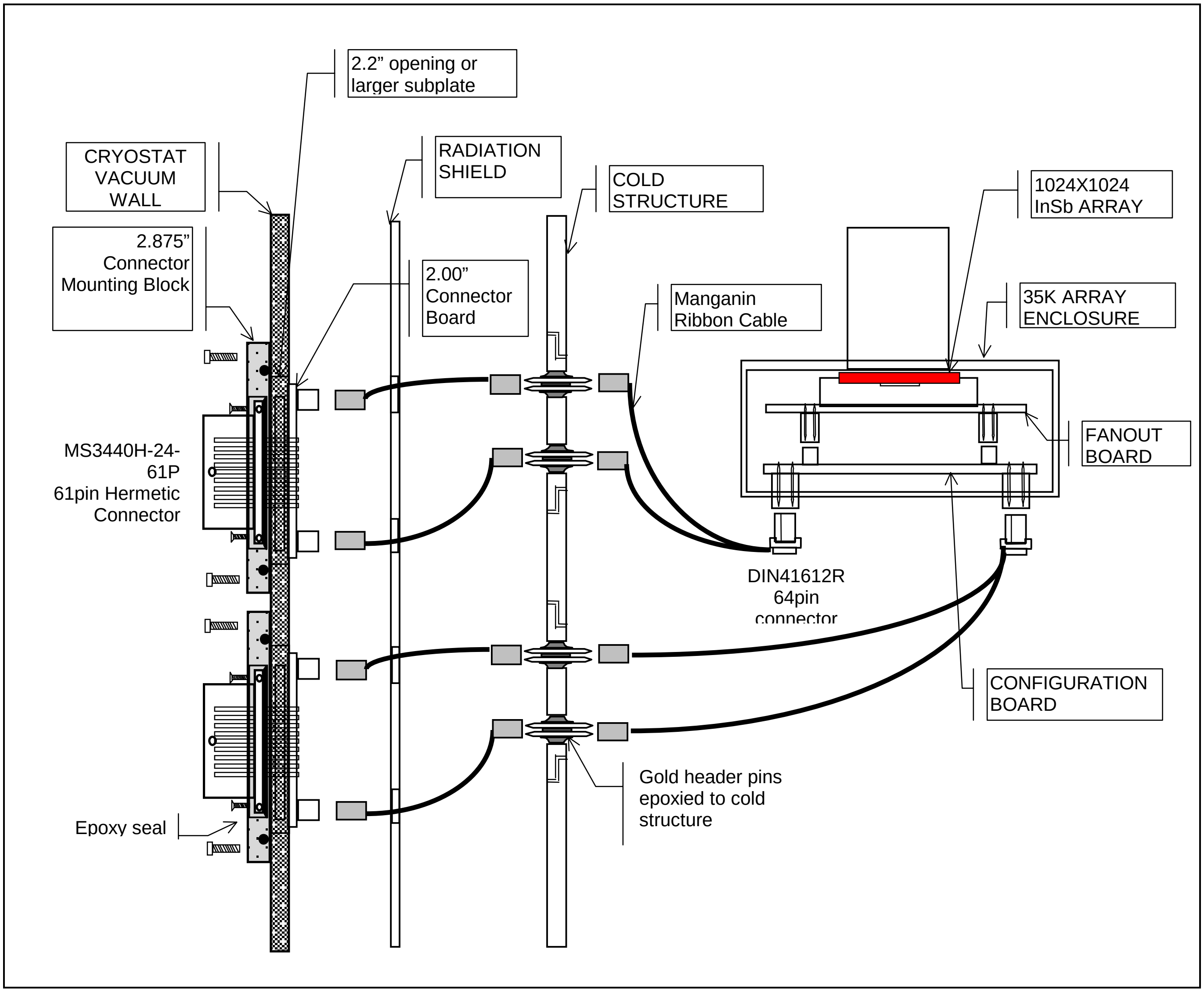
- Dimensions

5.1.1.3 Array Mount photos





5.1.1.4 Block Diagram Array Mount and Cyostat Cabling



5.1.1.5 Functional Description - Array Mount

5.1.5.1 Mechanical mount

Mechanical portion of the array mount provides the a physical location for the array and socket that holds it, a way to thermally clamp the device, and a electronic Faraday shield for the fanout and configuration electronics. A Yamaichi (IC51-124—410) LCC socket (see that following drawings) is epoxied into the front panel and the array fanout PCB is soldered onto the socket pins, creating a light tight barrier behind the array.

5.1.5.2 Array Fanout Board 700-150-01

The array fanout board takes the 124 pins from the Yamaichi socket and fans them out to four 0.05 inch pitch dual row headers. It aslo has 10 or 2Mohm electrostatic discharge protection resistors on all signals except the array outputs. See section 5.2.2 for more detailed information on the PCB.

5.1.5.3 Configuration Board 700-151-00

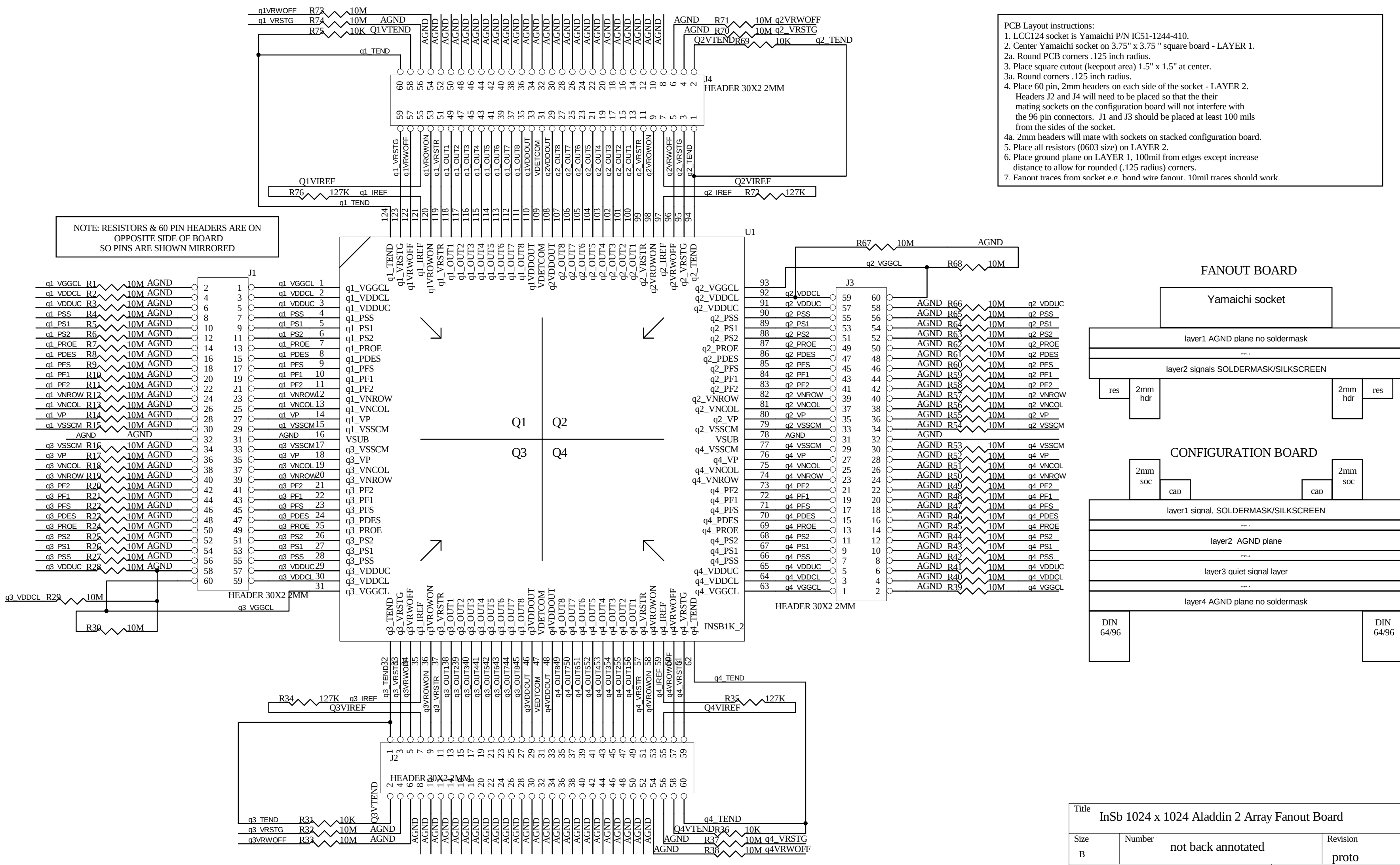
A configuration board plugs directly into the 0.05 inch pitch connectors of the Fanout board. The 700-151-00 version joins the clock and bias lines for quadrants 1 and 2 (Top) and quadrants 3 and 4 (Bottom) reducing the wire count. All of the resulting signals (including the unbussed outputs) are fed through two 64 pin DIN connectors. See section 5.2.3 for more detailed information on the PCB.

5.1.5.4 Heater Resistors

Four 100 ohm resistors are epoxied into copper mounts that are screwed into the fron plate of the array mount. Two resistors are wired in parallel, forming two 50 ohm loads. These resistors are eventually connected to the Lakeshore 300 temperature controller's heater output and are used to control the temperature of the entire assembly.

5.1.5.5 Lakeshore temperature diode

A calibrated Lakeshore Si doide is also mounted to the front plate of the mount and provides thermal sense ponit for the temperature controller.

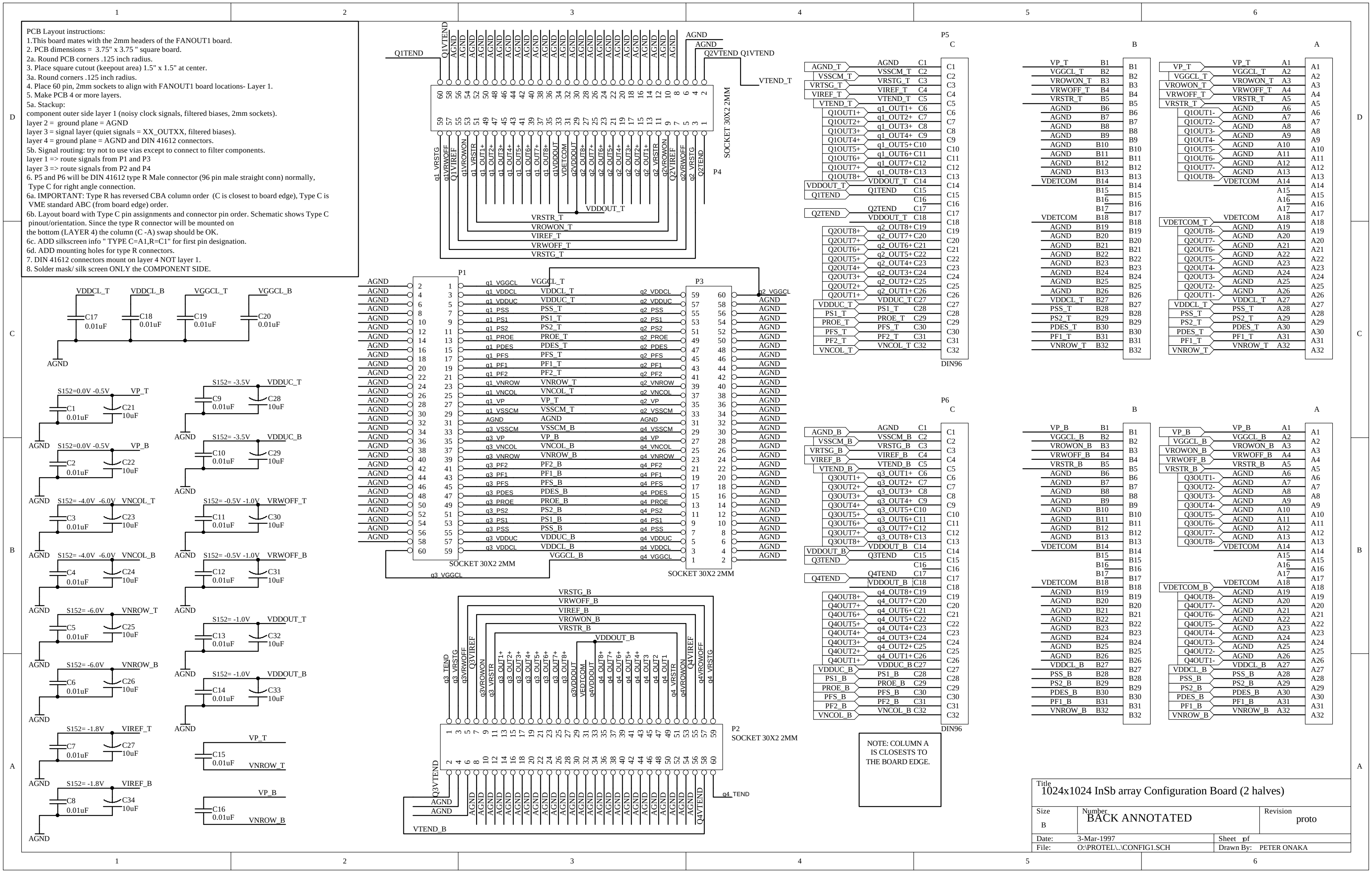


PCB Layout instructions:
1. LCC124 socket is Yamaichi P/N IC51-1244-410.
2. Center Yamaichi socket on 3.75" x 3.75 " square board - LAYER 1.
2a. Round PCB corners .125 inch radius.
3. Place square cutout (keepout area) 1.5" x 1.5" at center.
3a. Round corners .125 inch radius.
4. Place 60 pin, 2mm headers on each side of the socket - LAYER 2.
Headers J2 and J4 will need to be placed so that the their mating sockets on the configuration board will not interfere with the 96 pin connectors. J1 and J3 should be placed at least 100 mils from the sides of the socket.
4a. 2mm headers will mate with sockets on stacked configuration board.
5. Place all resistors (0603 size) on LAYER 2.
6. Place ground plane on LAYER 1, 100mil from edges except increase distance to allow for rounded (.125 radius) corners.
7. Fanout traces from socket e.g. bond wire fanout. 10mil traces should work.

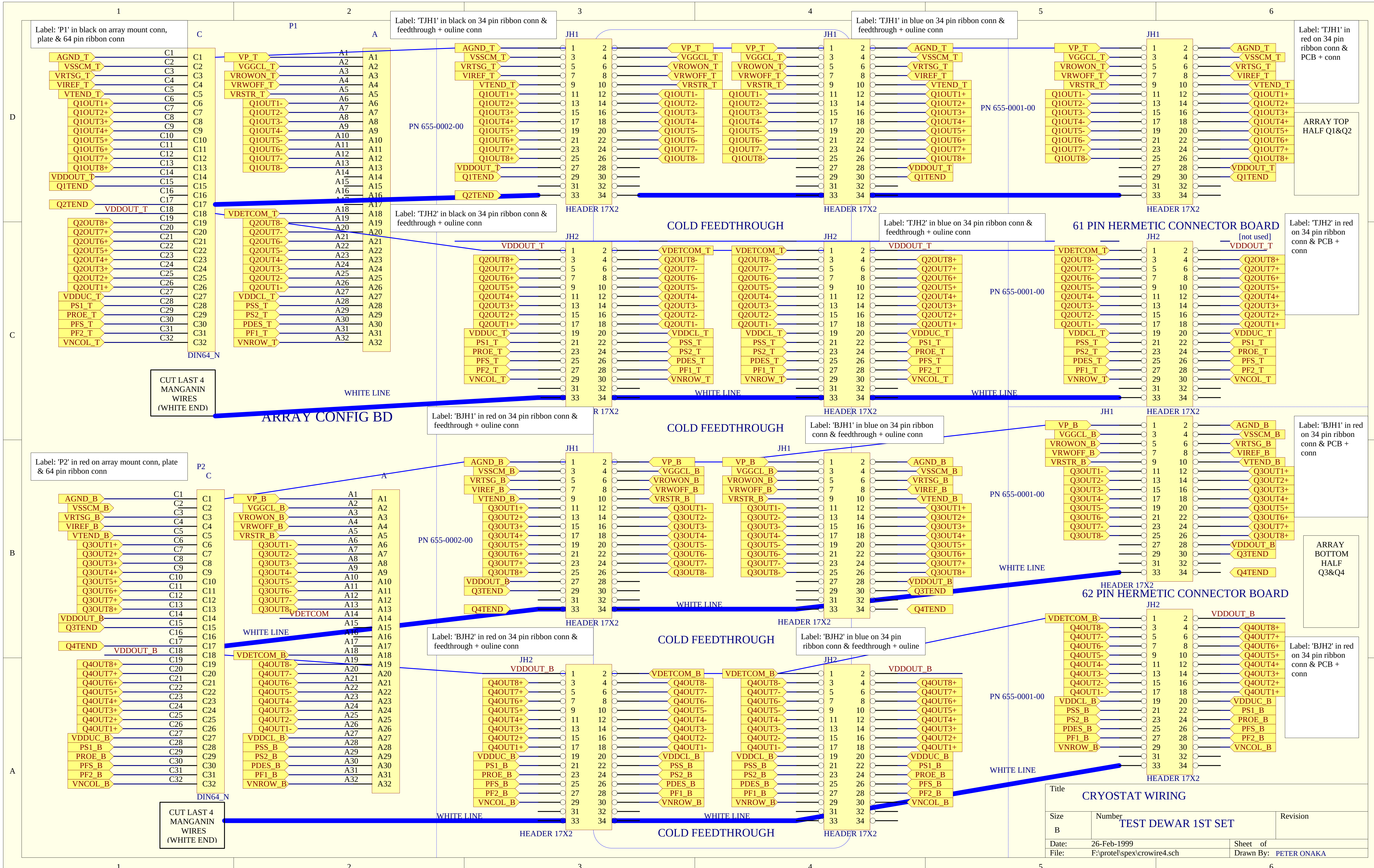
Title	InSb 1024 x 1024 Aladdin 2 Array Fanout Board		
Size: B	Number: not back annotated	Revision: proto	
Date:	26-Nov-1999	Sheet of	2 of x
File:	G:\protel\spex\fanout-150\700-150_Fanout.ddb	Drawn By:	Peter Onaka

PCB Layout instructions:

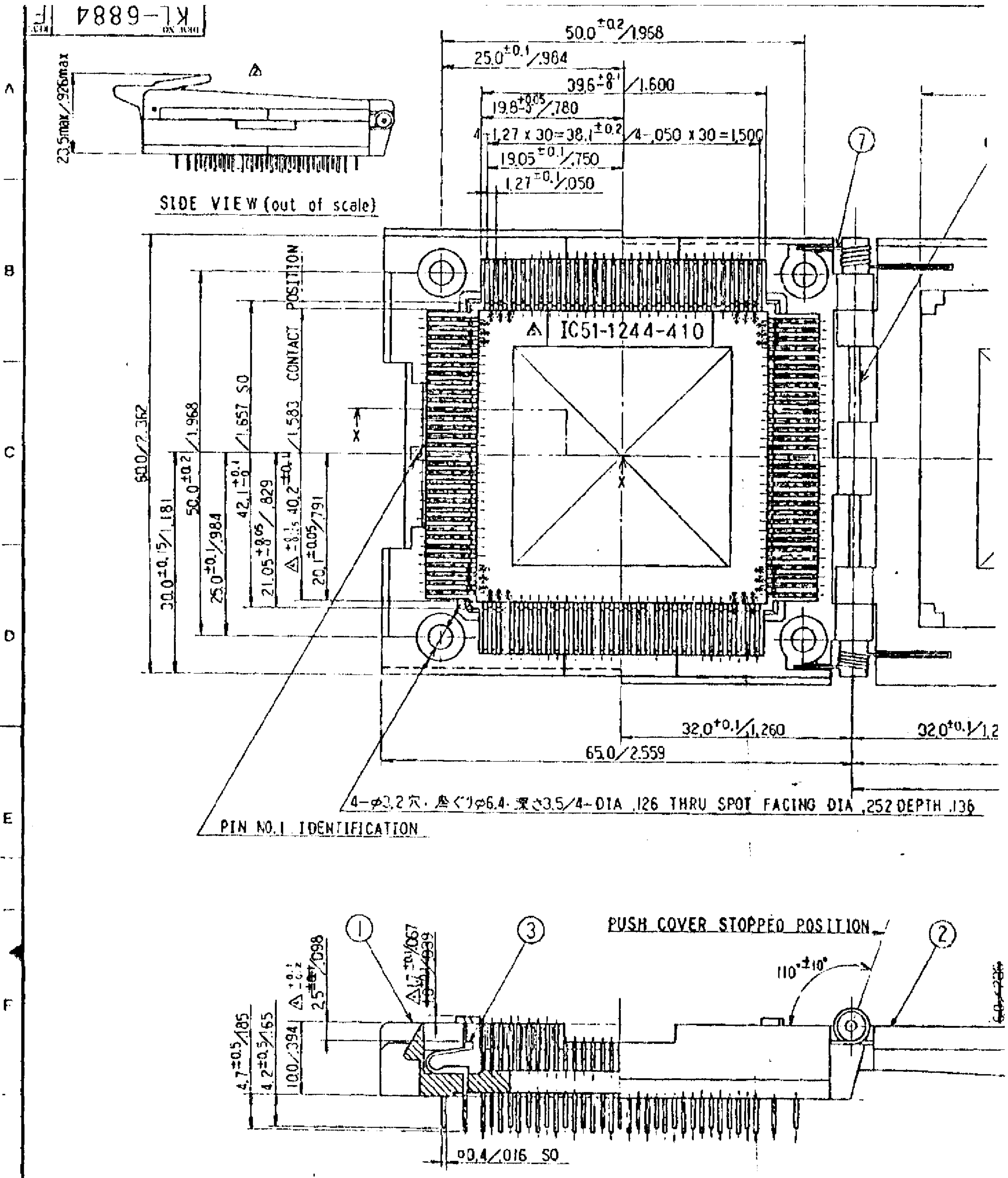
1. This board mates with the 2mm headers of the FANOUT1 board.
2. PCB dimensions = 3.75" x 3.75 " square board.
2a. Round PCB corners .125 inch radius.
3. Place square cutout (keepout area) 1.5" x 1.5" at center.
3a. Round corners .125 inch radius.
4. Place 60 pin, 2mm sockets to align with FANOUT1 board locations- Layer 1.
5. Make PCB 4 or more layers.
5a. Stackup:
component outer side layer 1 (noisy clock signals, filtered biases, 2mm sockets).
layer 2 = ground plane = AGND
layer 3 = signal layer (quiet signals = XX_OUTXX, filtered biases).
layer 4 = ground plane = AGND and DIN 41612 connectors.
5b. Signal routing: try not to use vias except to connect to filter components.
layer 1 => route signals from P1 and P3
layer 3 => route signals from P2 and P4
6. P5 and P6 will be DIN 41612 type R Male connector (96 pin male straight conn) normally, Type C for right angle connection.
6a. IMPORTANT: Type R has reversed CBA column order (C is closest to board edge), Type C is VME standard ABC (from board edge) order.
6b. Layout board with Type C pin assignments and connector pin order. Schematic shows Type C pinout/orientation. Since the type R connector will be mounted on the bottom (LAYER 4) the column (C -A) swap should be OK.
6c. ADD silkscreen info " TYPE C=A1,R=C1" for first pin designation.
6d. ADD mounting holes for type R connectors.
7. DIN 41612 connectors mount on layer 4 NOT layer 1.
8. Solder mask/ silk screen ONLY the COMPONENT SIDE.



Title: 1024x1024 InSb array Configuration Board (2 halves)			
Size: B	Number: BACK ANNOTATED		Revision: proto
Date: 3-Mar-1997		Sheet of	
File: O:\PROTEL\..\CONFIG1.SCH		Drawn By: PETER ONAKA	


Label: 'P1' in black on array mount conn, plate & 64 pin ribbon conn
P1
DIN64_N
CUT LAST 4 MANGANIN WIRES (WHITE END)
ARRAY CONFIG BD
WHITE LINE
Label: 'TJH1' in black on 34 pin ribbon conn & feedthrough + ouline conn
Label: 'TJH2' in black on 34 pin ribbon conn & feedthrough + ouline conn
PN 655-0002-00
JH1
JH2
HEADER 17X2
COLD FEEDTHROUGH
Label: 'TJH1' in blue on 34 pin ribbon conn & feedthrough + ouline conn
Label: 'TJH2' in blue on 34 pin ribbon conn & feedthrough + ouline conn
PN 655-0001-00
Label: 'TJH1' in red on 34 pin ribbon conn & PCB + conn
ARRAY TOP HALF Q1&Q2
61 PIN HERMETIC CONNECTOR BOARD
[not used]
Label: 'TJH2' in red on 34 pin ribbon conn & PCB + conn
Label: 'BJH1' in red on 34 pin ribbon conn & feedthrough + ouline conn
Label: 'BJH1' in blue on 34 pin ribbon conn & feedthrough + ouline conn
Label: 'BJH1' in red on 34 pin ribbon conn & PCB + conn
ARRAY BOTTOM HALF Q3&Q4
62 PIN HERMETIC CONNECTOR BOARD
Label: 'P2' in red on array mount conn, plate & 64 pin ribbon conn
P2
Label: 'BJH2' in red on 34 pin ribbon conn & feedthrough + ouline conn
Label: 'BJH2' in blue on 34 pin ribbon conn & feedthrough + ouline
Label: 'BJH2' in red on 34 pin ribbon conn & PCB + conn
Title CRYOSTAT WIRING
Size B
Number TEST DEWAR 1ST SET
Revision
Date: 26-Feb-1999
Sheet of
File: F:\protel\spex\crowire4.sch
Drawn By: PETER ONAKA

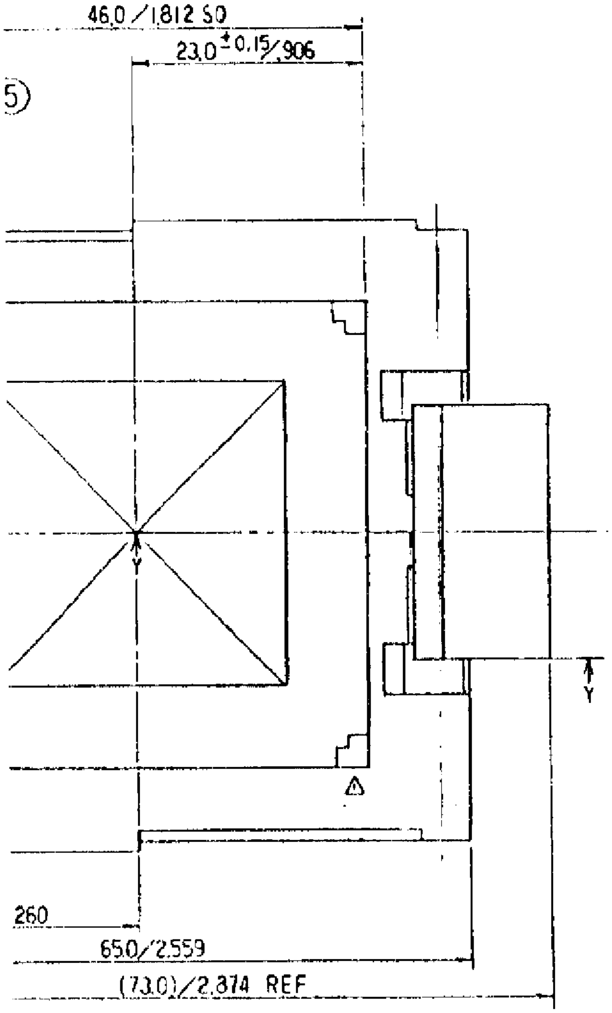
try.tif



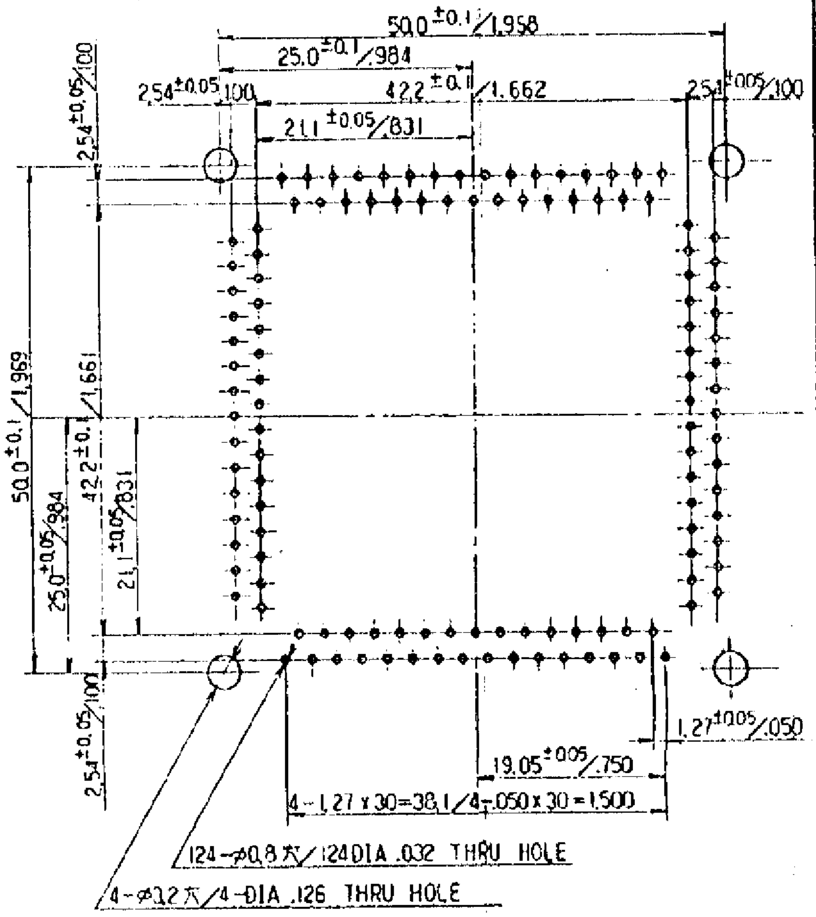
⚠	7	コイルばね02-3 COILED SPRING	1／1	~~MUSIC WIRE~~ SUS
	6	コイルばね COILED SPRING	1	MUSIC WIRE
⚠	5	シャフト M SHAFT-#18	2	BRASS
	4	ストッパー D9 LATCH	1	POLYETHERIMIDE GLASS F
	3	接触子 C/T 298-1 A/B	62／62	BERYLLIUM COPPER C1700R t0.4
	2	押え板 PUSH COVER	1	POLYETHERSULPHONE GLASS F
	1	絶縁基板 INSULATOR	1	POLYETHERSULPHONE GLASS F

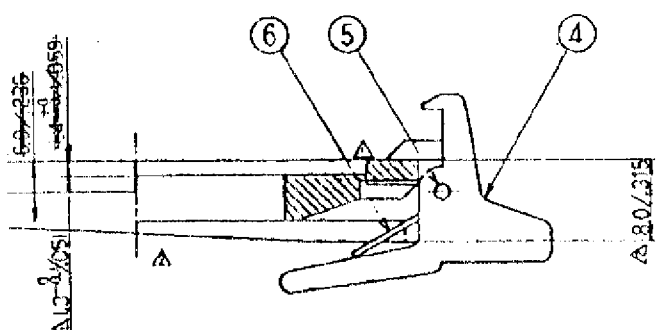
7 8 9 10 11 12

記号 x 数 SYM. - QNT.	変更内容 REVISION DESCRIPTION	承認 APP.	担当 SIGN.	年・月・日 DATE	変更通知書番号 REV. NOTICE NO.
△. 5	名称, 形状, 寸法 変更	[illegible]	[illegible]	[illegible]	[illegible]
△. 4	Design, dimension & part changed	[illegible]	[illegible]	86. 7. 31	86-101[illegible]
△. 1	Length of M-Hole was changed	[illegible]	[illegible]	86. 10. 3	86-126[illegible]
△. 2	TOLERANCE CHANGE	[illegible]	[illegible]	[illegible] 3. 22	[illegible]94-0422
△. 1	REDRAWN	[illegible]	[illegible]	95. 7. 31	[illegible]95-1742



CONTACT FIXED SCREW HOLE PATTERN (TOP VIEW)





SECTION Y-Y

性能：SPECIFICATIONS

1. 絶縁抵抗：INSULATION RESISTANCE.
   1000MΩ or more at 500V. DC.
2. 耐電圧：WITHSTAND VOLTAGE.
   700V. AC. for a minute.
3. 接触抵抗：CONTACT RESISTANCE.
   30mΩ or less at 10mA, 20mV.
4. 定格電流：RATED CURRENT.
   1A max.
5. 接触力：CONTACT FORCE.
   30~200g(0.295~1.966N) at moved distance of
   0.2~1.1mm/.008~.043IN each individual contact.
6. 使用温度：OPERATION TEMPERATURE.
   -55°C ～ +170°C max.

NOTE

※ Making 24pieces partition walls are hight to surface for location.

適合製品 Matching Device [illegible] ㈱ 山一電機工業株式会社