REF TEK™

Technical Overview
of the
72A-08 Data Acquisition System

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Technical Overview of the 72A-08 Series DAS

This document presents general and technical information on Refraction Technology's 72A-08 Data Acquisition System (DAS), it provides the following:

- A brief functional description
- Physical and performance specifications
- A list of the standard printed circuit boards
- Illustrations of the internal structure
- External interface details and internal bus data
- A description of the Unit ID and Unit Configuration software
- Mechanical handling instructions
- A simplified block diagram of the 72A-08

Functional Review

The 72A-08 DAS, also called a High Resolution Seismograph, is configured for three channels of 24-bit recording, plus three channels of 16-bit recording. The 72A-08/3 variant has only three channels of 24-bit recording and uses only the CH4-6 input (the CH 1-3 input is unused). Model variant 72A-08/6 has six 24-bit channels and uses two A-D converters (RT373's). Sensor calibration capability is provided. Remote DAS control via a built-in modem is another option. A maximum internal data storage of 12 Mbytes is available and all 72A-08 models support the use of external data recorders such as the REFTEK 72A-05. This document briefly describes the capabilities of the 72A-08 DAS unit. To better understand and effectively use all the unit's capabilities, see the REFTEK *Operations Reference Manual* for the 72A series DAS.

Data Recording Capabilities

Each 72A-08 DAS collects data based on a set of parameters that you select and download from a DOS-based control interface, such as a PC running the REFTEK Field Set-up Controller (FSC) software. The download can be via an on-site direct link or from a remote location using various means of transmission and a modem.

A 72A-08 DAS can collect and digitize data input within the frequency band of 0 to 250 Hertz. Multiple pre-set sampling rates from 1 to 1000 samples per second can be used. You can set up a maximum of eight data **streams** for simultaneous recording, each stream can include any of the recording channels that you have activated. Because the 72A-08 DAS uses a digital signal processor (DSP), you may set the various data streams to different (or identical) sample rates.

Note: When using a 72A-08 with both 16-bit and 24-bit channels, do not establish data streams that include **both** resolutions. Mixed resolution streams produce inaccurate data.

The 72A-08 24-bit channels have two gain settings; unity or 30 dB. Other gain setting combinations (for 24-bit channels) are available by special order. Each 16-bit channel has multi-level programmable gains. Input resolution for the three model variants is:

Model 72A-08	Channel 1-3 is 16-bit (slot 9)	Channel 4-6 is 24-bit (slot 10)
Model 72A-08/6	Channel 1-3 is 24-bit (slot 9)	Channel 4-6 is 24-bit (slot 10)
Model 72A-08/3	Channel 1-3 not applicable	Channel 4-6 is 24-bit (slot 10)

Triggers

You can select a specific trigger for each data stream. The type of trigger selected determines when the DAS records data for that stream. Each type of trigger has a set of parameters that determines the exact conditions under which the DAS records data. Eight types of triggering are presently specified:

1 a continuous trigger - records as soon as acquisition is initiated
2 a time trigger - occurs when a preset (DAS internal) time is reached
3 a time-list trigger - a repetitive time trigger
4 an external trigger -starts recording a user initiated event
5 a radio trigger - is self explanatory
6 a level trigger -depends only on the absolute value of incoming data
7 an event trigger -is initiated by seismic activity of a pre-determined nature
8 a cross trigger - is a trigger initiated by other data streams

ADC, DSP & Digital Filters

The 72A-08 has a DSP and an A-D converter on the 16-bit RT314 board. The RT373 24-bit digitizer board uses an A-D chipset that performs delta-sigma modulation. Both A-D converters operate at 1000 sps and the DSP continuously samples at 1000 sps then filters and decimates it's output at sample rates below 1000 sps. The final sampled data, at rates from 1 to 1000 sps, is applied via FIR filters that are scaled appropriately for anti-aliasing (-130 dB). The passband is 40% of the sample rate; the stopband is at 50% of the sample rate, and is 100 dB below the passband signal.

Memory Expansion

You can expand the unit's internal memory first by adding up to two megabytes of RAM to the unit's RT344 board, then by adding up to three RT284 boards, each with from one to four megabytes of RAM. Maximum *functional* RAM expansion allows the DAS to store 12 megabytes of data, rather than the standard half megabyte provided by the baseline instrument.

Data Storage Options

The DAS software is set so that an automatic data transfer to the external storage device occurs when RAM is approximately 70% filled. Data is transferred over the SCSI bus to a device such as a REFTEK 72A-05 Disk Recorder for primary data storage. A magneto-optical disk storage system is now in development.

Communications Capabilities

The 72A-08 DAS provides three asynchronous serial ports, one uni-directional, high-speed serial port, and one SCSI port. As options, you can add either an RT336 internal modem or an RT422 communications board using Point-to-Point Protocol to achieve a variety of telemetry communications and networking possibilities.

Calibration Functions

Because the 72A-08 DAS includes an RT275 test bus A-D converter board, it allows a user to test and calibrate certain types of seismic sensor(s).

If the DAS also has an RT280 filter board, it allows a user to calibrate the internal amplifiers for its three 16-bit channels.

For more comprehensive information on DAS capabilities and operations, including data recording parameters, triggers, calibration functions, communications, and basic hardware set-up, see the REFTEK *Operations Reference Manual* for the 72A Series DAS.

Data Acquisition Beeper

The DAS has a buzzer that indicates that it has successfully initiated data acquisition. Typically, software activates the buzzer every four seconds upon system power-up. Software deactivates the buzzer when the DAS receives the command to begin data acquisition.

You may disable the buzzer by removing a specific jumper located on the RT344 power supply board. See the RT344 document for more specific information.

Power Conservation

DC power to a SCSI peripheral device is controlled by the DAS. The 12-volt input to the DAS is available as an automatically switched output on both power connectors (designated **`12 VOLT SWITCHED`**). This feature conserves power usage by the peripheral. In addition to powering up the peripheral device, SCSI bus terminator power is also applied. The *FSC Operations* document provides further details.

Timekeeping

An internal crystal oscillator provides real time to $5x10^{-7}$ seconds accuracy. You can equip a DAS with an external timekeeping subsystem such as a REFTEK 111A GPS clock. Using an external clock, ensures that data among multiple units is time-synchronized by phase-locking the DAS units' internal crystal oscillators. Optionally, you can synchronize timing remotely over a telemetry link.

A DAS can synchronize its internal time (to ±1mS) with an external time source, such as a GPS clock. The time source signals consists of a serial (asynchronous RS-232) time string and a TTL level 1 Hz pulse (1pps). The time source is connected at the GPS connector as defined on page 9.

The (ASCII) time string is in industry standard format as follows:

<SoH>DDD:HH:MM:SSQ<CR><LF>

where <SoH> = a start-of-header character (01h)
DDD = three digit day-of-year (001-366)
HH = two digit hour-of-day (00-24)
MM = two digit minute-of-hour (00-60)
SS = two digit second-of-minute (00-60)
Q = time source quality indicator showing <SPACE>(20h) when the source is locked and accurate or a question mark (?=3Fh) when the source is unlocked
<CR> = carriage return (0Dh)
<LF> = line feed (0Ah)
: = a colon character (3Ah)

The start bit of the <CR> must align with the 1pps and the pulse must be at least 1 mS wide (2 mS is recommended). The rising edge must align with UTC.

Physical & Performance Specifications

Size:	12.75" x 8.25" x 7.75" (325 x 210 x 197mm)
Weight:	about 15 pounds (6.25 kg) depending on configuration
Case Type:	Cross-linked polyethylene - field gray
Temperature:	Operating -20° to +60° C Storage -40° to +70° C
Case Integrity:	Watertight. Tested with air over-pressure at 2.5 psi and immersion for 48 hours under six feet of water. Unit is buoyant
Shock:	36" drop on any axis will not cause mechanical or operational failure
Vibration:	A 5 to 500 Hz sine wave acceleration, 5g peak, 30 minutes on each axis, will not cause mechanical or operational failure
Power Requirements:	
In Sleep mode	0.5 milliWatts
CH 1-3 operating	2.2 Watts
CH 4-6 operating	2.5 Watts
Supply Voltage Range:	10 to 15 VDC
Configuration:	
Input Channels	3 @ 24-bit + 3 @ 16-bit, **or** 6 @ 24 bit, **or** 3 @ 24-bit resolution
Data Streams	8
Sample Rates	Variable across data streams (DSP); from 1 to 1000 sps
Gain	Programmable per channel; 24-bit channels have either unity or 30 dB gain; 16-bit channels have gains of either 1, 18, 30, 42, 54, 66, or 78 dB
Internal RAM	512k RAM - see options
Timekeeping	Internal oscillator (VCXO) with $5x10^{-7}$ accuracy
FIR Filters	Passband = 80% Nyquist Stopband = -130 dB (first filter), -100 dB(2^{nd} filter, used for re-sampling)
Full Scale Input	
24-bit channels	20 volts, peak-to-peak, differential (at unity gain)
16-bit channels	7.5 volts, peak-to-peak, differential (at unity gain)
Other Standard Features:	Sensor calibration function
Options:	
Configuration Options	Six input channels, all with 24-bit resolution RT336 internal modem RT301 low-noise preamplifier board (for 16-bit channels)
RAM Expansion	+1-2 megabytes on RT344 power supply +1-4 megabytes per RT284 mass memory Total 12 megabytes maximum possible
Primary Data Storage Options	External SCSI recording disk (REFTEK 72A-05) with a minimum of 1 Gigabyte and automatic data transfer from RAM.
Timekeeping Options	External 111A GPS clock or 111B Master clock for high precision timekeeping. Internal GPS is possible but **not** advisable.
Power Supply Options	72A-04 Auxiliary Power Subsystem. Solar panel, battery and charger setup.

List of Printed Circuit Boards

The 72A DAS unit has a modular design, it is built around multiple edge-mounted boards. See the block diagram on the last page. For individual board schematics and descriptions refer to the specific board document in the accompanying REFTEK *Technical Reference Documents* volume. The 72A-08 DAS typically contains the following boards:

Note: Board slots in DAS units are numbered as shown on the structural drawing

Board		**Slot #**
RT275	Test Bus Digital-to-Analog Converter	7
RT280	Three-Channel Filter (for channels 1-3)	9
RT291	Backplane	N/A
RT371	Communications	3
RT314	Analog-to-Digital Converter w/ DSP	8
RT319	Central Processing Unit (CPU)	2
RT329	Transition board	N/A
RT373	Analog-to-Digital Converter (for channels 4-6)	10
RT344	Power Supply	1
RT345	Interconnect	N/A

The 72A-08 DAS may contain the following optional boards:

RT380	GPS Time board	6 only *
RT284	Mass Memory boards (up to 3)	4, 5, or 6
RT301	Low-Noise Preamplifier Module	N/A
RT373	Analog-to-Digital Converter (replaces RT280)	9
RT336	Telemetry Modem board	4 (COMM connector pins change)

*This option cannot be added after purchase of the DAS - it must be specified when the unit is ordered since an RT387 will then replace the RT345 Interconnect board. In addition, although they are not mutually exclusive, REFTEK strongly recommends avoiding use of the internal RT380 GPS if a Modem (RT336) is installed, and vice-versa.

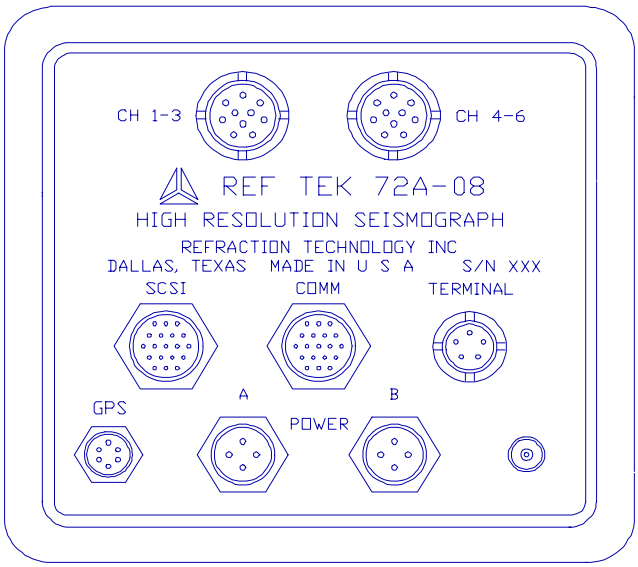
List of Internal Cable Assemblies

The internal cable assemblies of the 72A-08 are listed below. These assemblies can be ordered from REFTEK if they're ever needed as replacements:

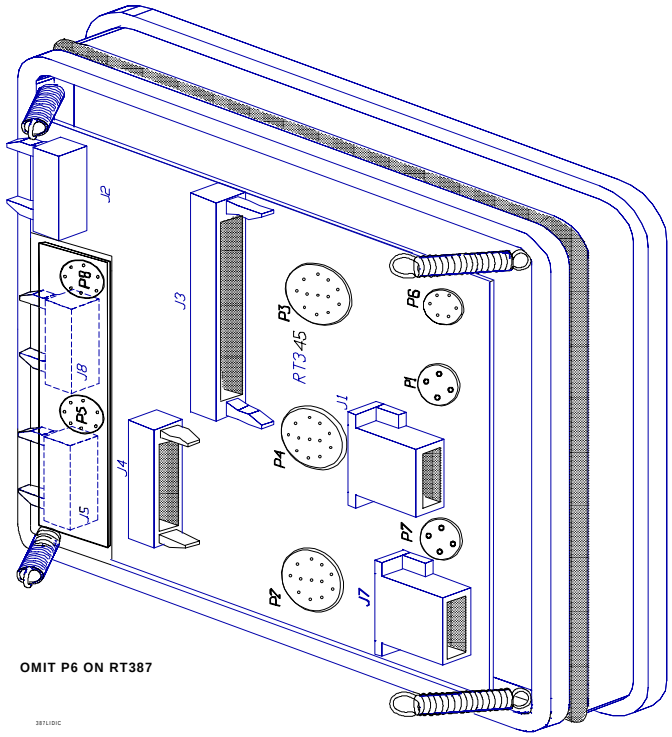
- 72-8086 Internal Communications cable
- 72-8087 Internal Terminal cable
- 72-8088 Internal Channels cable (for channels 1-3)
- 72-8088 Internal Channels cable (for channels 4-6)
- 72-8089 Internal Power cables (x2)
- 72-8090 Internal SCSI cable

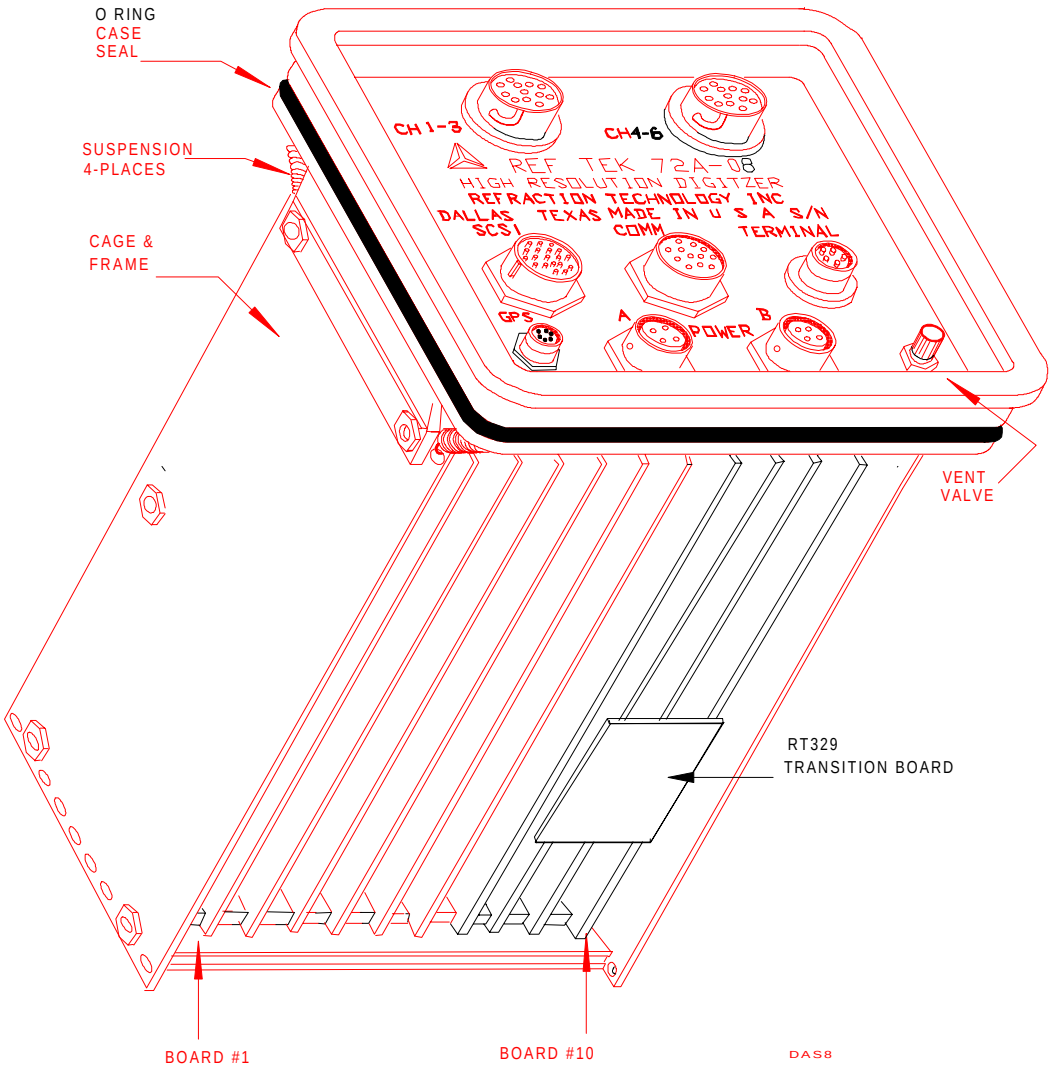
Internal Structure

The DAS internal structure is shown on the following pages (note however these views do not show the RT291 backplane where the DAS ID straps are located). Also, the RT329 is not required on a 72A-08.



Front panel &
Interface board





72A-08 - Structural Arrangement

Connector Pinouts

CH 1-3 Connector (U79/U)

Pin	Description	Board Destination	Board Connection
A	Channel 1+	RT280 or RT373	P2: 25A
B	Channel 1-	RT280 or RT373	P2: 25C
C	Channel 2+	RT280 or RT373	P2: 26A
D	Channel 2-	RT280 or RT373	P2: 26C
E	Channel 3+	RT280 or RT373	P2: 27A
F	Channel 3-	RT280 or RT373	P2: 27C
H	Calibration 1+	RT275	P2: 29C
J	Calibration Common	RT275	P2: 29A
K	Ground or +12 Volts	RT275	P2: 30C
L	Ground	RT275	P2: 30A

CH 4-6 Connector (U79/U)

Pin	Description	Board Destination	Board Connection
A	Channel 4+	RT373	P2: 25A
B	Channel 4-	RT373	P2: 25C
C	Channel 5+	RT373	P2: 26A
D	Channel 5-	RT373	P2: 26C
E	Channel 6+	RT373	P2: 27A
F	Channel 6-	RT373	P2: 27C
H	Calibration 4+	RT275	P2: 29C
J	Calibration Common	RT275	P2: 29A
K	Ground or +12 Volts	RT275	P2: 30C
L	Ground	RT275	P2: 30A

Communications Connector (PT07A14-19S)

Pin	Description	Board Destination	Board Connection
A	+High Speed Serial (HS+)	RT371	P2: 24C
B	- High Speed Serial (HS-)	RT371	P2: 24A
C	Ground	RT371	P2: 23A
D	Carrier Detect (CD*)	RT371	P2: 26C
E	Modem Serial Data In (SDIB*)	RT371	P2: 27A
F	Modem Serial Data Out (SDOB*)	RT371	P2: 27C
G	External Trigger In (CTSB*)	RT371	P2: 28A
H	Event Declared Out (RTSB*)	RT371	P2: 28C
J	Ground	RT371	P2: 29C
K	Packet Framing (PKTFRM)	RT371	P2: 29A
L	Transmit +12 Volts (TX12V)	RT371	P2: 30A
M	Ground	RT371	P2: 30C
N	GPS Serial Data In (SDIA)	RT319	P2: 31A
P	GPS Serial Data Out (SDOA)	RT319	P2: 31C
R	1 Hertz	RT371	P2: 26A
S	Ground	RT371	P2: 31C
T	Receiver 12 Volts Power (RX12V)	RT371	P2: 31A
U	Receiver 5 Volts Power (RX5V)	RT371	P2: 32A
V	Ground	RT371	P2: 32C

With an RT336 Modem installed and centralized time-keeping the following pins change

N	Modem Command In (or else Pin E if localized time-keeping is used)
A	Modem Command Return
B	Modem Data Out
C	Modem Data Return

GPS Connector (PT07A10-6S)

Pin	Description	Board Destination	Board Connection
A	1 Hertz	RT371	P2: 26A
B	Ground	RT371	P2: 23C
C	GPS Serial Data Out (SDOA)	RT319	P2: 31C
D	Ground	RT371	P2: 29C
E	GPS Serial Data In (SDIA)	RT319	P2: 31A
F	12 Volts	RT371	P2: 31A

Note: GPS input and output signals on both the DAS unit's GPS connector and Communications connector are identical. To avoid possible corruption of GPS data and time, do **not** make simultaneous connections to **both** input signals (F on the GPS connector, N on the COMM connector) or to **both** output signals (C on the GPS connector, P on the COMM connector). You may monitor the 1 Hertz signal on the unused 1 Hertz signal pin (C on the GPS connector or P on the COMM connector), but do not apply an input to both 1 Hertz pins.

Power A Connector (PT07A12-4S)

Pin	Description	Board Destination	Board Connection
A	+12 Volts (unswitched)	RT344	P3: 1
B	+12 Volts (switched)	RT344	P3: 2
C	Ground	RT344	P3: 3
D	Ground	RT344	P3: 4

Power B Connector (PT07A12-4S)

Pin	Description	Board Destination	Board Connection
A	+12 Volts (unswitched)	RT344	P4: 1
B	+12 Volts (switched)	RT344	P4: 2
C	Ground	RT344	P4: 3
D	Ground	RT344	P4: 4

Note: Power on pins B is logically switched to operate a REFTEK 72A-05 disk recorder.

SCSI Connector (PT07A14-19P)

Pin	Description	Board Destination	Board Connection
A	DB0	RT371	P3: 2
B	Ground	RT371	P3: All odd pins except 25; even pins 20-24, 28, 30, and 34
C	DB1	RT371	P3: 4
D	DB2	RT371	P3: 6
E	DB3	RT371	P3: 8
F	DB4	RT371	P3: 10
G	DB5	RT371	P3: 12
H	DB6	RT371	P3: 14
J	DB7	RT371	P3: 16
K	DBP	RT371	P3: 18
L	ATN	RT371	P3: 32
M	BSY	RT371	P3: 36
N	ACK	RT371	P3: 38
P	RST	RT371	P3: 40
R	MSG	RT371	P3: 42
S	SEL	RT371	P3: 44
T	C/D	RT371	P3: 46
U	REQ	RT371	P3: 48
V	I/O	RT371	P3: 50

Terminal Connector (U188/U)

Pin	Description	Board Destination	Board Connection
A	Receive (RCVA)	RT319	P2: 32A
B	Transmit (XMTA)	RT319	P2: 32C
C	Ground	RT319	P2: 30C
D	Power Enable (PE*)	RT319	P2: 30A
E	Ground for Power Enable (PE GND)	RT319	P2: 30C

Common Bus Connections on 72A Series DAS's

Pin #	P1 A	P1 C	P2 A	P2 C
1	VCC	VCC	Digital Gnd	Digital Gnd
2	IRQ7	IRQ1	DMA Req3*	DMA Ack3
3	IRQ6	ORQ4	A20	A21
4	IRQ3	IRQ2	A22	A23
5	SCLK	TCLK	I/O WR*	I/O RD*
6	VCC	VCC	Reserved	VBAT
7	PCLK	Bus Request*	+V STBY	Reserved
8	Bus Grant*	Bus Grant Ack	+V STBY	PE*
9	Reset*	DMA Req2*	-V STBY Gnd	-V STBY Gnd
10	Read*	Write*	+5 ANA	+5 ANA
11	Upper Data Strobe*	I/O Dec*	Digital Gnd	Digital Gnd
12	DMA Ack 2*	Add Strobe*	+V STBY SW	+V STBY SW
13	A0 (lsd)	A1	Analog Gnd	Analog Gnd
14	A2	A3	+VA	+VA
15	A4	A5	-VA	-VA
16	A6	A7	Analog Gnd	Analog Gnd
17	A8	A9	I/O – board specific	I/O – board specific
18	A10	A11	I/O – board specific	I/O – board specific
19	A12	A13	I/O – board specific	I/O – board specific
20	A14	A15	I/O – board specific	I/O – board specific
21	A16	A17	I/O – board specific	I/O – board specific
22	A18	A19	I/O – board specific	I/O – board specific
23	Digital Gnd	Digital Gnd	I/O – board specific	I/O – board specific
24	D0	D1	I/O – board specific	I/O – board specific
25	D2	D3	I/O – board specific	I/O – board specific
26	D4	D5	I/O – board specific	I/O – board specific
27	D6	D7	I/O – board specific	I/O – board specific
28	D8	D9	I/O – board specific	I/O – board specific
29	D10	D11	I/O – board specific	I/O – board specific
30	D12	D13	I/O – board specific	I/O – board specific
31	D14	D15	I/O – board specific	I/O – board specific
32	Digital Gnd	Digital Gnd	I/O – board specific	I/O – board specific

* is Active Low

Internal Architecture of 72A Series DAS

All 72A Series DAS's are microprocessor-based machines using a Motorola or Toshiba 68HC000 device. The hardware architecture includes a microprocessor bus that enables the distribution of functional circuits across several printed circuit boards. The CPU communicates with each of these functional circuits by using that circuits physical address (or range of addresses). The 68HC000 has a 16 megabyte address space that is accessible as either bytes or two-byte words that always begin on an even address. The addresses are specified by a six-digit hexadecimal value ranging from 000000 to FFFFFF. For more information see the RT319 CPU document in the *Technical Reference Documents* volume.

These paragraphs present the following information:

- a general address map for memory space
- address maps specifically for input / output memory space
- a list of interrupt priority levels
- an explanation of DAS ID and hardware configuration straps

General Address Map for 72A DAS Memory Space

The following chart shows the address ranges applicable to all 72A series DAS units.

Address Range	**Functional Description**
000000 - 07FFFF	Addresses for system RAM
080000 - 0FFFFF	Addresses for data RAM
100000 - 13FFFF	Addresses for EPROM (standard space)
140000 - 1FFFFF	Addresses for EPROM (expansion space)
200000 - 2EFFFF	Not currently used
2F0000 - 2FFFFF	Addresses for I/O operations - see *I/O Address Map for 72A Series DAS* below for board specific address allocations
300000 - 3FFFFF	Not currently used
400000 - FFFFFF	Address for mass data RAM

I/O Address Maps for 72A Series DAS Units

This list maps address ranges for the boards addressed by the 68HC000 microprocessor and is arranged to put the boards in numeric sequence.

Board		**Address Range**
RT275	D-A Test Bus	2F0080 to 2F00FF
RT280	Three Channel Filter	2F0000 to 2F007F
RT284	Mass Memory board (#1)	400000 to 7FFFFF
RT284	Mass Memory board (#2)	800000 to BFFFFF
RT284	Mass Memory board (#3)	C00000 to FFFFFF
RT314	ADC with DSP	2F1000 to 2F1FFF
RT319	CPU	2F0200 to 2F02FF
RT344	Power supply & PGA	2F00F0 to 2F00FF
RT371	Communications board	2F0100 to 2F01FF
RT373	ADC (for board #1)	2F0300 to 2F03FE
RT373	ADC (for board #2)	2F0340 to 2F037E

The following address map shows address ranges for boards that REFTEK no longer makes.

Board		Address Range
RT250	Filter / Preamp board	2F0000 - 2F003F
RT252	CPU board	2F0200 - 2F1FFF
RT254	DSP board	2F1000 - 2F1FFF
RT258	Communications board	2F0100 - 2F101F
RT260	Power Supply / Test Bus	2F00A0 - 2F00FF
RT276	DSP board	2F1000 - 2F1FFF
RT292	Communications board	2F0100 - 2F01FF
RT294	CPU board	2F0200 - 2F03FF
RT296	Power Supply	2F00F0 - 2F00FF
RT299	ADC	2F0300 - 2F03FF
RT303	One Channel Filter board	2F01C0 - 2F01FF
RT305	Communications board	2F0100 - 2F01FF
RT309	Three Channel Filter board	2F0000 - 2F007F
RT327	ADC board	2F0300 - 2F03FF

CPU Interrupt Priority Levels

The CPU in 72A Series DAS units allows seven levels of interrupt priority. Priority level seven is the highest and level one is the lowest. They are assigned as follows:

Level 7	currently unused
Level 6	Internal time clock - 1 millisecond
Level 5	Terminal Port, Radio Port, Radio Trigger, DMA controller
Level 4	DSP, A-D converter
Level 3	Modem Port, High Speed Serial Port, External Trigger, SCSI Host Controller
Level 2	Wake-up Alarm
Level 1	currently unused

Unit Identification & Configuration

Each DAS contains a set of hardware straps (soldered-in jumpers) that designate the unit's identity number. Thirteen straps are located on the backplane, and an additional three jumpers are situated on the RT319 CPU board. Ten of the thirteen straps define the unit ID, which usually reflects the last three digits shown by the front panel serial number. The remaining six bits provide hardware configuration information that the CPU can access. The LSB of the backplane straps is the one closest to the center of the board.

Note: The presence of a strap (or jumper) is equivalent to a binary zero.
The absence of the strap (or jumper) is equivalent to a binary 1.

The straps are arranged as follows:

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
CLK SPEED			F	S	A	UNIT ID									

A description of the bit assignments follows.

Bit(s)	Description
Unit ID	designates the unit serial number (modulo 100)
S and A	REFTEK Model indicator. Settings are: 00 = RT72 (RT275 supplies SCSI power) 01 = RT72 (RT260 supplies SCSI power) 10 = RT72A 11 = RT44D
F	Filter board indicator. 0 = counts, 1= decibels (dB)
Clk Speed	A multiplier factor for the clock crystal. 000 = x 1 001 = x 1.5 010 = x 2 011 = x 2.5

Software reads the straps and stores the unit ID and configuration information as separate entities. The DAS CPU expands the hardware configuration information and records it on the state-of-health (SoH) log as a 4-digit hexadecimal value.

The CPU stores the unit ID number in every packet header as a BCD value in the form *NUUU*. The components in the unit ID value provide the following information:

N = unit type designator. 0 = unit is either a 72A-02 or 72A-08
4 = unit is a 44D (or 112A) network recorder
6 = unit is a 72A-06
7 = unit is a 72A-07 (includes all versions)

UUU = unit ID number (base 10 digits) that usually reflect the last three digits of the unit serial number.

The diagram below shows the hardware configuration data as stored by the CPU in the SoH log.

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
P	R	x	x	T	L	H	C	x	x	CLK SPEED			F	S	A

Bits F, S, and A are the same as described previously.
CLK SPEED is the same as described previously
x = unused bits that are always set to zero
C = communications board indicator where:
0 = an older communications board is installed (on RT305 or earlier)
1 = an RT371 is installed
H = Hewlett-Packard ADC indicator (on custom model 97-18 DAS's only) where:
0 = RT303 board not installed
1 = RT303 board is installed
L = Low cost ADC indicator (on obsolete 72A-06 type DAS only) where:
0 = RT299 board not installed (on obsolete 72A-06 type DAS only)
1 = RT299 board is installed
T = ADC resolution indicator where:
0 = 16-bit converter (usually an RT314) installed. The unit may contain an RT331 but its operation is under DSP control.
1 = 24-bit converter (usually an RT331) installed that is under CPU control.

R = RAM installation indicator where:

0 = Static RAM is installed

1 = Pseudo-static RAM is installed

P = RT344 indicator where settings are:

0 = RT344 board is not installed

1 = RT344 board is installed

Reassembling DAS Units

All DAS units in plastic cases must be reassembled so that they remain properly sealed and moisture-proof. The lid incorporates an O-ring that forms the seal. The O-ring is very lightly lubricated with a hydrocarbon based silicone and it must be correctly seated before the DAS is reassembled. REF TEK provides a spares kit that includes an O-ring and other assembly hardware for each DAS. Extra O-rings can be ordered under part number 72-9077.

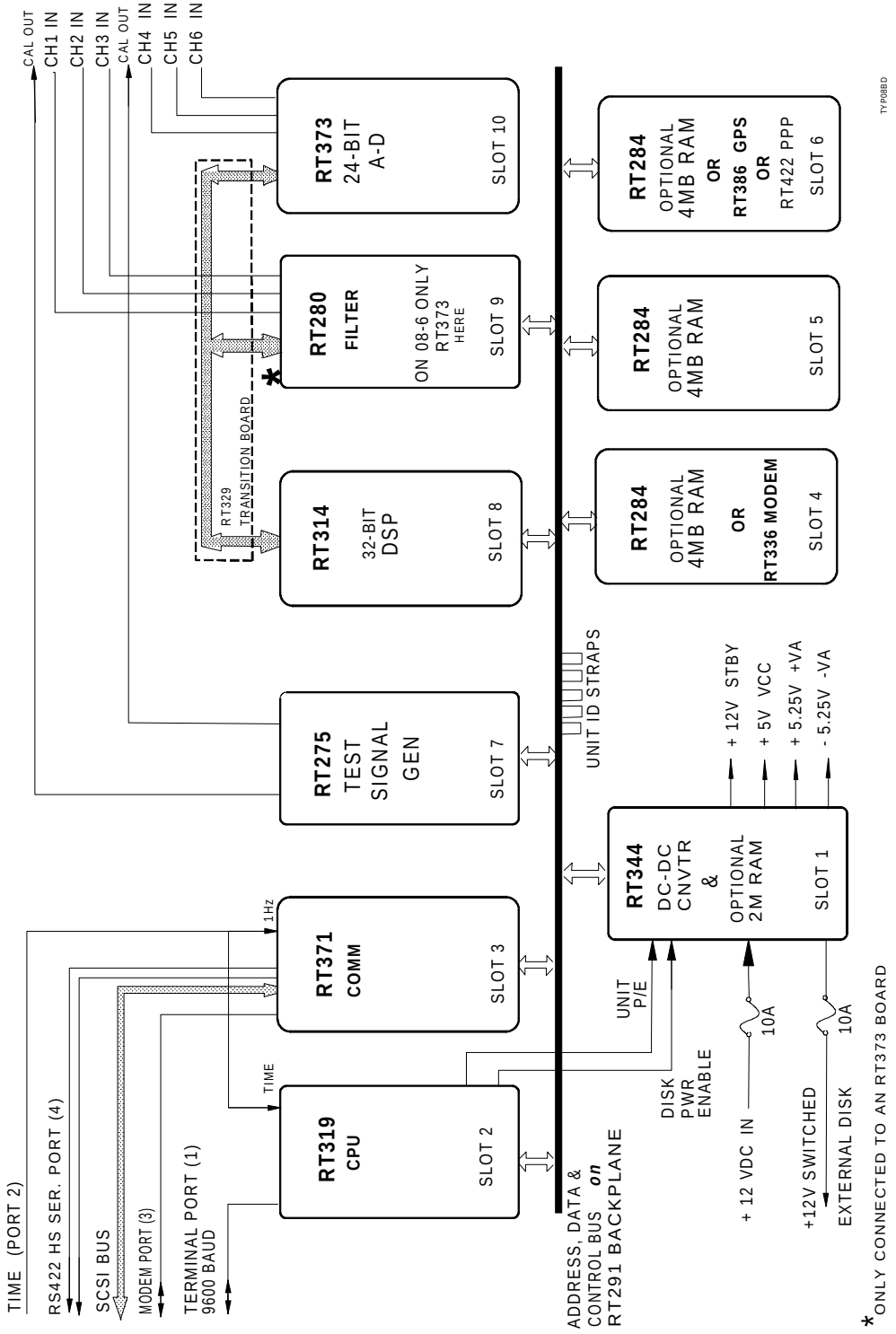
Each DAS also contains two desiccant packets that should be replaced when the DAS is opened. Desiccant packs can be reactivated by following the instructions printed on them. Alternately, a pair of desiccant packets can be 'microwaved' at half power for 3 to 5 minutes to reactivate them.

Following reassembly it is advisable to pressure test the DAS before use. After a successful test the DAS should be returned to atmospheric pressure. The test should show no significant drop in pressure (at a constant temperature) over a 24-hour period. To reassemble the DAS proceed as follows;

- Clean the O-ring groove in the lid and spray it lightly with silicone spray. Do not use a water based silicone, hydrocarbon based spray is usually available at automotive/hardware stores and Vaseline or petroleum jelly is an alternative.
- Carefully slide the O-ring into position and try to avoid stretching it unduly. The best way is to put the ring in place from the rear of the DAS rather than pulling it over the front corners of the lid. Excessive and repeated stretching will deform the O-ring so that it becomes too long to fit properly into its groove.
- Apply silicone spray once more around the O-ring when it is in place then carefully lower the DAS into the case with the foam packing on the cage base. Observe the O-ring and check that the corners do not get caught and displaced or gouged as the unit is seated in the case.
- Install the retaining screws and nuts and tighten them by hand.
- Over-pressurize the unit to around 3 psi (20 kPascals) and note the precise reading. This value should remain constant for at least 24 hours. Alternately, a 5-minute water immersion test could be done provided the tester keeps a very close observation.

Periodic Maintenance

In theory, no maintenance is needed - in practice it is to the user's advantage to inspect a unit at least every year or before and after any long-term field deployment. Shock, vibration and effects the user has no control over (vandalism for example) may occur and cause leaks in the case that result in dust or moisture accumulating inside and damaging components. For these reasons it is best to perform an annual inspection, clean off the boards, ensure that all components are in good condition and that socketed chips are properly seated and that all boards and connectors firmly mated. If you have a recurrent problem please advise REF TEK



Block Diagram - Typical 72A-08 DAS