TIMED - IDI

DEFINITION STUDY FINAL REPORT

IONOSPHERIC DYNAMICS INSTRUMENT INVESTIGATION

FOR THE TIMED MISSION

CONTRACT NO. NAS5-32571

UNIVERSITY OF TEXAS AT DALLAS

PRINCIPAL INVESTIGATOR
R. A. HEELIS

SEPTEMBER 1994

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ELECTRICAL SR. DESIGN	DON ZUCCARO UTD - X2814
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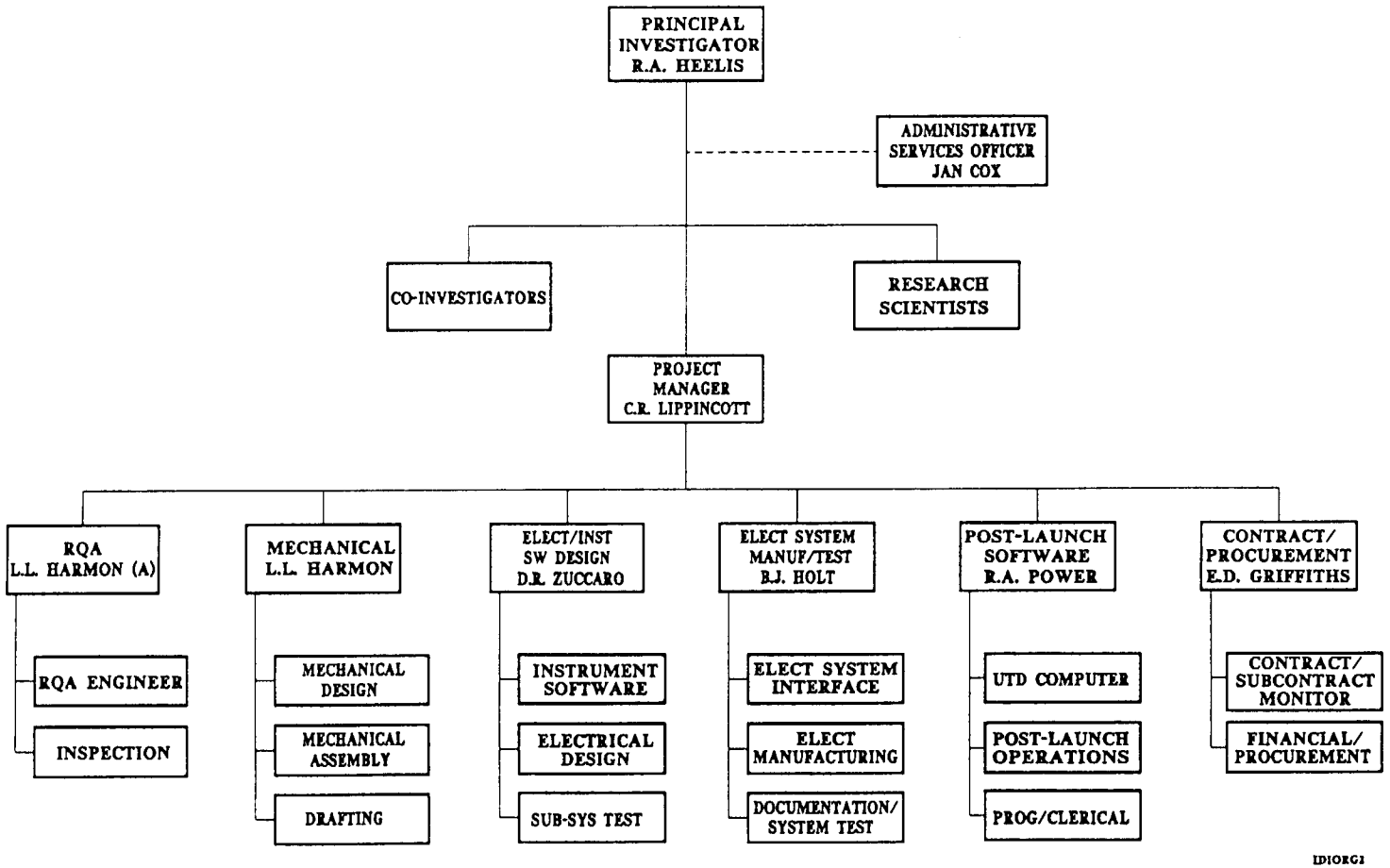
RQA (ACTING)	LARRY HARMON UTD - X2823
CONTRACT	DAN GRIFFITHS UTD - X2853

ORGANIZATION CHART

UTD CENTER FOR SPACE SCIENCES
IDI PROJECT ORGANIZATION



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CO-INVESTIGATORS RESPONSIBILITIES

W. B. HANSON - UTD

- PARTICIPATE IN DESIGN OF DATA ACQUISITION ALGORITHMS AND OPERATION OF PLASMA PLATE TO DERIVE THE APERTURE PLANE POTENTIAL
- ASSIST IN DEVELOPMENT OF DATA QUALITY FLAGS
- PARTICIPATE IN THE DATA REDUCTION AND ANALYSIS, PARTICULARLY IN THE AREA OF LOW LATITUDE ELECTRODYNAMICS

M. C. KELLEY - CORNELL UNIVERSITY

- PARTICIPATE IN DESIGN OF DATA ACQUISITION ALGORITHMS FOR THE DIGITAL SIGNAL PROCESSING
- ASSIST IN THE REDUCTION AND INTERPRETATION OF THE DATA FROM ON-BOARD FFT'S
- RESPONSIBLE FOR COORDINATING DATA ACQUISITION BETWEEN THE TIMED PAYLOAD AND GROUND RADAR FACILITIES
- PARTICIPATE IN JOINT ANALYSIS AND INTERPRETATION OF THE COORDINATED DATA

H. C. YEH - NATIONAL CENTRAL UNIVERSITY

- COORDINATE DATA ACQUISITION ACTIVITIES OF PACIFIC GROUND BASED OBSERVATORIES WITH OPERATION OF TIMED PAYLOAD
- PARTICIPATE IN THE ANALYSIS AND INTERPRETATION OF THE JOINTLY COLLECTED DATA SETS AS THEY APPLY TO THE RESPONSE OF THE ITM SYSTEM TO INTERNALLY GENERATED ELECTRIC FIELDS

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SCIENCE QUESTIONS

- WHAT IS THE RESPONSE OF THE ITM REGION TO JOULE HEATING AT HIGH LATITUDES?

- HOW EFFECTIVE IS AURORAL ZONE HEATING IN THE PRODUCTION OF DISTURBANCE MOTIONS AND DYNAMOS AT MIDDLE LATITUDES?

- WHAT IS THE RELATIONSHIP BETWEEN GLOBAL SCALE MOTIONS IN THE NEUTRAL ATMOSPHERE ABOVE 120 km AND THE ExB DRIFT MOTION OF THE CHARGED PLASMA?

- HOW ARE PLASMA STRUCTURES FORMED AND HOW DOES THEIR EVOLUTION DEPEND ON LARGER SCALE MOTIONS OF THE NEUTRAL ATMOSPHERE?

BASIC PHYSICAL PRINCIPLES

- ELECTRIC FIELDS APPLIED EXTERNALLY AND PRODUCED BY GRADIENTS IN NEUTRAL WIND DRIVEN CURRENTS
- ELECTRIC FIELD MEASURED FROM ION DRIFT VELOCITY VECTOR AND E = -VxB
- ELECTRIC FIELD MAPS ALONG MAGNETIC FIELD LINES IN KNOWN WAY
- NEUTRAL WIND DRIVEN CURRENTS DEPEND UPON WIND VECTOR AND CONDUCTIVITY
- NEUTRAL WINDS TO BE MEASURED AS A FUNCTION OF ALTITUDE
- CONDUCTIVITY CAN BE ESTIMATED FROM IONOSPHERIC MODELS AND KNOWLEDGE OF THE SOLAR euv AND PARTICLE PRECIPITATION
- SOLAR euv OBTAINED BY MEASUREMENT OR F10.7 RADIO FLUX
- PARTICLE PRECIPITATION FROM MODELS NORMALIZED IN LOCATION BY ION DRIFT MEASUREMENTS , AND IN MAGNITUDE BY IMAGING OR SECONDARY ELECTRON MEASUREMENTS OF RPA

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REQUIRED MEASUREMENTS

PRIMARY - IDI MEASURED

- ION TEMPERATURE
- TOTAL ION CONCENTRATION
- ION DRIFT VELOCITY
- ION CONCENTRATION AND VELOCITY STRUCTURES

PRIMARY - OTHER INSTRUMENTS

- MAJOR NEUTRAL ATMOSPHERE CONSTITUENTS
  >120 km
- NEUTRAL ATMOSPHERE TEMPERATURE
  >120 km
- NEUTRAL GAS VELOCITY
  >120 km

SECONDARY

- AIRLGOW IMAGING

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MEASUREMENT CAPABILITIES I

PARAMETER	DYNAMIC RANGE	ABSOLUTE ACCURACY	SENSITIVITY	SPATIAL RESOLUTION
ION VELOCITY RAM COMPONENT	±4 km/s	±20 m/s	20 m/s **	4 km
ION VELOCITY HORIZONTAL COMPONENT	±4 km/s	±4 m/s (0.03 deg*)	1.5 m/s	250 m
ION VELOCITY VERTICAL COMPONENT	±4 km/s	±4 m/s (0.03 deg*)	1.5 m/s	250 m
ION TEMPERATURE	100 to 10000 K	±3%	30 K **	4 km
MAJOR ION CONSTITUENT CONCENTRATION	10 to 106 cm-3	±5%	1cm^{-3}	4 km
TOTAL ION CONCENTRATION	10 to 106 cm-3	±5%	ΔN/N 0.1%	250 m
DENSITY AND VELOCITY POWER SPECTRA	0 to -70 DB 0 to 1 kHz	±10% (TBD)	TBD ALGORITHM DEPENDENT	8 km

* ASSUMED ATTITUDE DETERMINATION ERROR.

**SENSITIVITY IS ESTIMATED FROM CAPABILITIES OF LEAST-SQUARES ALGORITHM AND EXPECTED INSTRUMENT NOISE LEVELS.

MEASUREMENT CAPABILITIES II

- ALL MEASUREMENTS MADE IN-SITU AT SPACECRAFT ALTITUDE
- MEASUREMENTS CAN BE MADE UNDER ALL CONDITIONS AND IN ALL LOCATIONS WHEN SENSORS FACE THE RAM DIRECTION
- ELECTRIC FIELD DERIVED FROM E = -VxB ASSUMING MODEL B-FIELD
- ELECTRIC FIELD CAN BE EVALUATED AT ALL LOCATIONS ALONG B-FIELD THROUGH SATELLITE LOCATION
- ELECTRIC FIELD MEASURED AT ALL ALTITUDES AND LATITUDES OUTSIDE THE MAGNETIC FLUX TUBE WITH APEX HEIGHT = 400 km. THIS FLUX TUBE CROSSES 100 km AT ABOUT 12 DEGREES LATITUDE.

MEASUREMENT APPROACH I

- RPA
  - MEASURES RAM ENERGY AND TEMPERATURE FROM LOCATION AND SHAPE OF I-V CHARACTERISTIC
- IDM
  - MEASURES HORIZONTAL AND VERTICAL ION ARRIVAL ANGLES FROM ASYMMETRY IN CURRENT COLLECTION
- IT
  - MEASURES SATURATION ION CURRENT DIRECTLY

MEASUREMENT APPROACH II

- RPA MEASURES RAM ENERGY FOR GIVEN MASS

$$E^{M}_{R} = 1/2\ mV^2 + q\Psi$$

- ORIGINAL PROPOSAL
  MEASURE E^{M}_{R} FOR TWO MASSES TO SEPARATE V FROM Ψ

- ADOPTED APPROACH
  USE RPA PLASMA PLATE (RPA/PP) TO INDEPENDENTLY MEASURE Ψ

- ABILITY TO SWEEP MASS ANALYZER FOR ION MASS SPECTROMETRY IS LOST

- ABILITY TO OBTAIN Te FROM PLASMA PLATE IS GAINED

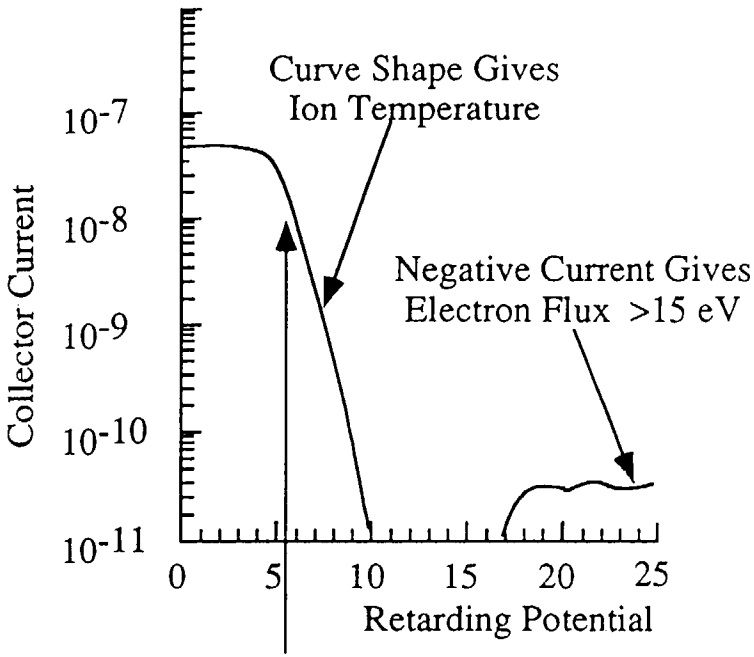
- MEASUREMENT APPROACH AND DEFINITION STUDY ASSUMED RPA/PP IMPLEMENTATION

MEASUREMENT STRATEGY

- 100% DUTY CYCLE DESIRABLE
- INSTRUMENT OPERATIONAL ONLY WHEN FACING RAM DIRECTION
- INSTRUMENT TO FUNCTION SIMULTANEOUSLY WITH NEUTRAL WIND AND WAVE MEASUREMENTS
- NO SUSCEPTIBILITY TO SUN ANGLE
- OPERATION DURING CONTROLLED S/C MANEUVERS IS DESIRABLE

SCIENCE PARAMETER EXTRACTION I

- RETARDING POTENTIAL ANALYZER
  - RAM ENERGY HAS COMPONENTS FROM DRIFT 1/2 mV² AND POTENTIAL qΨ
  - SEPARATION REQUIRES KNOWLEDGE OF RAM ENERGY FROM TWO MASSES OR INDEPENDENT MEASURE OF Ψ
  - ORIGINAL APPROACH UTILIZES MASS SPECTROMETER FOR RAM ENERGY FROM TWO MASSES
  - PRESENT APPROACH UTILIZES PLASMA PLATE TO MEASURE Ψ
  - MEASURES THERMAL ION ENERGY DISTRIBUTION ALONG SENSOR LOOK DIRECTION
  - PLATEAU CURRENTS GIVE MAJOR ION CONCENTRATIONS
  - CURVE SHAPE GIVES T_i
  - CURVE LOCATION GIVES RAM ENERGY



Half Power Point Gives
Total Ram Energy

$$\Phi(P) = \frac{n}{2} V_r \left[1 + \mathrm{erf}\beta f + \frac{1}{\sqrt{\pi}\beta V_r} \exp\left(-\beta^2 f^2\right) \right]$$

$$P = q(R_v + \psi_s) \qquad f = V_r - (2P/m)^{1/2}$$

$$V_r = -\left(\bar{V}_d + \bar{V}_s\right) \cdot \hat{n} \qquad \beta = (m/2kT)^{1/2}$$

$\hat{n}$ = unit normal in look direction of sensor

SCIENCE PARAMETER EXTRACTION II

- PLASMA PLATE
  - ELECTRON CURRENT INCREASES EXPONENTIALLY IN RETARDING REGION
  - DEPARTS FROM EXPONENTIAL FOR POSITIVE PLATE VOLTAGES > PLASMA POTENTIAL
  - DETECTION OF THIS LOCATION PROVIDES PLATE POTENTIAL

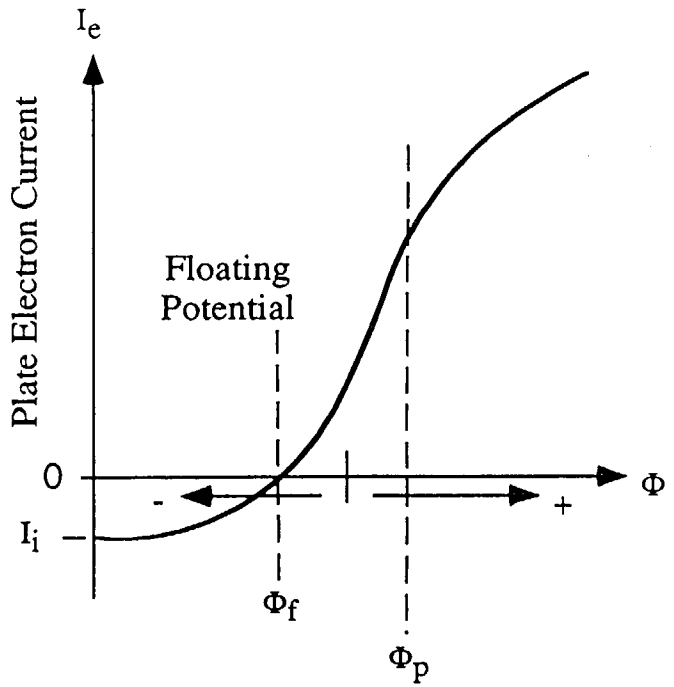


Plate potential at which current departs from logarithmic increase locates plasma potential with respect to plate

SCIENCE PARAMETER EXTRACTION III

- ION DRIFT METER
  - SIMULTANEOUSLY MEASURES TWO MUTUALLY PERPENDICULAR ION ARRIVAL ANGLES WRT SENSOR LOOK DIRECTION
  - CROSS TRACK HORIZONTAL AND VERTICAL DRIFTS OBTAINED FROM ANGLES AND RAM VELOCITY WRT SENSOR
- ION TRAP
  - MEASURES SATURATION ION CURRENT
  - ION FLUX DOMINATED BY S/C RAM VELOCITY
  - CURRENT DIRECTLY PROPORTIONAL TO TOTAL ION CONCENTRATION

DESCOPE OPTIONS

- PRESENTLY ADOPTED/NEW BASELINE
  - REMOVED MAGNETIC MASS ANALYZER
  - ADDED PLASMA PLATE TO RPA
  - ONLY SCIENCE IMPACT IS LOSS OF PRESUMABLY REDUNDANT ION MASS SPECTROMETRY DATA
  - ABILITY TO OBTAIN Te FROM PP IS GAINED
- FUTURE OPTIONS
  - REMOVE FFT CAPABILITY (SAVES 0.5 WATT, 0.45 LB., $100K)
  - REMOVE ONE ION DRIFT METER SENSOR (SAVES 0.3 WATT, 1.32 LBS., $50K)

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SCIENCE IMPACT OF FUTURE DESCOPE OPTIONS - I

The primary science objectives for IDI are related to studying the global response of the ITM to energy inputs from the magnetosphere and to understanding the ways in which electric fields are internally generated by neutral atmosphere motions in the lower thermosphere and mesosphere.

The energy inputs from magnetospheric fields contain an input at large spatial scales that can be quite easily characterized from measurements made with temporal resolution of 1 second. An important but not well studied energy input also arises from much smaller spatial scales requiring temporal sampling rates exceeding 20 Hz.

At low and mid latitudes the electric fields are generated by neutral atmosphere motions and temporal resolution on time scales of a second will adequately describe the global field and allow its relationship to neutral wind motion to be established. However, the redistribution of current systems and the electrodynamics associated with plasma structures requires temporal sampling rates at the highest possible frequencies.

The removal of one IDM sensor would require that the remaining sensor be operated with the axis alternating at a rate of 4 Hz or so. This would provide vector measurements of the velocity over a period of about 0.5 seconds. While adequate for describing the large scale electrodynamics, there would be no capability to observe small scale features associated with plasma structures at high or low latitudes without sacrificing the vector measurement.

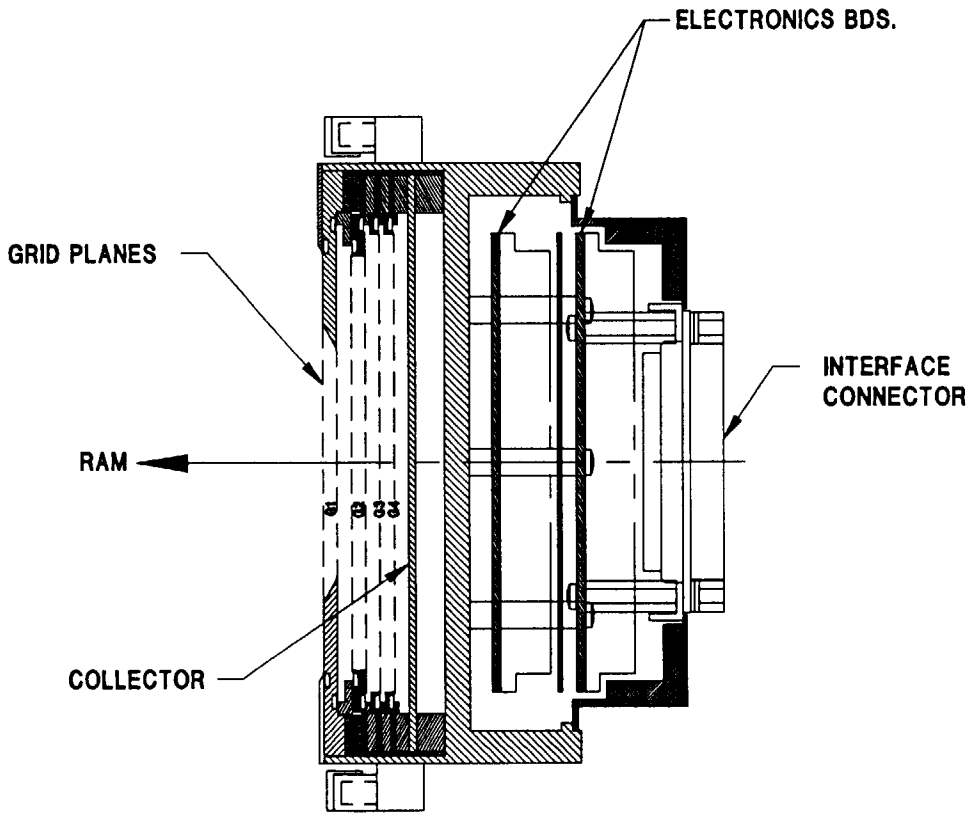
While potentially interesting and new science could be achieved from these data, it is unlikely that this smaller scale structure will dominate over the large scale features that are essential for understanding the system response.

SCIENCE IMPACT OF FUTURE DESCOPE OPTIONS - II

The removal of the FFT signal processing will not allow any specification of the energy input to the system at small spatial scales and would render impossible a diagnosis of small scale plasma structures. It would not compromise the major science goals that will be addressed by IDI, but the impact of a new and potentially interesting energy source would remain uninvestigated.

Deletion of one IDM sensor would not seriously compromise the ability of the IDI to record the high latitude, large scale energy input to the system or to diagnose the large scale internally generated electric fields. However, this investigation could not be performed on a full-time basis without losing the ability to investigate a new and potentially interesting energy source from smaller scale features at high latitudes and from small scale plasma structures at low and middle latitudes.

RPA SENSOR CROSS-SECTION

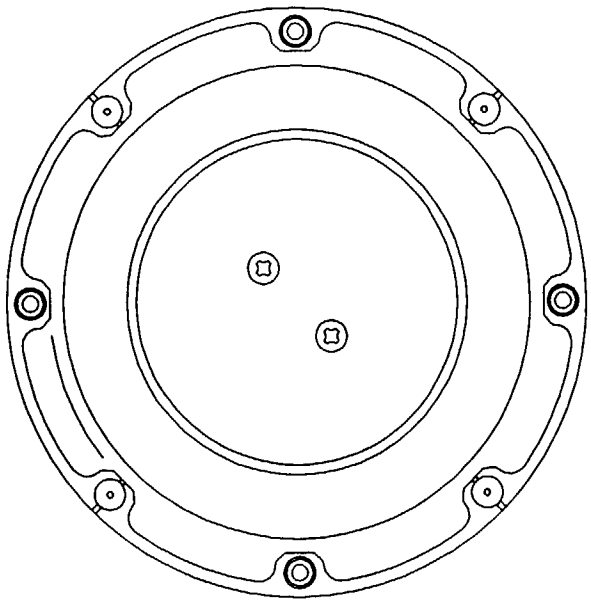


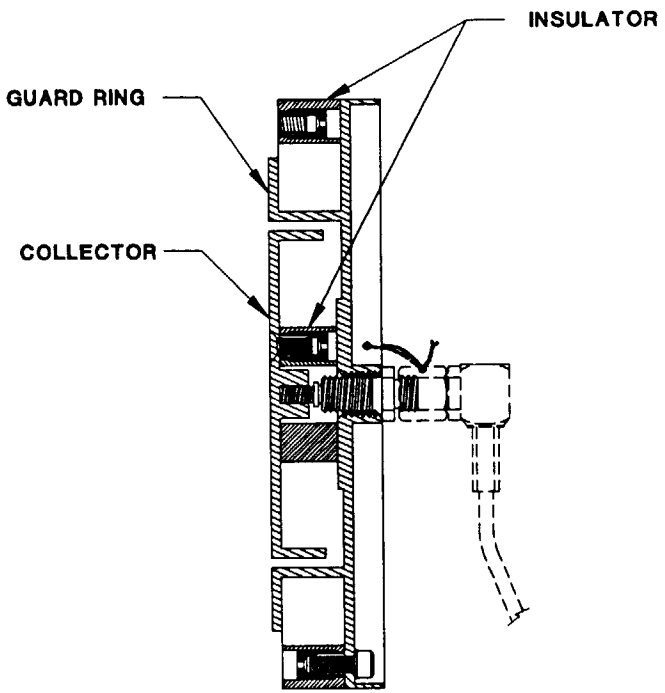
GRID DESCRIPTION

- G1- DUAL APERTURE
- G2- DUAL RETARDING
- G3- SUPPRESSOR
- G4- SHIELD

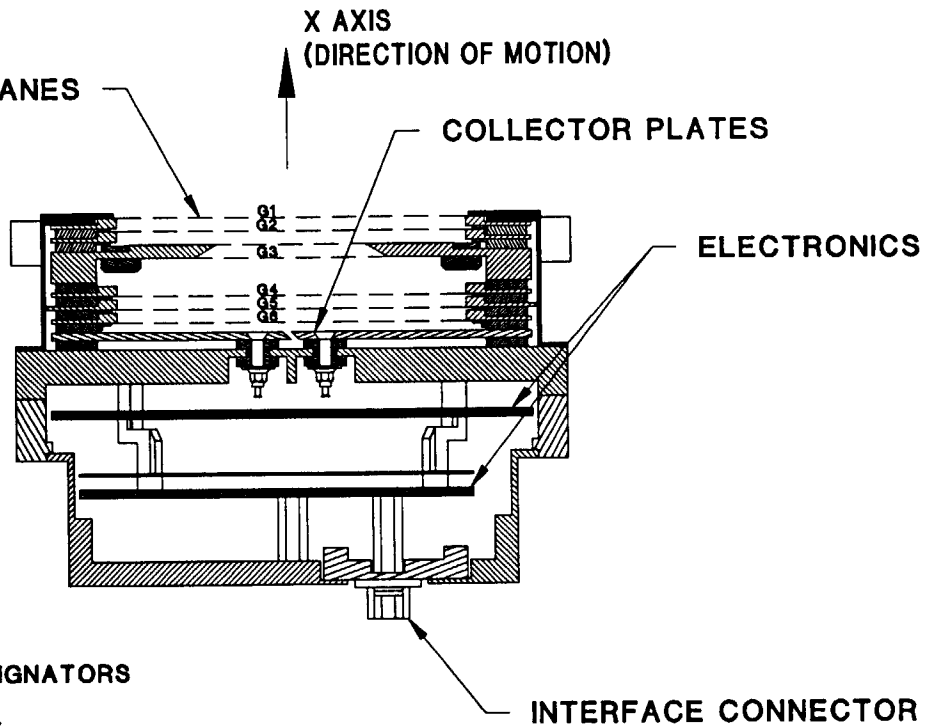
SK099910

PLASMA PLATE SENSOR CROSS-SECTION



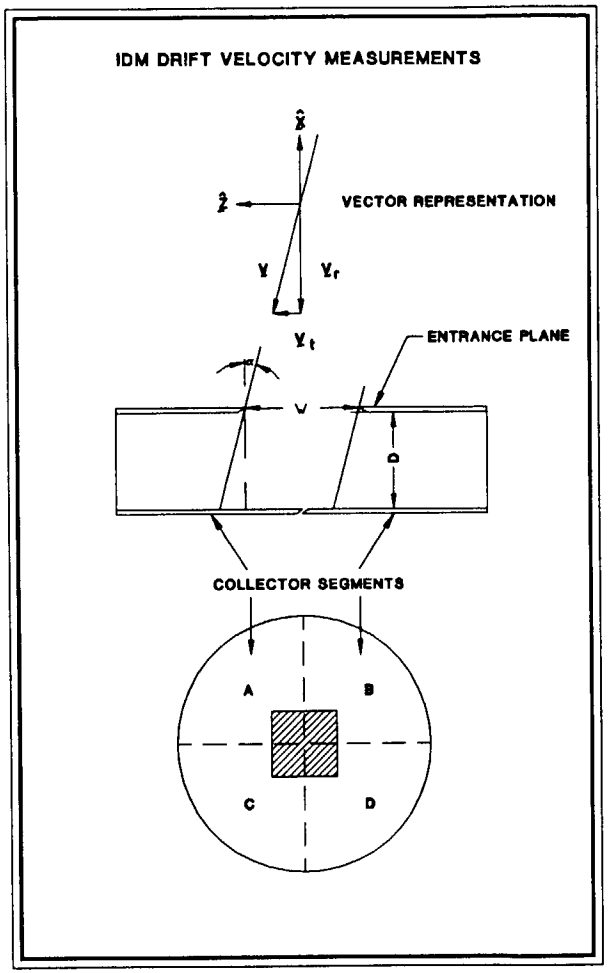


IDM SENSOR CROSS-SECTION



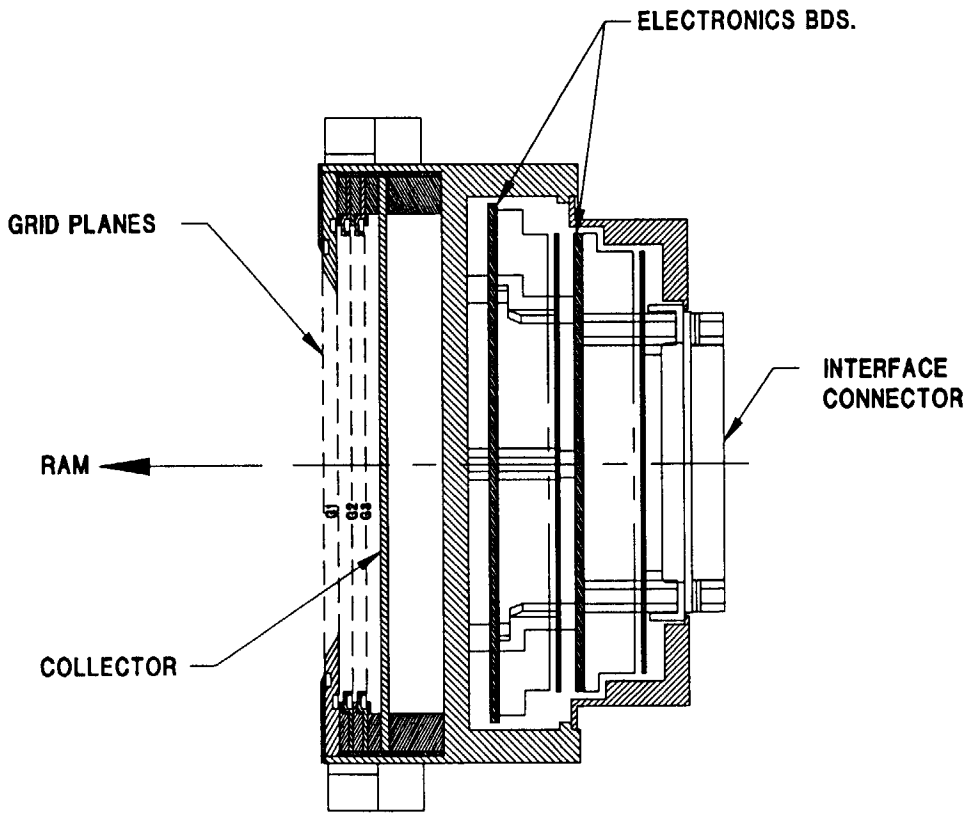
GRID DESIGNATORS

G1- INPUT
G2- RETARDING
G3- APERTURE
G4- SHIELD
G5- SHIELD
G6- SUPPRESSOR
(ALL 50 LINES/INCH)



SK099810

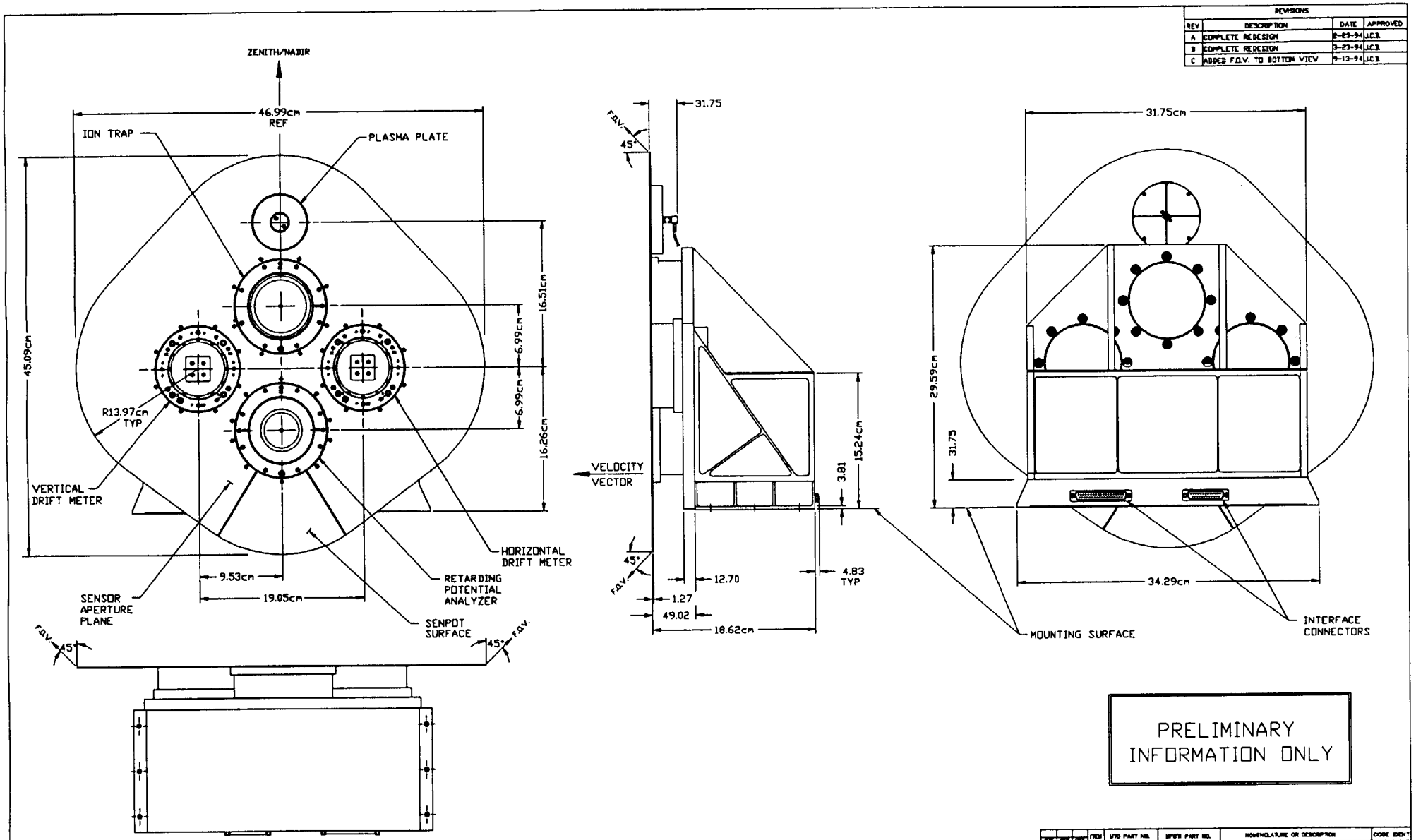
ION TRAP SENSOR CROSS-SECTION



GRID DESCRIPTION

G1- DUAL APERTURE
G2- SUPPRESSOR
G3- SHIELD
(ALL 50 LINES/INCH)

SK099510



REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	COMPLETE REDESIGN	8-23-94	J.C.B.
B	COMPLETE REDESIGN	8-23-94	J.C.B.
C	ADDED F.O.V. TO BOTTOM VIEW	9-13-94	J.C.B.

PRELIMINARY
INFORMATION ONLY

NOTES:
1. DIMENSIONS ARE IN MM UNLESS OTHERWISE NOTED.

QTY	REV	QTY	ITEM	VTD PART NO.	MFR'S PART NO.	NOMENCLATURE OR DESCRIPTION	CODE IDENT

PARTS LIST

QTY	NEXT ASSY	QTY	USED ON
APPLICATION			

AUTHENTICATION

	NAME	DATE
DRN.	JC.BROWN	9-8-94
DESIGN		
APP.		
APP.		
APP.		
APP.		

THE UNIVERSITY OF TEXAS AT DALLAS
2601 N. FLOYD RD. RICHARDSON, TEXAS 75080

INSTRUMENT OUTLINE-
IDI FOR TIMED

SIZE	CODE IDENT	DWG NO.	REV
D	14814	SK09891B	C
SCALE 1/2		SHEET 1 OF 1	

DESIGN DESCRIPTION - I

- IDI SENSORS INTEGRATED INTO A SINGLE PACKAGE
- SENSOR POTENTIAL (SENPOT) CONTROL -5V TO +15V WRT S/C GROUND
- MICROPROCESSOR CONTROL VIA PARALLEL I/O PORTS
- DEDICATED FFT SLAVE PROCESSOR
- MIL-STD-1553B
- SERIAL TIME CODE AND PERIODIC FIDUCIAL PULSE REQUIRED FOR DATA TIME TAGGING
- ELECTRICAL SCHEMATICS - SEE APPENDIX

DESIGN DESCRIPTION - II

RPA

- LINEAR ELECTROMETER, 8 RANGES
- 64 SAMPLES/SEC
- 10 BIT ELECTROMETER CONVERSION + 3 RANGE BITS PER SAMPLE
- 256 DISCRETE RV LEVELS AVAILABLE, 8 BIT D/A, 0-25.5V, 0.1V/STEP
- ONE OF FOUR RV FORMATS SELECTED BY GROUND COMMAND
- RV FORMATS DEFINED BY LOOK-UP TABLES IN DPU ROM/RAM

IT

- LOG ELECTROMETER, 12 BIT CONVERSIONS, 32 SAMPLES/SEC

DESIGN DESCRIPTION - III

PP

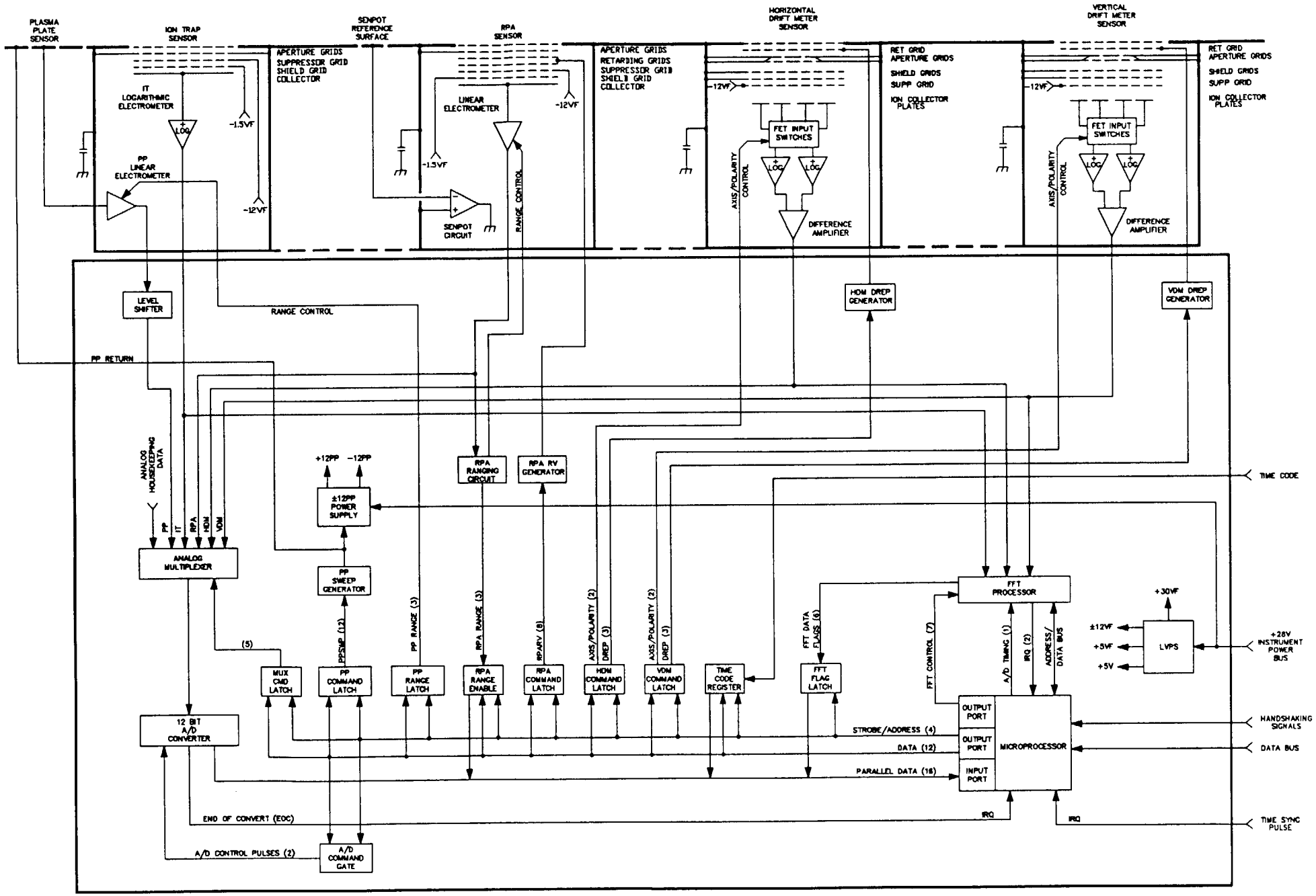
- OPERATION CONTROLLED BY DPU PP ALGORITHM
- LINEAR ELECTROMETER, 8 RANGES
- 4096 AVAILABLE SWEEP POINTS, +10V TO -10V, 12 BIT D/A
- 32 ELECTROMETER SAMPLES/SWEEP AT 64 SAMPLES/SEC RATE
- 12 BIT ELECTROMETER CONVERSIONS
- SWEEP FROM V_{START} TO V_{START} + 31 (ΔV), ΔV TYPICALLY < 0.1 V
- SWEEP ΔV FIXED BY GROUND COMMAND, V_{START} COMPUTED FROM PREVIOUS SWEEP
- ELECTROMETER RANGE SET AT BEGINNING OF EACH SWEEP, THEN LOCKED
- TELEMETER V_{START} (12 BITS) FOR EACH SWEEP
- 32 POINT SWEEP DURING ALTERNATE 1/2 SEC PERIODS

VDM

- 12 BIT CONVERSIONS OF DIFFERENCE AMPLIFIER OUTPUT, ±4 Km/SEC FULL SCALE, 32 SAMPLES/SEC

HDM

- SAME AS VDM



IDI FUNCTIONAL DIAGRAM

MICROPROCESSOR CONTROL TASKS

- ANALOG DATA MULTIPLEXING CONTROL
- A/D CONVERTER CONTROL
- SET PP SWEEP/ELECTROMETER RANGE
- SET RPA RETARDING VOLTAGE/ELECTROMETER RANGE
- SET HDM H^+ REPELLER VOLTAGE, HDM AXIS/COLLECTOR SELECTION
- SET VDM H^+ REPELLER VOLTAGE, VDM AXIS/COLLECTOR SELECTION
- CONTROL FFT SLAVE PROCESSOR
- PERFORM 1553B INTERFACE HOST PROCESSOR FUNCTIONS

FLIGHT SOFTWARE

- COLLECT DATA SAMPLES FROM SENSORS IN FIXED SEQUENCE
- OUTPUT PARALLEL CONTROL WORD TO EACH SENSOR IMMEDIATELY AFTER EACH SAMPLE
- CONTROL FFT SLAVE PROCESSOR/PERFORM FFT OUTPUT DATA SELECTION
- SENSOR CONTROL PRIMARILY FROM LOOK-UP TABLES
- AMPLIFIER RANGE SETTINGS DETERMINED BY ALGORITHM
- RECEIVE AND IMPLEMENT SERIAL MODE COMMANDS
- TIME TAG AND PACKETIZE DATA
- SERVICE 1553B INTERFACE
- 80C86 ASSEMBLY LANGUAGE CODE

ON-BOARD SIGNAL PROCESSING - I

The use of on-board processing to perform spectral analysis allows information from data taken at high temporal resolution to be sent to the ground with only modest telemetry allocations. The IDI uses the Raytheon TMC2310 dedicated FFT processor to perform fast fourier transforms (FFT) and to produce the magnitude squared of the resulting complex numbers.

Data is stored as a time series of 1024 points that are gathered in 1 second. There will be 3 such blocks of 1024 points originating respectively from the VDM, the HDM, and the IT. Thus the effective sample rates for each parameter will be about one KHz. The FFT function will produce 512 complex numbers from each 1024 point data set that represent the decomposition of each time series into sine waves with known amplitudes and frequencies. The magnitude squared function applied to these complex numbers will provide the power spectral density in 512 equally spaced frequency bins extending to 512 Hz . The input data will be digitized with 12 bit accuracy providing a sensitivity of 0.28% in $\Delta N/N$ and 2 m s^{-1} in ion drift velocity. The FFT and magnitude squared operations are performed with 16 bit precision and automatic scaling within 19 bits. Following these operations a representation of the power spectrum will be constructed to be sent to the ground along with 3 bits designating the automatic scaling shifts that were applied to all the points.

A representation of the spectrum will be obtained by using the 80C86 DPU to sum the spectral densities over fixed point ranges. Note that the low frequency end of the spectrum, up to 16 Hz, will overlap directly with that obtainable on the ground from the directly sampled IDM and IT outputs. Thus the point ranges to represent the 512 point power spectrum will be chosen to provide better frequency resolution at high frequencies by sacrificing some resolution at lower frequencies. Figure 1 shows the results of a rather simple algorithm that divides the point ranges into 19 intervals as shown in Table 1.

ON-BOARD SIGNAL PROCESSING - II

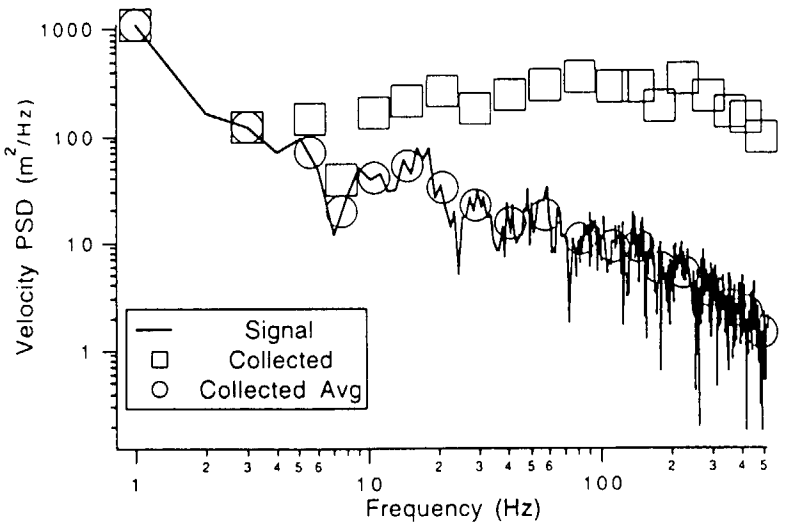


Figure 1. Representation of on-board derived power spectrum and average representation sent to the ground

Bin Number	Start Point	End Point	No of Points
1	1	1	1
2	3	3	1
3	5	6	2
4	7	8	2
5	9	12	4
6	13	16	4
7	17	24	8
8	25	32	8
9	33	48	16
10	49	64	16
11	65	96	32
12	97	128	32
13	129	160	32
14	161	192	32
15	193	256	64
16	257	320	64
17	321	384	64
18	385	448	64
19	449	512	64

Table 1. Bin Ranges for average representation of power spectrum

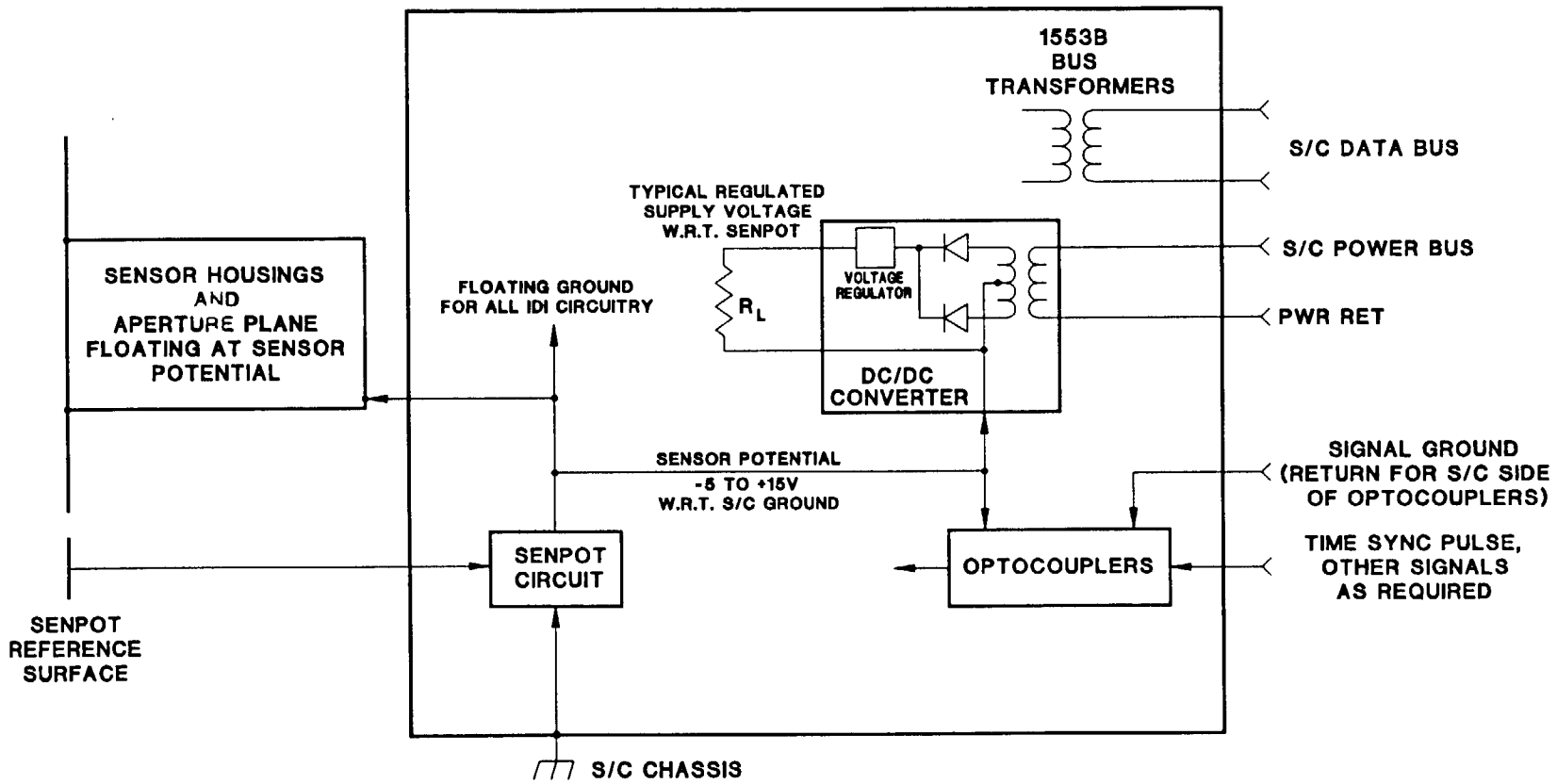
ON-BOARD SIGNAL PROCESSING - III

Shown in the figure is a solid trace denoting the signal as it appears after the magnitude squared operation. These data then have the rather simple accumulation shown in the table applied to collect them into 19 bins. The magnitude of the signal in each bin is shown by the open squares. These data are sent to the ground, where from the known bin widths the outputs can be corrected to retrieve an average representation of the spectrum. These corrected outputs are shown by the open circles. It can be seen immediately that plotted on a log-log scale the reduced data set can easily be used to derive the spectral characteristics of the original data set.

The rather sparse data at lower frequencies will be augmented by that obtained from the direct sampling of the VDM, HDM and IT and will also allow an additional normalization to be applied to the spectral output. Presently we anticipate that the data will be taken in 1 second and processed in 1 second. Thus the spectral densities from the three signals will be output once every 2 seconds and will apply to a 1 second (~8 km) section of the ionosphere.

Options to take the 1024 data points in a smaller time period, thus allowing diagnosis at higher frequencies over smaller sections of the ionosphere, or to perform the data acquisition and processing over periods of less than 2 seconds, will be evaluated and implemented if they are consistent with the available resources. Also note that the accumulation algorithm can be changed by changing the start points and bin widths in the table above.

IDI GROUNDING/BIAS DIAGRAM



NOTES:

1. ALL IDI CIRCUITRY IS FLOATING AT THE SENSOR POTENTIAL (SENPOT).
2. DC ISOLATION FROM S/C GROUND IS PROVIDED BY TRANSFORMERS AND OPTOCOUPLERS.
3. THE IDI BOX MOUNTING SURFACE AND ALL EXTERIOR SURFACES EXCEPT FOR THE APERTURE PLANE AND CYLINDRICAL SENSOR HOUSINGS ARE AT S/C CHASSIS GROUND.

BK102810

UTD
8/26/94

SPACECRAFT RESOURCES

(ORIGINAL PROPOSAL)

- MASS - 7.55 kg (7.8 Kg)
- POWER - 6.5 WATTS (7.5 W)
- TM - 2928 bps + PACKET OVERHEAD (3360 bps)
  - RPA - 832 bps
  - IT - 384 bps
  - PP - 384 bps
  - HDM - 384 bps
  - VDM - 384 bps
  - FFT - 480 bps
  - HK - 80 bps
  - PACKET OVERHEAD - TBD
- THERMAL CONTROL
  - OPERATING - 0°C TO +50°C
  - NON-OPERATING - -20°C TO +60°C

POWER BREAKDOWN

CIRCUIT	POWER (mW)
IDM-V	226
IDM-H	226
IT	74
RPA	204
SHARED CIRCUITS (SENPOT, FILTERS, A/D, TEMP SENSORS, ETC.)	649
FFT PROCESSOR	500
DPU & S/C INTERFACE	2308
POWER SUPPLIES	2210
TOTAL	6.5W

MASS BREAKDOWN

ELEMENT	MASS (Kg.)
RPA SENSOR	0.61
ION TRAP SENSOR	0.55
DRIFT SENSOR (H)	0.60
DRIFT SENSOR (V)	0.60
ELECTRONICS	1.23
STRUCTURE	2.38
APERTURE PLANE/PP	0.51
WIRE, CONN & MISC	1.07
TOTAL	7.55 Kg

NO CONTINGENCY IS CARRIED BY UTD IN THE ABOVE ESTIMATE

TIMED - IDI

SPACECRAFT REQUIREMENTS

- IDI MOST FORWARD MOUNTED INSTRUMENT
- SOLAR ARRAY ELECTRICALLY INSULATED FROM AMBIENT PLASMA
  SOLAR-CELL INTERCONNECTS INSULATED
- MAXIMIZE SPACECRAFT CONDUCTING AREA ON RAM-FACING SURFACE
  SPACECRAFT STRUCTURE, THERMAL BLANKET, ETC
- MINIMIZE EXPOSED POSITIVE POTENTIAL SURFACES
  LESS THAN 1% OF RAM CONDUCTING AREA
- KNOWLEDGE OF MAGNETIC FIELD AT SENSOR FACE
  MINIMIZE TO ORDER 0.05G (10% EARTH'S FIELD)
- INCLINATION $\geq 70°$ REQUIRED FOR ACCESS TO HIGH ALTITUDES
- IDI FULLY FUNCTIONAL AT ALTITUDES BELOW 900 km
- POSITION ACCURACY: TO ± 1 KM (POSTMISSION)
- UNIVERSAL TIME: TO 1 MSEC. (POSTMISSION)

VEHICLE POTENTIAL

- ELECTRONS CAN BE COLLECTED BY ALL CONDUCTING SURFACES
- IONS CAN BE COLLECTED BY RAM FACING CONDUCTING SURFACE AND OTHER SURFACES WITH LARGE NEGATIVE POTENTIAL
- NET CURRENT TO S/C WILL BE ZERO
- WITH NO POTENTIALS EXPOSED TO THE PLASMA, S/C WILL ASSUME A SMALL NEGATIVE POTENTIAL WRT PLASMA
- EXPOSED NEGATIVE POTENTIALS HAVE RELATIVELY SMALL EFFECT BECAUSE IONS ARE "STIFF" AND HAVE LOW MOBILITY
- EXPOSED POSITIVE POTENTIALS HAVE LITTLE EFFECT ON THE S/C POTENTIAL PROVIDED THAT:

$$A_I \geq 100\ A_P$$

WHERE:

A_P IS AREA OF POSITIVE POTENTIAL
A_I IS RAM FACING CONDUCTING AREA

- IF THIS CONDITION IS NOT SATISFIED THEN THE S/C WILL MOVE NEGATIVE WRT PLASMA TO RETARD ELECTRONS

S/C POINTING AND ATTITUDE

- S/C RAM AXIS IN ORBIT PLANE
- S/C AXIS PERPENDICULAR TO RAM IN ORBIT PLANE AND ALONG RADIUS VECTOR
- JITTER - 0.25°, FOR FREQUENCY GREATER THAN 1HZ
- STABILITY - LESS THAN 0.25°/MIN OVER PERIODS OF GREATER THAN 30 MINS
- DESIRABLE ATTITUDE KNOWLEDGE (POST-FLIGHT):
  - INERTIAL ATTITUDE OF S/C AXES KNOWN TO WITHIN 0.03°

TIMED - IDI

MOUNTING AND FOV

- THE IDI SENSOR APERTURES FACE ALONG AND ARE ALIGNED WITH THE S/C VELOCITY VECTOR
- A FIRST SURFACE MIRROR (APPROX. 2.5 CM DIA.) IS TEMPORARILY ATTACHED TO THE PRIMARY DRIFT SENSOR TO MEASURE IDI ALIGNMENT IN PITCH AND YAW AXES
- ROLL AXIS ALIGNMENT IS CONTROLLED BY THE INSTRUMENT/SPACECRAFT MOUNTING SURFACE AND IS NOT MEASURED ON THE S/C
- PLACEMENT - WITHIN 0.5° OF S/C RAM AXIS
- KNOWLEDGE - 0.1°
- IDI MOUNTS TO A FLAT S/C SURFACE WITH SIX M5 BOLTS
- THE INSTRUMENT APERTURE PLANE OVERHANGS (INTERSECTS WITH) THE MOUNTING PLANE (SEE INSTRUMENT OUTLINE)
- IDI SHOULD BE THE MOST FORWARD MOUNTED INSTRUMENT AND SHOULD HAVE AN UNOBSTRUCTED CONICAL FOV OF 45° HALF ANGLE CENTERED AROUND THE VELOCITY VECTOR AND ORIGINATING AT THE EDGE OF THE INSTRUMENT APERTURE PLANE

TIMED - IDI

TECHNOLOGY RISK AREAS

- RAYTHEON TMC2310 FFT PROCESSOR
  - NO UTD FLIGHT HISTORY
  - MIL-STD-883 VERSION AVAILABLE
  - RAD/TESTING OF ANOTHER PART USING SAME MANUFACTURING PROCESS SHOWS TOTAL DOSE >50 KRADS
  - DSP IMPLEMENTATION FOR FALLBACK OPTION

- ACTEL FIELD PROGRAMMABLE GATE ARRAY (FPGA)
  - NO UTD FLIGHT HISTORY
  - MIL-STD-883 AND DESC SMD VERSIONS AVAILABLE
  - EVIDENCE OF ACCEPTABLE TOTAL DOSE TOLERANCE
  - EXTENSIVE RELIABILITY TESTING PERFORMED
  - CD4000 SERIES CMOS FOR FALLBACK OPTION

- UTD CONSENSUS
  - LOW RISK

INSTRUMENT ACQUISITION

- INSTRUMENT DESIGN/FABRICATION/TEST AT UTD
  - PRIMARILY UTILIZING IN-HOUSE FACILITIES
  - EXPERIENCED SPACE SCIENCE TEAM
  - NO MAJOR SUBCONTRACTORS
- SOME MECHANICAL FABRICATION PERFORMED BY OUTSIDE MACHINE SHOPS - QA BY UTD
- FULL INSTITUTIONAL SUPPORT AS INDICATED BY PAST SUCCESSFUL MISSIONS
- PERSONNEL RESOURCES CAN BE SUPPLEMENTED BY LOCAL AEROSPACE INDUSTRY
- ALL MAJOR REQUIRED FACILITIES/EQUIPMENT IN PLACE
- NO MAJOR NEW TECHNOLOGY ITEMS/DEVELOPMENT HARDWARE
- ENVIRONMENTAL TESTING AT APL OR GSFC

FACILITIES AND EQUIPMENT

- CAD/CAM DRAFTING AND MACHINE SHOP
- PCB FABRICATION AND ASSEMBLY AREAS
- CONTROLLED ACCESS ASSEMBLY AND TEST AREAS
- LAMINAR FLOW BENCHES
- OIL FREE VACUUM TEST CHAMBERS
- ELECTRONIC TEST AND CHECKOUT EQUIPMENT
- CUSTOM DESIGNED ION/ELECTRON SOURCES FOR SENSOR TEST
- COMPUTATIONAL FACILITIES
  - DEDICATED VAX CLUSTER
  - LOCAL CONVEX SUPERCOMPUTERS
  - REGIONAL CRAY X/MP SUPERCOMPUTER

RELIABILITY AND QUALITY ASSURANCE

- IDI BUDGET BASED ON INFORMALLY-DOCUMENTED ANALYSES (WHERE REQUIRED)
- UTD PLAN USED ON PREVIOUS SUCCESSFUL NASA AND DOD PROGRAMS
- PLAN OVERVIEW
  - MANAGEMENT
  - PROCUREMENT REQUIREMENTS
  - AUDITS/REVIEWS
  - EEE PARTS CONTROL
    - SELECTION
    - NSPAR'S
    - CLASS C PARTS
    - PCB
    - PARTS LIST
  - MATERIALS AND PROCESSES CONTROL
    - MATERIALS LISTS
    - MRB
  - DRAWING/SPECIFICATION CONTROL
  - IDENTIFICATION AND TRACEABILITY
  - CONFIGURATION MANAGEMENT
  - DOCUMENT CHANGE CONTROL
  - CLASS D DOCUMENTATION
  - PROCUREMENT REQUIREMENTS CONTROL
  - NONCONFORMANCE CONTROL
  - ALERT INFORMATION
  - FABRICATION/WORKMANSHIP CONTROL
  - INSPECTIONS AND TESTS
  - TRAINING/CERTIFICATION

EEE PARTS

- PARTS BUDGET BASED ON GSFC-409-402, PAR FOR THE TIMED INSTRUMENTS, JUNE 11, 1993, CLASS C
- HIGHEST GRADE PART AVAILABLE CONSISTENT WITH BUDGET AND DELIVERY WILL BE USED (MIN BUY QTY, ETC.)
- PARTS FROM A QPL OR QML MANUFACTURER COMPLIANT TO MIL-STD-883C, STANDARD MILITARY DRAWING, OR THE SUPPLIER'S IN-HOUSE HI-REL PROCESSING FLOW ARE ACCEPTABLE

  EXAMPLES:

CD4XXXBKMSR	HARRIS IN-HOUSE RAD-HARD CLASS S EQUIVALENT CMOS
MP7545 UD/883	MIL-STD-883 LEVEL B COMPLIANT
2N4117A-2	INTERFET JFET WITH OPTION 2 PROCESS FLOW (JANTXV EQUIVALENT)

- NO ROUTINE DPA, QCI, OR ADDITIONAL SCREENING

ENVIRONMENTAL TESTING (T&E)

- UTD PREFERS T & E AT APL OR GSFC
- SUPPORTED BY UTD PERSONNEL AND GSE
- POSSIBLE TESTS
  - MASS PROPERTIES
  - VIBRATION
  - EMI/EMC
  - MAGNETIC MEASUREMENTS
  - THERMAL/VACUUM
  - ACOUSTICS (TEST MODEL ONLY)

TIMED - IDI

INSTRUMENT CALIBRATION

- GROUND
  - ELECTROMETER AND SWEEP VOLTAGE CALIBRATIONS TRACEABLE TO NBS
- ON-ORBIT
  - IDI HAS NO REQUIREMENTS FOR SPACECRAFT MANEUVERS
  - IN HIGH INCLINATION IONOSPHERIC COROTATION PROVIDES KNOWN VARIATION IN ION ARRIVAL ANGLE AROUND THE SATELLITE ORBIT OF ABOUT 7 DEGREES IN HALF AN ORBIT
  - CONTROLLED ROTATION OF SPACECRAFT ABOUT "PITCH" OR "YAW" AXIS WOULD PROVIDE ADDITIONAL CALIBRATION SIGNAL
  - ROTATION RATES OF 6 DEGREES PER SECOND (1 rpm) OR SLOWER ARE USEFUL

IDI GSE

BCE - BENCH CHECKOUT UNIT

- EMULATES ALL S/C ELECTRICAL INTERFACES TO IDI
- CONNECTS TO PC/AT COMPUTER FOR DATA ANALYSIS/DISPLAY/BENCH TEST

SU - STIMULATION UNIT

- SMALL, BATTERY-POWERED, SENSOR STIMULATION

STE - SPECIAL TEST EQUIPMENT

- PC/AT COMPUTER WITH COMMAND/DATA INTERFACE TO S/C GSE
- SOFTWARE FOR RETRIEVING IDI DATA PACKETS, AUTOMATED TESTS, DATA ANALYSIS/DISPLAY

GSE SOFTWARE

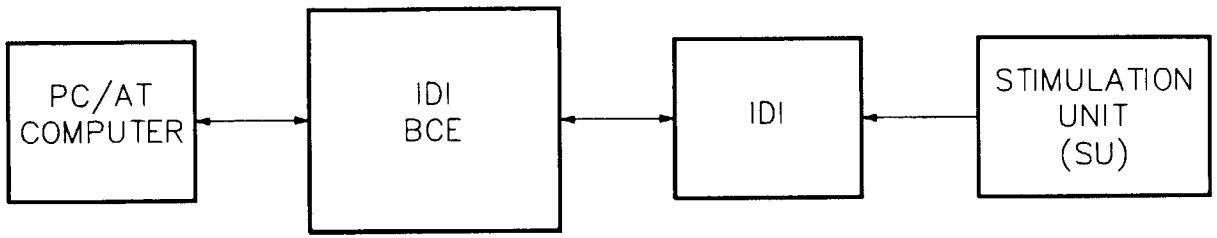
- MENU-DRIVEN INSTRUMENT COMMANDS/TEST SETUP
- INSTRUMENT DATA RETRIEVAL/STORAGE
- CRT AND HARD COPY FORMATTED DATA DISPLAY
- PATTERNED AFTER EXISTING DMSP GSE SOFTWARE (CODED IN "C")

IDI STIMULUS

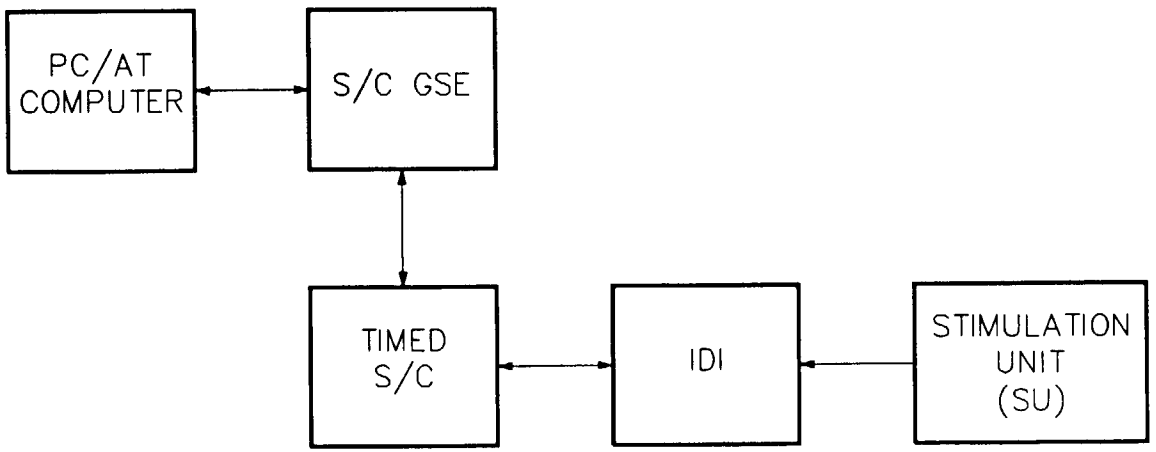
The IDI Stimulation unit (SU) is a small, battery-powered unit that is used to inject test currents into the sensors via test probes that screw into the sensor face. The SU case will be grounded if it is remotely located (within 3 or 4 feet of the sensor aperture plane) or connected to aperture potential(SENPOT) if the SU is attached to the sensor face. A 9-pin Cannon-D connector, accessible from in front of the aperture plane, will be used to provide buffered synchronization signals to the SU. No other connections to the SU are required.

The SU will be used only during a few designated tests after S/C integration; e.g., at initial integration, after S/C environmental testing, etc. It will not be used during S/C thermal vacuum tests. Functional and aliveness tests without stimulation will be used at other times.

IDI TEST CONFIGURATIONS



IDI BENCH TEST CONFIGURATION



IDI TEST CONFIGURATION
AFTER S/C INTEGRATION

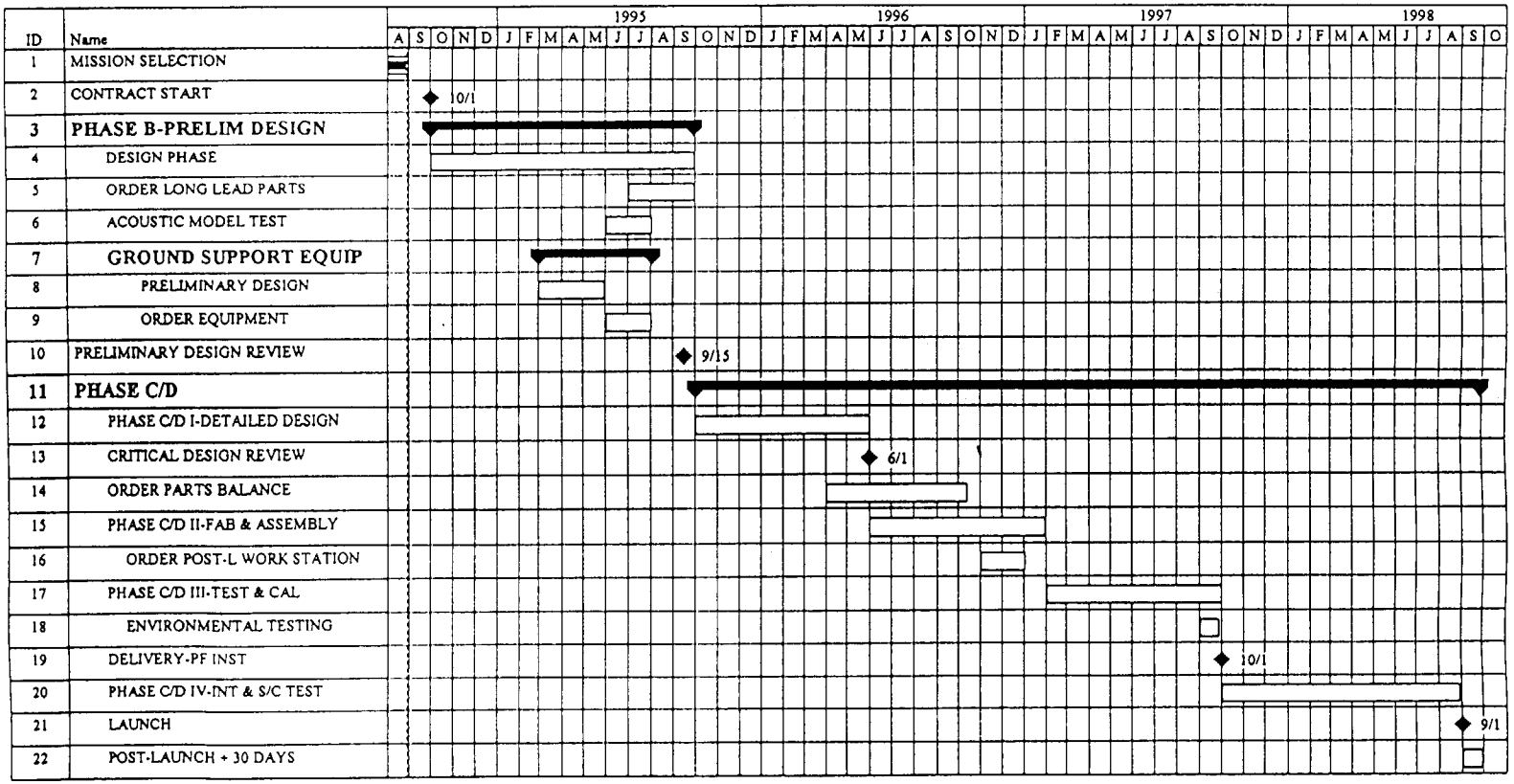
DATA CENTER INTERACTIONS

- DATA CENTER PROVIDES
  - — TIME ORDERED DATA PACKETS
  - — TIME TAGGED ORBIT/ATTITUDE DATA
- INVESTIGATOR SUPPLIES
  - — LEVEL 0 SOFTWARE
    IDI TELEMETRY PACKETS
  - — LEVEL 1 SOFTWARE
    ELECTROMETER OUTPUTS CORRECTED FOR SENSITIVITY
  - — LEVEL 2
    GEOPHYSICAL DATA
  - — LEVEL 3
    GLOBAL BIN AVERAGES
  - — LEVEL 4
    DERIVED HIGH LATITUDE CONVECTION PATTERN
- QUALITY FLAGS ON LEVEL 2 DATA AND ABOVE
- INTERACTIVE INTERFACE TO DATA CATALOGS FOR LEVEL 2 AND ABOVE
- DATA ACCESS FROM CD ROMS AND HARD DISK

TIMED - IDI

UTD PHASE C/D SCHEDULE

TIMED UTD/IDI SCHEDULE



TIMED - IDI

PHASE B/C/D BUDGET
- $K -

- ORIGINAL PROPOSAL

FIRST UNIT	-	2,414	
SECOND UNIT	-	610	
CONTINGENCY	-	0	
TOTAL		3,024	(FY92$)

- CURRENT PLAN

	FY95	FY96	FY97	FY98	TOTAL
IDI	626	648	630	170	2,074

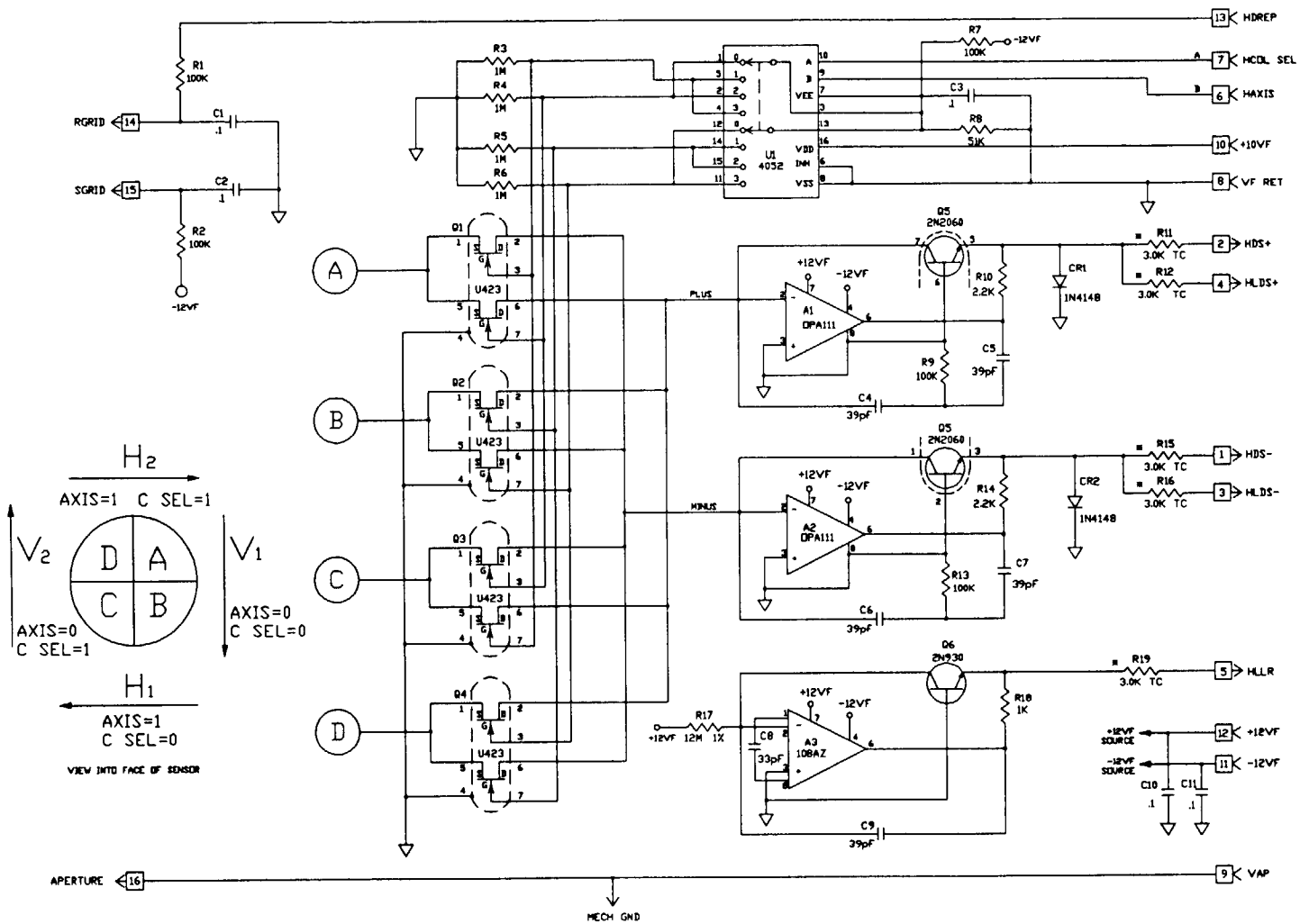
  - 1 P/F UNIT
  - FY 94$
  - REPLACE RPMA WITH RPA/PP
  - 3 YEAR C/D
  - CLASS D DOCUMENTATION
  - NO CONTINGENCY

APPENDIX

SCHEMATICS

1. HDM ELECTROMETER
2. HDM AMPLIFIER
3. ION TRAP LOG ELECTROMETER
4. TIMED PP ELECTROMETER
5. TIMED RPA ELECTROMETER
6. TIMED SENPOT CIRCUIT
7. DIGITAL/ANALOG BOARD
8. TIMED DATA SEL A/D
9. OUTPUT DATA BOARD
10. TIMED TIME CODE MUX
11. TIMED RPA AMPLIFIER
12. TIMED PPE AMPLIFIER
13. LOW PASS FILTERS
14. HOUSEKEEPING DATA SELECT
15. DIGITAL DECODE BOARD
16. VDM ELECTROMETER
17. VDM AMPLIFIER
18. IDI POWER SUPPLIES
19. FFT BOARD
20. MPU BOARD
21. 1553B CIRCUIT

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



FILE HDM-1S

NOTES:
1. = DENOTES TEMPERTURE COMPENSATION RESISTOR
2. MATCH R11 AND R15 TO WITHIN ONE OHM IF POSSIBLE

QTY	QTY	QTY	ITEM	UTD PART NO.	MFG'R PART NO.	NOMENCLATURE OR DESCRIPTION	CODE IDENT

PARTS LIST

UNLESS OTHERWISE NOTED:
ALL DIMENSIONS ARE IN INCHES
DIMENSIONS & TOLERANCES PER ANSI Y14.5
ANGLES ±1/2°
MACHINE FINISH
DECIMALS: .XXX = ±.010
.XX = ±.02
REMOVE ALL BURRS & SHARP EDGES
THIRD ANGLE PROJECTION

AUTHENTICATION	NAME	DATE
DRN	RL BICKEL	01/28/94
DSGN	RL BICKEL	09/30/93
APP		
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SCHEMATIC
HDM ELECTROMETER

C:\TIMED\HDM-1S TIMED

SIZE	CODE IDENT	DWG NO.	REV
C	14614		

SCALE

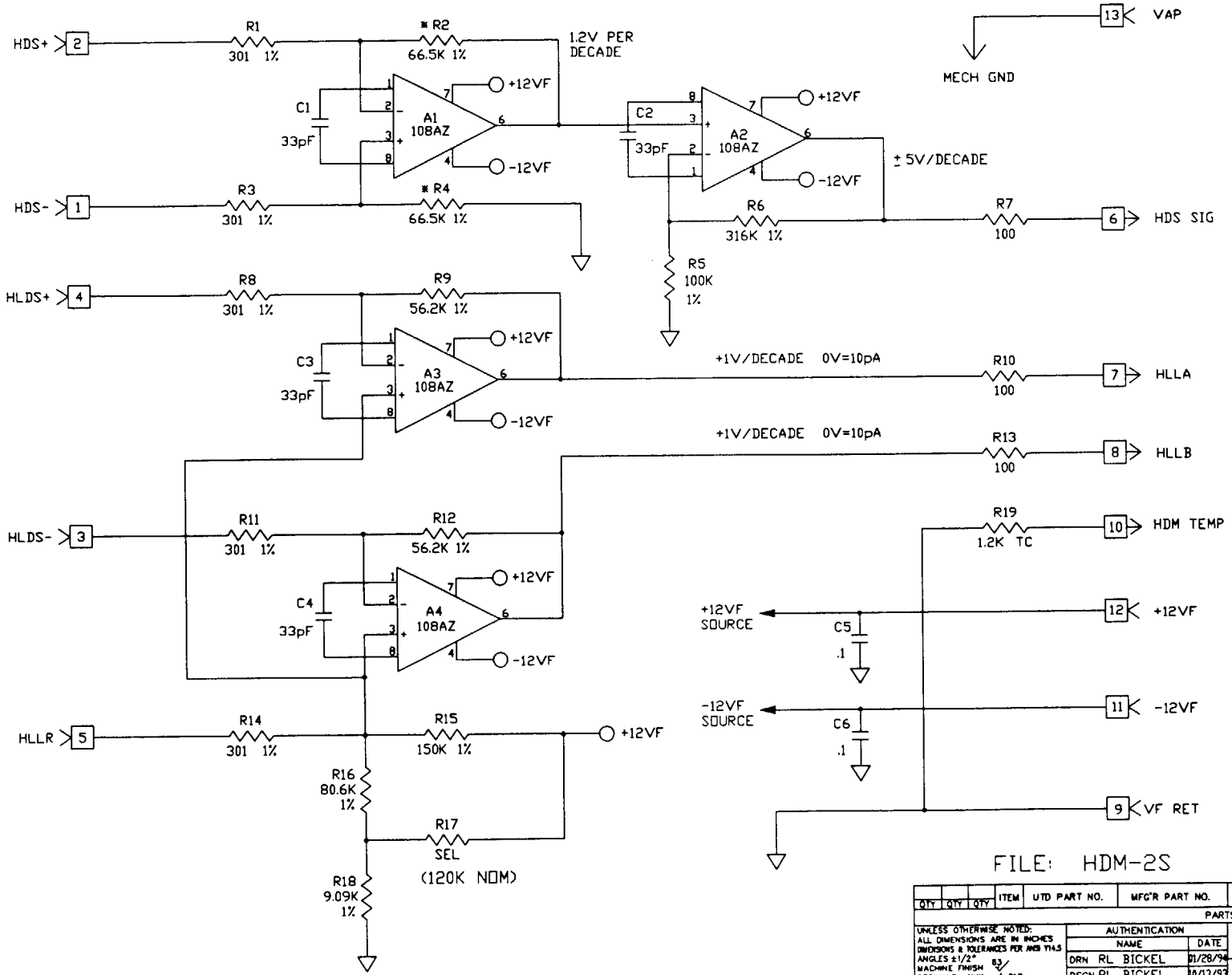
SHEET 1 OF 1

MATERIAL *****

FINISH *****

QTY	NEXT ASSY	QTY	USED ON
APPLICATION			

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



FILE: HDM-2S

* NOTE: MATCH R2 AND R4 TO WITHIN 20 OHMS IF POSSIBLE.

QTY	QTY	QTY	ITEM	UTD PART NO.	MFG'R PART NO.	NOMENCLATURE OR DESCRIPTION	CODE IDENT

PARTS LIST

UNLESS OTHERWISE NOTED:
ALL DIMENSIONS ARE IN INCHES
DIMENSIONS & TOLERANCES PER ANSI Y14.5
ANGLES ±1/2°
MACHINE FINISH 63
DECIMALS: .XXX = ±.010
.XX = ±.02
REMOVE ALL BURRS & SHARP EDGES
THIRD ANGLE PROJECTION

AUTHENTICATION	NAME	DATE
DRN	RL BICKEL	01/28/94
DSGN	RL BICKEL	10/13/93
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SCHEMATIC
HDM AMPLIFIER

C:\TIMED\HDM-2S TIMED

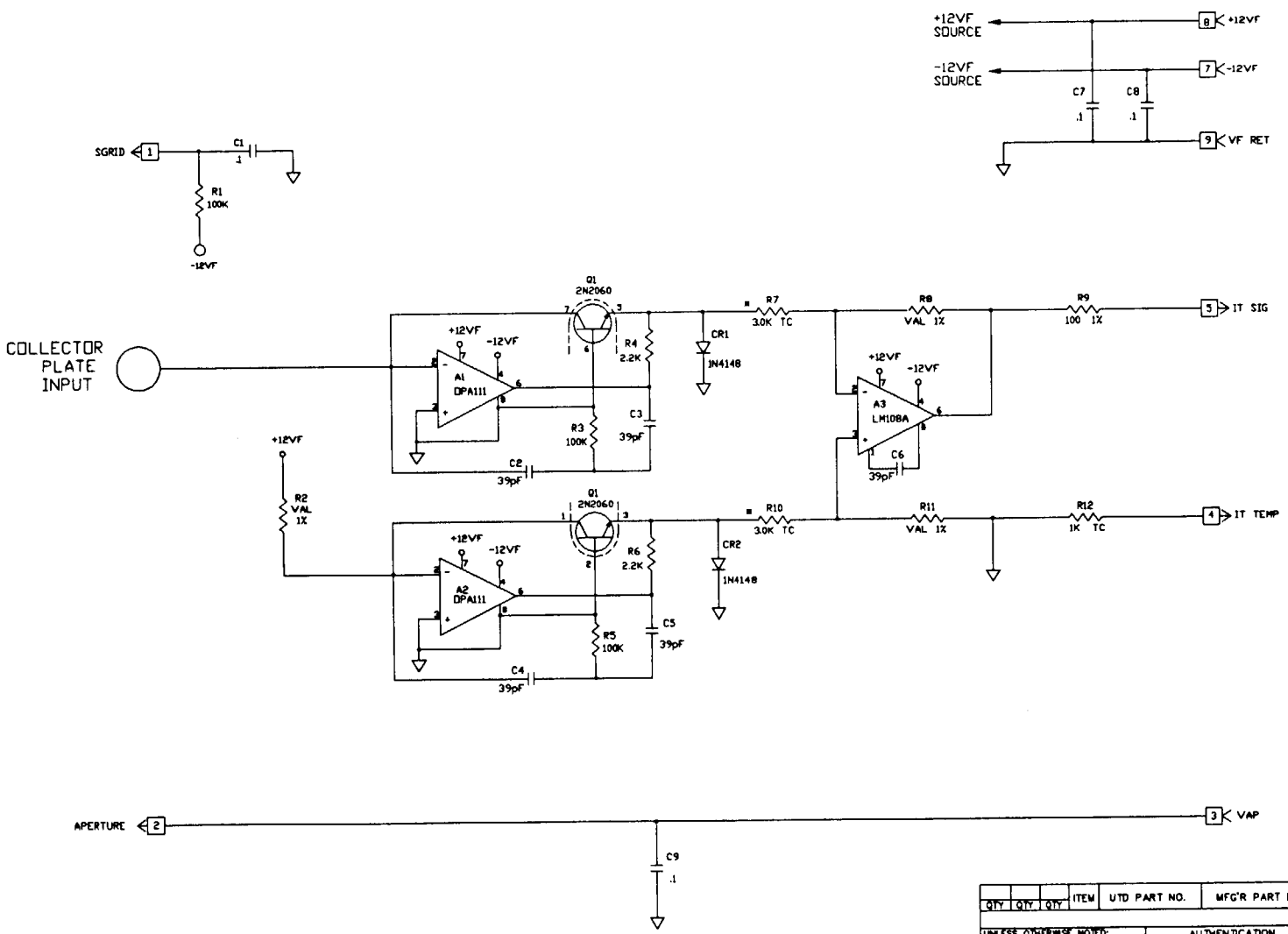
MATERIAL *****
FINISH *****

SIZE	CODE IDENT	DWG NO.	REV
C	14614		

SCALE | SHEET 1 OF 1

QTY	NEXT ASSY	QTY	USED ON
APPLICATION			

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



FILE IT-1S

NOTES:
1. ■ DENOTES TEMPERTURE COMPENSATION RESISTOR
2. MATCH R11 AND R15 TO WITHIN ONE OHM IF POSSIBLE

QTY	QTY	QTY	ITEM	UTD PART NO.	MFG'R PART NO.	NOMENCLATURE OR DESCRIPTION	CODE IDENT

PARTS LIST

UNLESS OTHERWISE NOTED:
ALL DIMENSIONS ARE IN INCHES
DIMENSIONS & TOLERANCES PER ANSI Y14.5
ANGLES ±1/2°
MACHINE FINISH 63
DECIMALS: .XXX = ±.010
.XX = ±.02
REMOVE ALL BURRS & SHARP EDGES
THIRD ANGLE PROJECTION

MATERIAL *****

FINISH *****

AUTHENTICATION	NAME	DATE
DRN	RL BICKEL	01/28/94
DSGN	RL BICKEL	10/26/93
APP		
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SCHEMATIC
ION TRAP LOG ELECTROMETER

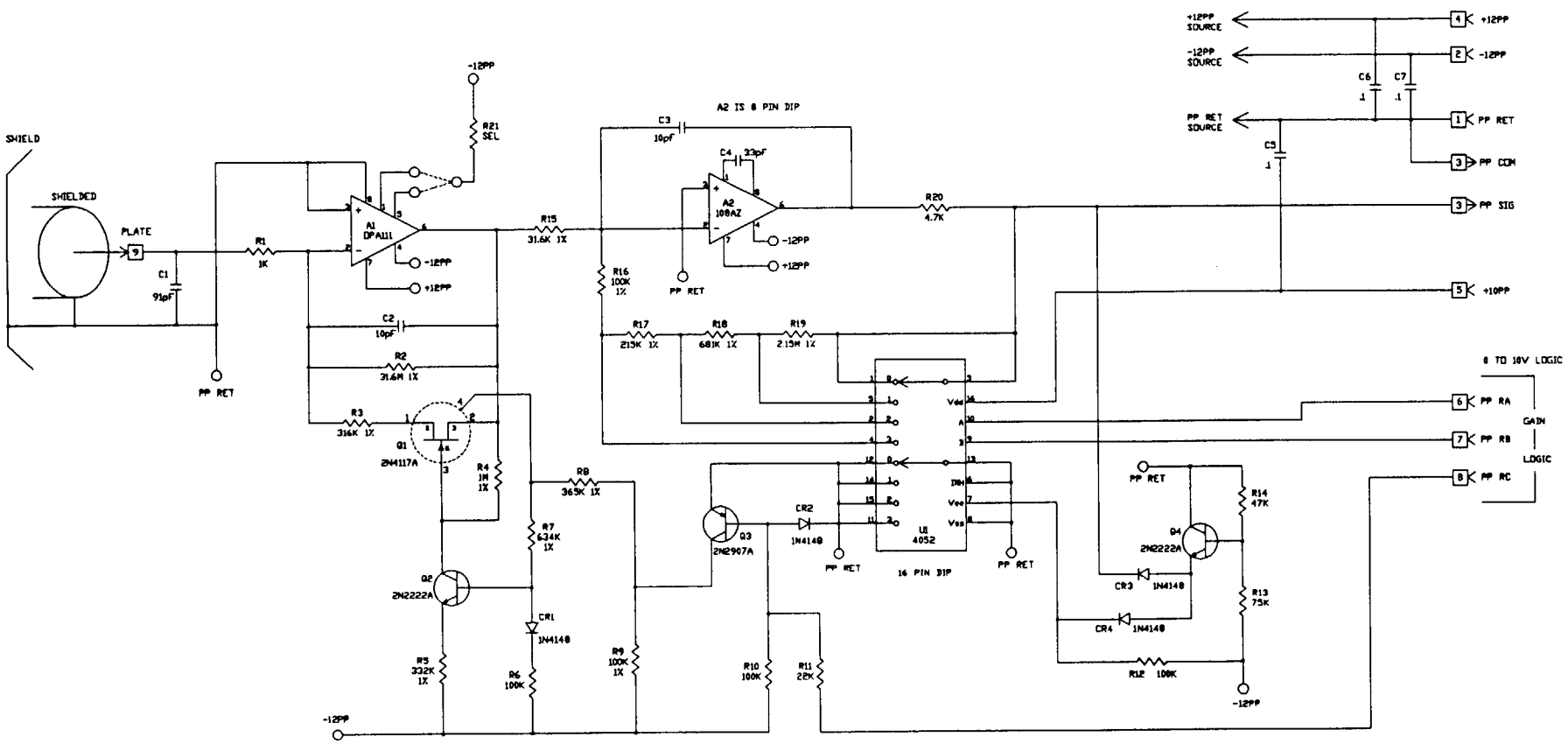
C:\TIMED\IT-1S TIMED

SIZE	CODE IDENT	DWG NO.	REV
C	14614		

SCALE | SHEET 1 OF 1

QTY	NEXT ASSY	QTY	USED ON
APPLICATION			

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	GENERAL REVISION FROM EM	04/28/93	DRZ



GAIN LOGIC C	B	A	CURRENT/VOLT
0	0	0	.316 nA/V
0	0	1	1.0 nA/V
0	1	0	3.16 nA/V
0	1	1	10 nA/V
1	0	0	31.6 nA/V
1	0	1	100 nA/V
1	1	0	316 nA/V
1	1	1	1000 nA/V

FILE: PPES

QTY	QTY	QTY	ITEM	UTD PART NO.	MFG'R PART NO.	NOMENCLATURE OR DESCRIPTION	CODE IDENT

PARTS LIST

UNLESS OTHERWISE NOTED:
ALL DIMENSIONS ARE IN INCHES
DIMENSIONS & TOLERANCES PER ANSI Y14.5
ANGLES ±1/2° 63
MACHINE FINISH
DECIMALS: .XXX = ±.010
.XX = ±.02
REMOVE ALL BURRS & SHARP EDGES
THIRD ANGLE PROJECTION

AUTHENTICATION	NAME	DATE
DRN	RL BICKEL	01/28/94
DSGN	RL BICKEL	04/18/92
APP		
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SCHEMATIC
TIMED PP ELECTROMETER

C:\TIMED\PPES TIMED

SIZE	CODE IDENT	DWG NO.	REV
C	14614		

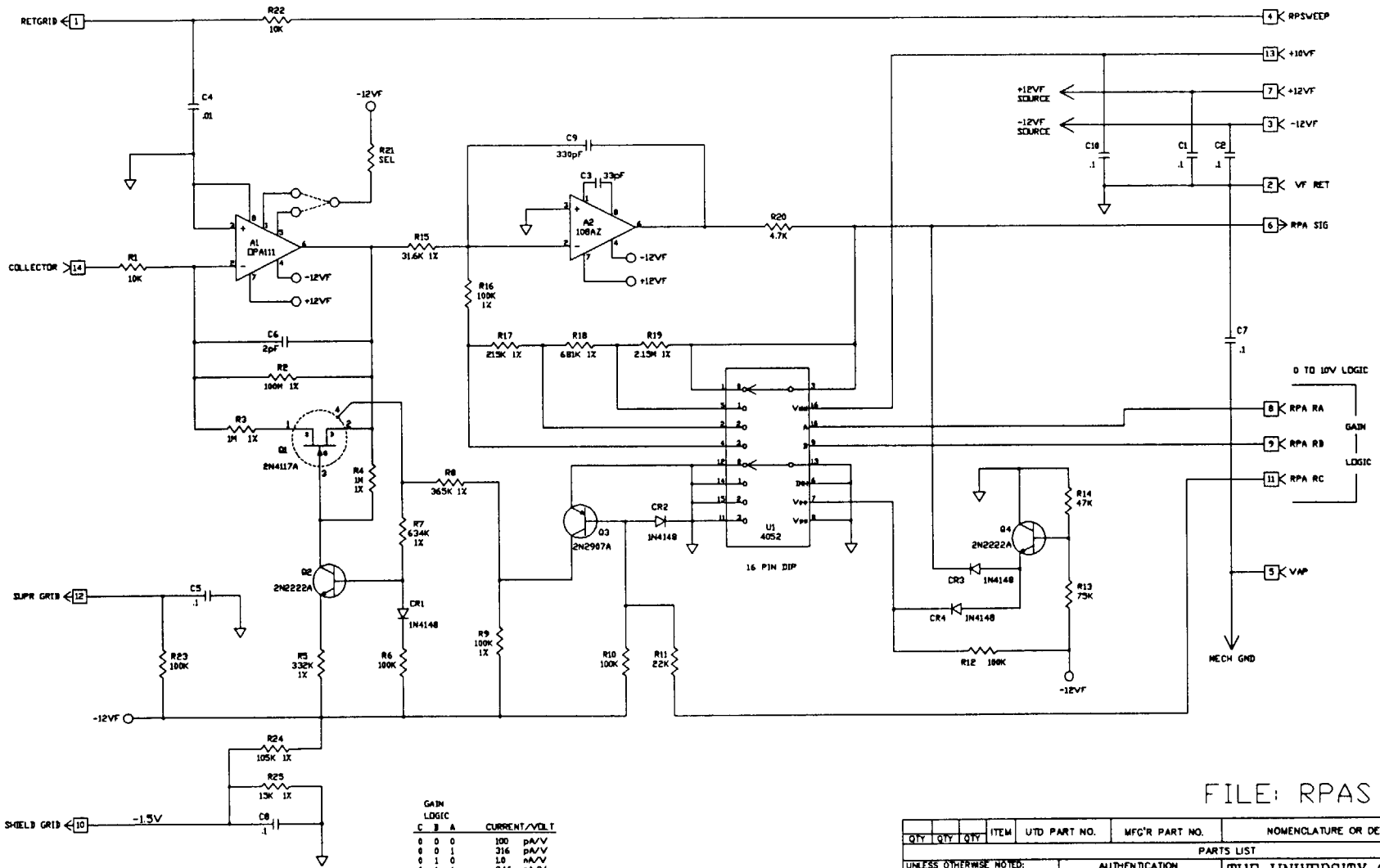
SCALE | SHEET 1 OF 1

MATERIAL *****

FINISH *****

QTY	NEXT ASSY	QTY	USED ON
APPLICATION			

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	GENERAL REVISION FROM EM	03/24/93	DRZ



GAIN LOGIC C	B	A	CURRENT/VOLT	
0	0	0	100	pA/V
0	0	1	316	pA/V
0	1	0	1.0	nA/V
0	1	1	3.16	nA/V
1	0	0	10	nA/V
1	0	1	31.6	nA/V
1	1	0	100	nA/V
1	1	1	316	nA/V

FILE: RPAS

QTY	QTY	QTY	ITEM	UTD PART NO.	MFG'R PART NO.	NOMENCLATURE OR DESCRIPTION	CODE IDENT

PARTS LIST

UNLESS OTHERWISE NOTED:
ALL DIMENSIONS ARE IN INCHES
DIMENSIONS & TOLERANCES PER ANSI Y14.5
ANGLES ±1/2°
MACHINE FINISH 63
DECIMALS: .XXX = ±.010
.XX = ±.02
REMOVE ALL BURRS & SHARP EDGES
THIRD ANGLE PROJECTION

AUTHENTICATION	NAME	DATE
DRN	RL BICKEL	02/03/94
DSGN	D ZUCCARO	04/01/92
APP		
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APP		

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SCHEMATIC
TIMED RPA ELECTROMETER

C:\TIMED\RPAS TIMED

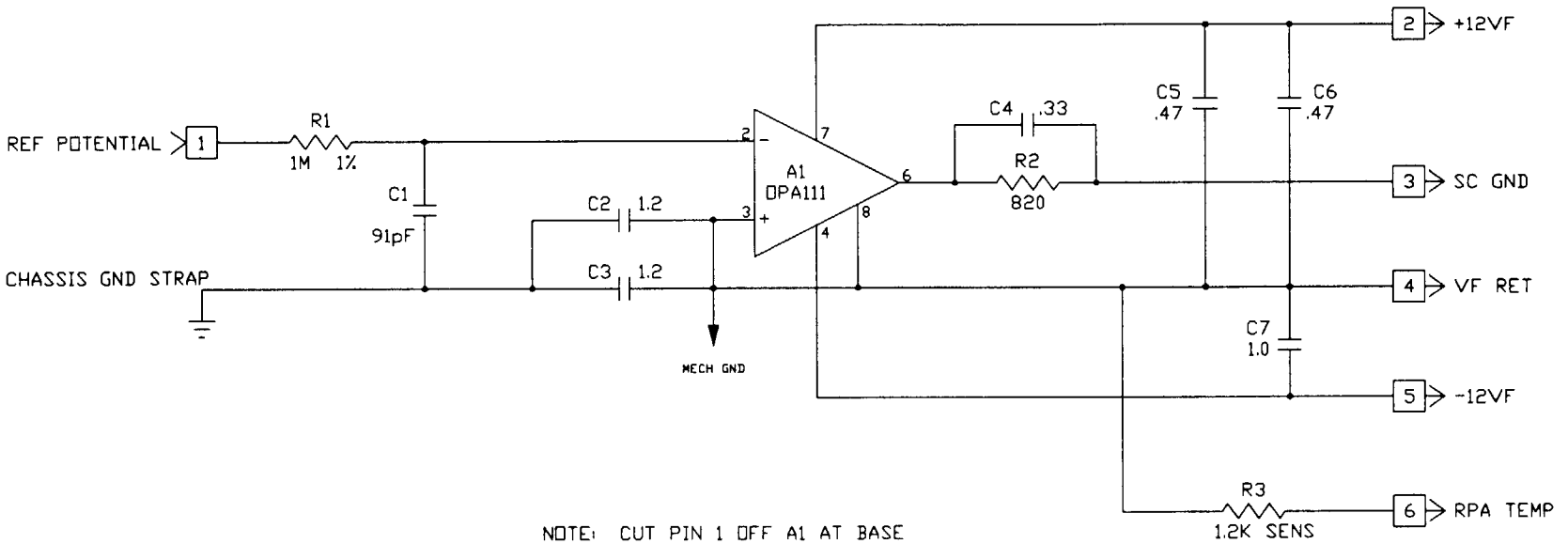
SIZE	CODE IDENT	DWG NO.	REV
C	14614		

SCALE | SHEET 1 OF 1

QTY	NEXT ASSY	QTY	USED ON
APPLICATION			

MATERIAL *****
FINISH *****

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	GENERAL REVISION FROM EM	03/23/93	DRZ



NOTE: CUT PIN 1 OFF A1 AT BASE
BEFORE INSTALLATION

FILE: SPC-1S

QTY	QTY	QTY	ITEM	UTD PART NO.	MFG'R PART NO.	NOMENCLATURE OR DESCRIPTION	CODE IDENT

PARTS LIST

UNLESS OTHERWISE NOTED:
ALL DIMENSIONS ARE IN INCHES
DIMENSIONS & TOLERANCES PER ANSI Y14.5
ANGLES ±1/2°
MACHINE FINISH 63
DECIMALS: .XXX = ±.010
.XX = ±.02
REMOVE ALL BURRS & SHARP EDGES
THIRD ANGLE PROJECTION

AUTHENTICATION	NAME	DATE
DRN	RL BICKEL	02/03/94
DSGN	D ZUCCARO	04/07/92
APP		
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APP		
APP		

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SCHEMATIC
TIMED SENPOT CIRCUIT

TIMED\SPC-1S TIMED

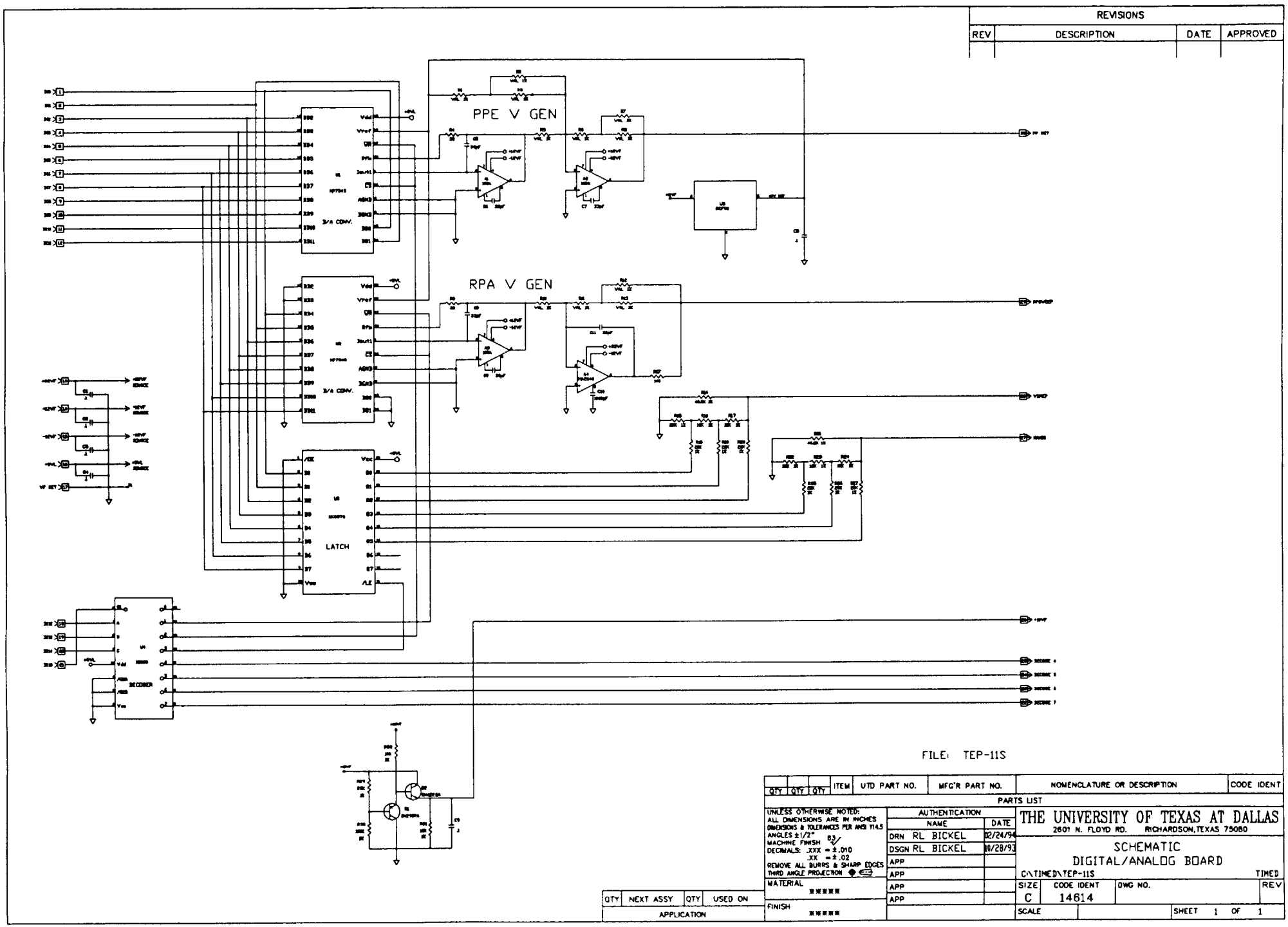
SIZE	CODE IDENT	DWG NO.	REV
C	14614		

SCALE | SHEET 1 OF 1

MATERIAL *****

FINISH *****

QTY	NEXT ASSY	QTY	USED ON
APPLICATION			



REVISIONS			
REV	DESCRIPTION	DATE	APPROVED

FILE: TEP-11S

QTY	QTY	QTY	ITEM	UTD PART NO.	MFG'R PART NO.	NOMENCLATURE OR DESCRIPTION	CODE IDENT

PARTS LIST

UNLESS OTHERWISE NOTED:
ALL DIMENSIONS ARE IN INCHES
DIMENSIONS & TOLERANCES PER ANSI Y14.5
ANGLES ±1/2°
MACHINE FINISH 63
DECIMALS: .XXX = ±.010
.XX = ±.02
REMOVE ALL BURRS & SHARP EDGES
THIRD ANGLE PROJECTION

AUTHENTICATION	NAME	DATE
DRN	RL BICKEL	02/24/94
DSGN	RL BICKEL	10/28/93
APP		
APP		
APP		
APP		

MATERIAL *****

FINISH *****

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2601 N. FLOYD RD. RICHARDSON, TEXAS 75080

SCHEMATIC
DIGITAL/ANALOG BOARD

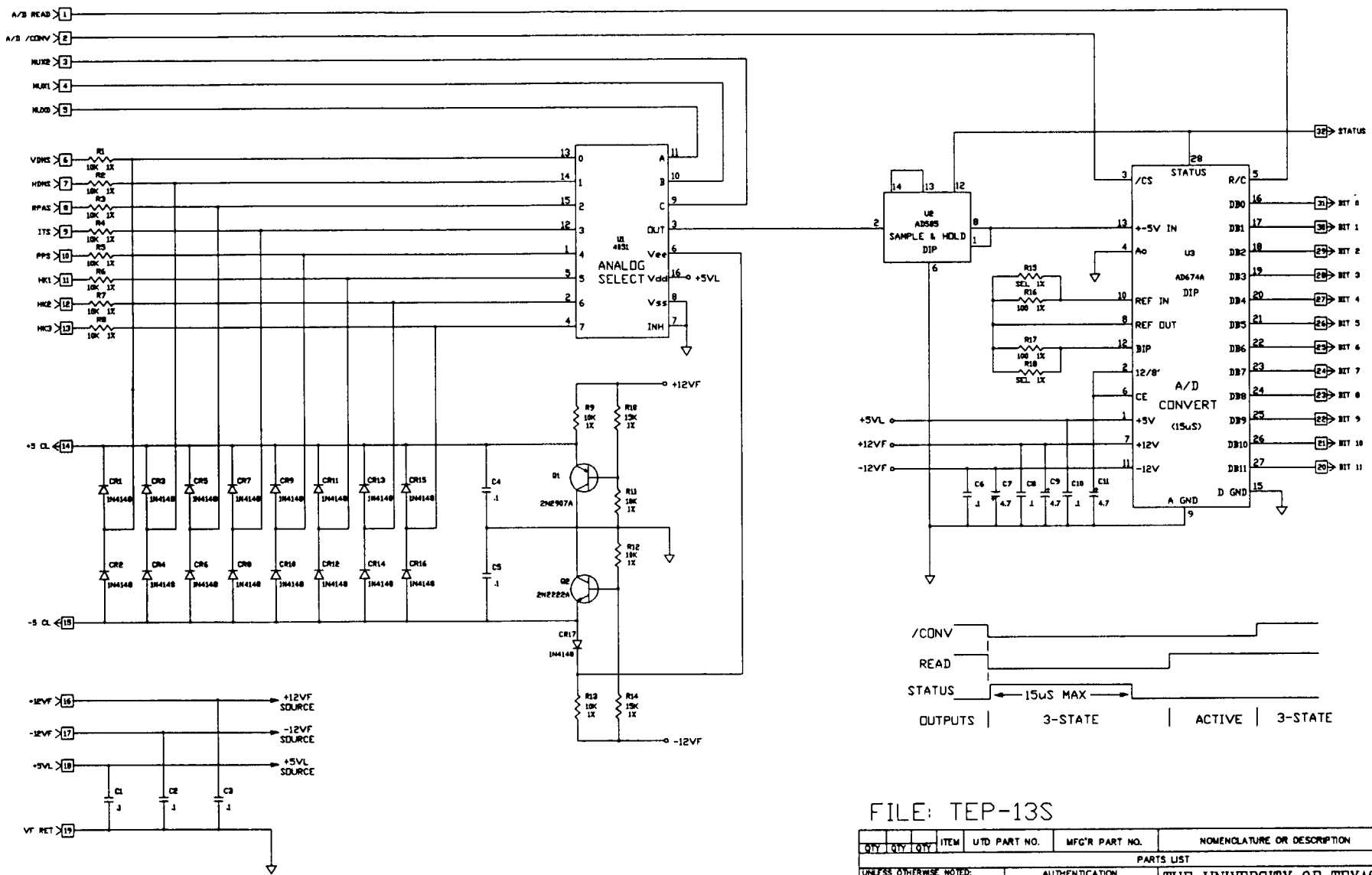
C:\TIMED\TEP-11S TIMED

SIZE	CODE IDENT	DWG NO.	REV
C	14614		

SCALE | SHEET 1 OF 1

QTY	NEXT ASSY	QTY	USED ON
APPLICATION			

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



FILE: TEP-13S

QTY	QTY	QTY	ITEM	UTD PART NO.	MFG'R PART NO.	NOMENCLATURE OR DESCRIPTION	CODE IDENT
				PARTS LIST			

UNLESS OTHERWISE NOTED:
ALL DIMENSIONS ARE IN INCHES
DIMENSIONS & TOLERANCES PER ANSI Y14.5
ANGLES ±1/2°
MACHINE FINISH 63
DECIMALS: .XXX = ±.010
.XX = ±.02
REMOVE ALL BURRS & SHARP EDGES
THIRD ANGLE PROJECTION

AUTHENTICATION	NAME	DATE
DRN	RL BICKEL	02/03/94
DSGN	RL BICKEL	11/27/93
APP		
APP		
APP		
APP		

THE UNIVERSITY OF TEXAS AT DALLAS
2601 N. FLOYD RD. RICHARDSON, TEXAS 75080

SCHEMATIC
TIMED DATA SEL A/D

TIMED

MATERIAL *****

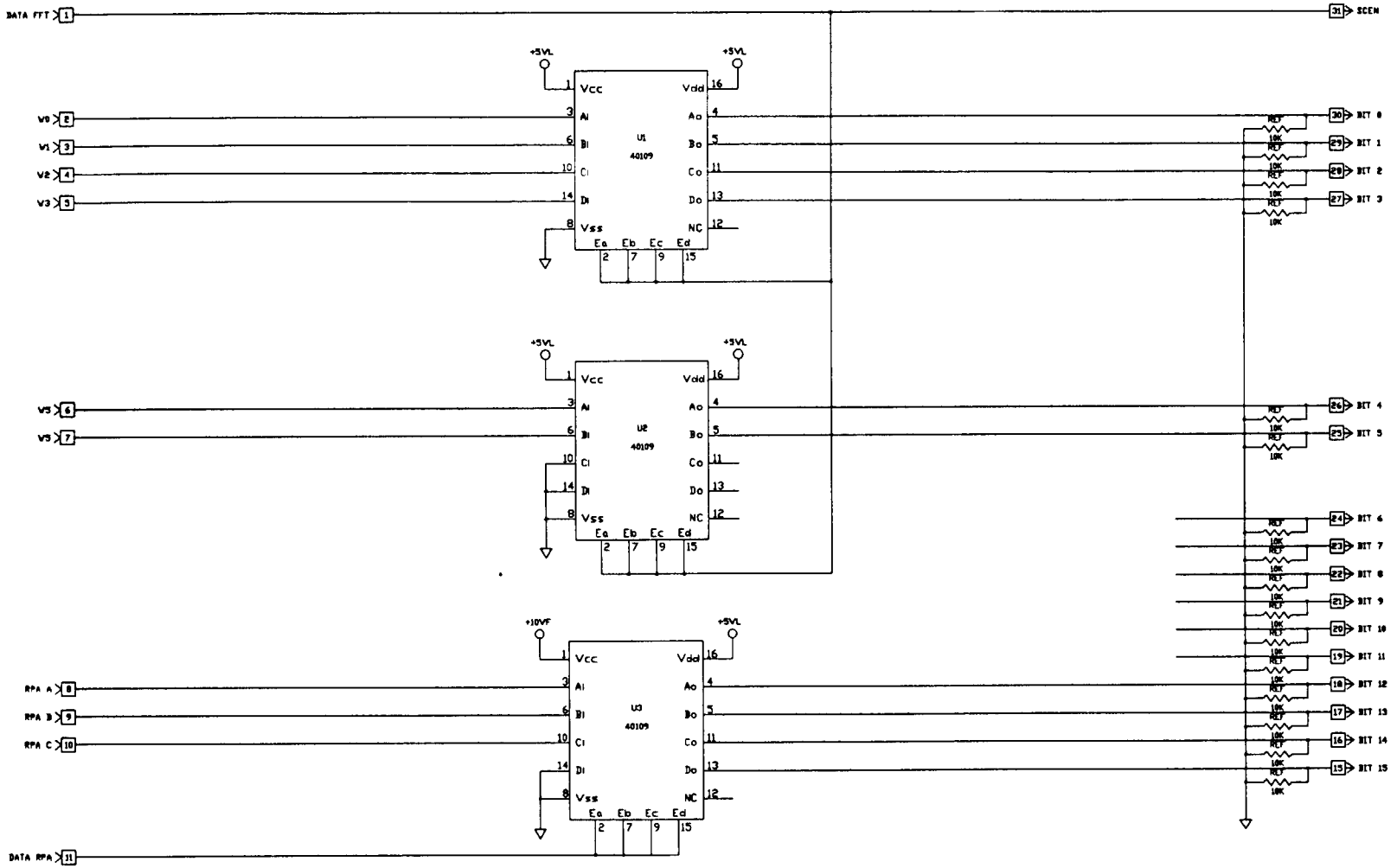
FINISH *****

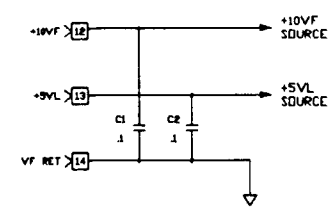
SIZE	CODE IDENT	DWG NO.	REV
C	14614		

SCALE | SHEET 1 OF 1

QTY	NEXT ASSY	QTY	USED ON
APPLICATION			

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED





FILE: TEP-15S

QTY	QTY	QTY	ITEM	UTD PART NO.	MFG'R PART NO.	NOMENCLATURE OR DESCRIPTION	CODE IDENT

PARTS LIST

UNLESS OTHERWISE NOTED:
ALL DIMENSIONS ARE IN INCHES
DIMENSIONS & TOLERANCES PER ANSI Y14.5
ANGLES ±1/2°
MACHINE FINISH 63
DECIMALS: .XXX = ±.010
.XX = ±.02
REMOVE ALL BURRS & SHARP EDGES
THIRD ANGLE PROJECTION

AUTHENTICATION	NAME	DATE
DRN	RL BICKEL	02/03/94
DSGN	RL BICKEL	01/27/94
APP		
APP		
APP		
APP		

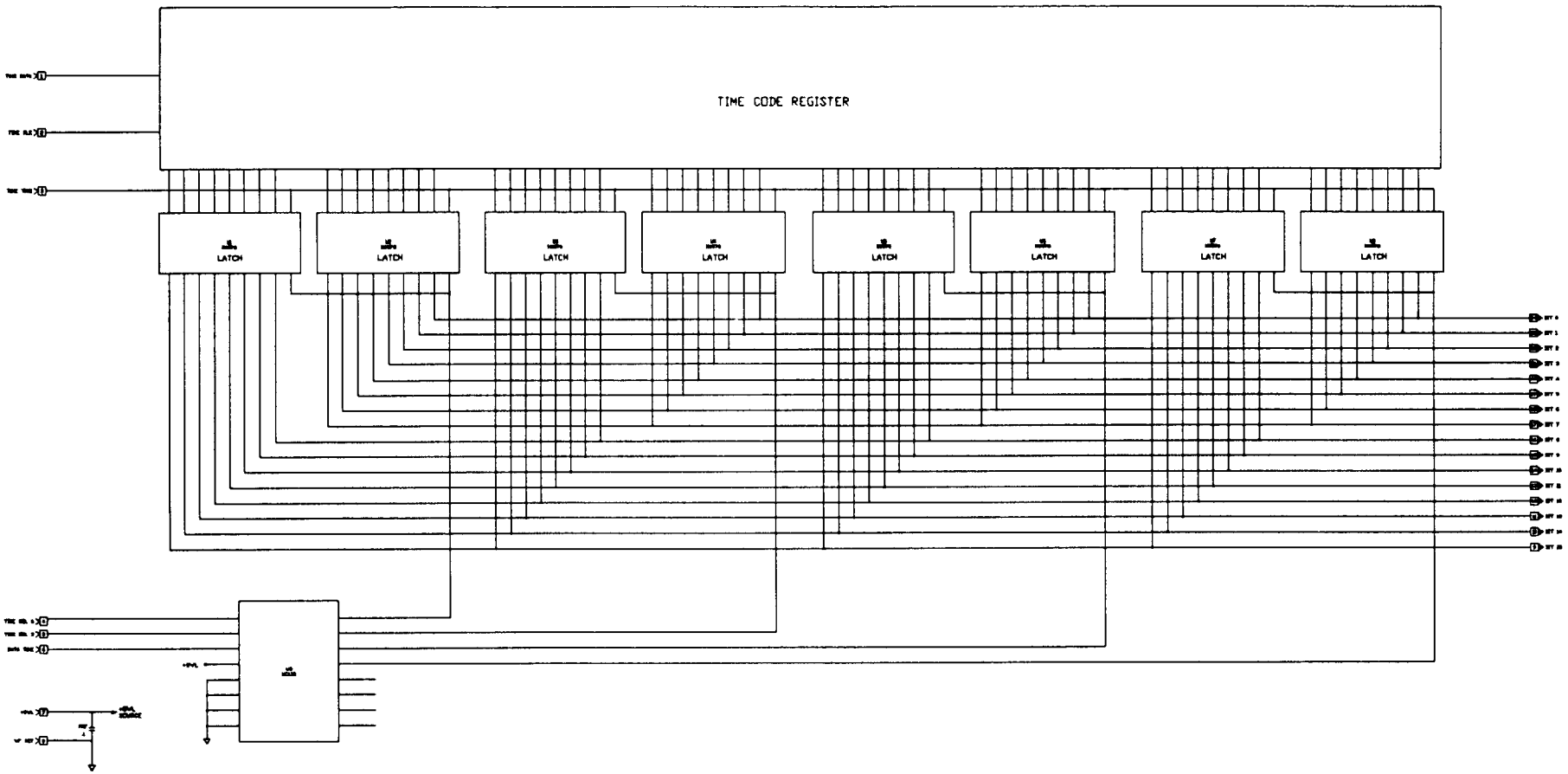
THE UNIVERSITY OF TEXAS AT DALLAS
2601 N. FLOYD RD. RICHARDSON, TEXAS 75080

SCHEMATIC
OUTPUT DATA BOARD

MATERIAL	SIZE	CODE IDENT	DWG NO.	REV
*****	C	14614		
FINISH *****	SCALE		SHEET 1 OF 1	

QTY	NEXT ASSY	QTY	USED ON
APPLICATION			

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



FILE: TEP-17S

QTY	QTY	QTY	ITEM	UTD PART NO.	MFG'R PART NO.	NOMENCLATURE OR DESCRIPTION	CODE IDENT
PARTS LIST							

UNLESS OTHERWISE NOTED:
ALL DIMENSIONS ARE IN INCHES
DIMENSIONS & TOLERANCES PER ANSI Y14.5
ANGLES ±1/2°
MACHINE FINISH
DECIMALS: .XXX = ±.010
.XX = ±.02
REMOVE ALL BURRS & SHARP EDGES
THIRD ANGLE PROJECTION

AUTHENTICATION	NAME	DATE
DRN	RL BICKEL	12/03/94
DSGN	RL BICKEL	12/02/94
APP		
APP		
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THE UNIVERSITY OF TEXAS AT DALLAS
2601 N. FLOYD RD. RICHARDSON, TEXAS 75080

SCHEMATIC
TIMED TIME CODE MUX

TIMED

MATERIAL *****

FINISH *****

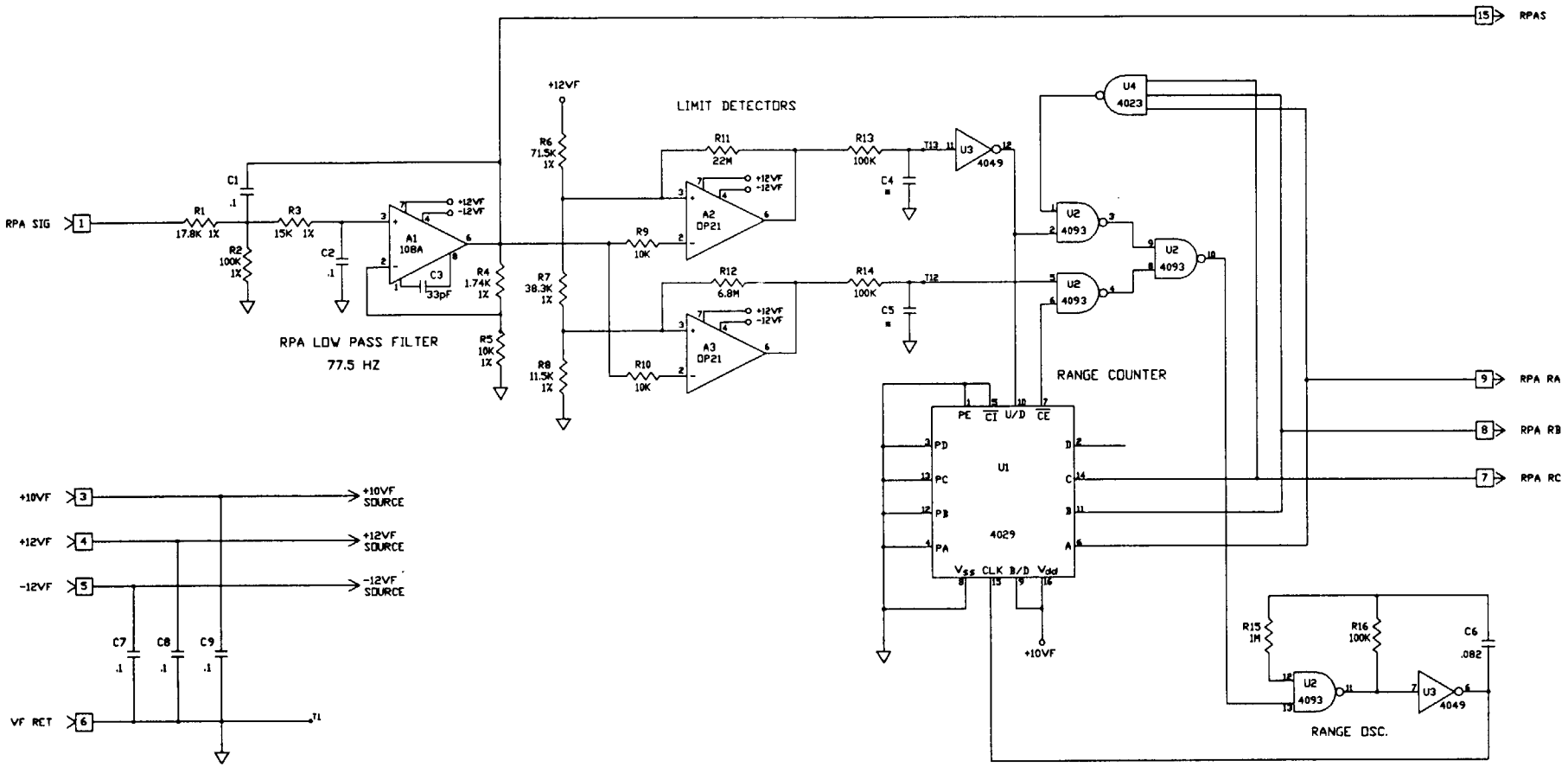
SIZE	CODE IDENT	DWG NO.	REV
C	14614		

SCALE

SHEET 1 OF 1

QTY	NEXT ASSY	QTY	USED ON
APPLICATION			

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



FILE: TEP-1S

* SELECT VALUE DURING TEST

QTY	QTY	QTY	ITEM	UTD PART NO.	MFG'R PART NO.	NOMENCLATURE OR DESCRIPTION	CODE IDENT

PARTS LIST

UNLESS OTHERWISE NOTED:
ALL DIMENSIONS ARE IN INCHES
DIMENSIONS & TOLERANCES PER ANSI Y14.5
ANGLES ±1/2°
MACHINE FINISH 63
DECIMALS: .XXX = ±.010
.XX = ±.02
REMOVE ALL BURRS & SHARP EDGES
THIRD ANGLE PROJECTION

AUTHENTICATION	NAME	DATE
DRN	R L BICKEL	02/03/94
DSGN	D ZUCCARO	03/31/92
APP		
APP		
APP		
APP		

MATERIAL *****

FINISH *****

QTY	NEXT ASSY	QTY	USED ON
APPLICATION			

THE UNIVERSITY OF TEXAS AT DALLAS
2601 N. FLOYD RD. RICHARDSON, TEXAS 75080

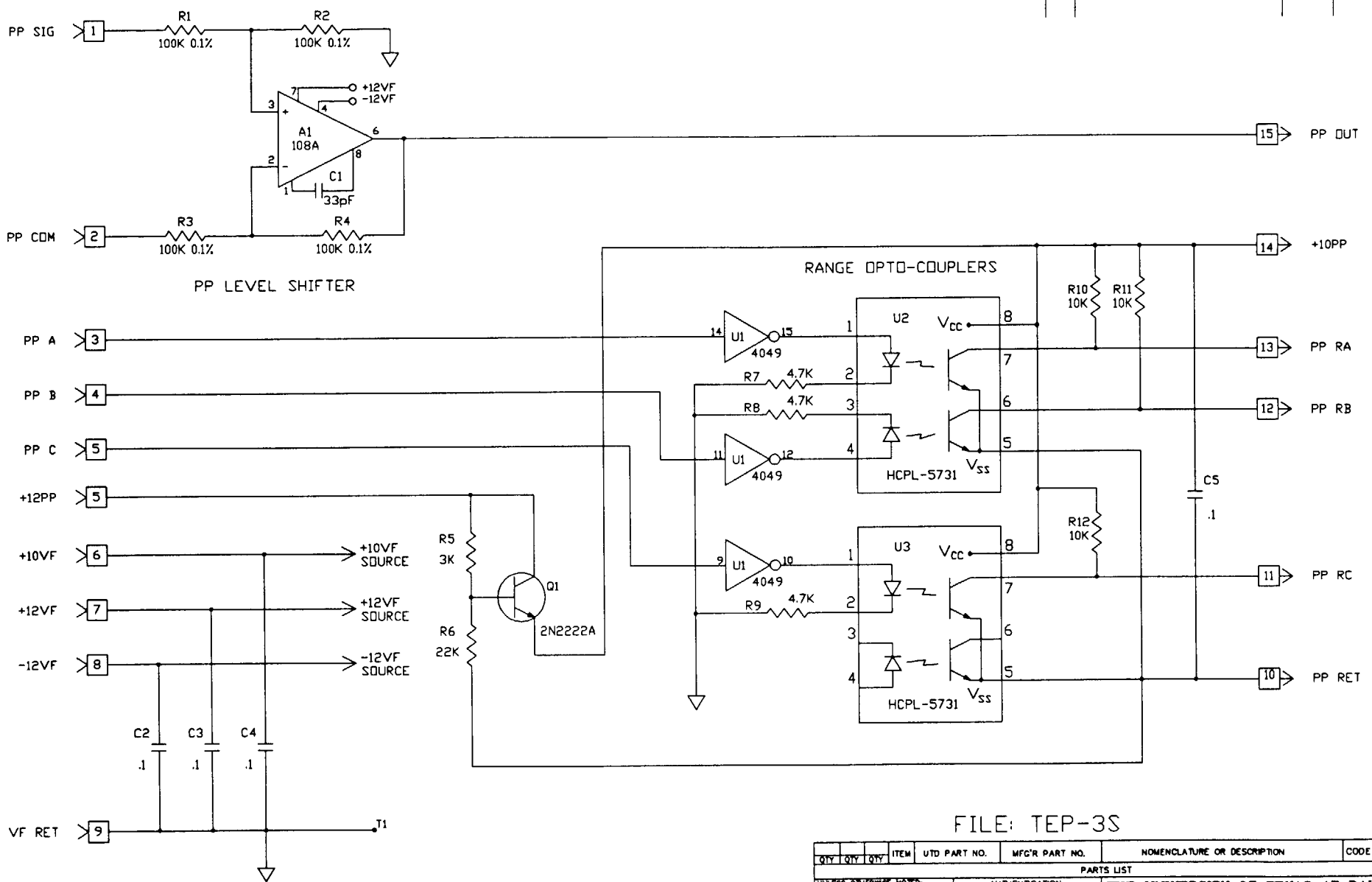
SCHEMATIC
TIMED RPA AMPLIFIER

C:\TIMED\TEP-1S TIMED

SIZE	CODE IDENT	DWG NO.	REV
C	14614		

SCALE | SHEET 1 OF 1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



FILE: TEP-3S

QTY	QTY	QTY	ITEM	UTD PART NO.	MFG'R PART NO.	NOMENCLATURE OR DESCRIPTION	CODE IDENT

PARTS LIST

UNLESS OTHERWISE NOTED:
ALL DIMENSIONS ARE IN INCHES
DIMENSIONS & TOLERANCES PER ANSI Y14.5
ANGLES ±1/2°
MACHINE FINISH 63
DECIMALS: .XXX = ±.010
.XX = ±.02
REMOVE ALL BURRS & SHARP EDGES
THIRD ANGLE PROJECTION

AUTHENTICATION	NAME	DATE
DRN	R L BICKEL	02/03/94
DSGN	D ZUCCARO	03/31/90
APP		
APP		
APP		
APP		

MATERIAL *****

FINISH *****

QTY	NEXT ASSY	QTY	USED ON
	APPLICATION		

THE UNIVERSITY OF TEXAS AT DALLAS
2601 N. FLOYD RD. RICHARDSON, TEXAS 75080

SCHEMATIC
TIMED PPE AMPLIFIER

SEP-5 TIMED

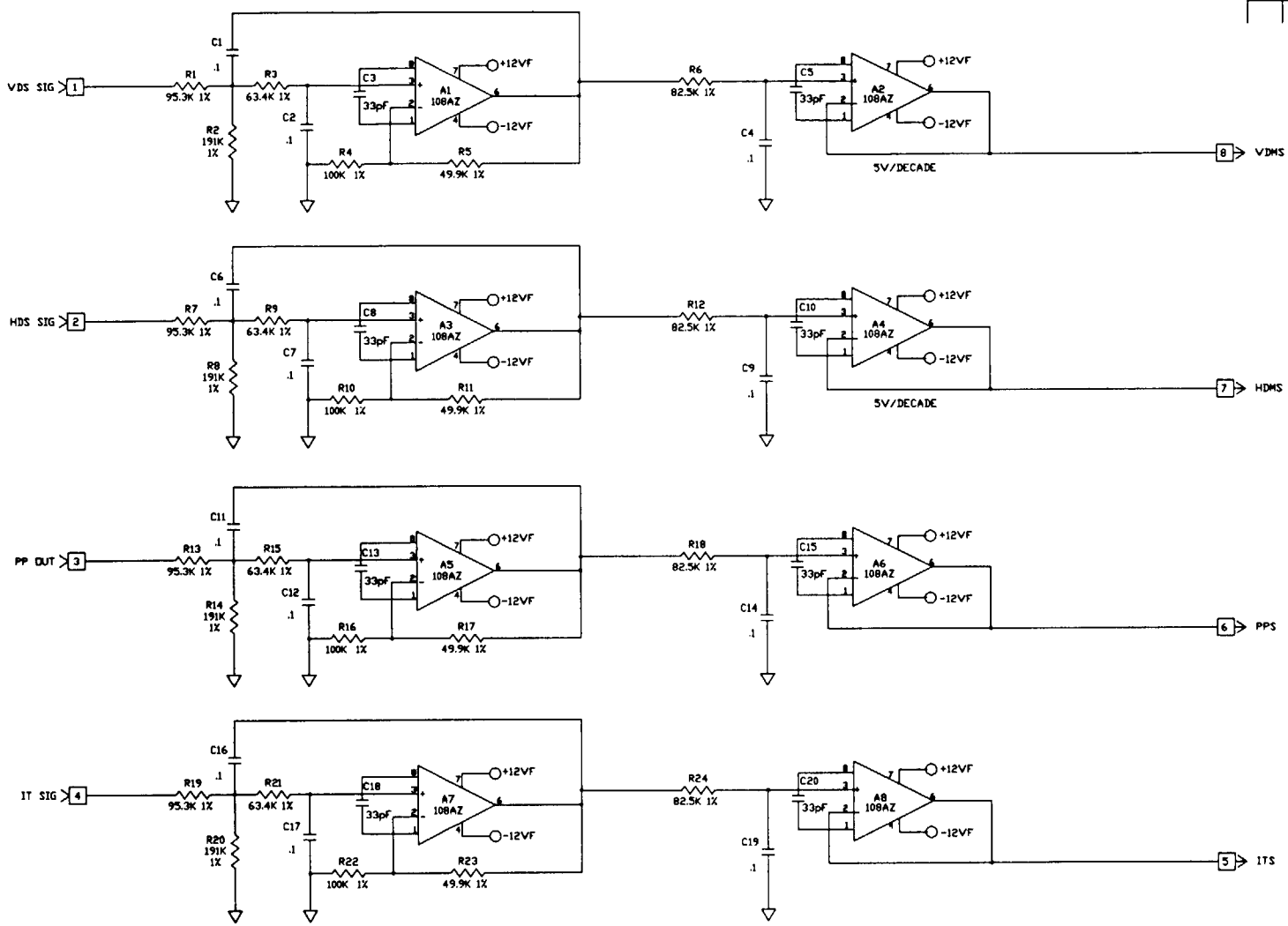
SIZE	CODE IDENT	DWG NO.	REV
C	14614		

SCALE

SHEET 1 OF 1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED

3 POLE BESSEL FILTER - 3 DB DOWN AT 16 HZ



FILE: TEP-5S

QTY	QTY	QTY	ITEM	UTD PART NO.	MFG'R PART NO.	NOMENCLATURE OR DESCRIPTION	CODE IDENT

PARTS LIST

UNLESS OTHERWISE NOTED:
ALL DIMENSIONS ARE IN INCHES
DIMENSIONS & TOLERANCES PER ANSI Y14.5
ANGLES ±1/2°
MACHINE FINISH 63
DECIMALS: .XXX = ±.010
.XX = ±.02
REMOVE ALL BURRS & SHARP EDGES
THIRD ANGLE PROJECTION

AUTHENTICATION	NAME	DATE
DRN	RL BICKEL	01/28/94
DSGN	RL BICKEL	10/29/93
APP		
APP		
APP		
APP		

THE UNIVERSITY OF TEXAS AT DALLAS
2601 N. FLOYD RD. RICHARDSON, TEXAS 75080

SCHEMATIC
LOW PASS FILTERS

C:\TIMED\TEP-5S TIMED

QTY	NEXT ASSY	QTY	USED ON
APPLICATION			

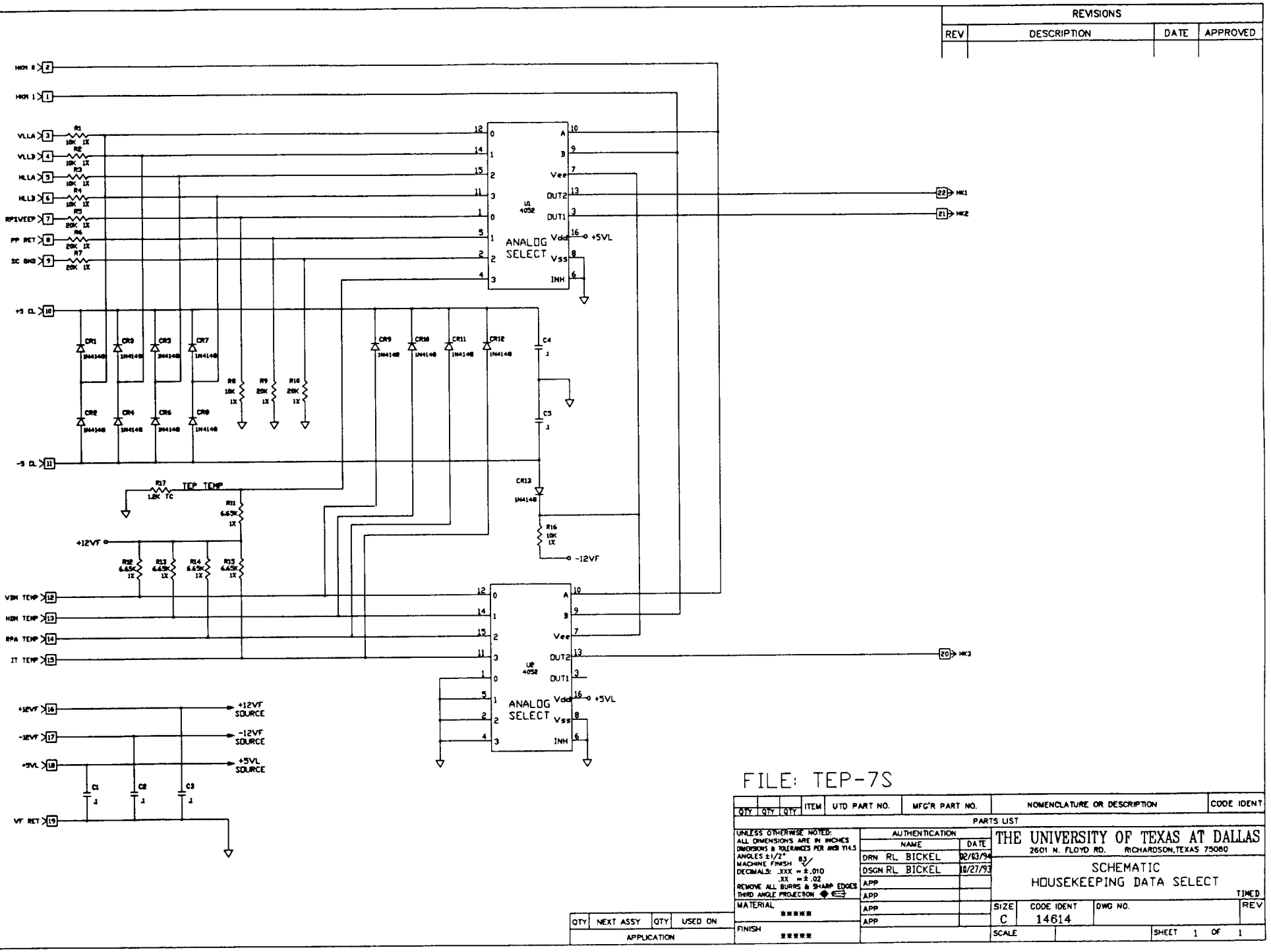
MATERIAL *****

FINISH *****

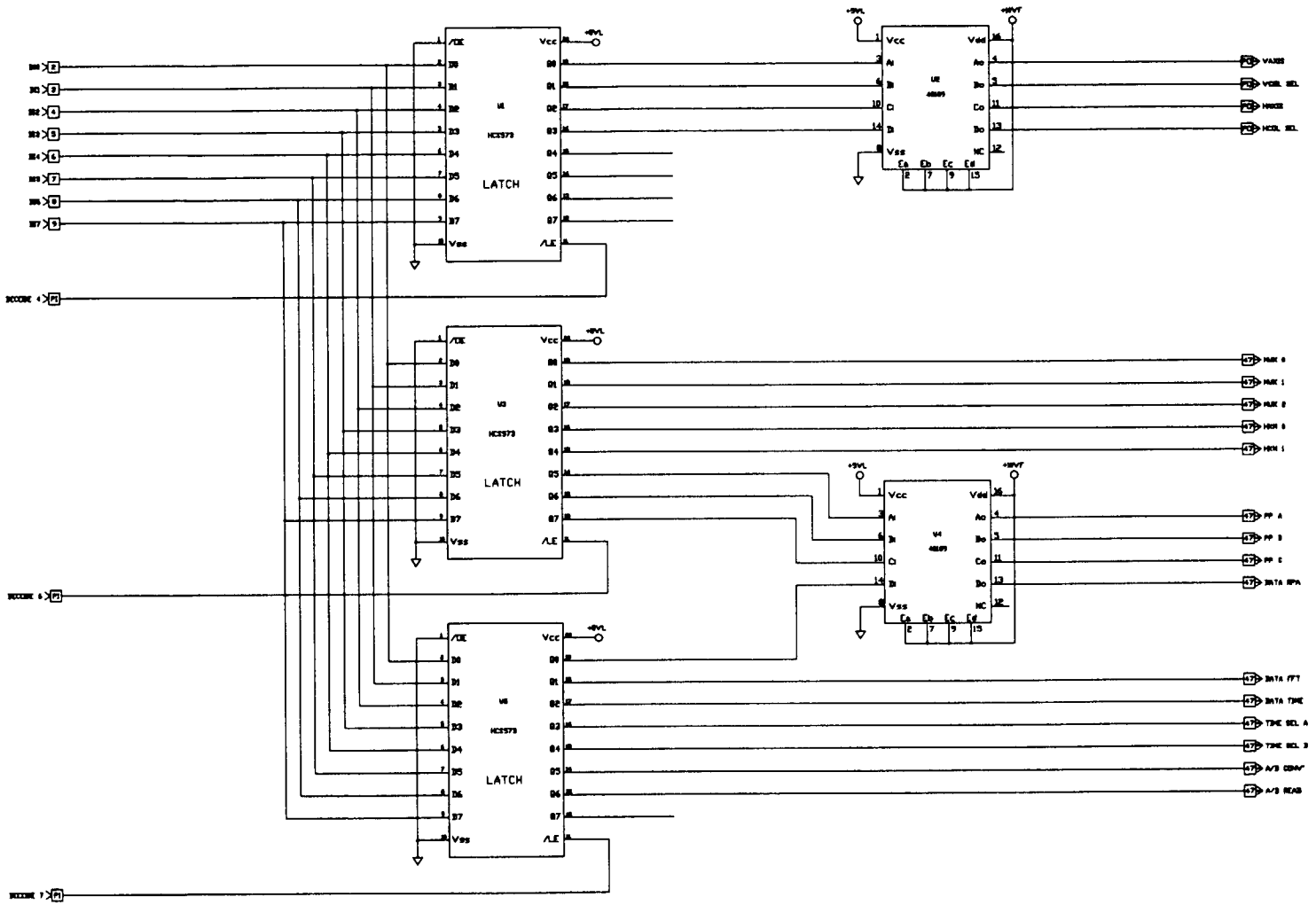
SIZE	CODE IDENT	DWG NO.	REV
C	14614		

SCALE

SHEET 1 OF 1


REVISIONS
REV
DESCRIPTION
DATE
APPROVED
HKM 6
HKM 1
VLLA
VLLB
HLLA
HLLB
RPSVEEP
PP RET
SC GND
+5 CL
-5 CL
R1
R2
R3
R4
R5
R6
R7
10K 1%
20K 1%
U1
4052
ANALOG SELECT
Vee
Vdd
Vss
INH
DUT1
DUT2
+5VL
HK1
HK2
HK3
CR1
CR2
CR3
CR4
CR5
CR6
CR7
CR8
CR9
CR10
CR11
CR12
CR13
1N4148
R8
R9
R10
C4
C5
.1
TEP TEMP
R17
1.8K TC
R11
6.65K 1%
+12VF
-12VF
R12
R13
R14
R15
R16
VBM TEMP
HBM TEMP
RPA TEMP
IT TEMP
+12VF SOURCE
-12VF SOURCE
+5VL SOURCE
VF RET
C1
C2
C3
FILE: TEP-7S
QTY
ITEM
UTD PART NO.
MFG'R PART NO.
NOMENCLATURE OR DESCRIPTION
CODE IDENT
PARTS LIST
UNLESS OTHERWISE NOTED:
ALL DIMENSIONS ARE IN INCHES
DIMENSIONS & TOLERANCES PER ANSI Y14.5
ANGLES ±1/2°
MACHINE FINISH 63
DECIMALS: .XXX = ±.010
.XX = ±.02
REMOVE ALL BURRS & SHARP EDGES
THIRD ANGLE PROJECTION
MATERIAL *****
FINISH *****
AUTHENTICATION
NAME
DATE
DRN RL BICKEL 02/03/94
DSGN RL BICKEL 10/27/93
APP
THE UNIVERSITY OF TEXAS AT DALLAS
2601 N. FLOYD RD. RICHARDSON, TEXAS 75080
SCHEMATIC
HOUSEKEEPING DATA SELECT
TIMED
SIZE
C
CODE IDENT
14614
DWG NO.
REV
SCALE
SHEET 1 OF 1
QTY NEXT ASSY QTY USED ON
APPLICATION

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



FILE: TEP-9S

QTY	QTY	QTY	ITEM	UTD PART NO.	MFG'R PART NO.	NOMENCLATURE OR DESCRIPTION	CODE IDENT
						PARTS LIST	

UNLESS OTHERWISE NOTED:
ALL DIMENSIONS ARE IN INCHES
DIMENSIONS & TOLERANCES PER ANSI Y14.5
ANGLES ±1/2°
MACHINE FINISH 63
DECIMALS: .XXX = ±.010
.XX = ±.02
REMOVE ALL BURRS & SHARP EDGES
THIRD ANGLE PROJECTION

MATERIAL
*****

FINISH
*****

AUTHENTICATION		
	NAME	DATE
DRN	RL BICKEL	02/03/94
DSGN	RL BICKEL	10/28/93
APP		
APP		
APP		
APP		

THE UNIVERSITY OF TEXAS AT DALLAS
2601 N. FLOYD RD. RICHARDSON, TEXAS 75080

SCHEMATIC
DIGITAL DECODE BOARD

C:\TIMED\TEP-9S TIMED

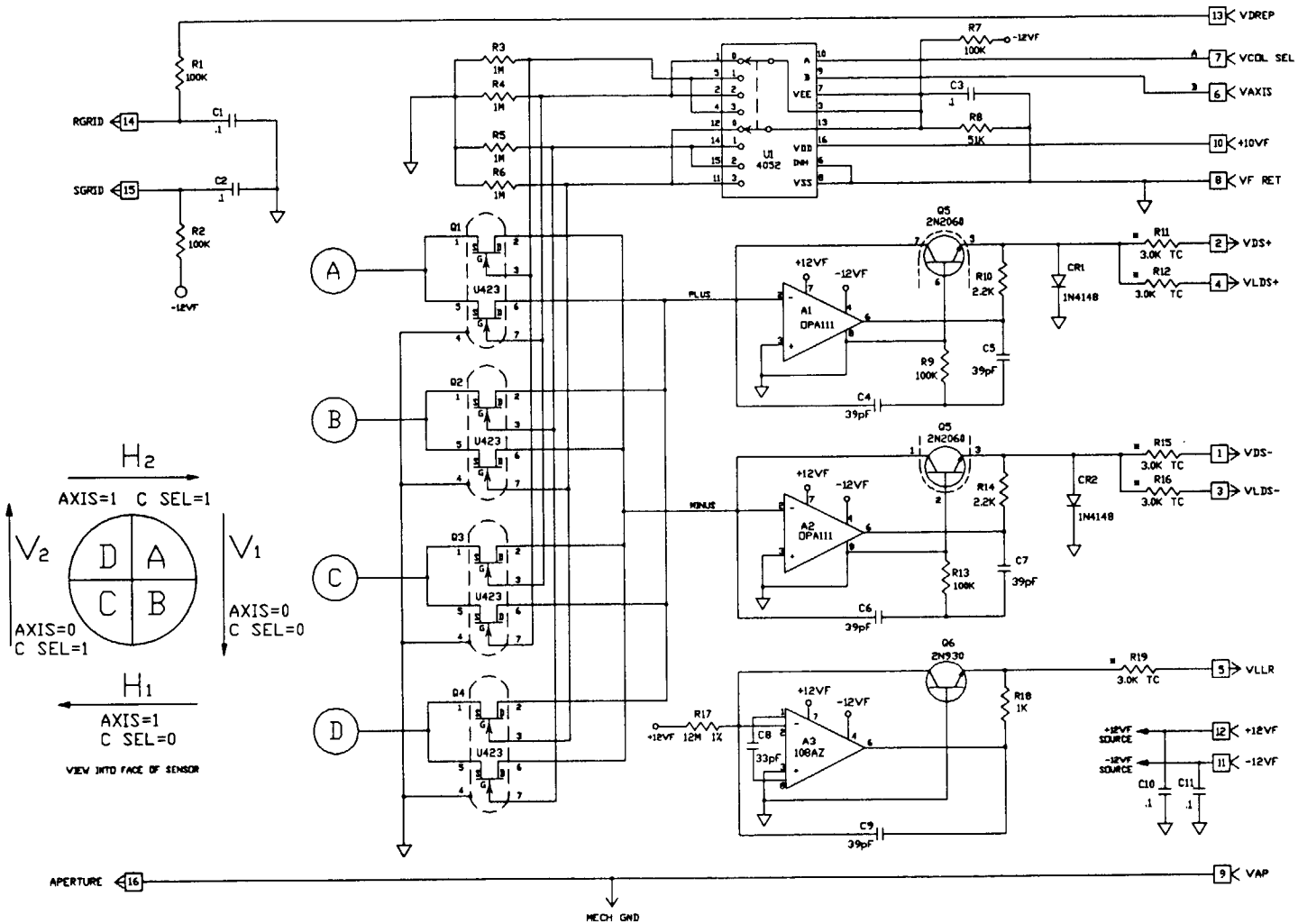
QTY	NEXT ASSY	QTY	USED ON
APPLICATION			

SIZE	CODE IDENT	DWG NO.	REV
C	14614		

SCALE

SHEET 1 OF 1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



FILE VDM-1S

NOTES:
1. ■ DENOTES TEMPERTURE COMPENSATION RESISTOR
2. MATCH R11 AND R15 TO WITHIN ONE OHM IF POSSIBLE

QTY	QTY	QTY	ITEM	UTD PART NO.	MFG'R PART NO.	NOMENCLATURE OR DESCRIPTION	CODE IDENT

PARTS LIST

UNLESS OTHERWISE NOTED:
ALL DIMENSIONS ARE IN INCHES
DIMENSIONS & TOLERANCES PER ANSI Y14.5
ANGLES ±1/2°
MACHINE FINISH 63
DECIMALS: .XXX = ±.010
.XX = ±.02
REMOVE ALL BURRS & SHARP EDGES
THIRD ANGLE PROJECTION

AUTHENTICATION	NAME	DATE
DRN	RL BICKEL	01/28/94
DSGN	RL BICKEL	09/30/93
APP		
APP		
APP		
APP		

MATERIAL *****

FINISH *****

QTY	NEXT ASSY	QTY	USED ON
APPLICATION			

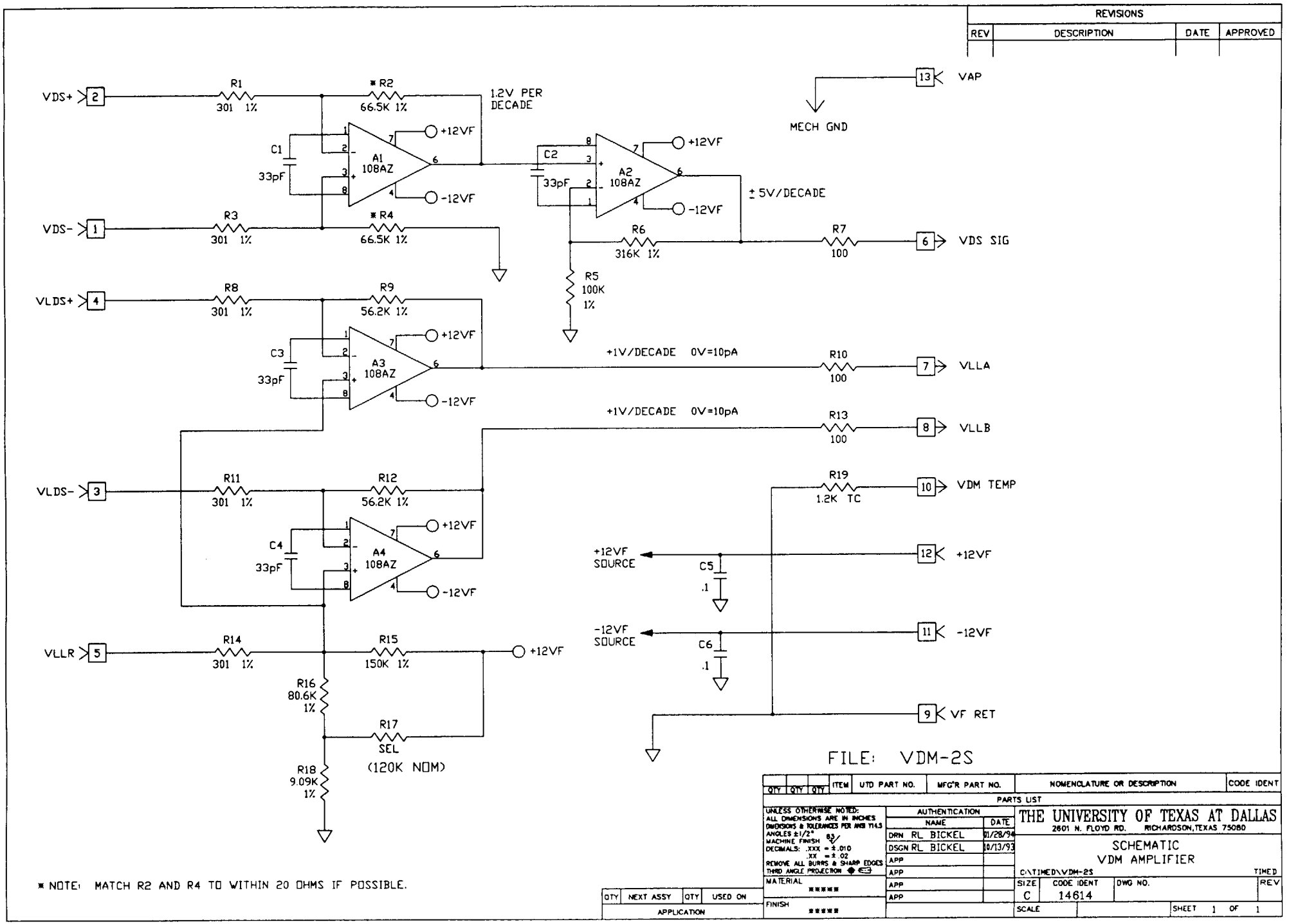
THE UNIVERSITY OF TEXAS AT DALLAS
2601 N. FLOYD RD. RICHARDSON, TEXAS 75080

SCHEMATIC
VDM ELECTROMETER

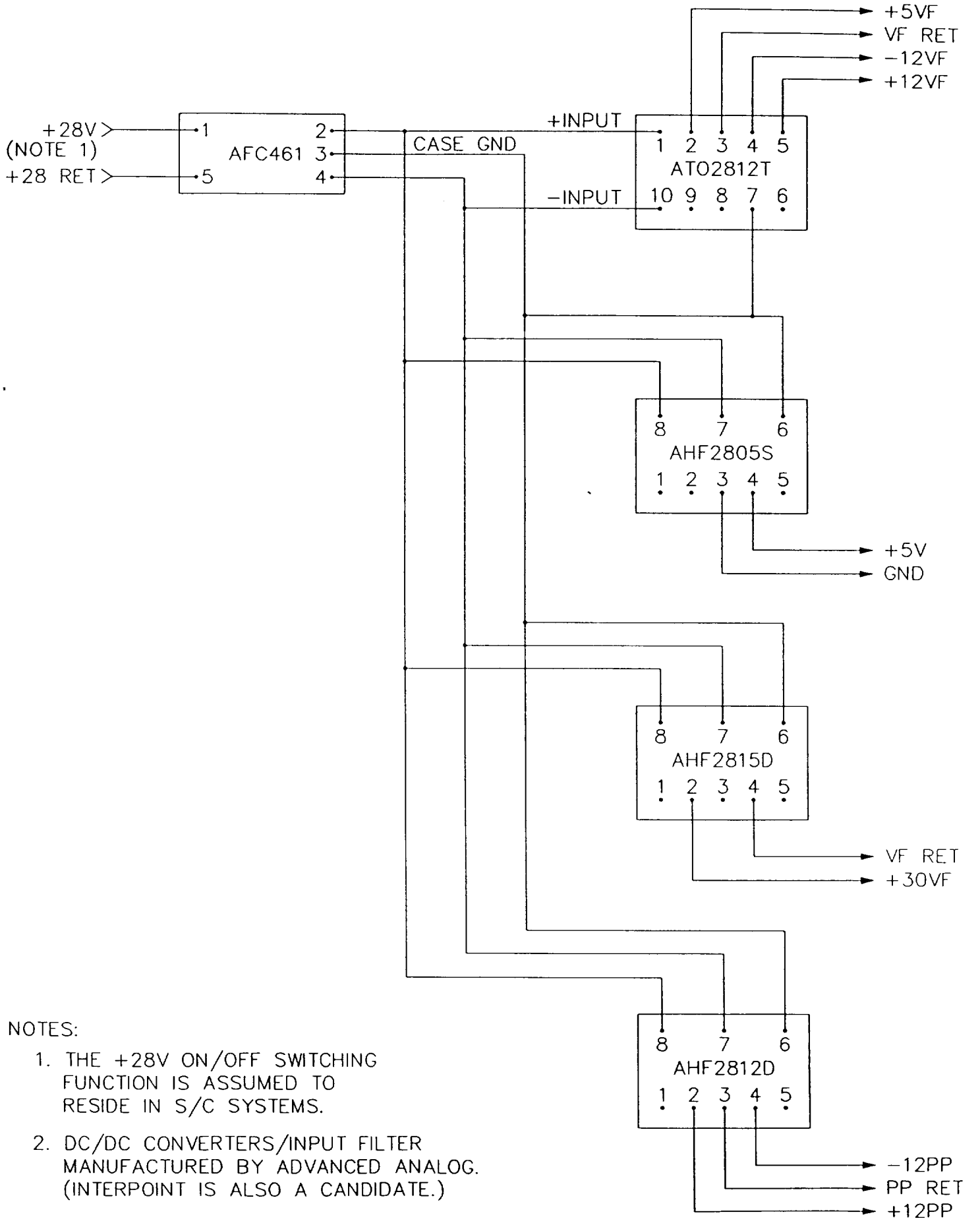
C:\TIMED\VDM-1S TIMED

SIZE	CODE IDENT	DWG NO.	REV
C	14614		

SCALE | SHEET 1 OF 1


REVISIONS
REV
DESCRIPTION
DATE
APPROVED
VDS+ 2
R1 301 1%
* R2 66.5K 1%
1.2V PER DECADE
C1 33pF
A1 108AZ
+12VF
-12VF
C2 33pF
A2 108AZ
± 5V/DECADE
13 VAP
MECH GND
VDS- 1
R3 301 1%
* R4 66.5K 1%
R6 316K 1%
R7 100
6 VDS SIG
R5 100K 1%
VLDS+ 4
R8 301 1%
R9 56.2K 1%
C3 33pF
A3 108AZ
+1V/DECADE 0V=10pA
R10 100
7 VLLA
R13 100
8 VLLB
VLDS- 3
R11 301 1%
R12 56.2K 1%
C4 33pF
A4 108AZ
R19 1.2K TC
10 VDM TEMP
+12VF SOURCE
C5 .1
12 +12VF
-12VF SOURCE
C6 .1
11 -12VF
VLLR 5
R14 301 1%
R15 150K 1%
R16 80.6K 1%
R17 SEL (120K NOM)
R18 9.09K 1%
9 VF RET
FILE: VDM-2S
* NOTE: MATCH R2 AND R4 TO WITHIN 20 OHMS IF POSSIBLE.
QTY QTY QTY ITEM UTD PART NO. MFG'R PART NO. NOMENCLATURE OR DESCRIPTION CODE IDENT
PARTS LIST
UNLESS OTHERWISE NOTED: ALL DIMENSIONS ARE IN INCHES DIMENSIONS & TOLERANCES PER ANSI Y14.5 ANGLES ±1/2° MACHINE FINISH DECIMALS: .XXX = ±.010 .XX = ±.02 REMOVE ALL BURRS & SHARP EDGES THIRD ANGLE PROJECTION
MATERIAL *****
FINISH *****
QTY NEXT ASSY QTY USED ON
APPLICATION
AUTHENTICATION
NAME DATE
DRN RL BICKEL 01/28/94
DSGN RL BICKEL 10/13/93
APP
APP
APP
APP
THE UNIVERSITY OF TEXAS AT DALLAS
2601 N. FLOYD RD. RICHARDSON, TEXAS 75080
SCHEMATIC
VDM AMPLIFIER
C:\TIMED\VDM-2S
TIMED
SIZE C
CODE IDENT 14614
DWG NO.
REV
SCALE
SHEET 1 OF 1

IDI POWER SUPPLIES

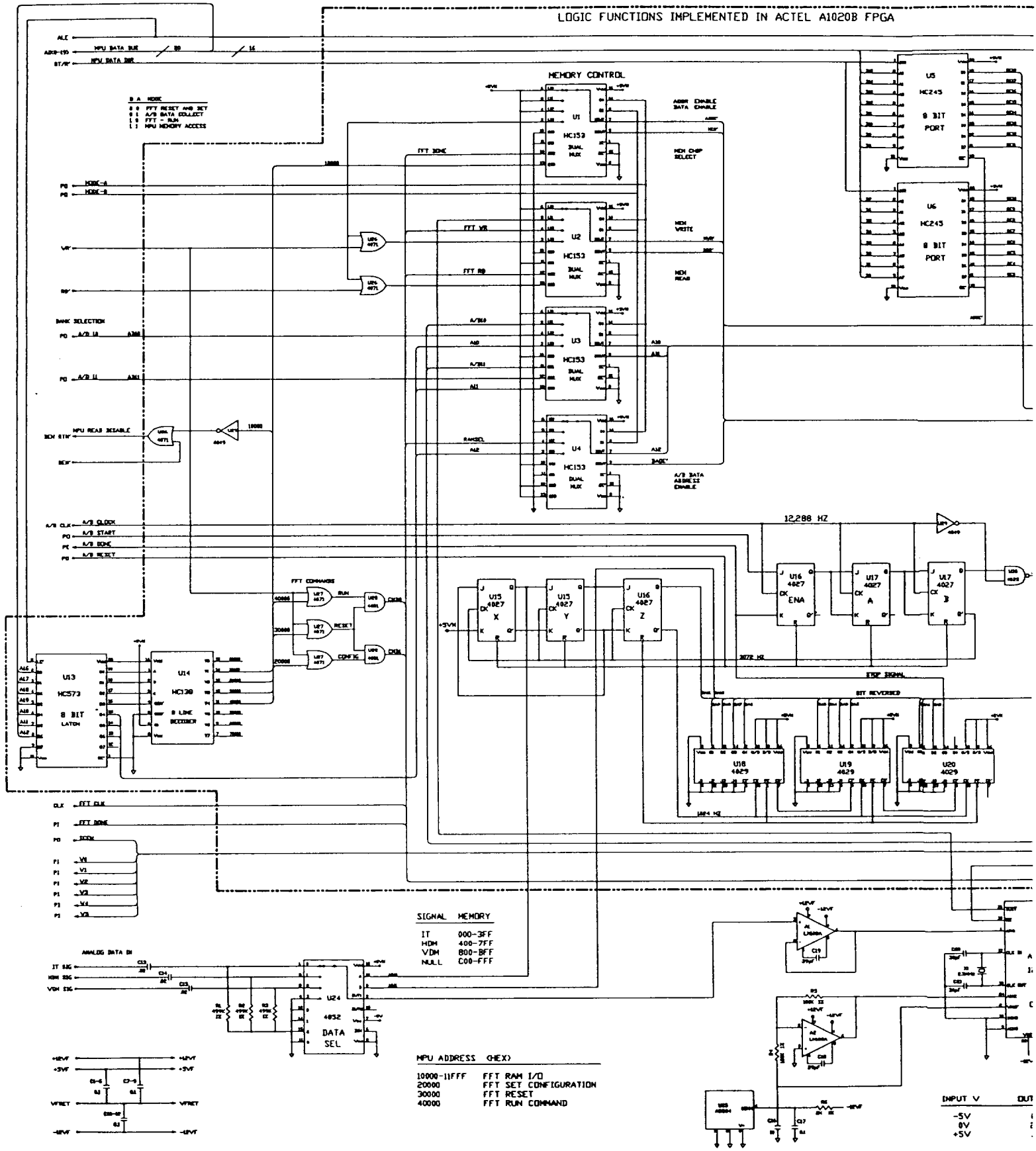


NOTES:

1. THE +28V ON/OFF SWITCHING FUNCTION IS ASSUMED TO RESIDE IN S/C SYSTEMS.
2. DC/DC CONVERTERS/INPUT FILTER MANUFACTURED BY ADVANCED ANALOG. (INTERPOINT IS ALSO A CANDIDATE.)

TMED/IDILVPS2 08/16/94

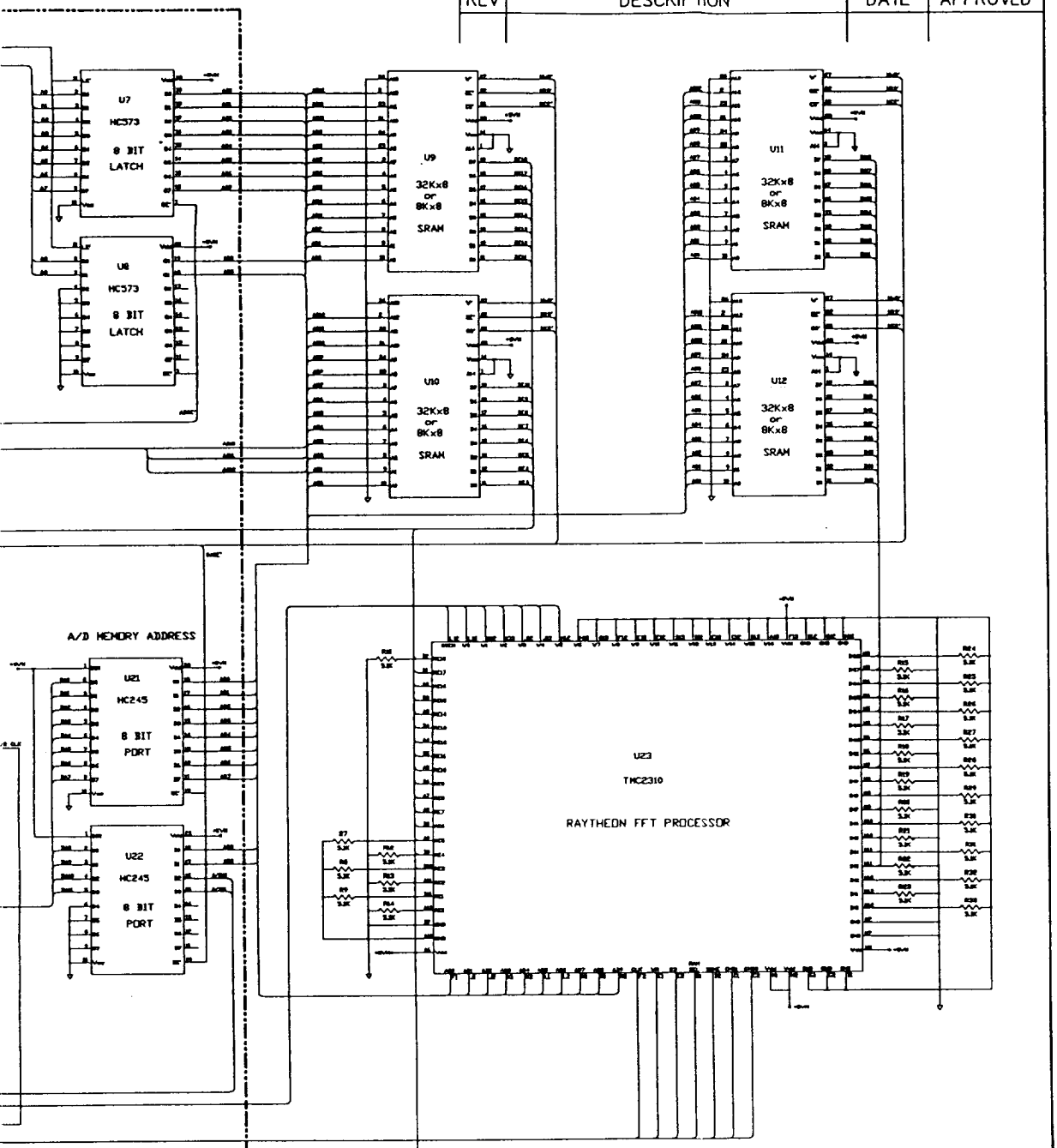
FOLDOUT FRAME 1



QTY	NEXT ASSY	QTY	
	APPLICATION		

FOLDOUT FRAME 2

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



FILE: FFT1S

QTY	QTY	QTY	ITEM	UTD PART NO.	MFG'R PART NO.	NOMENCLATURE OR DESCRIPTION	CODE IDENT

PARTS LIST

UNLESS OTHERWISE NOTED:
ALL DIMENSIONS ARE IN INCHES
DIMENSIONS & TOLERANCES PER ANSI Y14.5
ANGLES ±1/2°
MACHINE FINISH 63
DECIMALS: .XXX = ±.010
.XX = ±.02
REMOVE ALL BURRS & SHARP EDGES
THIRD ANGLE PROJECTION

MATERIAL *****

FINISH *****

AUTHENTICATION		
	NAME	DATE
DRN	RL BICKEL	02/17/94
DSGN	RL BICKEL	01/07/94
APP		
APP		
APP		
APP		

THE UNIVERSITY OF TEXAS AT DALLAS
2601 N. FLOYD RD. RICHARDSON, TEXAS 75080

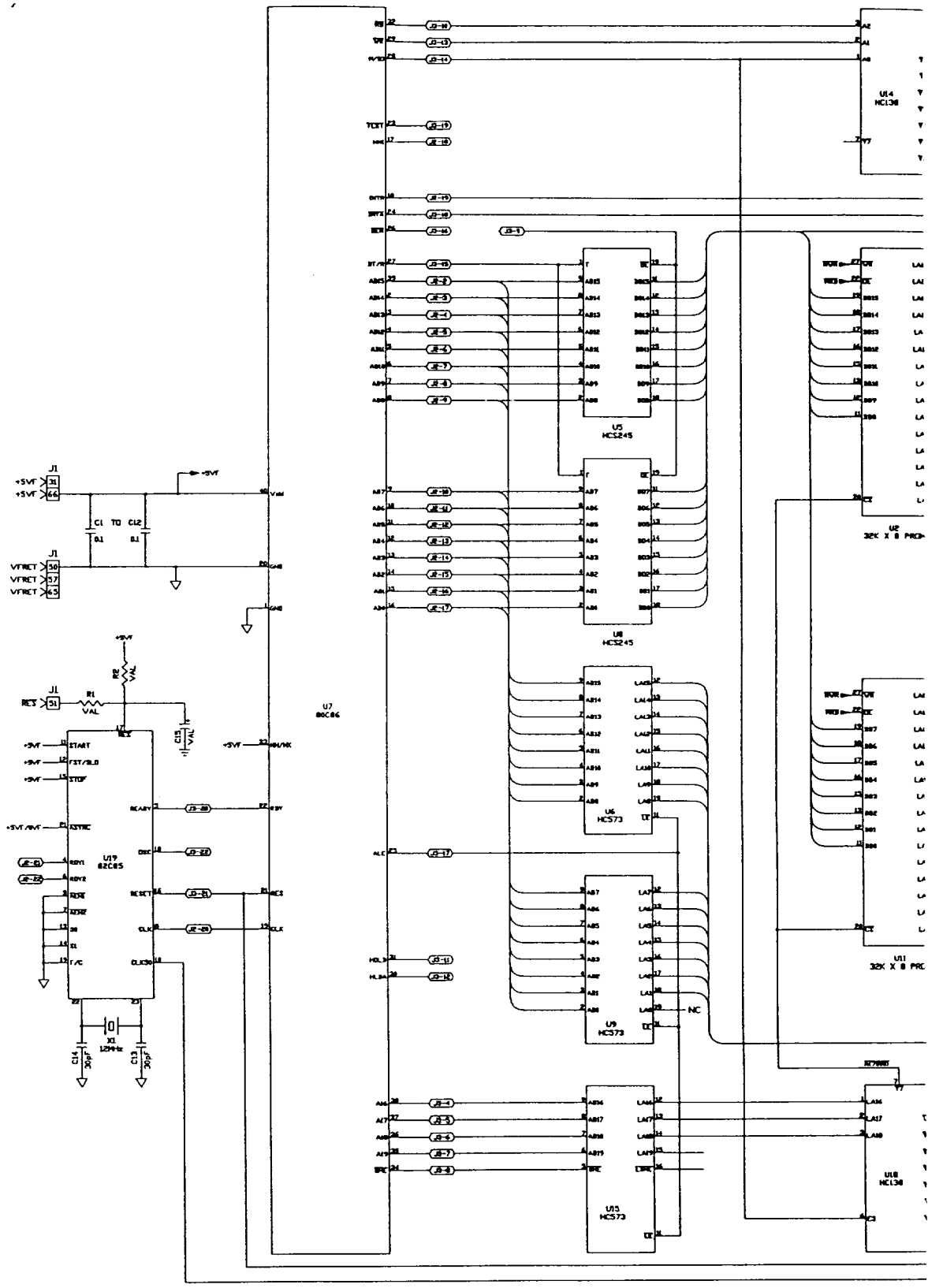
SCHEMATIC
FFT BOARD

TIMED

SIZE	CODE IDENT	DWG NO.	REV
C	14614	137-509	*

SCALE | SHEET 1 OF 1

FOLDOUT FRAME

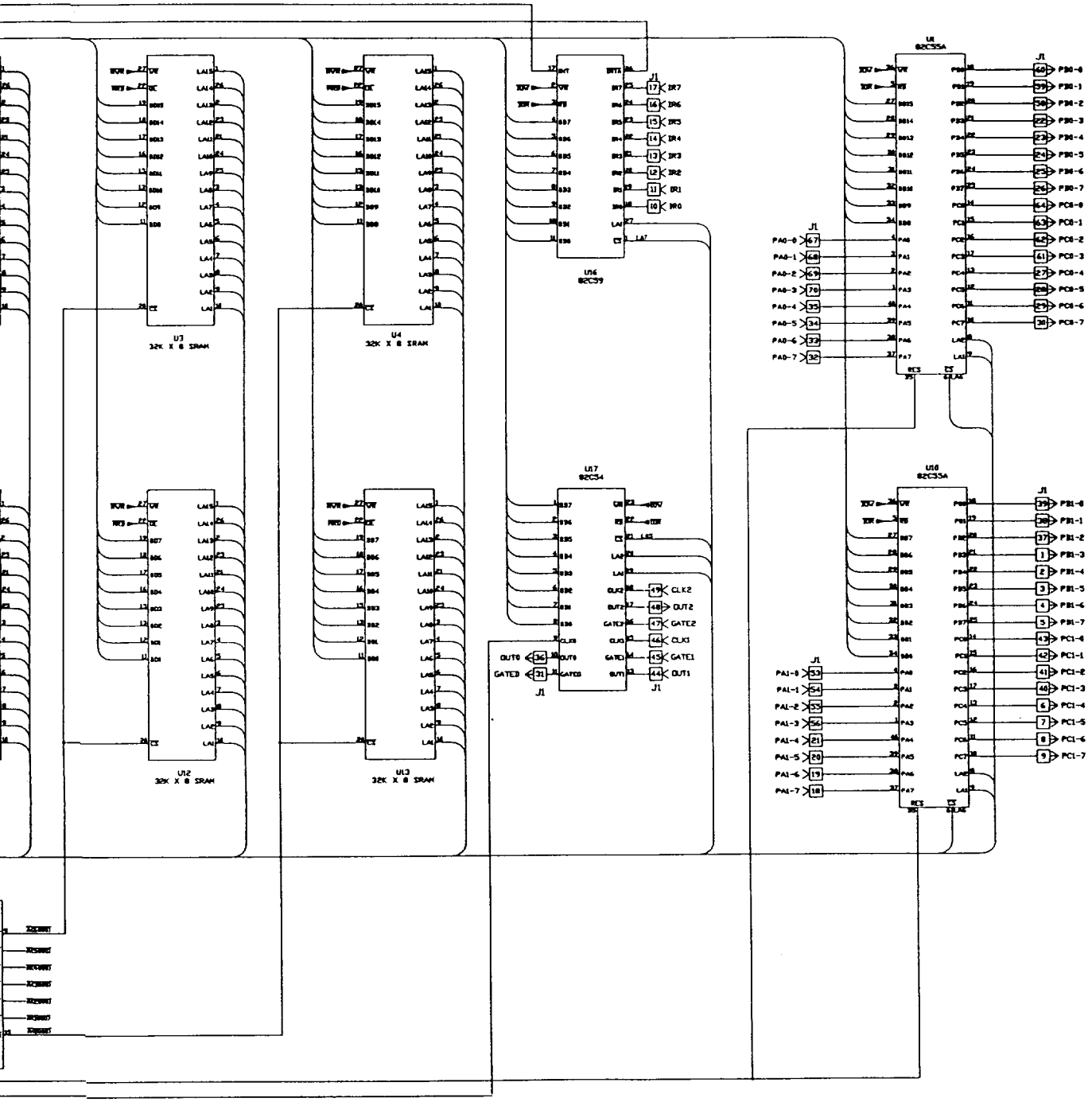


NOTES:

1. XX >XX AND XX> XX INDICATES J1 CONNECTOR
2. (XX-XX) INDICATES J2 AND J3 CONNECTORS

FOLDOUT FRAME 2

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



QTY	QTY	QTY	ITEM	UTD PART NO.	MFG'R PART NO.	NOMENCLATURE OR DESCRIPTION	CODE IDENT

PARTS LIST

UNLESS OTHERWISE NOTED:
ALL DIMENSIONS ARE IN INCHES
DIMENSIONS & TOLERANCES PER ANSI Y14.5
ANGLES ±1/2°
MACHINE FINISH 63
DECIMALS: .XXX = ±.010
.XX = ±.02
REMOVE ALL BURRS & SHARP EDGES
THIRD ANGLE PROJECTION

MATERIAL *****

FINISH *****

AUTHENTICATION	NAME	DATE
DRN	J C BROWN	3-31-94
DSGN	D. ZUCCARO	3-31-94
APP		
APP		
APP		
APP		

THE UNIVERSITY OF TEXAS AT DALLAS
2601 N. FLOYD RD. RICHARDSON, TEXAS 75080

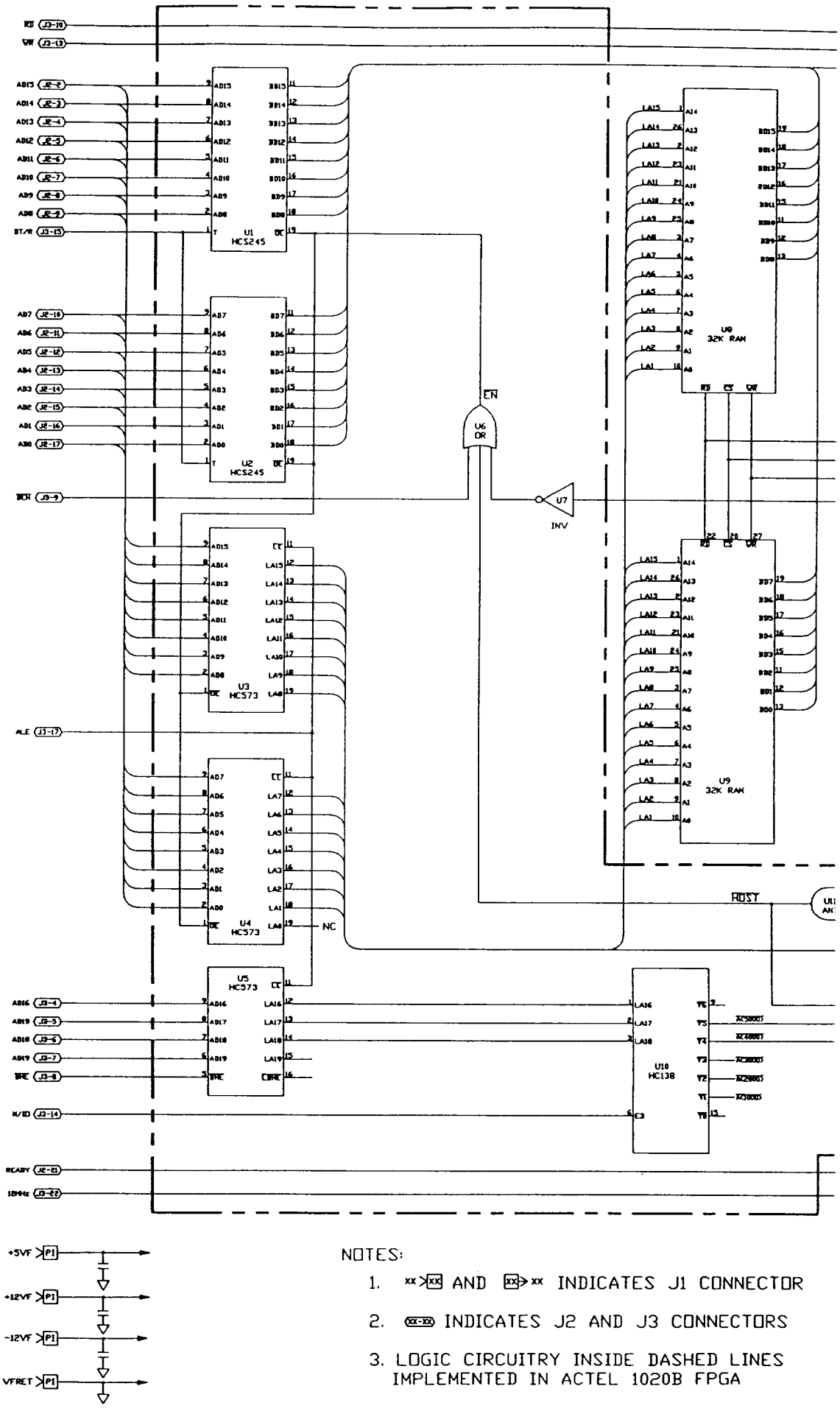
SCHEMATIC
MPU BOARD

MPU TIMED

SIZE	CODE IDENT	DWG NO.	REV
C	14614	137-505	*

SCALE | SHEET 1 OF 1

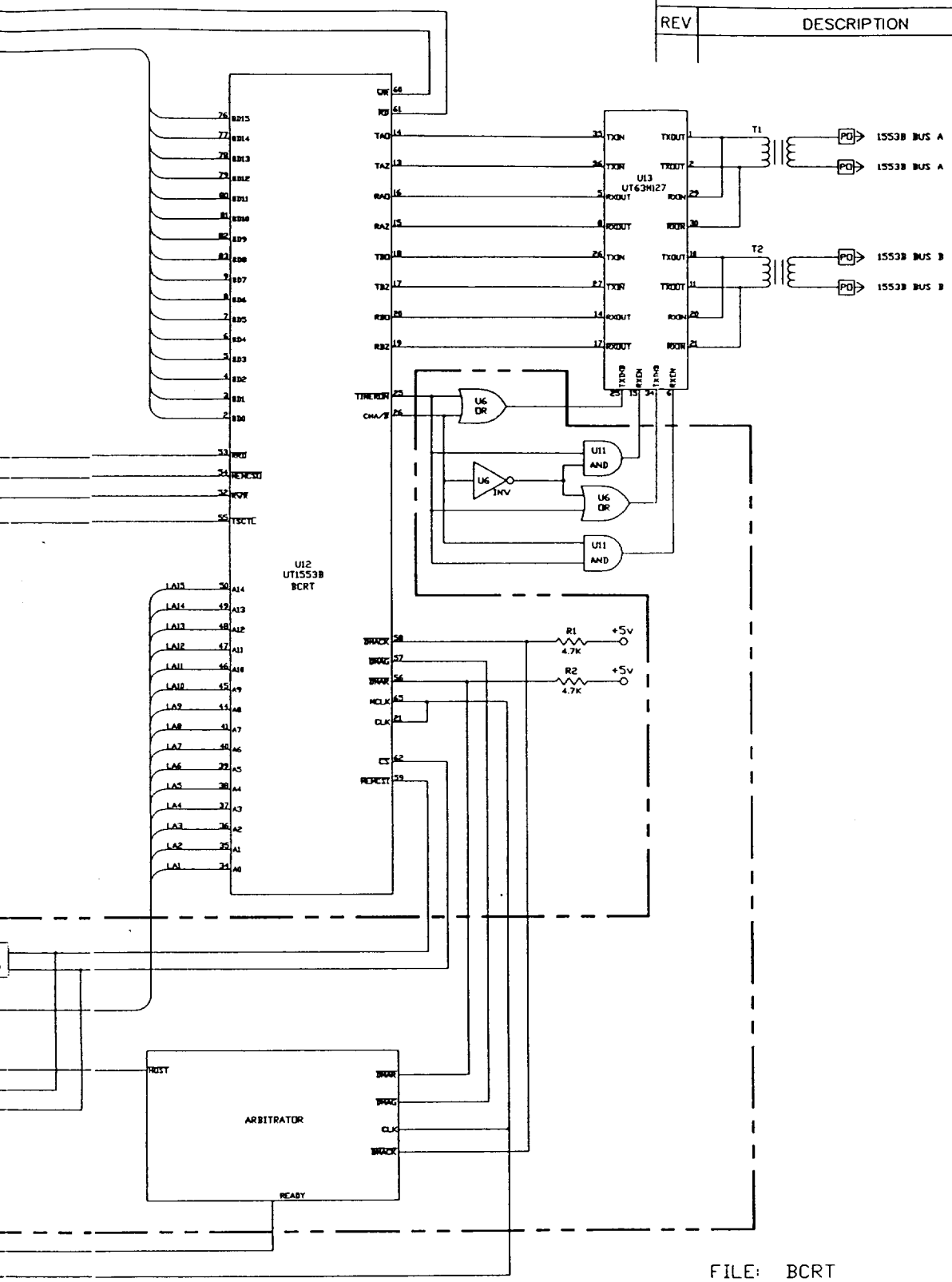
QTY	NEXT ASSY	QTY	USED ON
APPLICATION			



NOTES:

1. XX>XX AND XX>XX INDICATES J1 CONNECTOR
2. XX-XX INDICATES J2 AND J3 CONNECTORS
3. LOGIC CIRCUITRY INSIDE DASHED LINES IMPLEMENTED IN ACTEL 1020B FPGA

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



FILE: BCRT

QTY	QTY	QTY	ITEM	UTD PART NO.	MFG'R PART NO.	NOMENCLATURE OR DESCRIPTION	CODE IDENT

PARTS LIST

UNLESS OTHERWISE NOTED:
ALL DIMENSIONS ARE IN INCHES
DIMENSIONS & TOLERANCES PER ANSI Y14.5
ANGLES ±1/2°
MACHINE FINISH 63
DECIMALS: .XXX = ±.010
.XX = ±.02
REMOVE ALL BURRS & SHARP EDGES
THIRD ANGLE PROJECTION

MATERIAL
*****

FINISH
*****

AUTHENTICATION	NAME	DATE
DRN	SUDHIR W.	08-11-94
DSGN	SUDHIR W.	08-11-94
APP		
APP		
APP		
APP		

THE UNIVERSITY OF TEXAS AT DALLAS
2601 N. FLOYD RD. RICHARDSON, TEXAS 75080

SCHEMATIC
1553B CIRCUIT

PCB (TIMED)

SIZE	CODE IDENT	DWG NO.	REV
C	14614	137-513	*

SCALE | SHEET 1 OF 1

QTY	NEXT ASSY	QTY	USED ON
APPLICATION			