GE Medical Systems

Technical Publications

46-253807
Revision B

RT 3600

Service Manual

Operating Documentation

MH4220ASER

PREINSTALLATION

Chapter 2

Pre-Installation

Table of Contents

2-1 Forward

This manual provides service information relating to the RT3600. The RT3600 is a stand-alone, real time ultrasound imaging machine containing a linear and sector real time scanner.

2-2 Abstract

2-2-1 Description

The RT3600 is an ultrasound scanner used by a physician to aid in medical diagnosis. It allows the physician to "see into" a patient's body using ultrasound wave energy. When the physician places the transducer on the patient's skin, a scan is automatically obtained by electrically steering the beams entrance into the body. Echoes from internal objects are processed, amplified, and arranged to form an image on a TV monitor. The image corresponds to a cross-sectional picture of the patient's body under the transducer.

The RT3600 is a stand-alone unit. All necessary functions are performed in the console and in the attached transducers. The console mainframe includes a CRT viewing monitor and a CRT monitor dedicated to a Polaroid camera.

The console front panel contains a special keyboard that allows the physician to enter data onto the image. In addition, a computer inside the console automatically places certain machine parameters onto the image. The operator can modify particular imaging parameters through the keyboard.

Selected keys are highlighted upon actuation. Unacceptable keyboard entries enable a beeper alarm.

The built-in Polaroid camera is coupled to an independent CRT monitor, allowing photos to be made for diagnosis and record keeping.

The console is compact and highly mobile. This allows a variety of applications within a clinic or hospital. Various linear and sector transducers extend the RT3600's versatility.

Video connections are provided to allow video recording and playback on the CRT monitors **Which have a dedicated aspect ratio by design.**

2-2 Electrical Specifications

The RT3600 operates at either 115 or 230 volts A.C., single phase, 48 to 63 Hz. Current drain is 4.4 amps at 115volts, and 2.2 amps at 230 volts. Voltage set-up is performed in the factory because different rear panels are used for each voltage.

Total ground leakage current is less than 100 microamps. Patient leakage current is less than 10 microamps.

The instrument is classified as Class II, The B equipment in accordance with IEC-601.

2-2-3 Physical Specifications

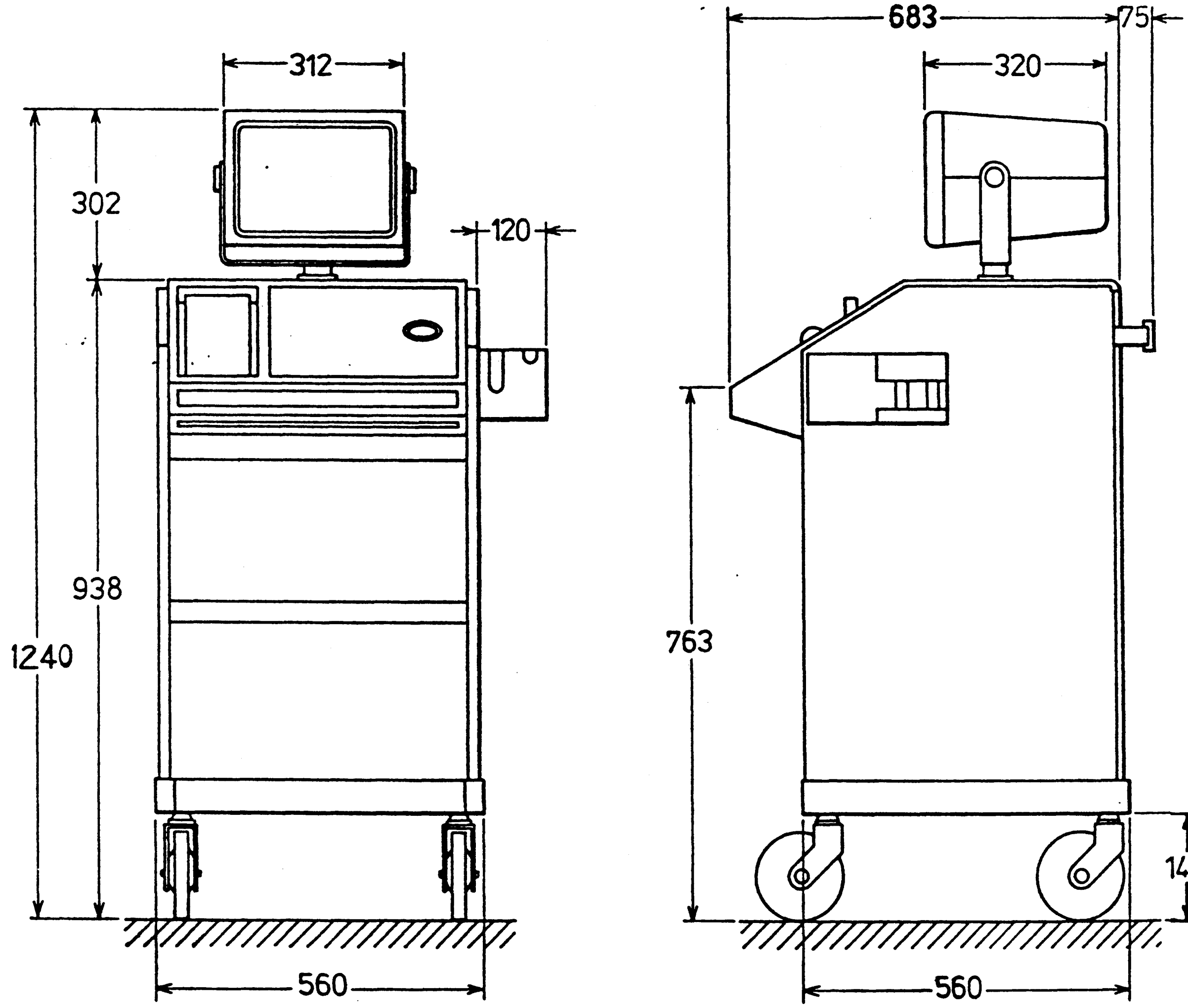
The RT3600 (excluding accessories) weighs 280 lbs. (125 kg). For dimensions details see Figure 2-1.

2-2-4 Operating Conditions

The RT3600 has been designed to operate within a temperature range of **60** F°to 105 F°(**15.6** C°to **40.5** C°), and a relative humidity range of 5% to 85%.

For the best performance, the RT3600 should be operated in an environment where electromagnetic noise is at a minimum. Sources for this type of noise include microwave ovens, certain electronic surgical equipment, high frequency or high power equipment, and high data rate digital equipment such as desk top computers or terminals. These noise sources should be kept at least 5 meters away from the RT3600 and preferably operated in separate rooms. Wood or plastic walls, doors, floor, and ceilings provide a minimum of shielding to electromagnetic noise. _Also, the power supply for these noise sources should not be in parallel with the source for the RT3600.

Fig.2-1



Unit:mm

If a site is close to a radio communication or broadcasting station, certain precautions to minimize interference may be necessary. In general, the maximum interference signal level should be no more than 100dB above 1 microvolt/meter (in a frequency range of 10 KHz to 100 MHz).

For information on optimum performance in the electromagnetic environment, refer to Chapter 8, Diagnostics .

2-2-5 Shipping and Storage Requirements

The RT3600 and optional accessories are shipped in a single container.

Maximum weight is 330 pounds (150 kg.). The size of the container is 59 in. x 32 in. x 28 in. (1.5m x 80cm x 70cm). The container can pass through a standard door having a 30 x 60 in. opening.

Requirements for shipping, storage, installation, and operation are listed in the following table:

		Storage	Shipping	Installation	Operation
Temperature	C°	-4.4-60	-4.4 to 60	15.6 to 60	15.6 to 40.5
	F°	-40 to 140	-40 to 140	60 to 140	60 to 105
Max. Altitude	(m)	2,700		2,700	2,000
	(ft)	8,000		8,000	6,000
Humidity	(%)	5 to 80	5 to 85	5 to 85	5 to 85

For patient comfort, it is recommended that additional limits be observed. They are as follows:

Temperature .... 70 to 75 F° (21 to 24 C°)

Humidity .... 50% to 70%

2--2-6 Floor Loading

The floor shall be capable of supporting the RT3600 which places a load of 400 kg/m^2 onto it. Additional loading occurs with the accessory equipment such as a video recorder and multiformat camera. The floor load is calculated from the floor space taken up by the RT3600, which is 0.314m^2.

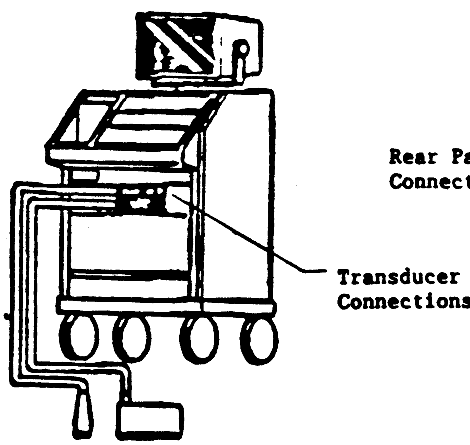


Figure 2-2

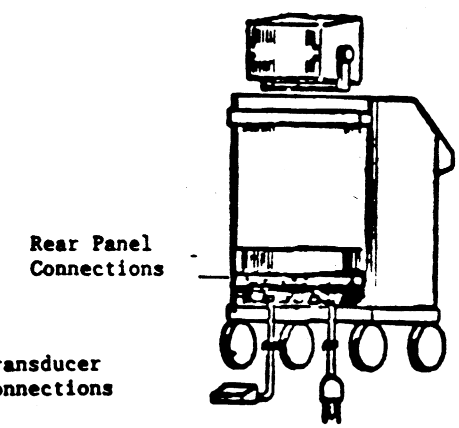


Figure 2-3

2-3 INSTRUMENT DIMENSIONS

2-4 ELECTRICAL CONNECTIONS

2-4-1 TRANSDUCER CONNECTIONS

Up to two transducers can be coupled to the RT3600. The desired transducer is selected by a key on console. A twist lever lock provides an easy and reliable transducer connection.

2-4-2 REAR PANEL CONNECTIONS (Refer to Figure 2-4).

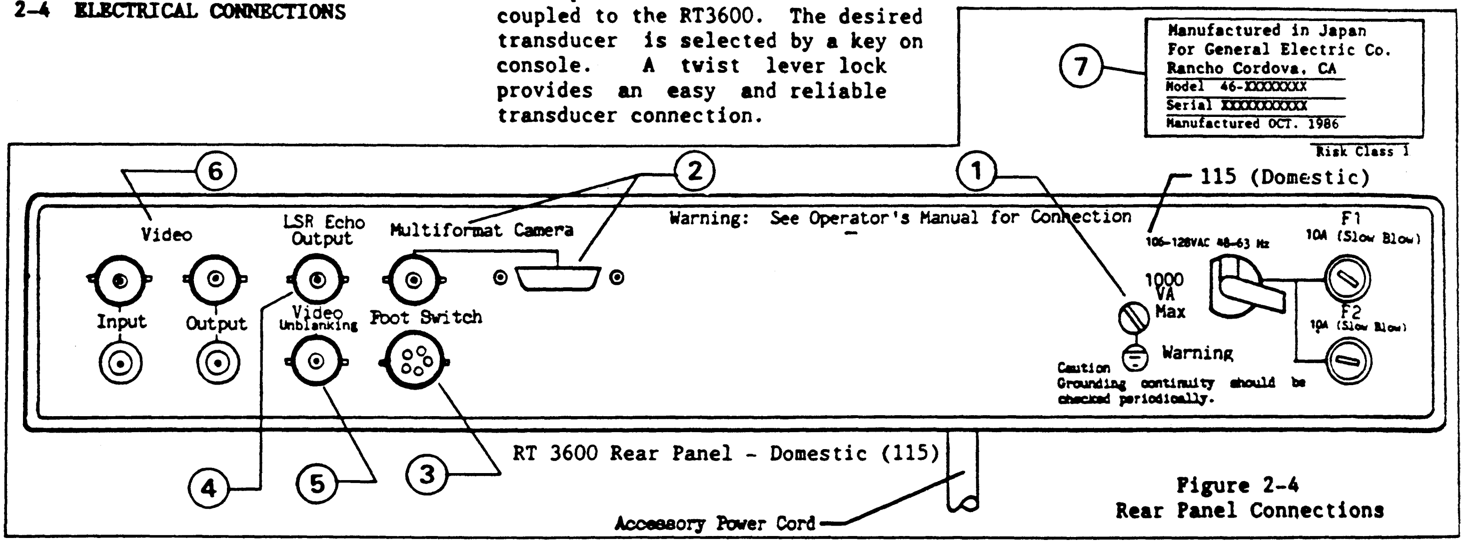


Figure 2-4
Rear Panel Connections

Figure 2-4
Rear Panel Connections

1 **Power Cord**
A nondetachable, 15 ft., low leakage power cord with a hospital grade plug delivers power for the instrument.

2 **Multiformat Camera**
Provides video and shutter signals to operate an accessory multiformat camera. The coaxial video output drives a 75 ohm load with an RS170A video signal. The shutter control permits the camera to be operated from the console front panel.

3 **Foot Switch**
Connects to a remote footswitch which controls the image FREEZE signal.

4 **LSR Output**
Provides a video signal to an external line scan recorder.

5 **LSR Video Unblanking.** See Operator Manual.

6 **Video**
Two connectors provide the CRT monitor signal to external video devices such as a video recorder. The BNC or pin jacks should be terminated with 75 ohm devices.

Two input connectors, also BNC and pin jack, are provided to allow the CRT monitor to act as a playback device for an external recorder.

7 **Rating Nameplate**
Lists instruments model, serial number, options, and electrical requirements.

2-5 General Information

2-5-1 Power Line Requirements

Prior to installation, the following power line requirements should be verified:

Voltage Range	103 to 127 VAC in U.S.
	206 to 254 VAC in Europe
	90 to 110 VAC in Far East
Frequency	48 to 63 Hz (regardless of voltage)
Transients	Less than 25% of nominal peak voltage for less than 1 millisecond for any type of transient including line frequency synchronous, asynchronous, or aperiodic.

If some transient disturbance is expected, the use of transient suppressor is recommended.

If lower system leakage current is required, an isolation transformer will be necessary to isolate the main power input or the nonisolated aux power outlet.

If the applied voltage range ever changes, or if different power plugs and aux outlets are required, the rear panel assembly and internal wiring must be changed.

Separate Power Receptacle

A separate outlet with a 10 amp breaker for 100 or 150 volt systems, or 5 amp breaker for 220 to 240 volt systems, is recommended. The receptacle should be a three-wire grounded type, Hubbell 8300 or equivalent (for the U.S.). The power receptacle will depend on each country's power line standards. However, all should have the approval of applicable safety agencies- Underwriter's Lab (UL) in the U.S., or the International electrotechnical Commission. (IEC).

Power for accessories

Two outlets provide identical voltage and frequency as that supplied to the console.

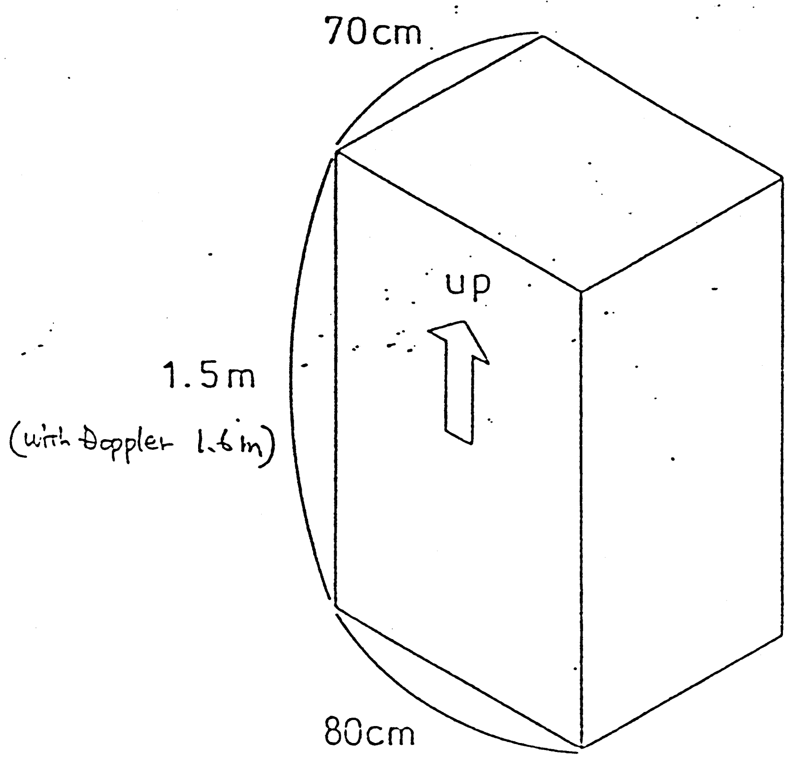
One isolated output provides up to 100VA for isolated equipment such as the multiformat camera.

A nonisolated output provides up to 300 VA for equipment using nonisolated power sources: the video tape recorder, for example.

Each outlet has its own current limiting fuse in the rear panel.

2-5-2 Shipping Configuration

As discussed earlier, the RT3600 is shipped in a signal container. Figure 2-5 shows the shipping configuration of the RT3600.



Weight ≦ 150kg
(with Doppler 170kg)

Fig.2-5

2-5-3 Mean Time to Install

Installation of the RT3600 requires **4 man hours**. This includes the time required for unpacking, assembly, connections, and functional checks **of the counsole only.**

2-5-4 Pre-installation

Site preparation should be accomplished before the RT3600 is installed. This work includes installation of conduit, junction boxes, ducts, outlets, breakers, and switches. Air conditioning or other temperature control may be required to maintain a room temperature of 64 to 82 F° (18 to 28 C°) Relative humidity should be maintained between 50% and 70% for patient comfort.

It should also be verified that electromagnetic noise is a minimum. Refer to Section **2-2-4** of this chapter.

2-6 Recommended Ultrasound Room

2-6-1 Standard Requirements for an Ultrasound Room

Size : 130ft^2 (12 m^2) of floor area.

Power Supply: 100, 115, or 230 volts AC, single phase,
50 or 60 Hz.

Radiation Shielding: None required for ultrasound energy.

Electromagnetic Shielding: See Chapter 8, Troubleshooting.

Temperature : 70 to 75 F°(21 to 24 C°) for patient comfort.

Humidity : 50% to 70% for patient comfort.

Cooling : The RT3600 requires **1200** BTU/HR. Each person in the room requires 300 BTU/HR.

2-6-2 Desirable Ultrasound Room Facilities

Lab sink with hot and cold water

Emergency oxygen supply

Dimmer control for overhead lights

Film viewer

Film and linen storage

Medical equipment storage

Dedicated, hospital Grade, power outlet

Power outlets for auxiliary equipment

Document storage area for operating manuals

Convenient waiting room, dressing room, lavatory

Trash bin

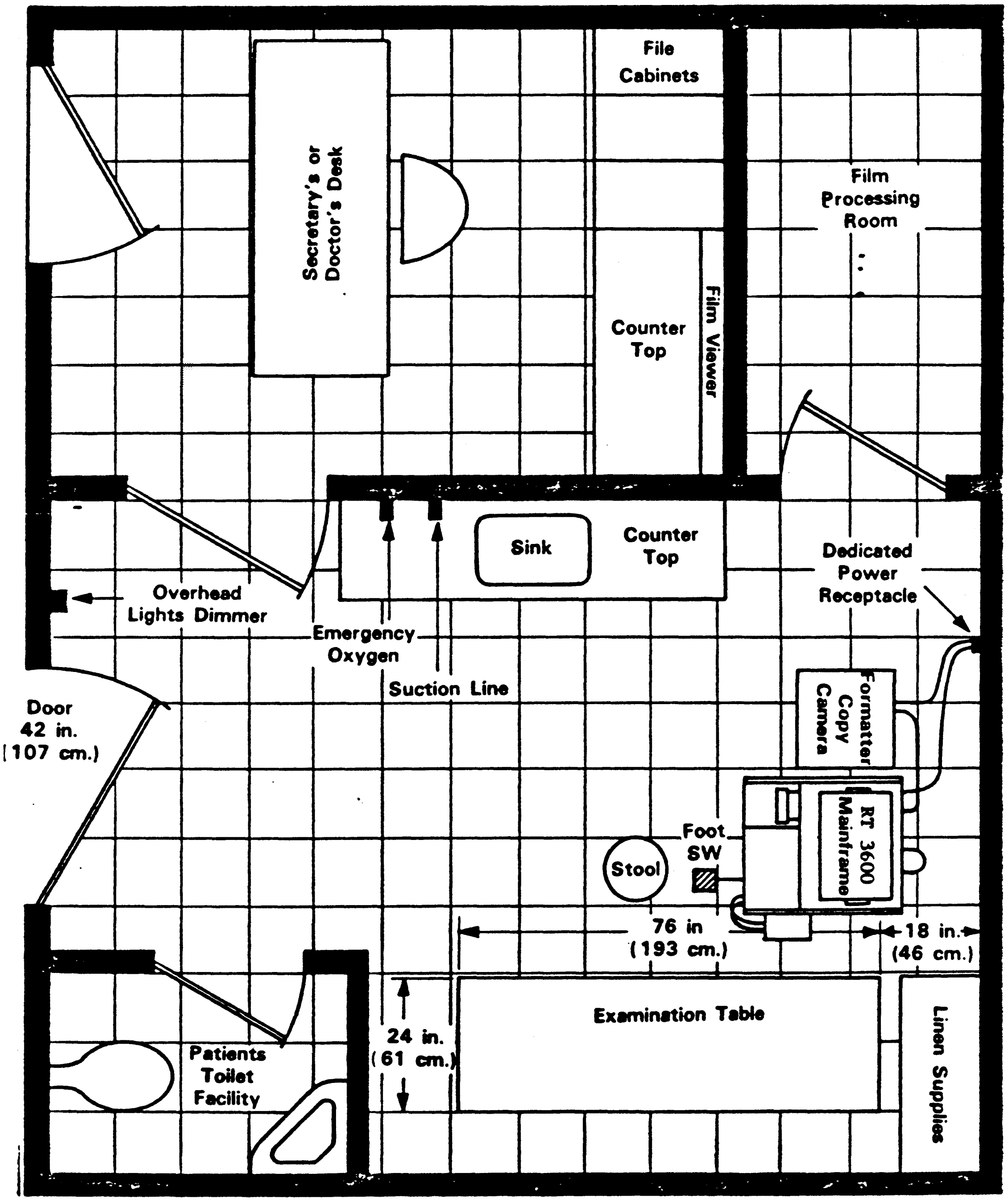
2-7 Recommended Floor Plan

Figure 2-6 is an example of the recommended floor plan.

Figure 2-7 is an alternative floor plan.

—RT3600—

Standard Ultrasound Room Floor Plan



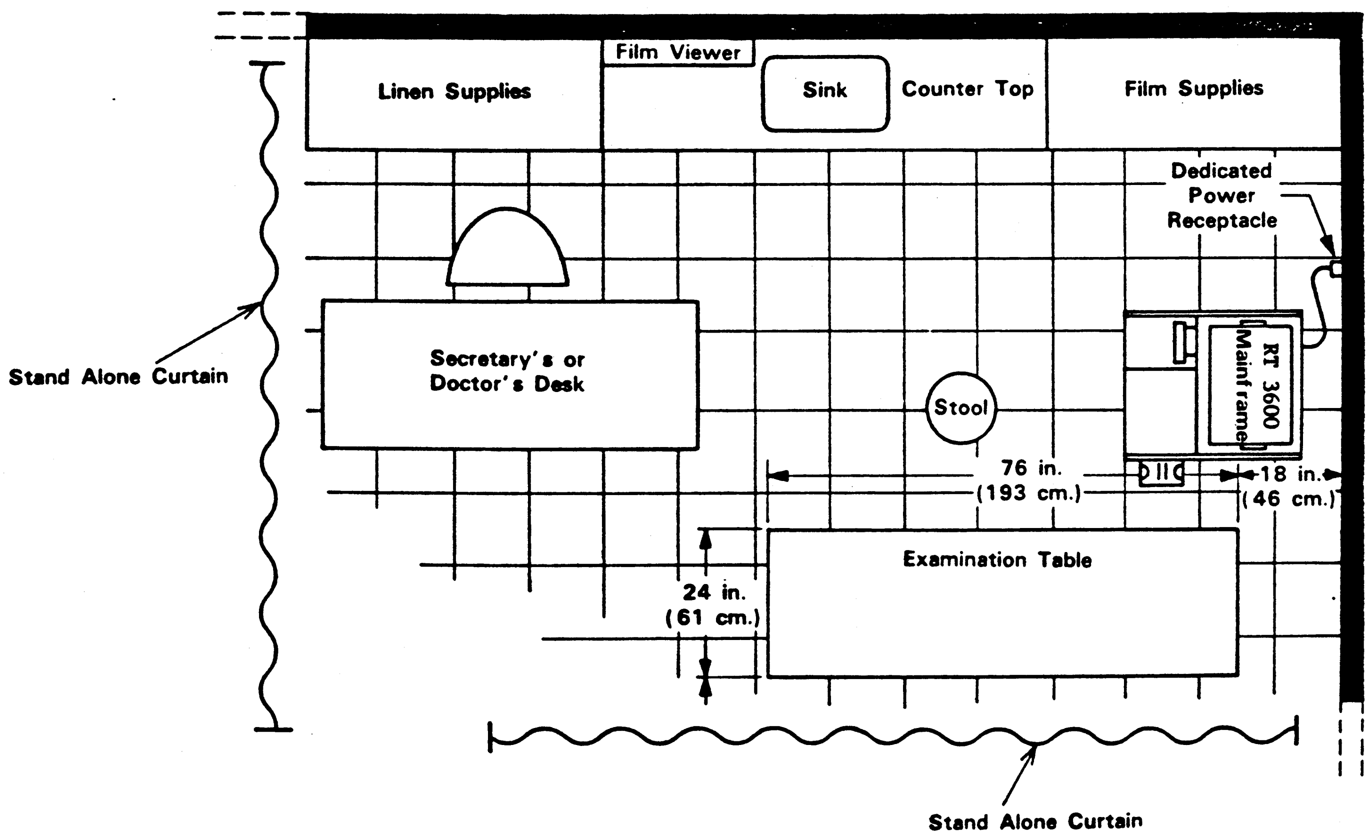
Scale: Each Square Equals One Square Foot.

Fig.2-6

—RT3600—

Alternative Ultrasound Corner Floor Plan

Fig.2-7



2-8 RT3600 with Doppler Option

This section presents information of RT3600 with Doppler option. The procedures are similar to RT3600 with some procedures added. Mainly the Doppler Option is described, please refer to section 2-1 to 2-7 of this Chapter.

2-8-1 Electrical Specification

The RT3600 with Doppler Option operates at either 115 or 230V AC. Single Phase, 48 to 63 Hz. Current drain is as follows:

5.0 amps at 115V

2.5 amps at 230V

2-8-2 Physical Specification

The RT3600 with Doppler Option (excluding accessories) weighs 318 lbs (142 kg). For dimension details, see Figure 2-8.

2-8-3 Shipping and Storage Requirements

The RT3600 with Doppler Option and accessories are shipped in a single container. Maximum weight is 380 pounds (170 kg). The size of container is 63 in. x 32 in. x 28 in. (1.6m x 0.8m x 0.7m).

Refer to Figure 2-7.

Requirements for shipping, storage, installation and operation are the same as RT3600.

2-8-4 Additional Connections

CW probe and Microphone can be connected to RT3600 with Doppler Option.

Refer to Figure 209, 2-10, and 2-11. The other connections are same as RT3600.

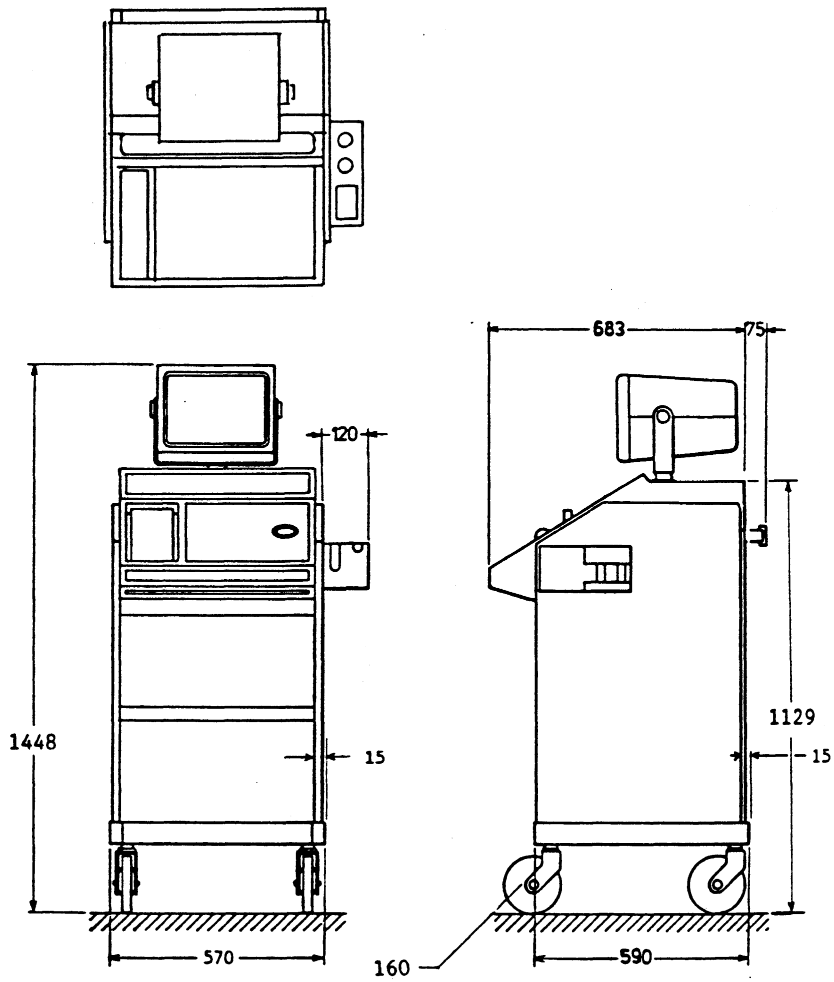


Figure 2-8
(measurements in mm)

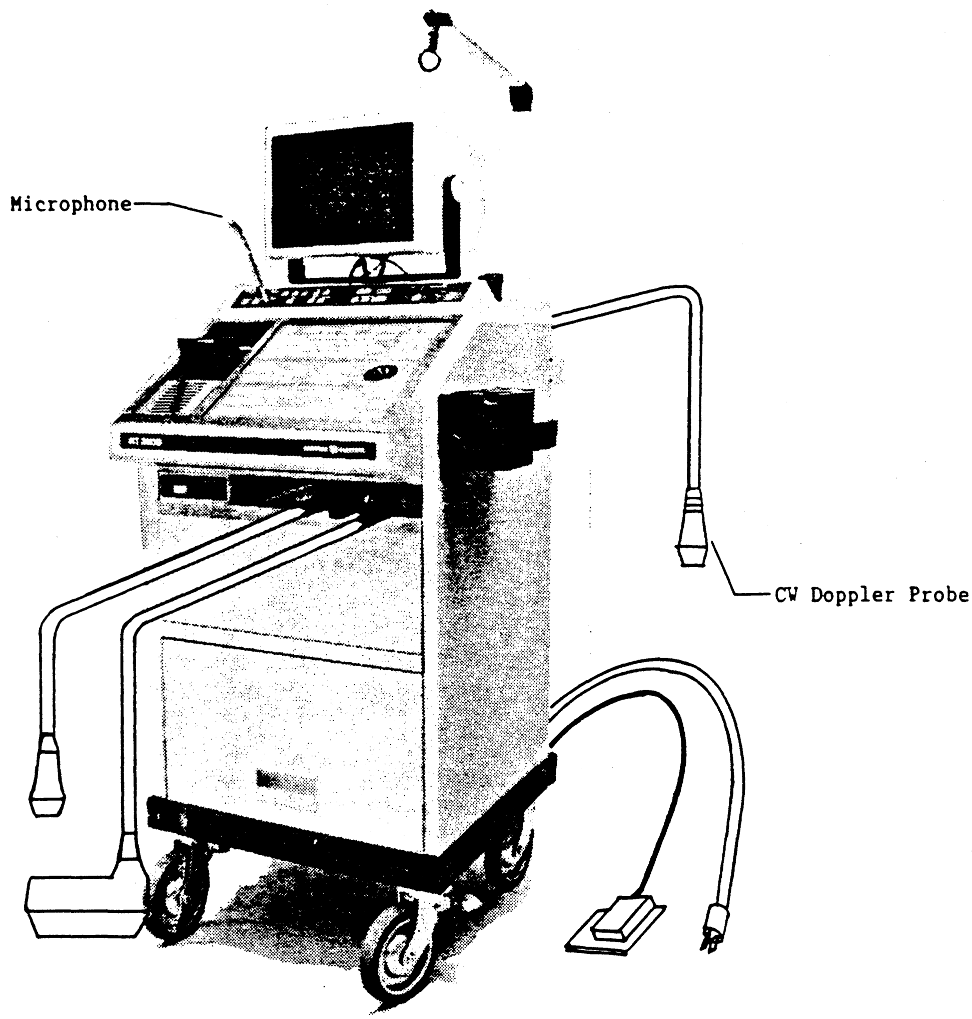


Figure 2-9

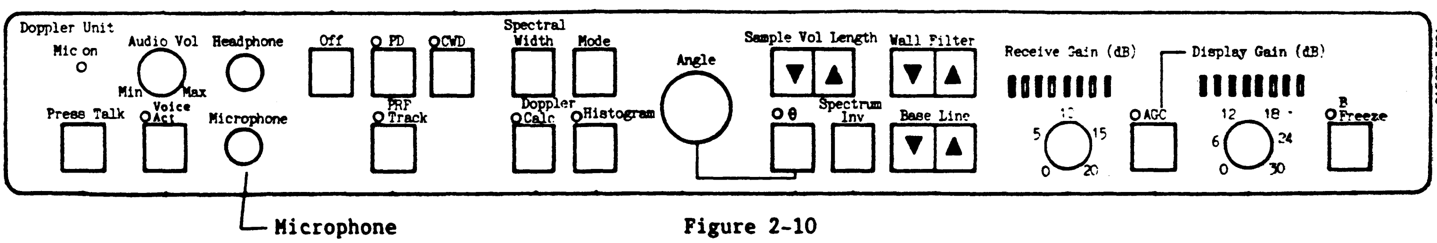


Figure 2-10

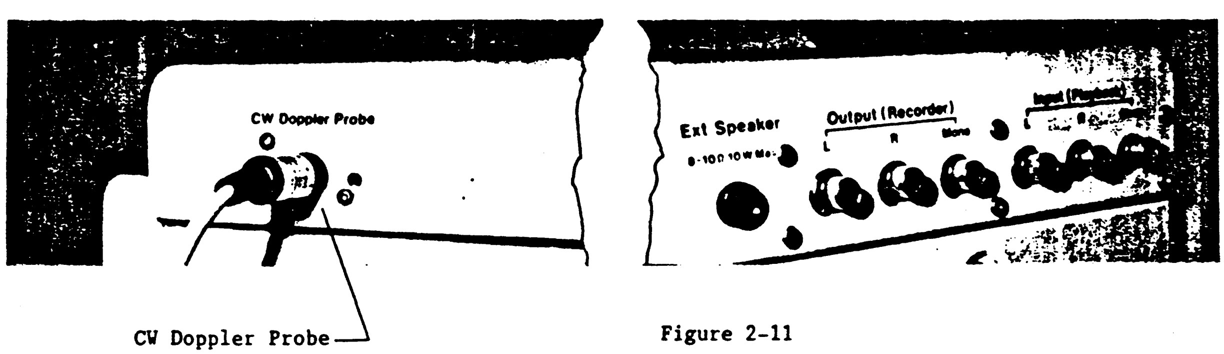


Figure 2-11

INSTALLATION

Chapter 3
Installation
Table of Contents

3-1 Abstract

This chapter contains the information required to allow qualified service personnel to unpack, setup, and checkout the RT3600. Shipping and transportation instructions are included, as is a Report on Technical Publications.

3-1-1 Mean Time to Install

The RT3600 has been designed to be installed by one person. Approximately four hours are required for installation and checkout.

3-2 WARNINGS

To ensure safe operation of this equipment, the following precautions should be made:

1. This manual should be read and understood before operating the RT3600. It should also be kept nearby for quick reference.

2. Although the ultrasound energy transmitted from the RT3600 transducer is within AIUM/NEMA standards, unnecessary exposure should be avoided. Only trained personnel should operate the machine.

3. To prevent electrical shock, the machine should be connected to a properly grounded receptacle. Do not use a three prong to two prong adapter.

4. The RT3600 has no components that are to be serviced by an operator. To prevent shock, do not remove any covers or panels. Should problems or malfunctions occur, unplug the power cord. Only qualified service personnel should attempt to resolve the problem. Refer to a General Electric Service Representative for information.

5. The RT3600 is a compact and mobile machine . It is recommended, however, that two people be used to relocate the RT3600.

3-3 Shipping Inspection

The RT3600 is shipped in a single container. The main console requires no assembly. The transducer is also included in the container.

The RT3600 and the container weigh approximately 330 pounds (150 kilograms)**(with doppler, 380 pounds,170 kg.)**

3-3-1 Delivery to Customer

When shipped by air flight, the RT3600 is sent to the customer's receiving dock.

When shipped by a ground carrier, it is sent to the customer's designated address.

3-3-2 Shipping Damage

Upon delivery, the RT3600 should be inspected for damage. If any is found, a notation should be made on the bill of lading. If the damage is concealed and found at a later time, notify transportation as soon as possible for an inspection report.

3-3-3 Van Delivery Damage

Damage during shipment by a van service should be reported to Traffic Office at G. E. Medical System Headquarters, Milwaukee, Wisconsin (DialComm 8-328-4240, or 414-786-0310 ext. 4240). Do not contact a local agent. Be prepared to provide the following information:machine part number, serial number, and extent of damage.

3-4 Unpacking Instructions

3-4-1 Special Instructions

Check the shipping container for special instructions.

Verify that the container is intact.

In some cases, a secondary container may be used. Ask the carrier for instructions for unpacking.

3-4-2 Removing The Container

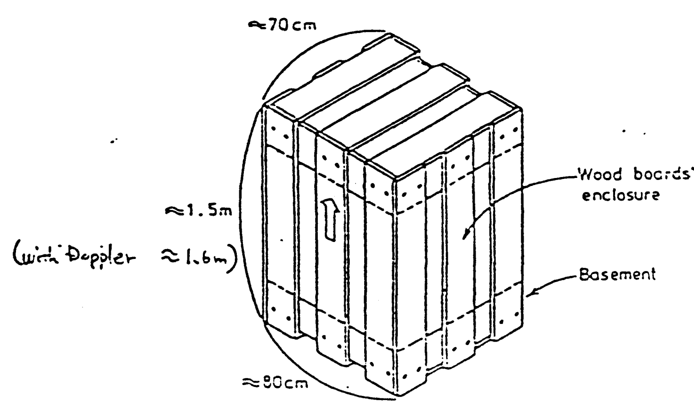


Figure 3-1

The RT3600 is shipped in a wooden container. Approximate size and weight during shipping are shown in Figure 3-1.

First, carefully remove the sides of the container. Leave the bottom of the container intact as this supports the weight of the RT3600. This step will reveal a reinforced cardboard box.

Cut the band straps (see Figure 3-2). The box can now be pulled up and removed (see Figure 3-3).

Remove the protective packing material. (NOTE: If further shipment is required, the packing material should be saved).

Carefully lift the machine from the wooden platform.

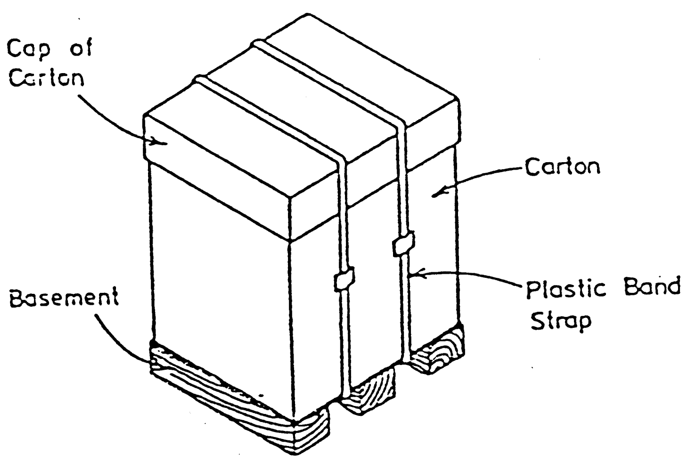


Figure 3-2

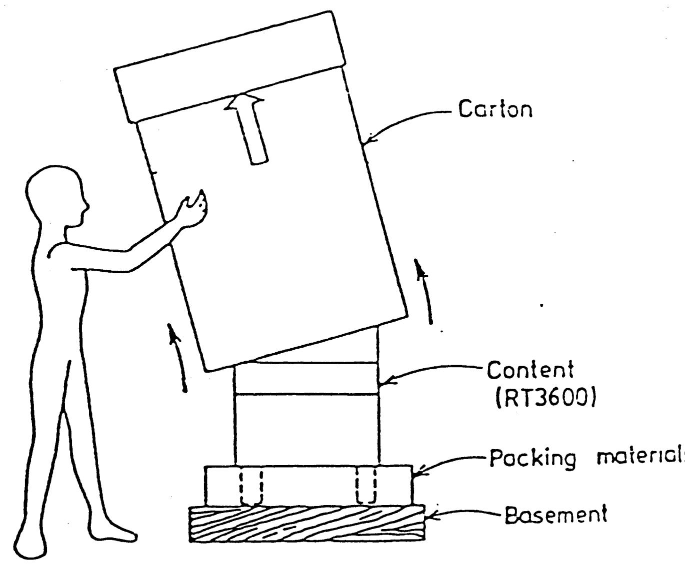


figure 3-3

3-5 Assembly Instructions

The RT3600 is shipped in a "ready to use" configuration. Cable connections, gel caddy attachment, and transducer support arm attachment are all that is required. These accessories are stored in the bottom drawer of the console.

3-6 Transducer Connections

The RT3600 has two transducer receptacles. To connect a transducer transducer, perform the following:

1: Push the transducer plug toward the receptacle, keeping the twist lock lever at 2 o'clock position.

2: Keeping contact between the connectors, twist the locking lever clockwise into 6 o'clock position.

(Refer to **Figure 3-10** .)

It is not necessary to power down to connect/disconnect a transducer.

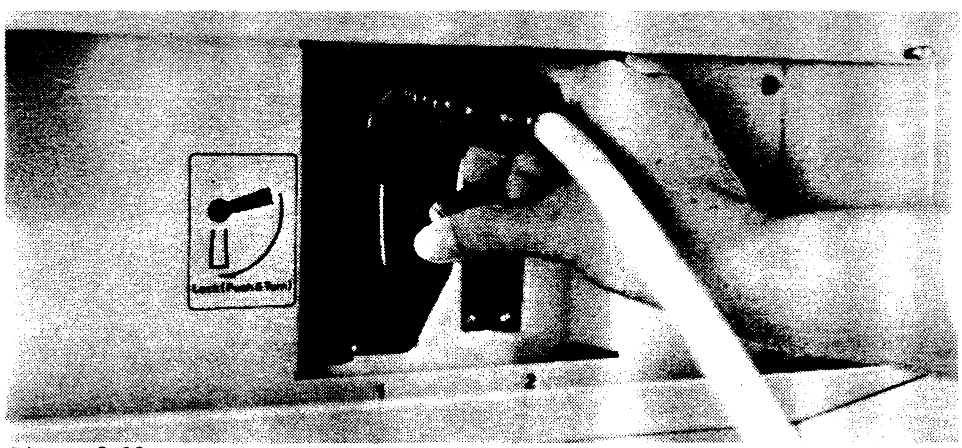


Figure 3-10

3-7 Cable Connections

3-7-1 Foot Switch

Connect the foot switch cable connector to the rear panel connector labeled "Footswitch".

Figure 3-9

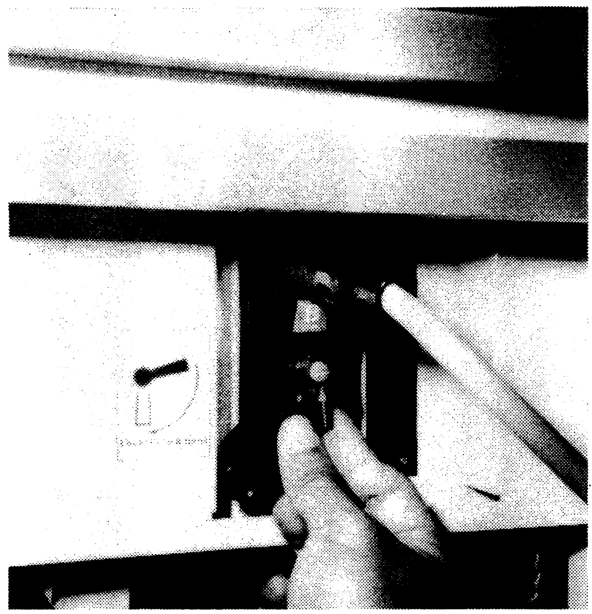


Figure 3-10

Figure 3-11

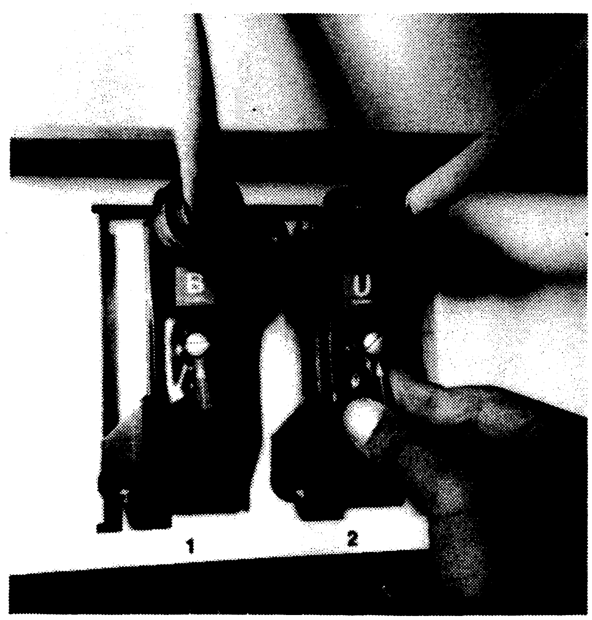


Figure 3-12

3-7-2 Line Scan Recorder (Optional)

A Line Scan Recorder (LSR), such as the Honeywell LS-8, may be connected to the RT3600. "Video" signal from the LSR is connected to the connector marked "LSR Echo Output" on the console rear panel. "Unblank" from the LSR goes to the connector labeled "Unblanking". Both connectors are BNC type.

3-7-3 Power Cord

Verify that the console power switch is off before connecting a power source. Use a properly grounded receptacle marked "Hospital Grade". Do not use a three prong to two prong adapter.

3-7-4 Auxiliary Protective Grounding

An independent ground terminal is provided at the console rear panel. This is to be used to ground external equipment used with the RT3600.

3-8 Power Line Requirements

The power source should be monitored for one week prior to installation. The recommended device for monitor is the Dranetz model 605-3 with option 101. Power line requirements are listed below:

Voltage Range	103 to 127 vac (U.S.) 206 to 254 vac (Europe) 90 to 110 vac (Far East)
Frequency Variation	48 to 63 HZ
Transients	
Decaying oscillation	less than 15% of peak voltage for less than 1 msec.
Voltage	less than 25% of peak voltage for less than 1 msec.

If the power line voltage is other than 115 volts, adjustments can be made within the console (see next section). If lower system leakage current is necessary, use an isolation transformer.

3-8-1 Internal Isolation Transformer

The power transformer is located in the lower right corner the console (as seen from the rear). Rewiring the transformer will allow various line voltages to be used. Refer to Figure 3-4 for transformer connections. When the transformer is rewired, fuses and the rating label must also change. Only qualified service personnel are to rewire the transformer.

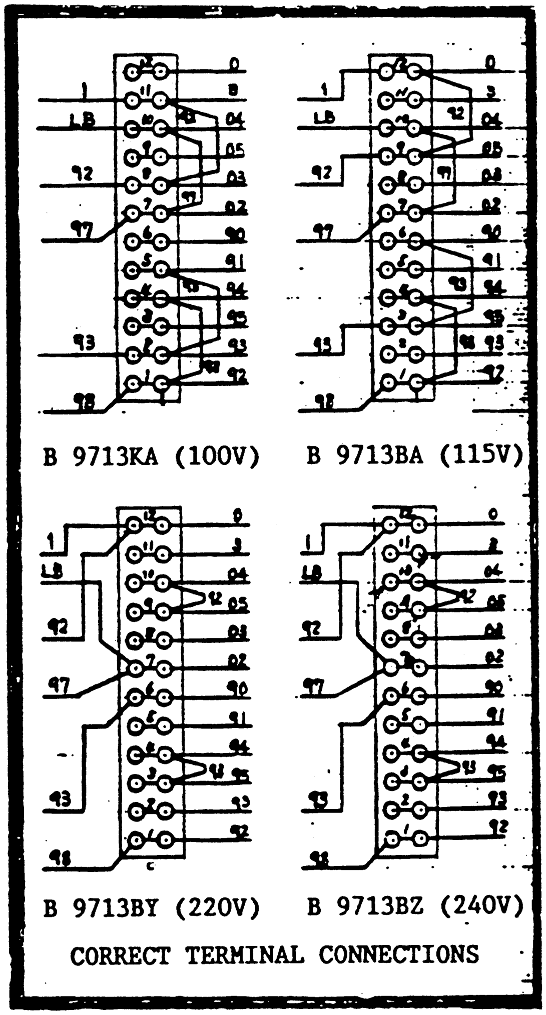


Figure 3-4

NOTE: The transformer terminal block is shown upside down. Tap number 12 (top of the terminal block in the figure) is actually at the bottom of the terminal blocks as mounted on the transformer. Numbers over connections to the terminal bock refer to wire color. Use the resistor color code (for example; 98 is a gray/white wire, LB is light blue).

3-9 Electrical Safety Test

To ensure patient and operator safety, system leakage current and ground continuity should be tested at the time of installation.

Leakage current is the current which could flow through a patient or operator in the event of a system fault. Transducers and exposed console surfaces are to be tested.

Ground continuity shall be checked between the AC power supply and different points on the console. A continuous ground ensures electrical safety in the event of wiring faults.

All measurements are to be made with the Microguard Model MG-5 Microammeter, built by Bio-Design, Inc.

3-9-1 Test1: Outlet Wiring

1. Check the batteries in the Microguard tester by moving the selector switch to Batt-" and the "Batt+". The meter needle should move over the box labeled "Batt" for both switch positions if the batteries are good. Refer to the illustration on the tester panel.

2. Set the power switch to the "Off" position and move the selector switch to "Outlet Test".

3. Connect the Microguard power cord into the three-wire, 120 VAC outlets in the installation area. The meter will indicate wiring conditions in the five colored arcs at the bottom of the scale. If any reading other than "OK" is found, there is a flaw in the outlet wiring. Any flaws are to be corrected before the installation can proceed.

3-9-2 Test2: Transducer Source Leakage Current

Turn off the tester and the RT3600. Plug the RT3600 into the tester and connect the tester into an AC outlet. Set the tester selector switch to "200". This position will provide a meter reading of 200 microamps at full scale. Set the Patient Lead Selector switch to the "All Other Tests" position. Set the Input switch to "Red Probe Only".

Wrap the transducer in aluminum foil. The foil should be firmly wrapped so that it makes good contact with the transducer surface (the acoustic aperture).

Suspend the transducer by the cable or place it on an insulating surface.

Place the red probe of the tester against the aluminum foil and record the ammeter reading.

NOTE: When the console is powered up, it automatically selects B-mode and begins scanning after a few seconds of initialization. Record the ammeter after scanning has begun.

Record the ammeter readings for the following test conditions:

Console Power	Tester Power Switch	Tester Ground Switch	Reading
On	Norm	Open	______
On	Norm	Closed	______
On	Rev	Open	______
On	Rev	Closed	______
Off	Norm	Open	______
Off	Norm	Closed	______
Off	Rev	Open	______
Off	Rev	Closed	______

The test passes when all readings are less than 10 microamps. This test shall be repeated for all transducers that will be used. These readings must be kept as part of the installation record.

CAUTION: Do not touch the console when tester ground switch is open.

3-9-3 Test3: Chassis Source Leakage Current

Leave the tester and console in the same setup as Test 2. Locate the tree test points listed below:

A. Inside the console. One of the screws attaching the transducer connector guide.

B. Caster wheel support.

C. CRT monitor housing rear screw.

Using these test points make the following readings using the red probe. Test conditions are identical to Test 2.

Console Power	Tester Power Switch	Tester Ground Switch	Test Point A	B	C
On	Norm	Open			
On	Norm	Closed			
On	Rev	Open			
On	Rev	Closed			
Off	Norm	Open			
Off	Norm	Closed			
Off	Rev	Open			
Off	Rev	Closed			

<u>CAUTION:</u> Do not touch the console when the tester ground switch is in the open position.

This test passes when all readings are less than 100 microamps. These readings must be kept as part of the installation record.

3-9-4 Test4: Ground Continuity

Disconnect the tester from the AC outlet. Disconnect the RT3600 from the tester. Place the tester selector switch to the "Ohms" position. Set the input switch to "Red and Black Probes" and set Patient Lead Switch to "All Other Tests".

Plug the black probe into the jacket next to the red probe lead. Short the red and black probes together to calibrate zero ohms (use zero ohms adjustment underneath the selector switch).

Measure the resistance from the ground pin of the power plug to the three test points used in the previous test and two additional test points- the Polaroid camera mounting screw, and the rear panel ground terminal.

The test passes when all measurements are below 100 milliohms.

3-10 Checklist

3-10-1 Final Steps

Complete the Functional Checks listed in Chapter 4. Complete the Installation Checklist below. If problems are found during a Functional check, refer to Chapter 6 Adjustments and Chapter 8 Troubleshooting.

3-10-2 Installation Checklist

_____ Observe safety precautions

_____ Equipment Inspection

_____ Cable Connections

_____ Transducer Connections

_____ Power Line Requirements

_____ Leakage Current Test

_____ Ground Continuity Test

_____ Power-on Tests

_____ Basic Operating Checks

_____ Phantom Imaging

_____ Noise Pedestal Tests

_____ Zone Continuity Check/Adjustments

_____ Polaroid Photo

_____ Auxiliary Equipment Operation

3-11 Moving the RT3600

3-11-1 Moving the RT3600 to Another Room

In general, a single adult can move the RT3600 along an even surface. It is recommended that at least two people move the instrument when large humps or grooves will be encountered.

At a slope of 5 degrees, 10 Kg. of force are required to move the RT3600.

It is better to "pull from the rear" rather than "push from the front". The mover should inspect the route before moving the RT3600.

Verify that the console power switch is off. Remove the power cord form the power supply outlet. Remove the transducer caddy and set it inside the bottom drawer.

Transducers and their cables should be placed in the middle drawer. Care should be exercised so that the acoustic aperture is not damaged. Wrap the transduers in soft cloth or foam.

3-11-2 Transporting the RT3600

To transport the RT3600, follow the above instructions with some additional precautions.

(NOTE: The original packaging should not be used when transporting the RT3600. General Electric shall repackage the console prior to shipment.)

Carefully load the RT3600 on board the van. **Use four strapes to fix** the instrument in position and prevent lateral movement. Set the instrument over the van's center of gravity. Tape the drawers shut.

When transporting the RT3600, the most important precaution is to prevent shock. Be careful at road crossings and avoid unpaved roads. A maximum speed of 40mph (60Km/hr) is recommended for paved roads.

It is not recommended that the RT3600 be "laid down for shipment". If this cannot be avoided, the neck must be removed and protective pads are to be used to support the console and monitor.

At the destination, repeat the installation steps. Do not operate the machine until the installation checklist is completed.

3-12 Report on Technical Publications

To Correct errors, omissions, and unclear statements, users of this document are requested to forward the form entitled "Report on Technical Publications".

3-13 RT3600 with Doppler Option

The installation of RT3600 with Doppler option is almost same as RT3600's. The RT3600 has been designed to be installed by one person. **Aproximately four and a half hours are required** for installation and checkout. Warnings, Delivery to Customer, Shipping Damage, Van Delivery Damage, Unpacking Instrucitons, Assembly Instructions are same as RT3600.

Refer to Figure 3 of this chapter.

3-13-1 Trasducer Conections

Connect the CW Doppler Probe and Microphone to console. The other connections are same as RT3600.

Refer to Figure 3-5, 6, and 7.

3-13-2 Others

Cable Connections, Power Line Requirements, Electrical Safety Test, Checklist, Moving, Transporting, Report are same as RT3600.

Refer to 3-7, 8, 9, 10, 11, 12 of this chapter.

FUNCTIONAL CHECKS

Chapter 4

Functional checks

Table of Contents

4-2 Abstract

This chapter provides the procedures for making quick checks of the major functions of the RT3600. These functional checks are one of the three major service chapters.

NOTE: After installation, all the functional checks called out in this chapter should be performed. When service is required, the functional checks under the heading of a particular problem are to be performed first.

4-3 Image Evaluation

4-3-1 Phantom Image Evaluation

a. Connect a Type B transducer.
b. Hold the transducer in air and power up the RT3600.
c. Wait 10 to 15 seconds and look for an image on the display. Do not touch the keyboard. The image must appear automatically.
d. Verify a high pitched sound coming from the transducer.
e. Verify the displayed image is dark at the top and bottom with uniform noise "grains" flashing.
f. Verify that the image is free from cyclic or burst noise. If the image is drastically different from Figure 4-1, refer to Chapter 8.
g. Scan th Ecobloc phantom so that an image similar to Figures 4-2 and -3 is obtained. Adjust system gain as necessary to obtain the proper image. The gain parameters should be within +/- 4 dB of the gain values given in the photos shown. If the gain has to be adjusted outside the +/- 4 dB tolerance, a machine fault is likely. Make sure, though, that the Acoustic Power Output Switch is set to the 100% position.

h. While continuing to scan, shift the transducer back and forth along the Ecobloc and observe image on the display. Carefully examine the image for any shading. The shading may indicate a machine fault.

i. Lift the transducer slightly off the Ecobloc surface but still within the coupling media. Observe the image and find the "skin line" of the phantom (refer to Figure 4-4). The skin line should be clearly visible (NOTE: The black section at the top of the image is the coupling layer between the transducer and the Ecobloc surface). Verify that no artifacts exist in the black region over the skin line and that the skin line retains its detail throughout the image.

j. Slightly tilt the transducer and verify a rotation of the skin line in the display.

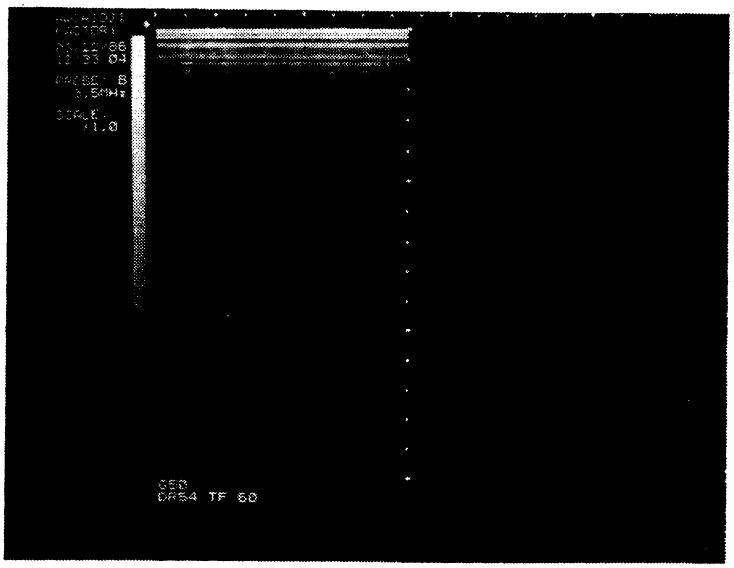


Figure 4-1

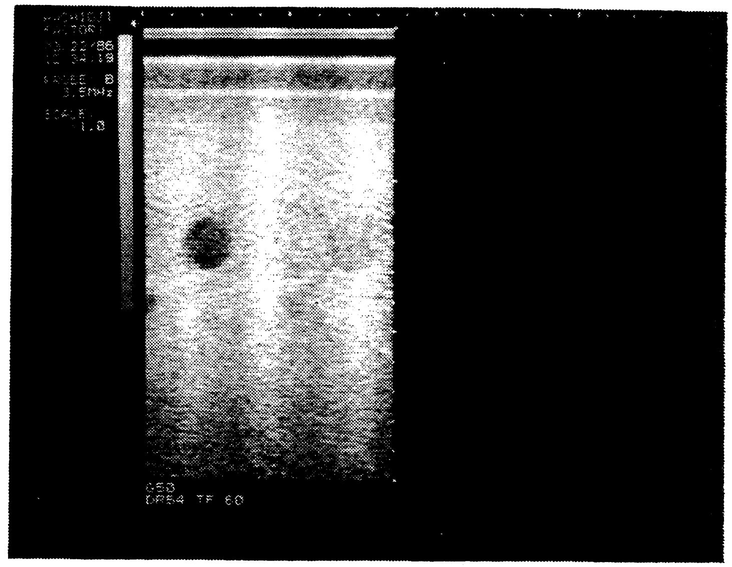


Figure 4-2

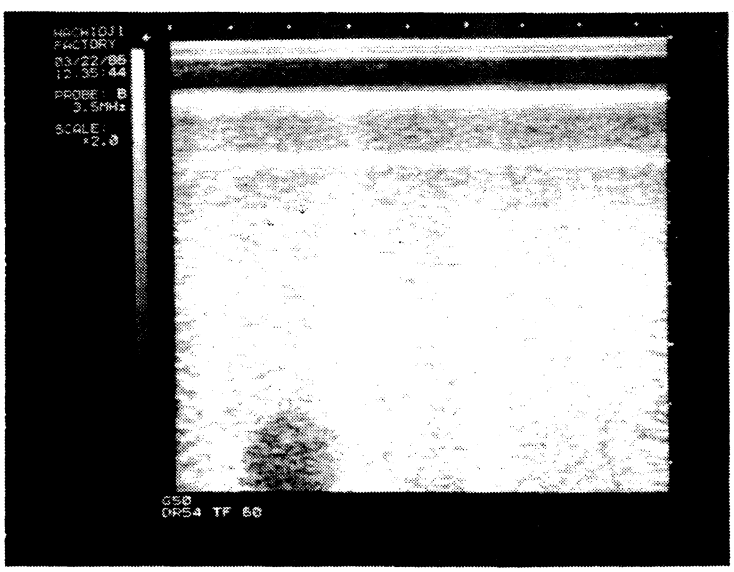


Figure 4-3

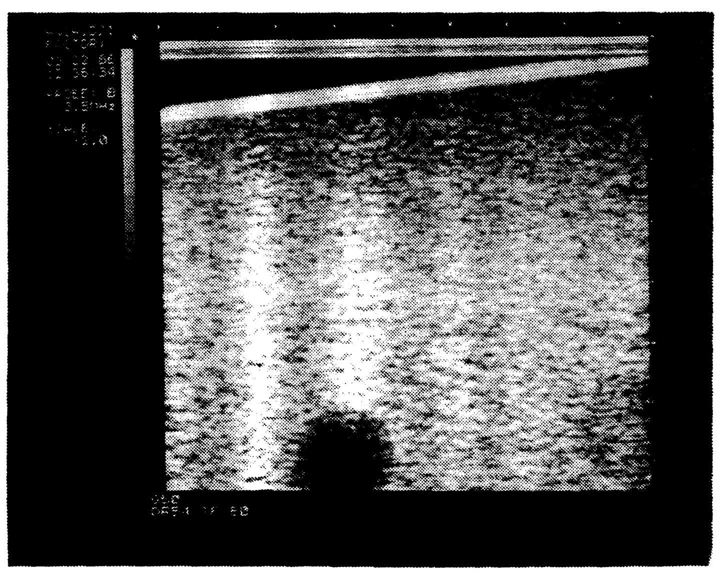


Figure 4-4

4-3-2 Rod Scan

The rod scan test checks the ability of every individual element in an array to transmit and receive ultrasound pulses. This test will detect weak, dead, or shorted transducer elements. It can also detect open channels on the T/R boards or faults in scan switching.

The test requires the use of a Philips screwdriver which will be used as a scanning rod.

a. Select SCALE FACTOR X1 and scan. Other settings should be initialized as power-up.
b. Hold the transducer with its face up and place a drop or two of coupling gel over the aperture surface.
c. Place the rod directly across one end of the aperture surface. Hold the rod firmly and made sure there is direct contact between the rod and the transducer.

   NOTE: It is not necessary to apply much pressure. (If the acoustic opening of the transducer bends, then you are applying too much pressure).

d. While watching the monitor, slowly move the rod from one end of the array towards the other end. Always keep the rod perpendicular to the long axis of the array surface.
e. The rod should be seen in the image as a bright vertical band. The top section will appear narrow, and the middle and lower sections will appear fat. The reduction in the top section's width represents the aperture width change as a result of near field echoes.
f. The middle and bottom sections of the rod image should be exactly 32 acoustic scan lines wide. This means that the element directly under the rod is used 32 times in a scanning sequence to produce the displayed image. The smaller width at the top of the image shows the same element to be used much less in the presence of near field echoes.

g. As the rod is moved across the transducer, verify that the displayed image moves continuously across the CRT. Verify that the rod's image does not darken. If there are weak or dead spots in the image, the fault is most likely in the transducer. However, a faulty T/R circuit or XPSW could produce the same result. If possible, rerun the rod scan test with another transducer. This will help determine if the fault is in the transducer or in the console.

h. Ensure that the middle and bottom parts of the rod image remain constant (32 scan lines) and that the rod moves uniformly and at a constant rate.

i. Variation in width, shape, or movement rate are most likely due to shorts between neighboring elements in the transducer. An irregular appearance of a bright line, spot or zone may indicate a scan switching problem in the crosspoint switch.

j. If the test fails or an odd image appears, perform troubleshooting.

4-3-3 Penetration

a. Connect a B-type transducer to the console.

b. Turn power on.

c. Set up the following scan parameters:

Focus	3
Scale	X1
Gain	50dB
Dynamic Range	54dB
TGC volume	Mid Position

d. Suspend the transducer in air.

e. Press "FREEZE". Then select "CONTROL E ENTER".

f. Using the trackball, position the cursor in the bottom right corner of the image.

g. Press "MEAS." A number corresponding to the noise level will appear next to the cursor. Verify the number is less than 2.

h. Scan a phantom. Using the above procedure, measure the echo level at 5 points in an area between 3 to 14cm. into the phantom. Verify that all levels are below 34. (NOTE: Because there is a great disparity in echo levels, the above measurements may fall out of torelance. If this is the case, rerun the test but make all five points lie at the same level. If one measurement is within tolerance, **the test has passed)**.

4-3-4 Sector Scanning

a. Connect a sector transducer to the console.
b. Scan a phantom.
c. Verify the sector pattern appears and that the image quality is good.

NOTE: Most of the functional checks are performed in the linear mode. It may be assumed that if all the checks are successful in the linear mode, then they will also function for sector.

4-3-5 Saturation

a. Connect a B-type probe and turn the system on.
b. Press the "AUTO" key.
c. Set Analog TGC to mid-position.
d. Set the Acoustic Power Output Switch to 100%.
e. Scan a phantom. Verify the dark zone (saturation zone) at the top of the image is less than 1cm deep.

4-3-6 Side Lobe Artifact

a. Connect a B-type probe and turn the power on.

b. Press "AUTO" and set Analog TGC to mid position.

c. Scan an Ecobloc phantom.

d. At "SCALE X1", take a Polaroid picture of the image.

e. Select "SCALE X2", and take another picture.

f. Remaining at "SCALE X2", use "LINEAR SCROLL" to reach the lowest limit of the image. Take another picture.

g. Compare the photos to the Figure 4-5. Side lobe artifact should be no greater than that seen in the figure.

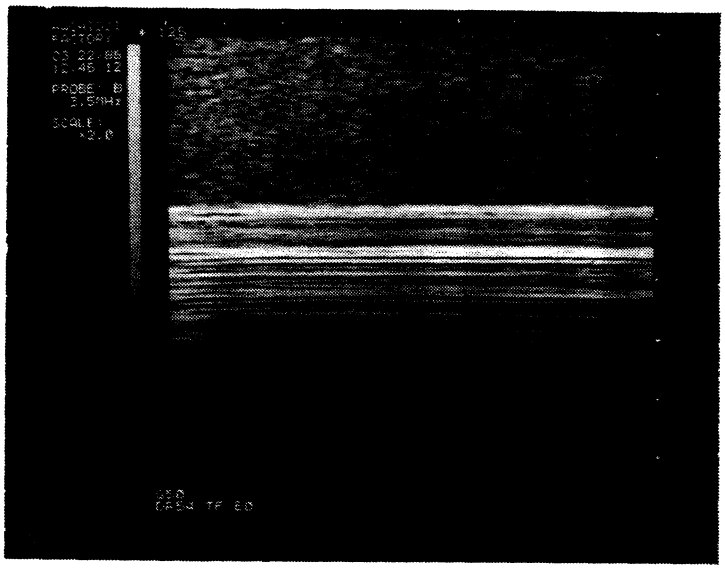


Figure 4-5

4-3-7 Polaroid Camera

In the previous section, the check for the "RECORD" key should have verified the operation of the Polaroid shutter.

It should also be verified that just before the Polaroid shutter **opens the TV monitor picture changes slightly and returns to normal** after the shutter closes. The monitor picture changes because a processed video picture matched to the Polaroid film is different than a monitor setup for direct viewing.

Scan a phantom. Select FREEZE so that the image contains a wide variety of gray levels and details. Set the CONTRAST on the camera to position 5. Use Polaroid film type 667 and record the image.

Inspect the photo carefully. Check for the following:

1. In the gray scale bar, verify each step of the scale is clear and distinct from the adjacent step. Exceptions can be made for the extreme ends of the gray scale bar. However, at least 14 levels should be recognized.
2. In the image field, verify that the texture details and gray levels are the same as seen on the viewing monitor. No saturation or compression should be seen at either extreme of the gray bar scale.

A poor photo print may be due to either a malfuction or misadjustment in the camera shutter control, camera aperture, or the Polaroid CRT monitor. Refer to Chapter 6 for appropriate adjustments.

<u>4-3-8</u> <u>Multiformat Camera</u>

This procedure is the same as that used for the Polaroid camera. Select the MFC for RECORD by the following keyboard entry:

CONTROL M ENTER

This will disable the Polaroid camera shutter and enable the external MFC to be accessed by the RT3600. Verify the correct connections between the MFC and the RT3600.

Select a display that will present a wide variety of gray scale and texture details. Press the RECORD button. Develop the film.

Inspect the film for the same qualities as specified for the Polaroid print; however, the MFC film is capable of recording a wider range of gray scale.

The RT3600 is responsible for providing the shutter control signal and the video signal. Verify that the MFC shutter can be controlled through the RECORD key on the RT3600. Verify that the video appears on the monitor.

4-3-9 CRT Monitors

The viewing monitoring at the top of the console is obviously functional if suitable images are obtained. The Polaroid monitor is functional if the proper photos have been obtained. However, it is recommended that some additional checks be performed. These checks place software generated test patterns on the CRTs.

Enter service software by the following keyboard entry:
CONTROL S ! ENTER

Select B-mode, scale factor X1, and FREEZE. To call the test pattern press CONTROL S A ENTER. A test pattern similar to the one seen in Figure 4-6 should appear on the CRT monitor.

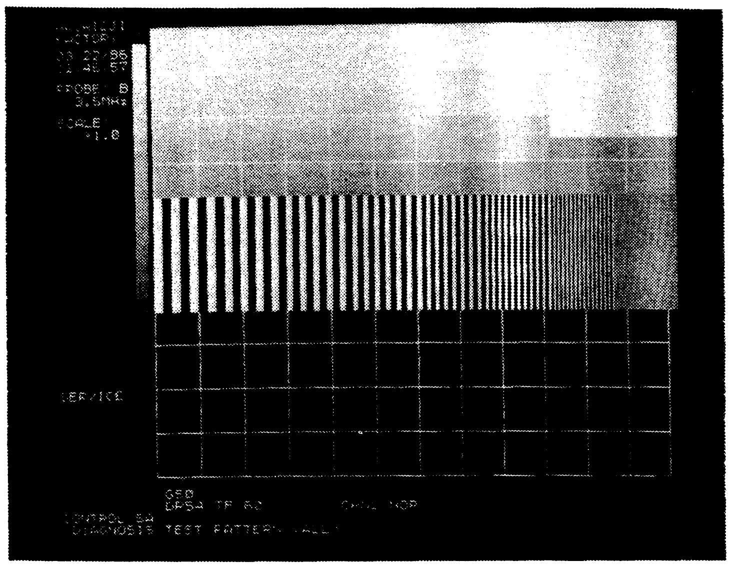


Figure 4-6

The entire gray scale should be distinguishable. The multiburst vertical stripes should also be distinguishable.

Examine the grid pattern appearing **in the test pattern display.** It should be uniform for any part of the picture. Stretched or compressed areas of the grid are an indication of linearity errors in the monitor deflection system.

To check the Polaroid CRT monitor, take a picture of the displayed test pattern. It should also be uniform throughout. Keep the photo for installation and maintenance records.

Verify that the CRT cutoff level is correct. To check this, examine the darkest areas of the displayed image field. It should be very dark, but not as completely black as the unscanned part of the CRT screen. The difference will probably only be noticed by close inspection of a corner of the screen. Dimming the room lights may make the difference easier to see.

Verify that the square edge of the raster is distinguishable from the unscanned parts of the CRT. It will also be very faint.

To make these checks easier, set the contrast control to zero. Adjust the brightness control for a faint illumination of the screen. Adjust contrast for suitable intensity of the image. Turning the contrast up too much will make characters on the screen "bloom"; that is, they will appear enlarged and blurred.

4-4 Front Panel Functions

Leave the RT3600 in the set-up used for the phantom scan. Try to access and perform all the functions, features, and controls accessible from the front panel and keyboard. A menu of these items is given in the Operator's Manual. A summary of the major items is provided in the following list:

1. GAIN
2. Analog TGC
3. FOCUS
4. SCALE
5. IMAGE DIRECTION
6. DYNAMIC RANGE
7. MODE
8. AUTO
9. LINEAR SCROLL
10. ERASE
11. MULTI IMAGE
12. FREEZE
13. BODY PATTERN
14. POSITION
15. IMAGE MEMORY
16. ID NUMBER
17. NAME
18. COMMENT
19. MEASUREMENT
20. FUNCTION
21. NEW PATIENT
22. RECORD

4-4-1 Preparation

TEST	PROCEDURE
Preparation	a. Turn the system on. Make the following keyboard entries when installing a new system. **CONTROL S! ENTER" (service software enter)** **CONTROL SV ENTER"(Note: this will clear all preset parameters)** **CONTROL SZ ENTER" (system reset)**

4-4-2 Initialization

PROCEDURE

a. Verify that two beeps are heard when the system is turned on.

b. Verify that all keyboard LEDs flash on. The lights for the keys marked "AUTO", Mode "B", Focus "3", and Scale "X1" shall remain on.

c. Check for regular hum from the transducer.

d. An image shall appear on the monitor after approximately 30 seconds.

4-4-3 Gain

TEST	PROCEDURE
"Gain"	a. Press "GAIN Δ" and "GAIN ∇".
	b. Verify that the brightness of the overall image area changes in 1 dB steps.
	c. Constant pressure on the key causes a continuous change in the brightness of the image.
	d. The image brightness changes in a uniform manner.
	e. Gain can be adjusted from 0 to 99 dB. Verify this in the annotation in the display.
	f. Press "AUTO".
	g. Gain returns to a 50 dB level.

4-4-4 Analog TGC

TEST	PROCEDURE
"ANALOG TGC"	a. Set Analog TGC controls to mid position.
	b. Move each analog TGC controls to left and right.
	c. Verify the changing brightness becomes darker and brighter.
	d. Check all Analog TGC controls.

4-4-5 Focus

TEST	PROCEDURE
"FOCUS"	Verify that the following key actions the proper image annotation responses:
* Linear	"FOCUS 1": The annotation in the display says "TF 20".
	"FOCUS 2": The annotation changes to "TF 40".
	"FOCUS 3": The annotation changes to "TF 60".
	"FOCUS 4": The annotation changes to "TF 100".
	"COMB": The annotation changes to "TF DYN".
* Sector	"FOCUS 1": "TF 30".
	"FOCUS 2": "TF 60".
	"FOCUS 3": "TF 90".
	"FOCUS 4": "TF 140".
	"COMB" : "TF DYN".

4-4-6 Scale

TEST	PROCEDURE
"SCALE"	Verify that the following key actions produce the listed changes in the image and annotations.
	Verify that the image scale changes. Also, check that the scale marker and range marker change with image size changes.
	The annotation should read the same as the select key.
	"SCALE X0.7"
	"SCALE X1"
	"SCALE X1.5"
	"SCALE X2"

4-4-7 Image Direction

TEST	PROCEDURE
"IMAGE DIRECTION"	Verify the following:
	a. Press "RVS". The display image shall be reversed. An LED backlight should light. An arrow in the top of the image is reversed.
	b. Press "RVS". The displayed image returns to its original form. The LED backlight goes off.

4-4-8 Dynamic Range

TEST	PROCEDURE
"DYNAMIC RANGE"	Check the follwing:
	a. Press the "DYNAMIC RANGE" up and down keys.
	b. Verify the dynamic range can be adjusted from 36 to 72 dB in 6 dB steps.
	c. Verify the image changes from high contrast at 36 dB to low contrast at 72 dB.

4-4-9 Mode

TEST	PROCEDURE
"MODE"	a. Press the key marked "B/M". Compare the image to Figure 4-7.
	b. Press "M". Verify a M-mode sweep time of 2 seconds. See Figure 4-8.
	c. Press "M FAST". Verify the sweep time decreases to 1 second.
	d Press "CONTROL R 1 ENTER". Verify a sweep time of 8 seconds.
	e. Press "M FAST". Verify the sweep time decreases to 4 seconds.
	f. Press "B/M". Activate GAIN, and DYNAMIC RANGE keys. Verify that these keys affect the M-mode image only.
	g. Press "AUTO".

4-4-10 AUTO

TEST	PROCEDURE
"AUTO"	a. Press the GAIN, and DYNAMIC RANGE keys. Check that the annotations in the display are constantly updated. Verify the "AUTO" backlight goes out.
	b. Press "AUTO". The backlight shall come on. The annotations in the display should return to their initial settings. The display should indicate the following:

G50

DR54 TF 60

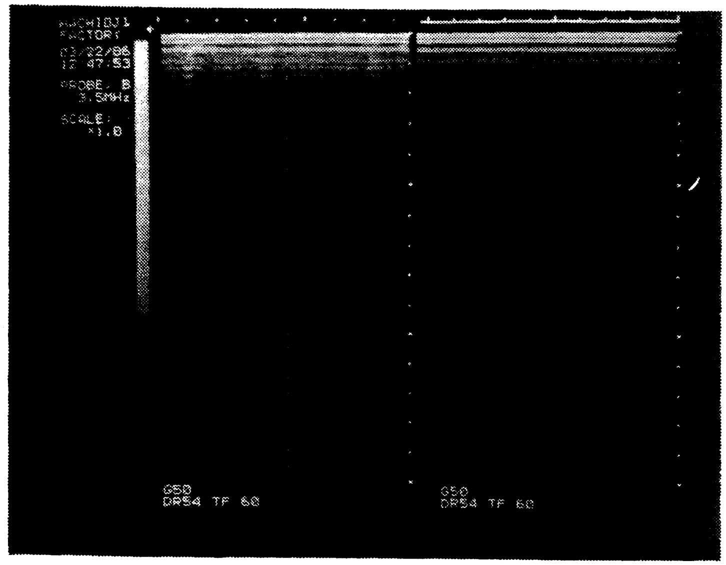


Figure 4-7

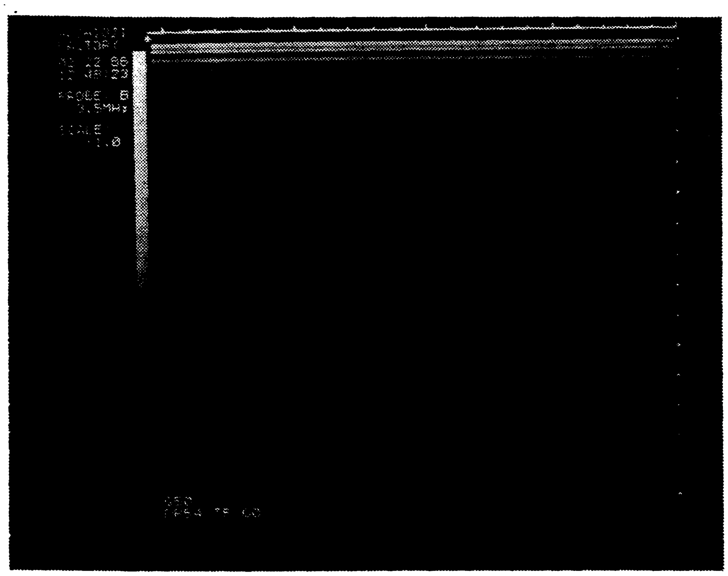


Figure 4-8

4-4-11 Linear Scroll

TEST	PROCEDURE
"LINEAR SCROLL"	a. Select the "SCALE X1".
	b. Press the "LINEAR SCROLL"up key. Verify that the depth scrolled in displayed in the top left of the image.
	c. Press "SCALE X1.5". Verify the "LINEAR SCROLL" still functions. Repeat this step for "SCALE X2" and "COMB".

The relationship between the scale factor and the scrolled depth is listed below (all distances are in millimeters):

Scale factor	X0.7	X1	X1.5	X2
Scrolled Distance per step		1.5	1	.75
Displayed scrolled distance		1 to 2	1	0 to 1
Maximum scrolled distance		50	100	**

** 125 for single focus. 116 for combination focus.

Note: Less than 1 mm not desplayed, greater than **0.5 mm** rounded off.

4-4-12 Erage

TEST	PROCEDURE
"ERASE"	a. Press the "ERASE" key. Verify that all images are erased and a real time image appears on the left side of the display.

4-4-13 Freeze

TEST	PROCEDURE
"FREEZE"	a. Press the "FREEZE" key. Verify that the real time image is frozen. b. Press "FREEZE" again. The image shall return to a real time display.

4-4-14 Multi Image

TEST	PROCEDURE
"ERASE"	a. Press the "MULTI IMAGE" (◁) key. Verify the beep sounds. b. Press the "MULTI IMAGE" (▷) key. Verify the left image is frozen and a real time image appears on the right side of the display. Only the real time image will update the annotations. c. Press the "MULTI IMAGE" left (◁) key. The right image shall freeze and the left image will be real time.

4-4-15 Body Pattern

TEST	PROCEDURE
"BODY PATTERN"	a. Press the "BODY PATTERN L" key. Verify the back-light comes on and that a body pattern appears. b. Press "BODY PATTERN SEL". A new body pattern will appear. It should be a right oblique pattern. c. Repeat step b. Verify that a right, supine, and head body pattern appears. d. Press the "MULTI IMAGE RIGHT" key and the "BODY PATTERN R" key. Verify that the backlight under "L" goes out and the one under "R" comes on. Check that the same body patterns appear on the right image. e. Press "BODY PATTERN SEL". Verify that all the body patterns can be selected under the right image. f. Make the following keyboard entry: Control J Enter g. Verify that body pattern package is changed to package B from package A. h. Press "BODY PATTERN SEL". Verify that all the body patterns can be selected.

4-4-16 Position

TEST	PROCEDURE
"POSITION"	a. Verify the operation of the five position keys: left, right, up, down, and rotation. b. Verify that the representation of the transducer in the "BODY PATTERN" moves in the appropriate direction.

4-4-17 Image Memory

TEST	PROCEDURE
"IMAGE MEMORY"	a. Select "FREEZE". Verify the image is frozen. b. Press "IMAGE MEMORY". Check that the backlight comes on and the image is erased. c. Select "SCALE X2", "LINEAR SCROLL (Δ)", and "FREEZE". d. Again press "IMAGE MEMORY". Verify that the image frozen in step a. reappears on the display. Check that all annotations are correct. c. Press "IMAGE MEMORY". Verify that the image frozen in step c, reappears and that all annotations are correct.

4-4-18 ID Number

TEST	PROCEDURE
"ID NO."	a. Press the key labeled "ID NO." Check that the back-light comes on. Examine the display "ID" and a line cursor will appear. b. From the keyboard, enter 16 characters onto the display. They should appear on two lines (8 charac-ters on each line). c. Select "ENTER". Verify that the "ID NO." backlight goes out and the characters remain on the screen.

4-4-19 Name

TEST	PROCEDURE
"NAME"	a. Press the key labeled "NAME". Check that the back-light comes on. Examine the display "NAME" and a line cursor should appear. b. From the keyboard, enter 32 characters onto the display. They shall appear on 4 lines (8 characters on each line). c. Select "ENTER". Verify that the "NAME" backlight goes out and the characters remain on the screen.

4-4-20 Comment

TEST	PROCEDURE
"COMMENT"	a. Select "FREEZE". b. Press the key labeled "COMMENT". Check that the backlight comes on. Verify that a line cursor appears on the display. c. Press the "POSITION" keys. Verify that the cursor moves in the direction chosen by the "POSITION" key. d. Enter all available characters from the keyboard. Verify that the characters area shown correctly on the display. e. Select Backspace "BS". Verify the cursor appears under the last character input. f. Press "ENTER". Verify the "COMMENT" backlight goes out as does the line cursor.

4-4-21 Measurement

TEST	PROCEDURE
"MEASUREMENT"	a. Select "SCALE X1" and "COMB" focus.
	b. Set DYNAMIC RANGE to 36 dB.
	c. Press the "DIST" key. Verify that the backlight comes on. Also verify that a "D" appears on the display with four cursors.
	d. Press the "TRACE" key. Verify that the backlight comes on. Check to make sure a "C" appears in the display along with two cursors.
	c. Press the "AREA" key. Verify the backlight comes on. Also, verify that an "A" appears in the display along with one cursor.

4-4-22 Function

TEST	PROCEDURE
"FUNCTION"	a. Press Measurement "OFF".
	b. Press "DIST".
	c. Using the trackball, measure the four different distances indicated in Figure 4-9. Verify that each distance is 50mm.
	d. Select "TBL 1" from the Function keys.
	e. Select among the five menus by using the left or right arrow Function keys. The measurement values **shall be as listed following the enter key as below.**

Menu	Measurement
BPD	21W0D ± 3
CRL	11W6D ± 5
FL	**26W2D ± 2W**
AC	NO MSR
HC	NO MSR

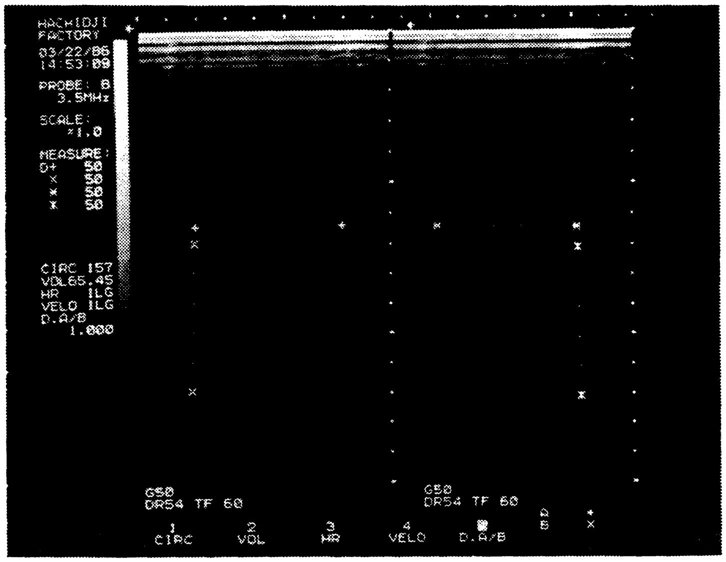

HACHIOJI
FACTORY
03/22/86
14:53:09
PROBE: B
3.5MHz
SCALE:
×1.0
MEASURE:
D+ 50
× 50
50
50
CIRC 157
VOL65.45
HR ILG
VELO ILG
D.A/B
1.000
G50
DR54 TF 60
G50
DR54 TF 60
A
B
1
CIRC
2
VOL
3
HR
4
VELO
D.A/B

Figure 4-9

f. Select "CAL 1". Select among the menus as in step e. The measurement values shall be as listed below:

Menu	Measurement
CIRC	157
VOL	65.45
HR	ILG
VELO	ILG
D.A/B	1,000

g. Select M-mode.

h. Using the trackball and "DIST" key, measure **a** oblique line between the limit points at the **bottom** left corner and the **top right corner.** Do this **for all four measurements.**

i. Verify the measured distance is "150" on the monitor.

j. Select "CAL 1". With the same procedure as in step e., choose the menus labeled HR and VELO. The display should indicate the following:

Menu	Measurement
HR	**24.81**
VELO	**31.01**

k. Select B-mode and "COMB" focus. Set Gain to **50 dB** and Dynamic Range to 54 dB.

l. Press "FREEZE".

m. Select the key labeled "MAP". Select all five menus in turn. Verify the display reflects an image as shown in the indicated figures:

Menu	Figure
NORMAL	4-10
1	4-11
2	4-12
3	4-13
4	4-14

n. Select "Wdo". Select all four menus in turn. Verify the display reflects an image as shown in the indicated figures:

Menu	Figure
A	4-17
B	4-18
C	4-19
D	4-20

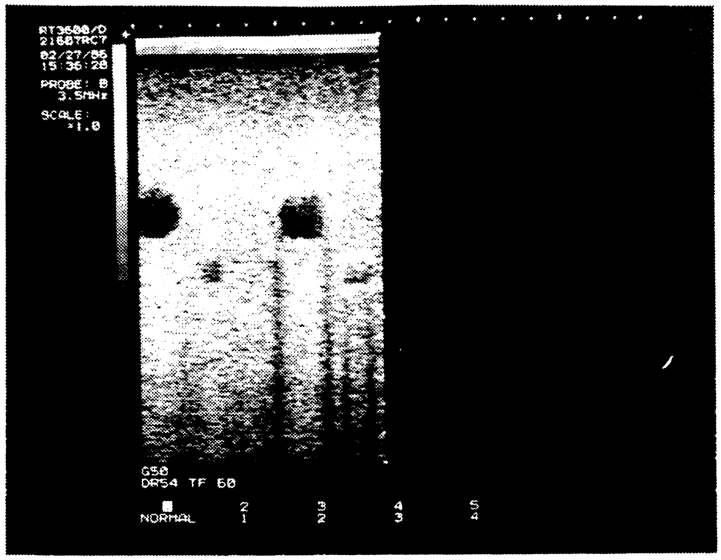


Figure 4-10

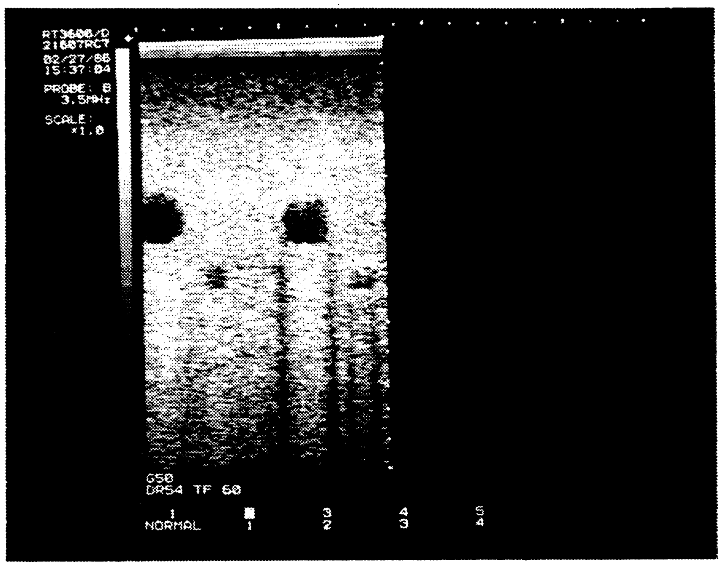


Figure 4-111

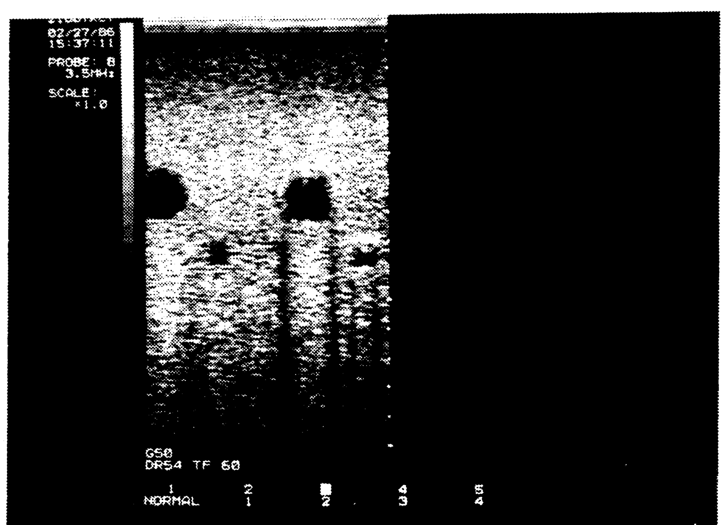
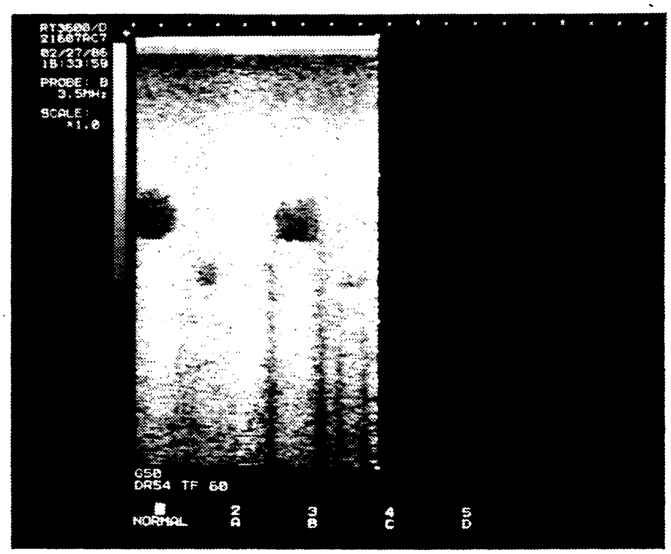


Figure 4-12

Figure 4-13

Figure 4-14

Figure 4-15



Fogire 4-16

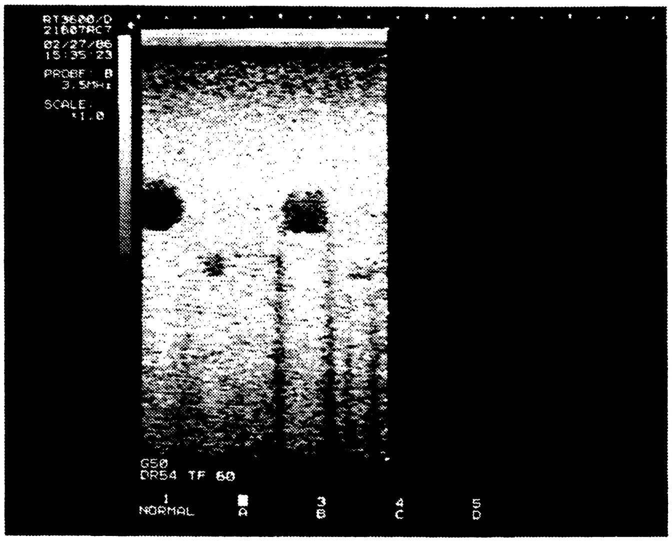


Figure 4-17

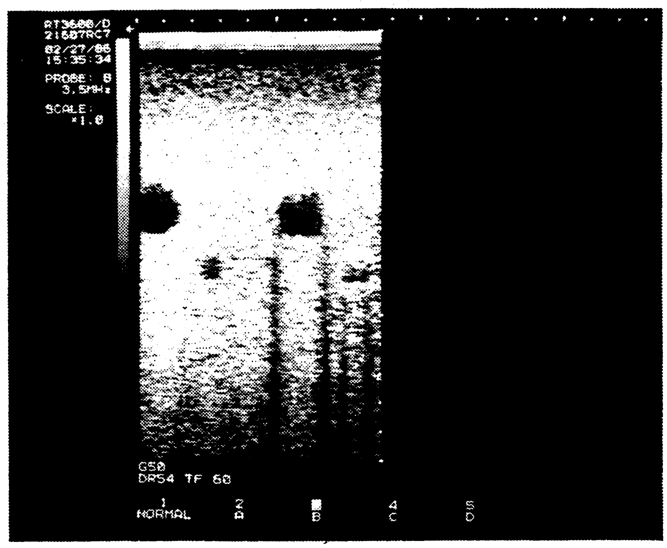


Figure 4-18

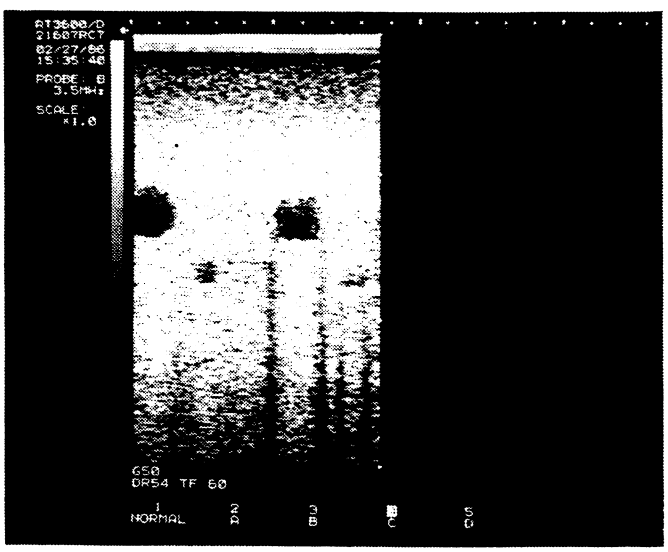


Figure 4-19

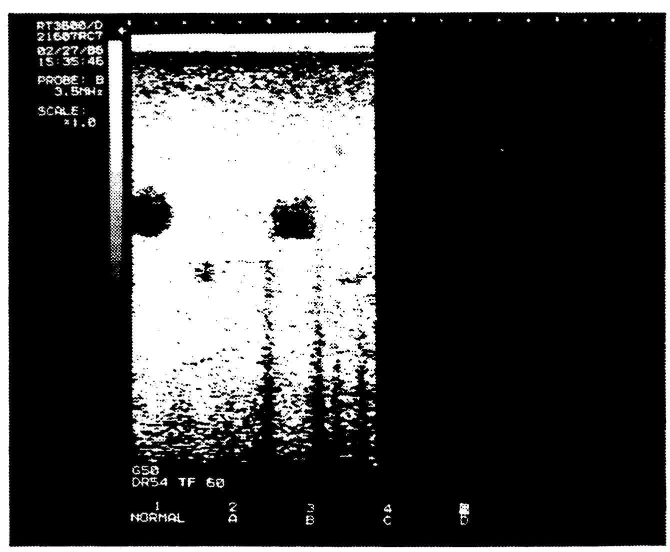


Figure 4-20

4-4-23 New Patient

TEST	PROCEDURE
"NEW PATIENT"	a. Press the key label "NEW PATIENT".
	b. Verify that ID, NAME, MEASUREMENT and COMMENT characters are erased. A real time image shall appear on the left. Any body marks shall continue to be shown on the left-hand image.

4-4-24 Record

TEST	PROCEDURE
"RECORD"	a. Press "CONTROL M ENTER".
	b. Press "CONTROL I 2 ENTER".
	c. Select "RECORD". Verify the white-on-black image is momentarily inverted to a black-on-white image.
	d. Press "CONTROL P ENTER" and "RECORD". Verify the same momentary change in the display and that the Polaroid shutter opens.
	e. Press "CONTROL I 1 ENTER".

4-5 Doppler Unit

NOTE: The following test requires a headphone set or VCR to complete. If the customer does not have either headphone or VCR do not continue test.

4-5-1 Microphone Test

NOTE: Headphones are not supplied with unit.

a. Connect a headphone and a microphone to Doppler front panel.

b. Press "PD".

c. Press "Press Talk". An LED "Mic On" should light.

d. Input some voice to the microphone and verify that the voice is heard from headphones or recorded on the VCR.

e. Stop pressing "Press Talk". After two seconds, the LED "Mic On" should turn off.

f. Press "Voice Act".

g. Verify that the LED "Mic On" should lights and the voice is heard from the headphone at the time.

(Speaker audio should mute if no headphones are attached.)

h. Re-press "Voice Act", verify a green LED turns off.

NOTE: Speaker audio volume should return to normal if headphones are **disconnected**. The voice will no longer be heard from the headphones.

4-5-2 PD

a. Connect a Sector transducer.

b. Press "PD" on the Doppler keyboard, verify a green LED lights, and the display appears as Figure 4-21.

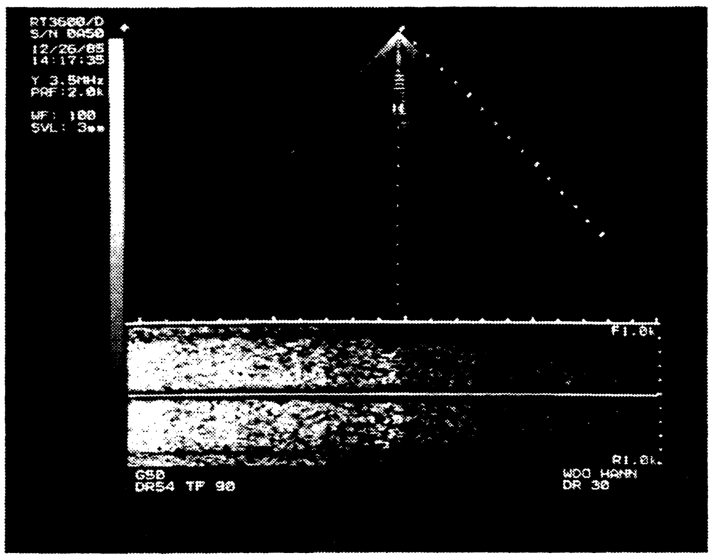


Figure 4-21

4-5-3 CWD

a. Connect a CWD transducer.

b. Press "CWD", verify a green LED lights, and the CWD display appears as Figure 4-22.

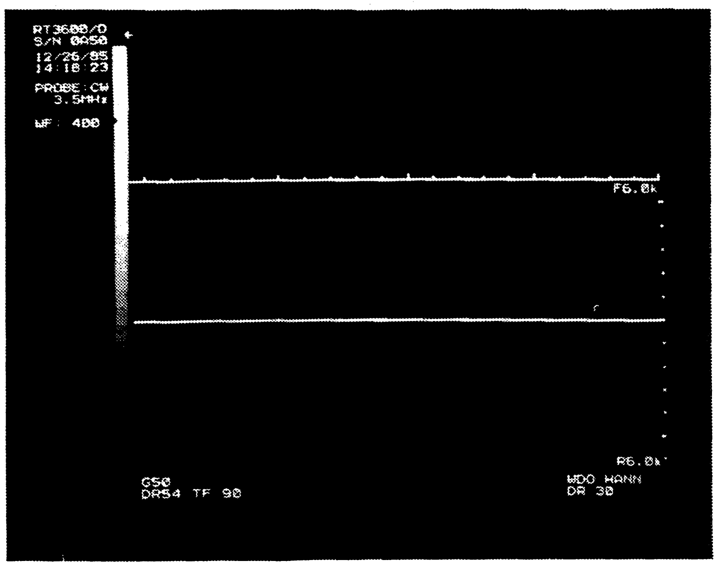


Figure 4-22

4-5-4 DCALC

Press "DCALC", verify a green LED lights, and the display appears as Figure 4-23.
Re-press "DCALC", verify the green LED turns off.

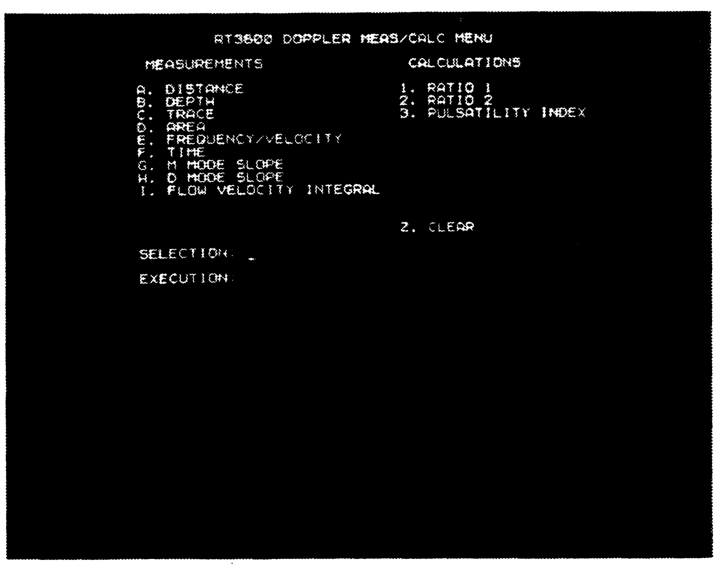


Figure 4-23

4-5-5 PRF TRACK

a. Press "PD".

b. Press "PRF TRACK", verify a green LED lights.
Press position key "▲", "▼", verify the PRF changes automatically.

c. Re-press "PRF TRACK", verify the green LED turns off.

NOTE: 8KHz PRF is not available for type W, Y and Z transducers.

4-5-6 AGC

a. Connect a CWD probe and set as follows:

Mode	CWD
Scale	X0.7
Audio Vol	Mid Position
Sweep	R1 (CONTROL R1 ENTER)

b. Hold the CWD probe in the air without gel.

c. Press "AGC", verify a green LED lights.
And the FFT spectrum display becomes brighter by the operation of AGC. At this time, the should of noise is heard from a internal speaker.

d. Press "M-Fast".

e. Rub the aperture of CWD probe with your finger.

f. At this time, the sound and spectrum image should diminish rapidly by the operation of AGC.

g. After this, the spectrum image should stabilize to some nominal value.

h. Re-press "M-Fast". And make key input "Control R0 Enter".

4-5-7 B-FREEZE

a. Press "PD"

b. Press "B-FREEZE", verify a green LED lights and the B-mode image freezes.

At this time, verify the increase of PRF and frequency of doppler display scale. And also note an increase in the frequency components of the Doppler audio.

c. Re-press "B-FREEZE".

4-5-8 θ and ANGLE

a. Press "θ".

b. Verify a green LED lights and the line of the θ correction cursor appears on the monitor.

c. Turn "ANGLE" Knob right, verify the line turns right and there is a change of display velocity.

d. Turn "ANGLE" knob left verify the line turns left and there is a change of display velocity.

Refer to Figure 4-24.

e. When angle becomes greater than 80°, the velocity scale disappears and the θ display flashes.

4-5-9 HIST

a. Press "CWD". And display the live Doppler spectrum image.

b. Set Sampling Frequency to 6KHz, press "Freeze" on console.

c. Press "HIST", verify a green LED lights, and a Histogram appears with the timing cursor.

Refer to Figure 4-24.

d. Move timing cursol with the trackball and verify the histogram is updated.

e. Turn off the histogram by pressing Measurement off key.

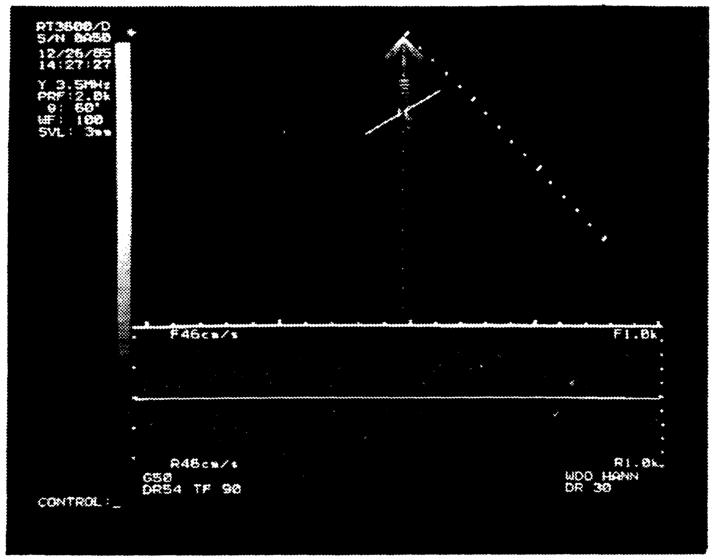


Figure 4-24

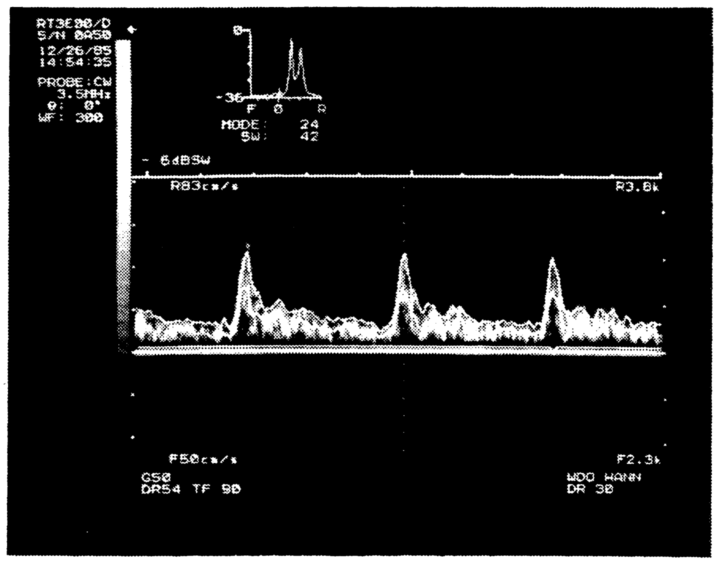


Figure 4-25

4-5-10 MODE

a. Press "CWD", and display the line Doppler spectrum image.

b. Set Sampling Frequency to 6 KHz, press "Freeze" on console.

c. Press "MODE", and verify the MODE trace appears.

d. Turn off Mode waveform by pressing Measurement off key. Refer to Figure 4-25.

4-5-11 SPECTRAL WIDTH

a. Press "CWD", and display the live Doppler spectrum image.

b. Press "FREEZE", and press "SPECTRAL WIDTH".

c. Select "1" (-3dB) and press "ENTER".

d. Verify the Spectral Width display appears as Figure 4-24.

e. Turn off the Spectral Width by pressing Measurement off key.

4-5-12 Wall Filter

a. Connect a sector probe, and set as follows.

Doppler	PD
Mode	D/B (Press "B" on console)

b. Hold the transducer in air.

c. Adjust the Receive-Gain and Display-Gain, so a slightly bright spectrum is displayed.

d. Press "Wall Filter ▼ " .

e. Verify the changing of cut off frequency and a dark band above and below spectrum baseline.
Refer to Figure 4-26.

f. Press "Wall Filter ▲ " and verify opposite change from "e".

4-5-13 Display Gain

a. Connect a sector probe. Press "PD".

b. Set Receive Gain to 0dB.

c. Turn Display Gain knob right, verify the LED level meter displays a higher level. And Spectrum image appears brighter.

4-5-14 Receive Gain

a. Set Display Gain to max.

b. Set Sample Volume cursor to highest position.

c. Turn Receive Gain knob right, verify the LED meter displays a higher level.

4-5-15 OFF

Press "OFF", verify the green LED (PD or CWD) turns off from on. This shuts all Doppler Functions off. And the display returns to B mode.

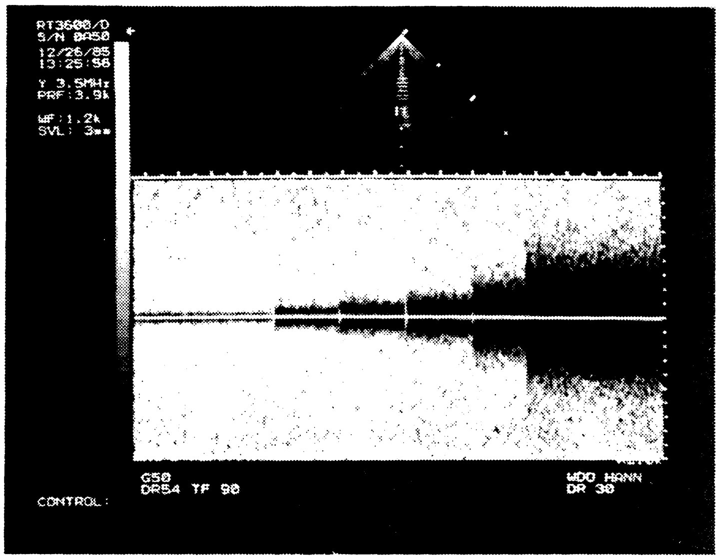

RT3600/D
S/N 0A50
12/26/85
13:25:56
Y 3.5MHz
PRF:3.9k
WF:1.2k
SVL: 3mm
G50
DR54 TF 90
WDO HANN
DR 30
CONTROL:

Figure 4-26

PRINCIPLES OF OPERATION

Chapter 5

Theory of Operation

Table of Contents

5-1 Principles of the Ultrasound Image

In order to observe an object's internal structure, the object must be transparent. Biological bodies such as human tissues are obviously not transparent to visible wavelengths of light; however they appear transparent to the wavelengths used in X-ray and ultrasound.

The ultrasound image is derived from sound wave propagation. The similarity in the use of a sound wave and an electromagnetic wave can be seen in the comparison of a RADAR and SONAR system.

The basic principle of RADAR and SONAR is echo detection. RADAR relies on electromagnetic waves, and SONAR uses sound waves- but the end result is the same. Beam forming technology is almost always used in both applications to identify echo source direction; while echo return time is counted to determine echo source range.

In general, the technique used is called "echo sounding." When the echo source is mapped with the beam direction, the technique is called echography or sonography (if sound waves are used).

The RT3600 is an echographic instrument dedicated to medical diagnostic applications.

The optimal wavelength of sound used in a medical echographic instrument is in the millimeter or submillimeter region. This results in the best echo source intensity (reflectivity) and body transparency (penetration). Ultrasound frequencies of 0.5 to 15 MHz are in this range. At these frequencies, the human body and water show similar acoustic characteristics.

5-1-1 Beam forming and 1-D Echo Sounding

For submillimeter wavelengths, a tiny piezoelectric ceramic planar disc can generate and receive a beam of Ultrasound energy. Ultrasound energy is converted to and from electrical energy which is transmitted and received by terminals imbedded in the ceramic. The diameter of a sound beam from such a planar transducer will be the same (or larger) as the transducer itself (see figure 5-1). The selectivity, or directivity, of such a beam is not ideal. However, this simple configuration permits a one-dimensional echo source map and is graphically represented in an A-trace image which displays echo intensity per distance along the beam axis.

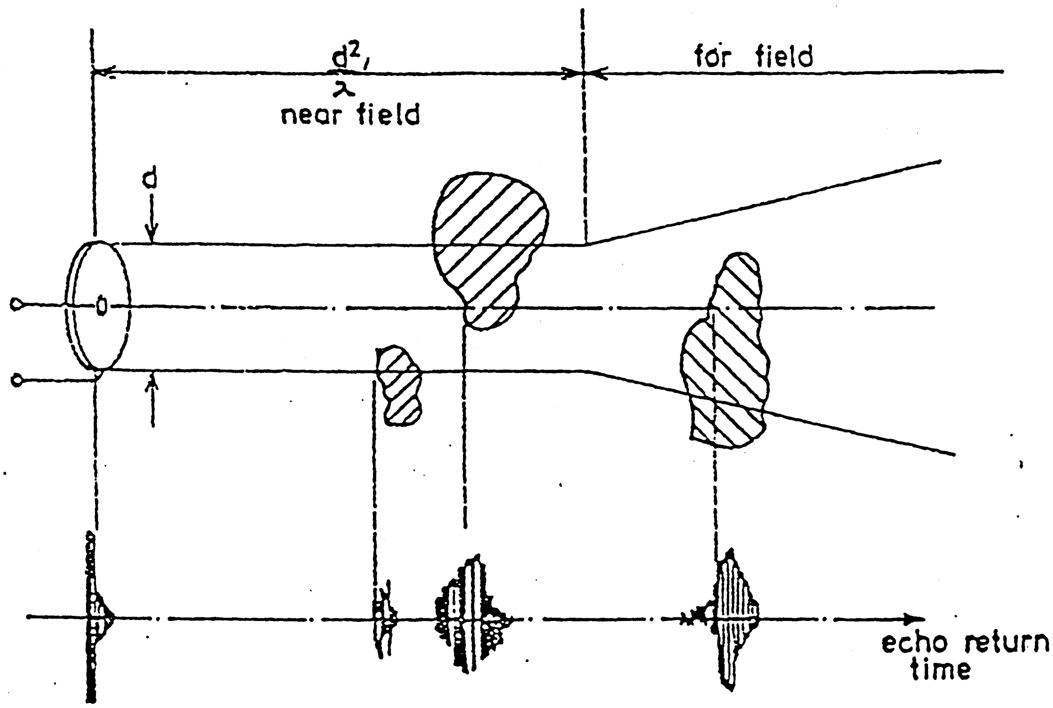


Figure 5-1

5-1-2 2-D Echo Source Mapping

A "scan" is generated when a transducer is rotated or shifted during a continuous echo sounding operation. The position or angle of a sensor coupled to the transducer enables a simulated beam line to be swept across the CRT display. Echo source intensity is seen as spot instensity in each sweep. This scheme is called B-scan and provides a two-dimensional echo source location and intensity map of an object body. (See Figures 5-2 and 5-3).

5-1-3 Switched Array vs. Phased Array

It is difficult to obtain precise position and angle information from a mechanically rotated transducer. However, by using a group or array of transducers it is possible to electronically "shift" the ultrasound beam and obtain a similar scan.

A switched linear array of transducers simulates the parallel shift of acoustic scan lines produced by physically moving a single transducer perpendicular to the beam axis. This method requires a large array of transducers.

A more efficient method would be to group a set of narrow width elements of an array together. In consecutive order, each group is switched on and off until the entire array has been stepped through. (Refer to Figure 5-4.)

The switched array requires a large number of elements to produce a scan. The switching principle is similar to that of a telephone exchange station.

On the other hand, a phased array technique generates and receives a steered ultrasound wave. Consider a single source first.

A single transducer of a small size compared to a quarter wavelength can be considered as a point source. A point source radiates energy equally in all directions so a circular wavefront is generated (see Figure 5-5). It can be considered as an omnidirectional transducer. A set of omnidirectional transducers distributed along an array will superimpose their circular wavefronts into the acoustic media when they are simultaneously excited at their ports. If these transducers are equally spaced, with adequate separation, their combined wavefronts will simulate that of a planar transducer and form a planar wavefront.

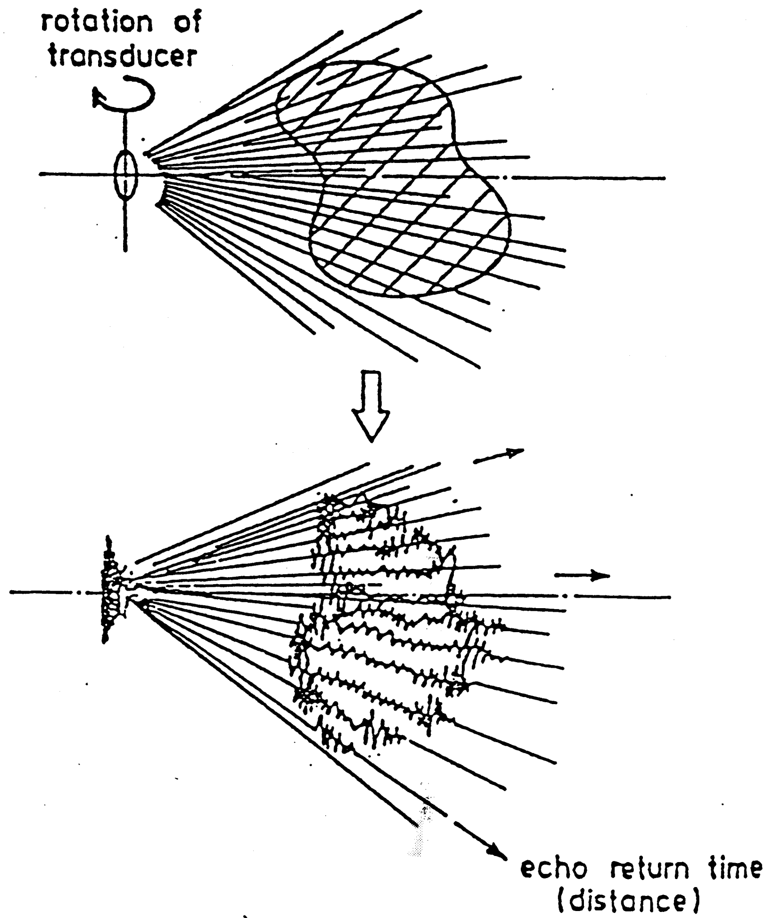


Figure 5-2

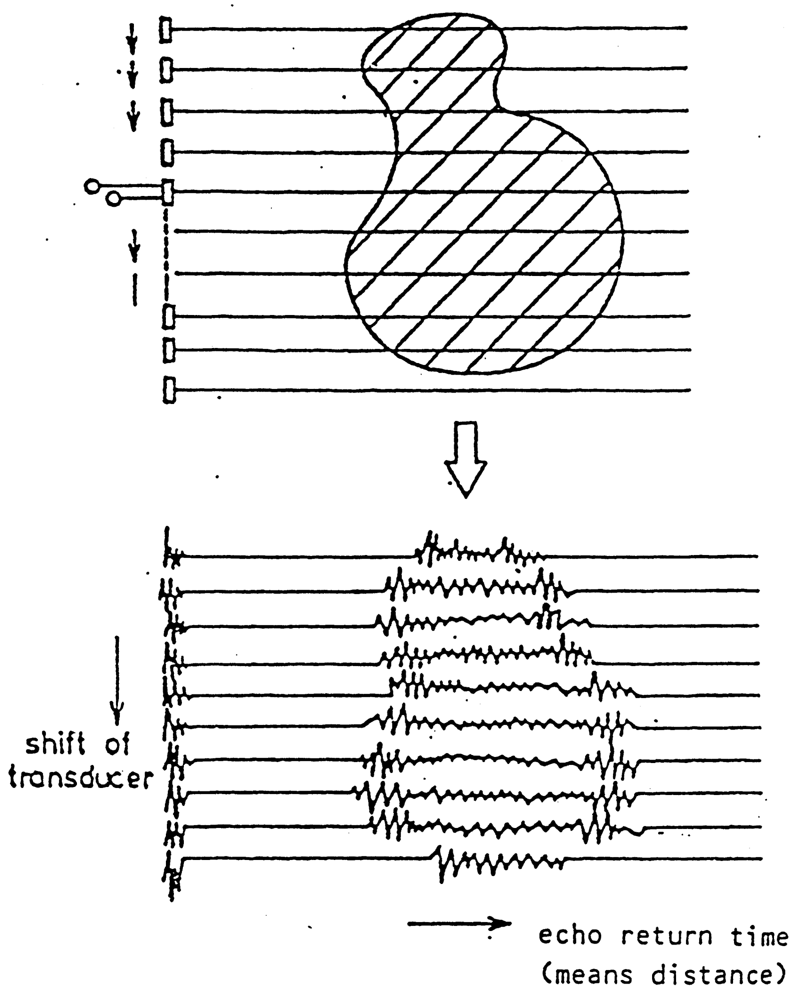


Figure 5-3

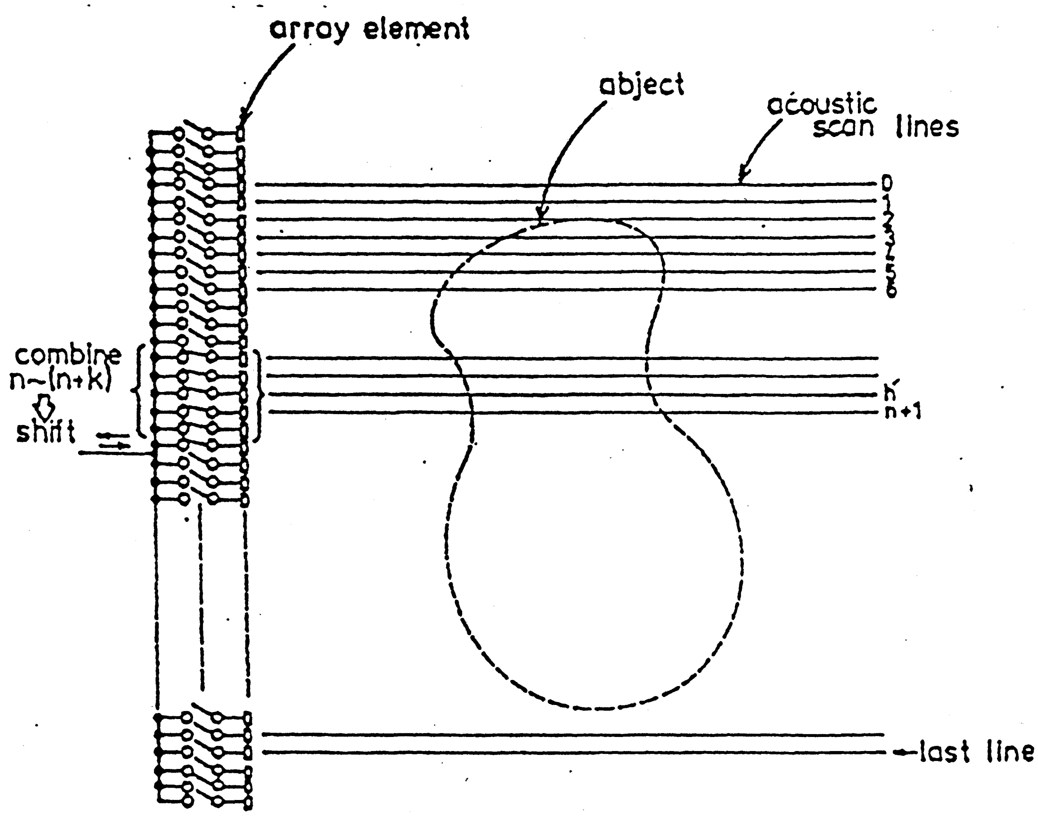

array element
object
acoustic scan lines
0
1
2
3
4
5
6
combine n~(n+k)
shift
n
n+1
last line

Figure 5-4

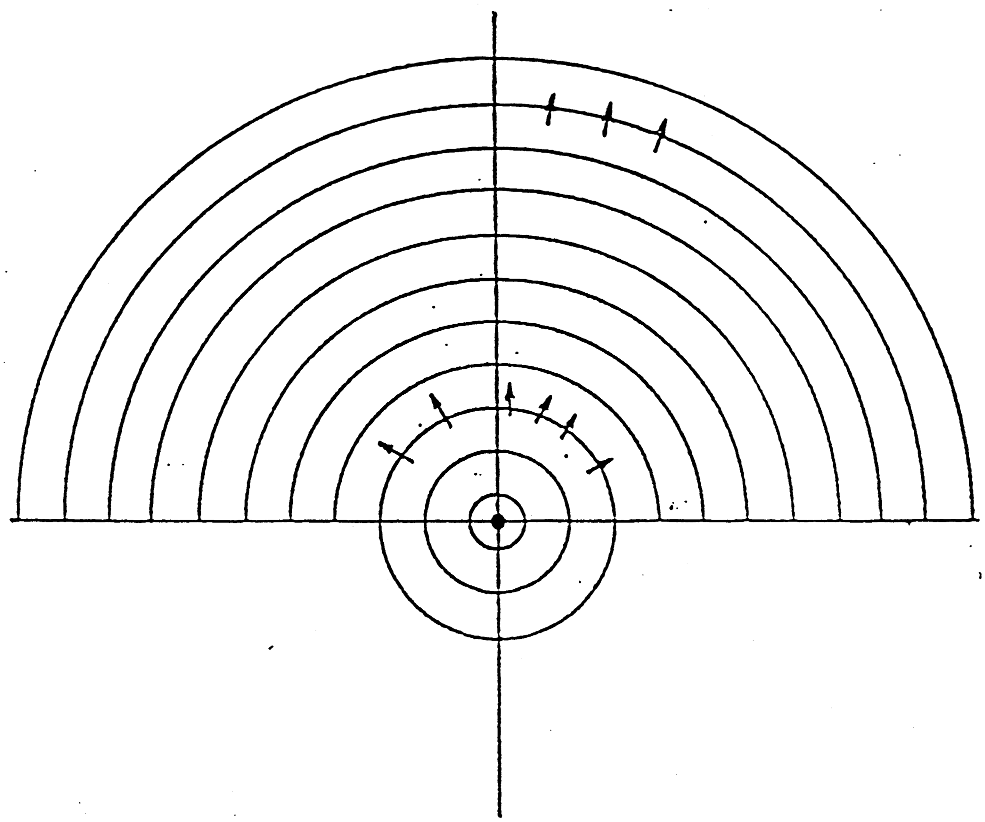


Figure 5-5

However, when the transducers are not simultaneously excited or have unequal delay times, multiple circular wavefronts having unequal radii will coexist in the media and form a wavefront with no significant directivity (see Figure 5-6).

If a uniform delay is imposed across the array, the elemental wavefronts will be larger at one end and taper to smaller wavefronts at the other end and form a "steered" Wavefront (see Figure 5-7). The angle of the wavefront is determined by the pitch of the elements and the time delay distribution.

In receiving such a wavefront, the order is reversed. An angled wavefront is summed at delay line outputs. The delay is chosen to give maximum sensitivity to a given angle. Wavefronts other than the chosen one arrive at the output of the delay line out of phase and chancel out.

The technique of a phased array then is to steer an ultrasound beam by imposing a time delay distribution across the array. A scan is performed by dynamically changing the time delay (this process is called a delay map). The phased array method requires variable time delay lines in each transducer element line.

5-1-4 Focusing

As discussed earlier, a planar transducer can provide a sound beam with the same or larger diameter as the transducer itself. However, smaller sound beams would improve lateral resolution in an echo field. Smaller sound beams are formed from converging wavefronts produced from concave disc transducers or from planar transducers with an acoustic lens attached (refer to Figure 5-8b, c). This focusing technique is simulated in an array by using a quadratic delay distribution (see Figure 5-8d).

In transmission, the wavefront is determined in the transducer by an electrical signal distributed across the array. As the wavefront passes through the echo field it cannot be controlled. This means that transmission focusing can only be accomplished for a certain depth, or zone, for each transmitted wave. This doesn't mean areas out of the focal zone can't be imaged, they will only have reduced intensity.

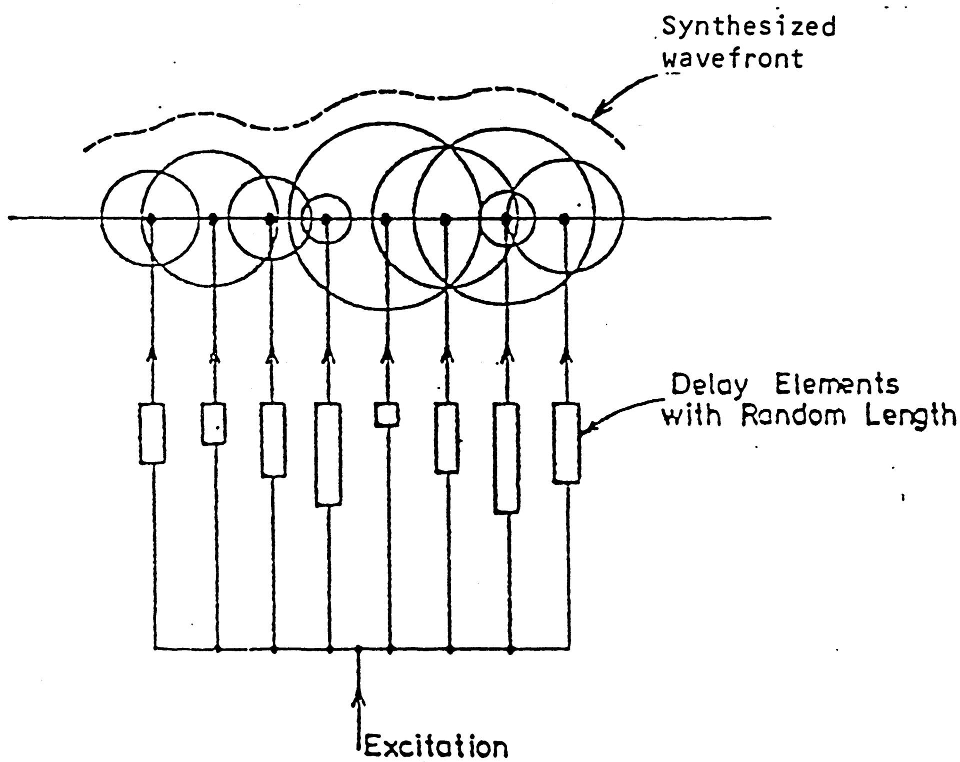

Synthesized
wavefront
Delay Elements
with Random Length
Excitation

Figure 5-6

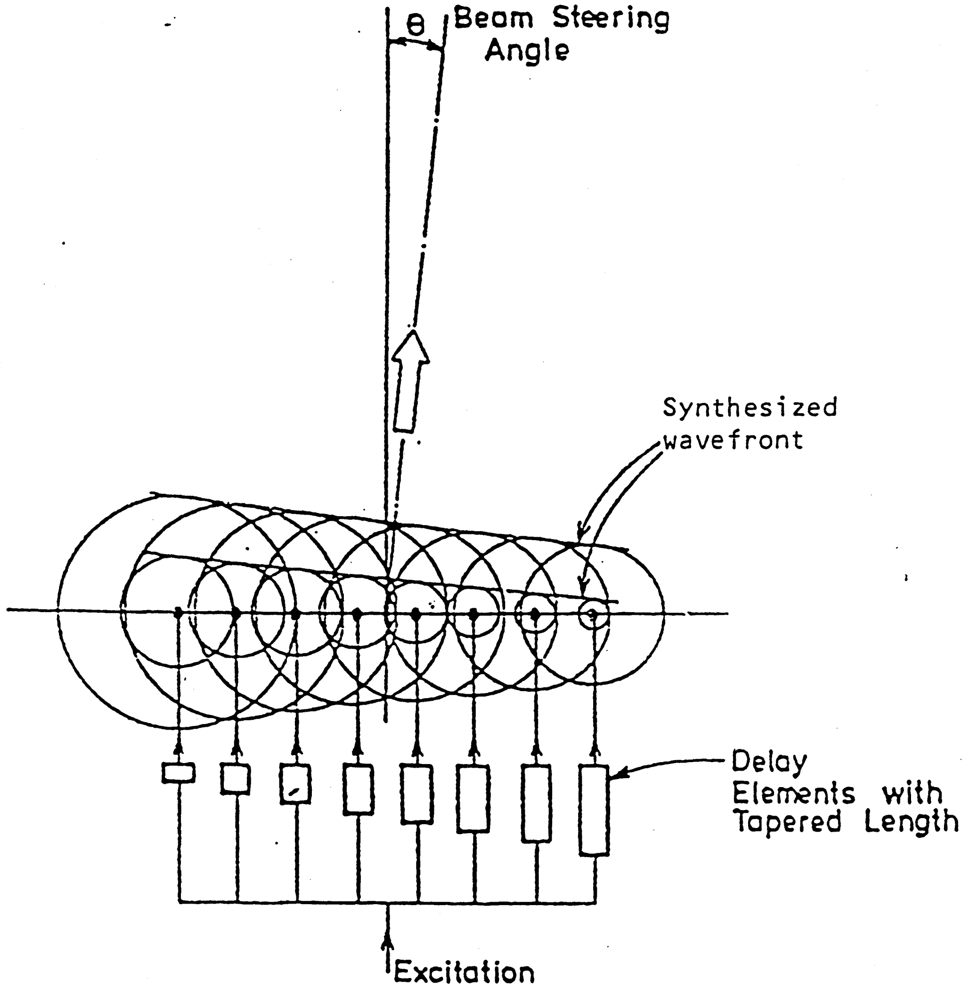

θ
Beam Steering
Angle
Synthesized
wavefront
Delay
Elements with
Tapered Length
Excitation

Figure 5-7

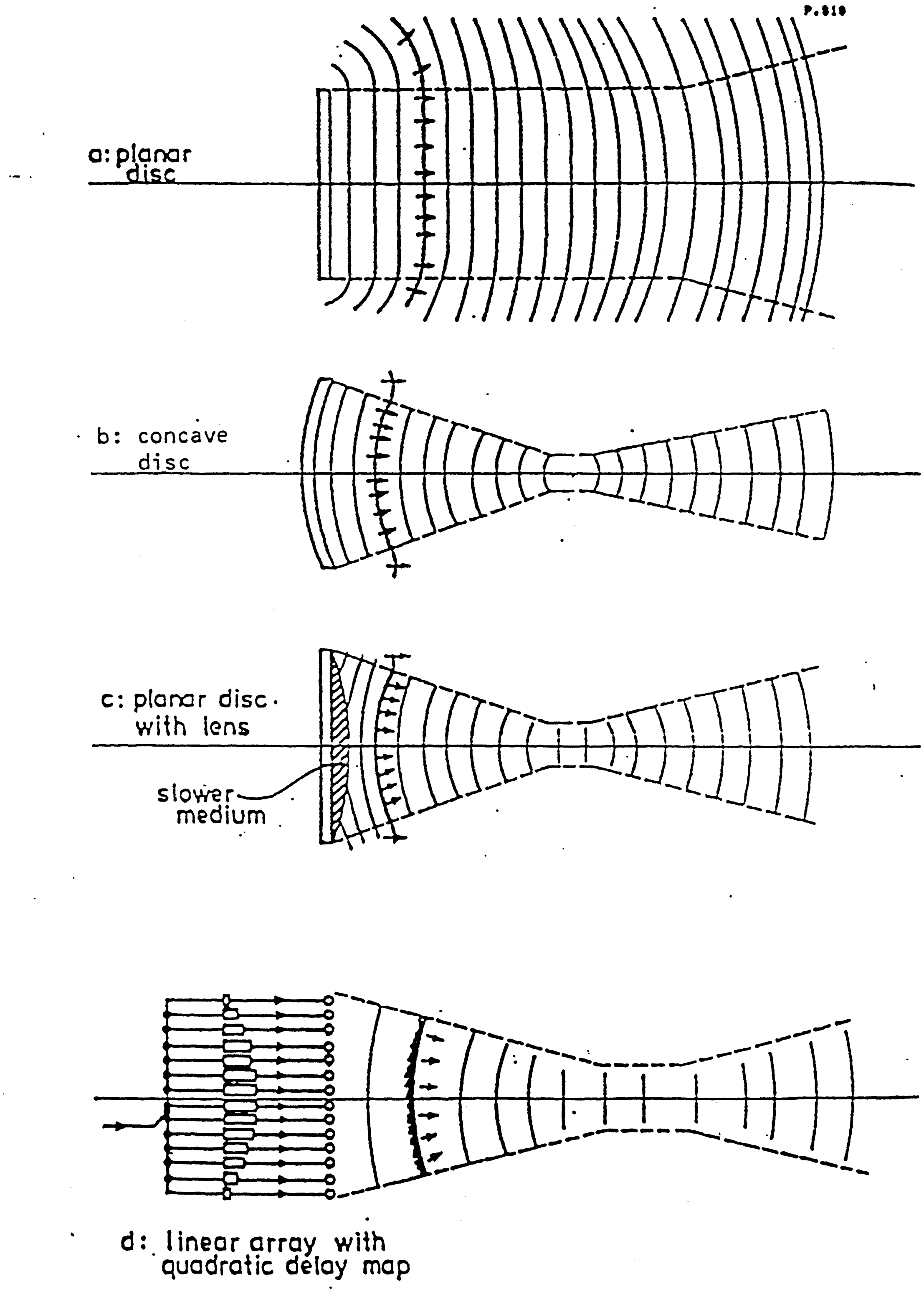

P.818
a: planar disc
b: concave disc
c: planar disc with lens
slower medium
d: linear array with quadratic delay map

Figure 5-8

Echo wavefronts from echo sources also have "circular" patterns. Echo returns to the transducer are distributed according to their distance from the transducer. A received echo wavefront is formed from individual sources and its angle is determined from echo return times. In receiving such a wavefront, a dynamically changing focal length is used to track echo source distance. In practice, this is done by changing the quadratic delay distribution across the array (see Figures 5-9 and 5-10). This technique is called "dynamic focusing".

However, in the zone closest to array, where the echo wavefront is at its steepest, a modified focusing method is used. In this near field a smaller beam is produced by using only a limited number of transducer elements from the center of the array. This method reduces side-scatter from near field echo sources and improves resolution, while eliminating the need for a complex delay map. This process of changing the aperture size is called dynamic aperture control (see Figure 5-11).

In practice, the delay map is switched during reception, and not the electrical length of individual delay lines (which is somewhat difficult to accomplish). The delay distribution requirements for focusing and beam steering are included in a single delay map which is unique to every scan line. The delay map is applied through a long, multiple-tap delay line which is combined with a crosspoint switch matrix. The crosspoint switch is described in detail later.

The focusing method described so far has been a two-dimensional representation of an echo field, where elemental transducers have been depicted as point sources and detectors. In actual operation, however, image geometry in a three-dimensional object is affected by transducer directivity, also (see Figure 5-12). Resolution and focusing in the Y-axis (thickness direction) must also be considered. An acoustic lens is coupled to the array surface to provide Y-axis focusing. The lens is a cylindrically degenerated one which does not affect X-axis beam steering.

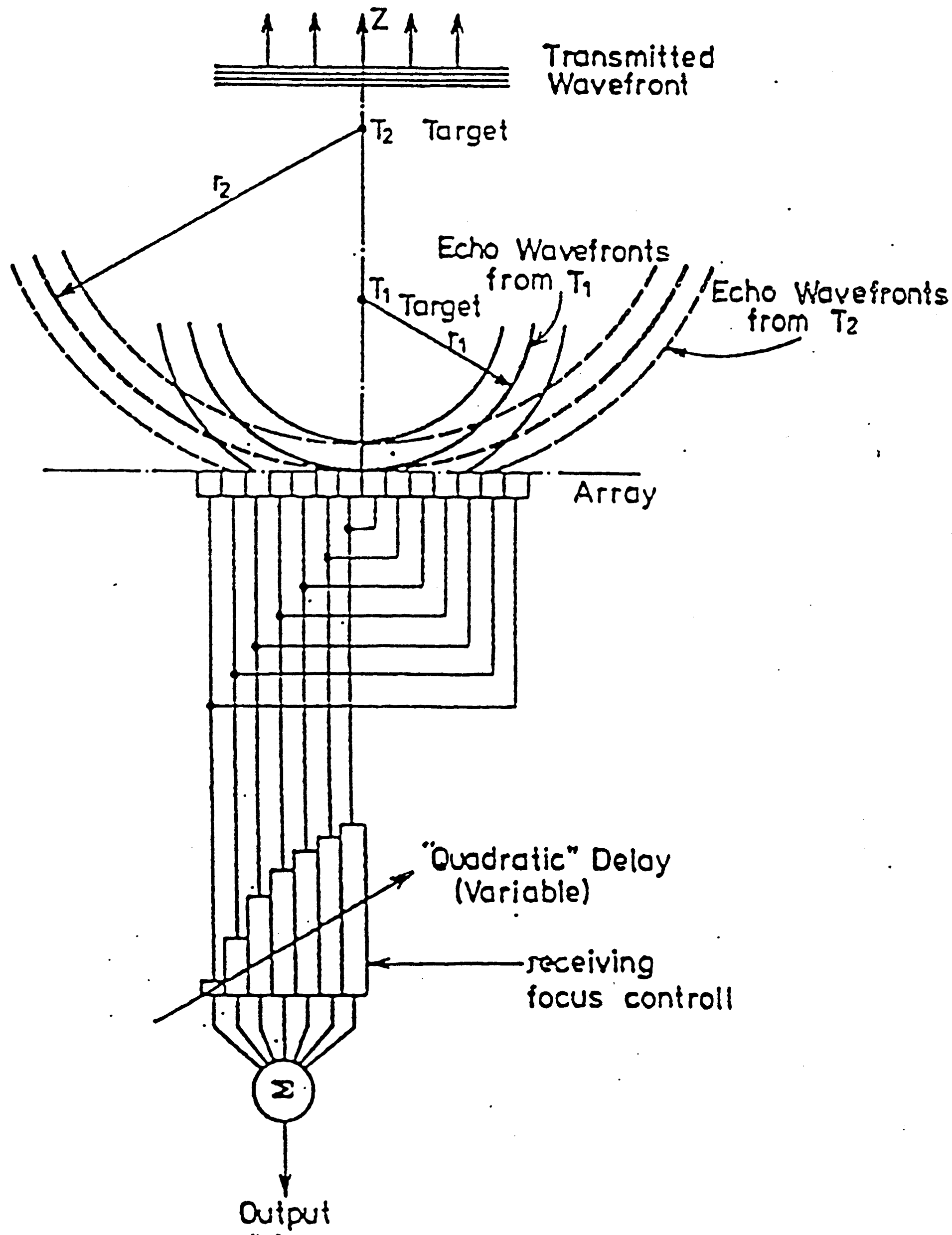
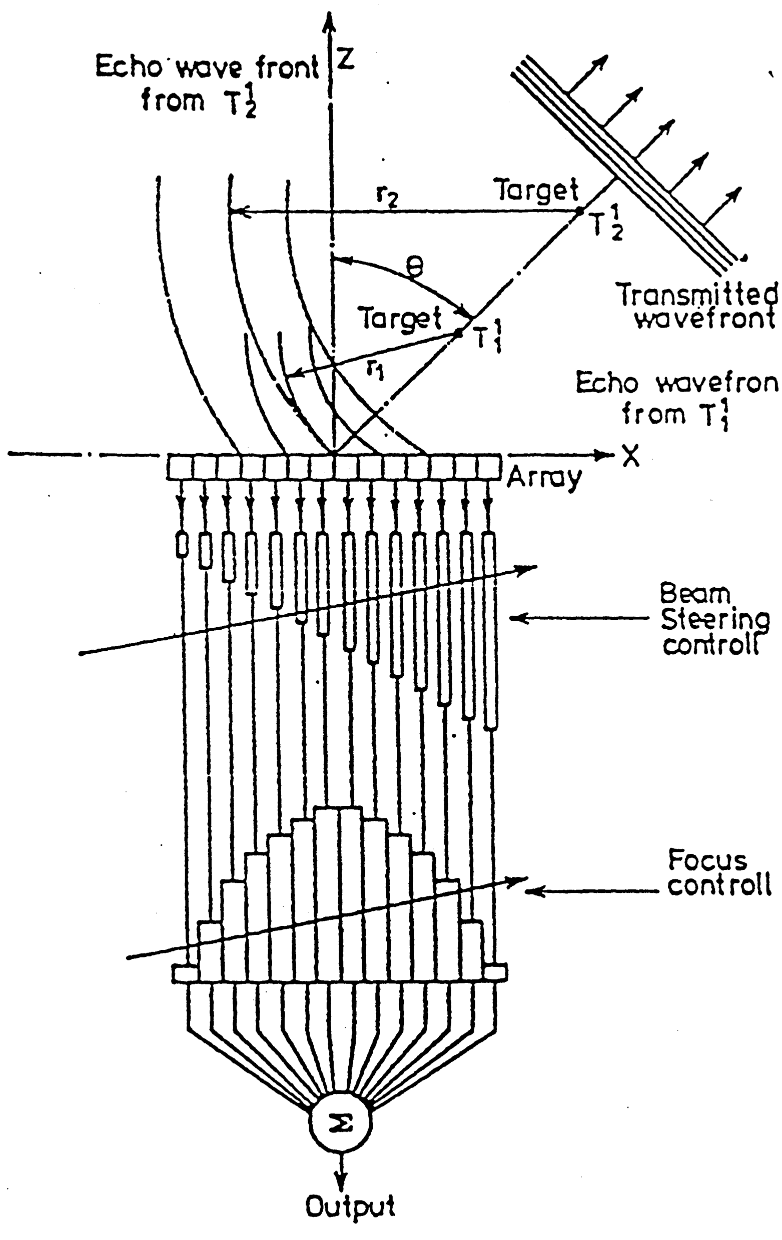
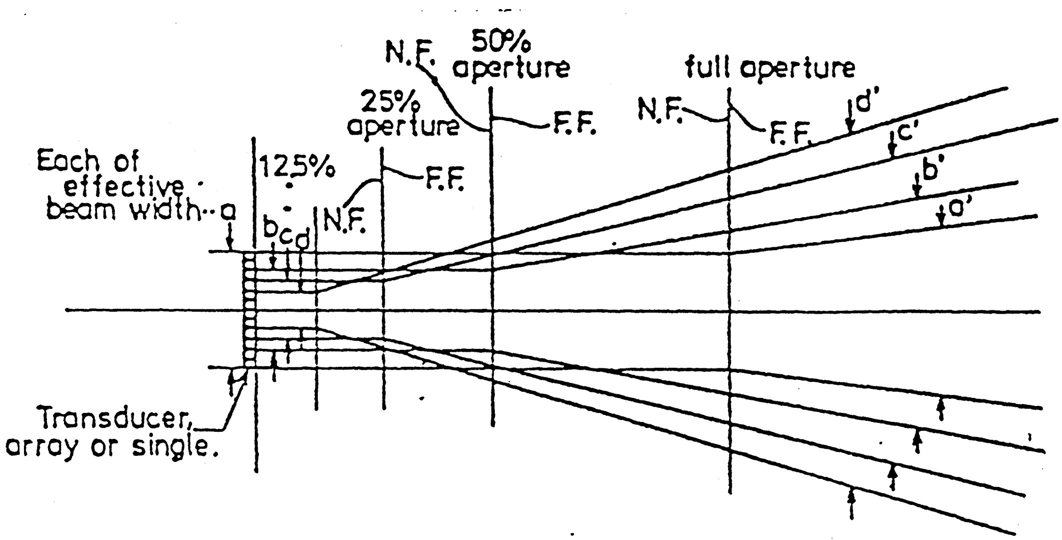

Z
Transmitted Wavefront
T2 Target
r2
Echo Wavefronts from T1
T1 Target
r1
Echo Wavefronts from T2
Array
"Quadratic" Delay (Variable)
receiving focus controll
Σ
Output

Figure 5-9



Echo wave front from T_2^1
Z
r_2
Target
T_2^1
θ
Transmitted wavefront
Target
T_1^1
r_1
Echo wavefront from T_1^1
X
Array
Beam Steering controll
Focus controll
Σ
Output

Figure 5-10



N. F. near field—up to D^2/λ
F. F. far field—beyond D^2/λ } D:diameter, λ:wavelength

Shrinking aperture method improves nearest field beam width (a→b→c→d) and resolution(with cost of far field's (a'→b'→c'→d') even with out aid of focusing means:

Figure 5-11

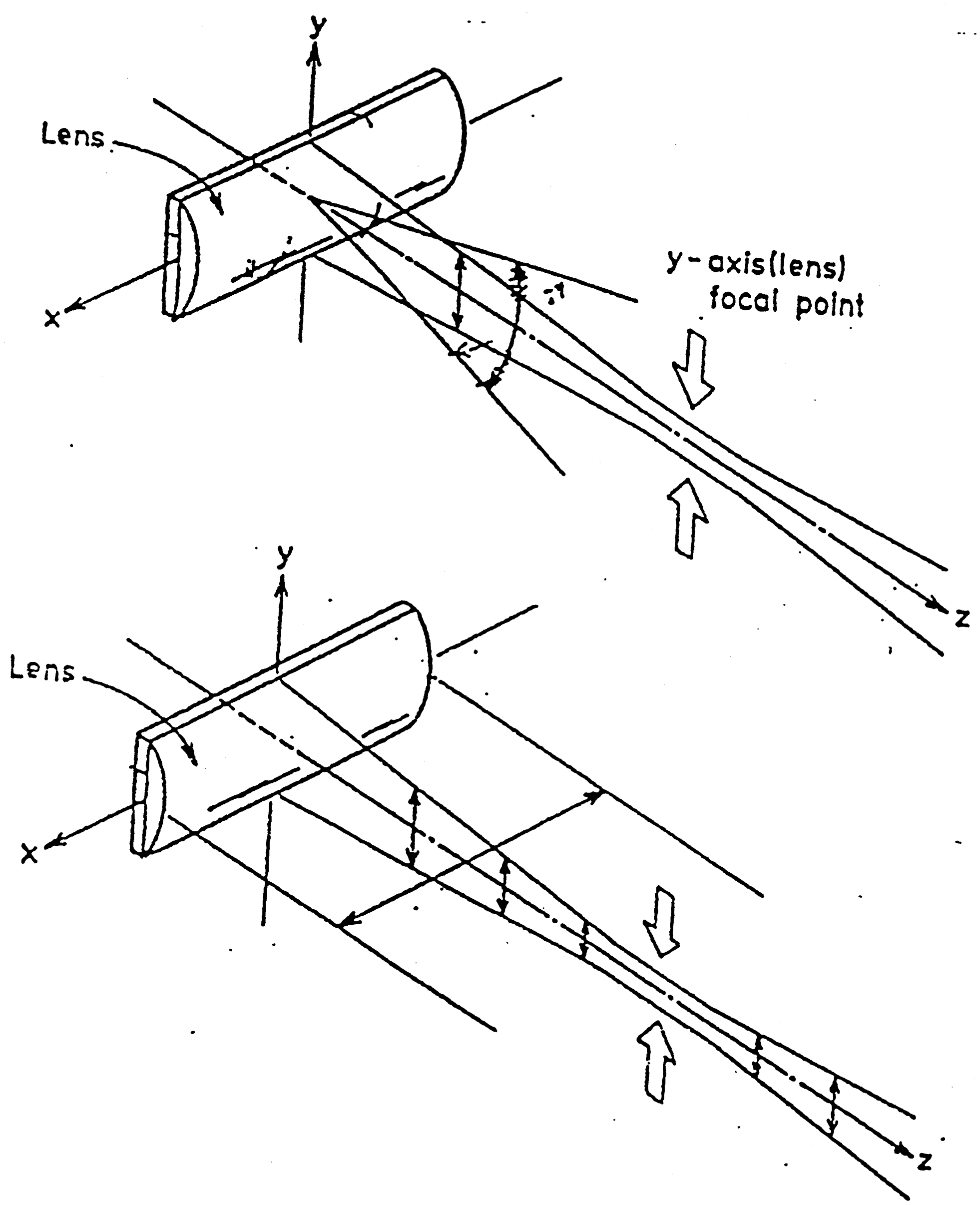


Figure 5-12

5-1-5 Echo Signal Processing

The receiving echo signal has a large variation in level and frequency spectrum as well as return time. This is due not only to echo source intensity, but also to the attenuation of ultrasound energy in the human body. Typically, a range of more than 100 dB exists between the strongest echoes and the detectability limit. To deal with such a wide dynamic range of received signal, a logarithmic compression of the high frequency signal is performed prior to detection. This permits a uniform display of the echo source regardless of the depth. After detection, a compensating signal called TGC (Time Gain Control) is applied.

In the past, TGC has been applied to a receiver's linear amplifier and served as the actual gain control. Performance suffered as a result of inherent uncertainty in how to control the signal. However, post-detection TGC applied in a logarithmic amplifier is not multiplicative but additive because the echo signal is log-scaled into a proportional voltage signal. This method is more accurate and reliable in it's amplitude transfer characteristics (see Figure 5-13).

TGC is dependent on probe type, center frequency and individual patient acoustic characteristics.

In addition to logarithmic compression, frequency response must be considered. In order to obtain high resolution, the receiver must have a wide bandwidth. In general, the component that has been most bandwidth limited has been the transducer. So if the bandwidth of the transducer is made sufficiently wide, the receiver must be made to accept or adjust itself within a given transducer passband.

The problem with such a wide passband is excessive noise, especially in the far field where the system noise floor determines the detectability limit.

Also, in the far field, where the overall path length of the ultrasound beam is so long, a significant shift of the frequency spectrum occurs due to attenuation in the body.

On the other hand, in shallow fields, echoes are the strongest and the frequency spectrum is unchanged. So, a wide bandwidth is ideal for near field echoes, but detrimental for far field echoes.

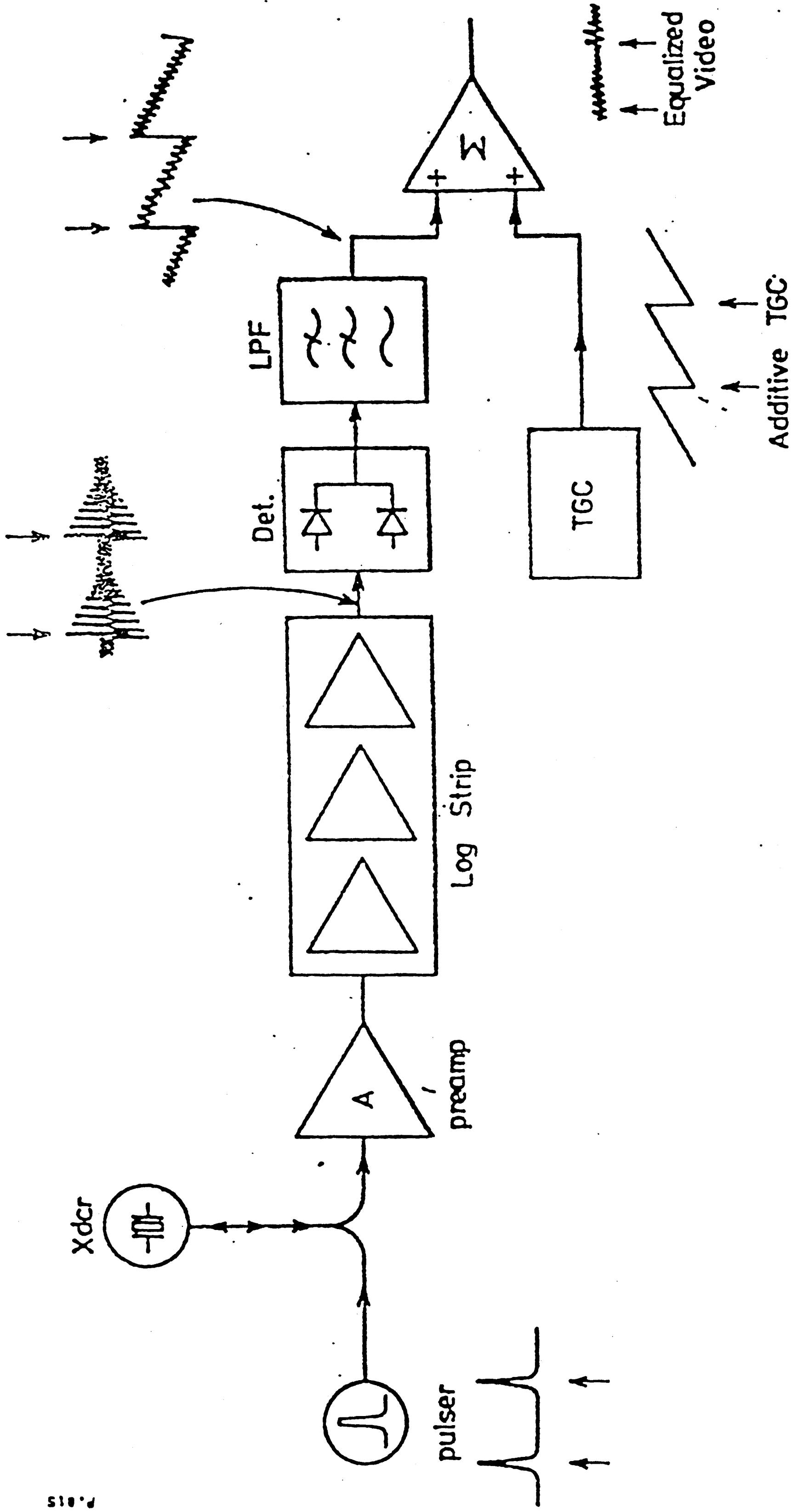
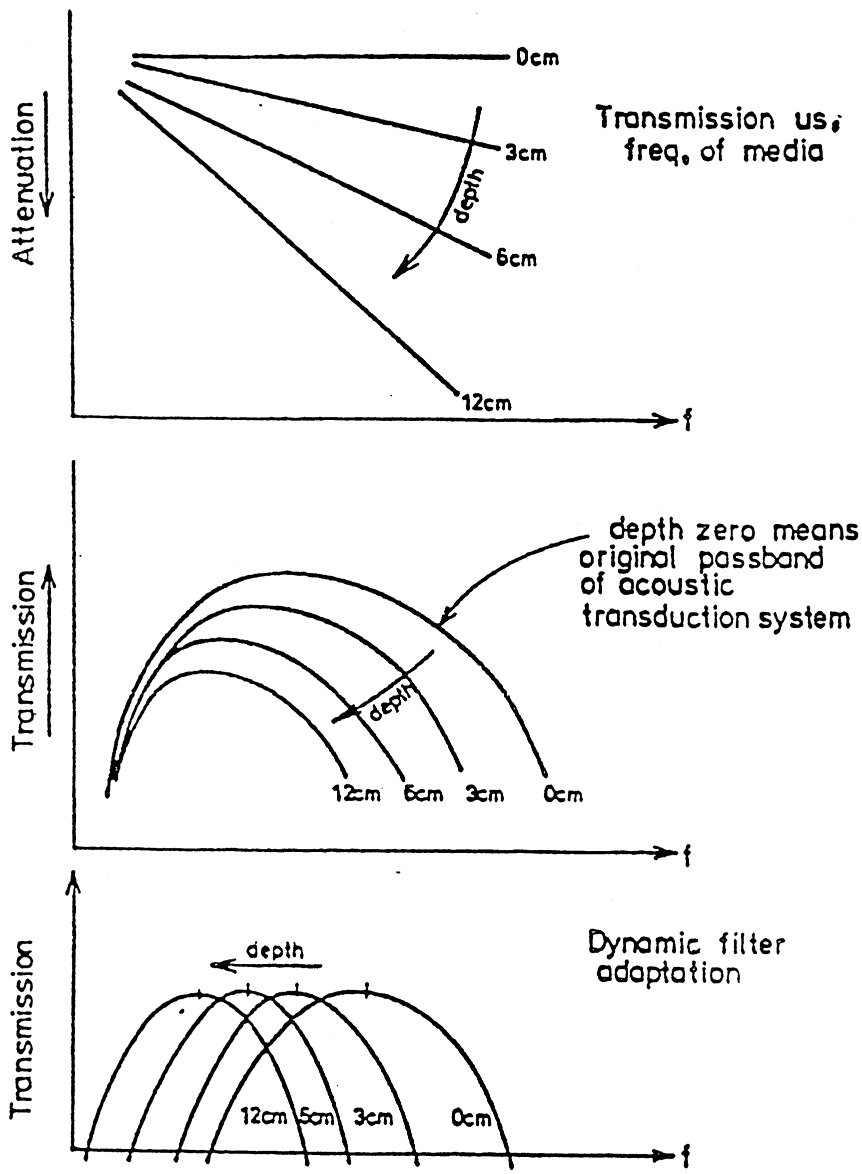

pulser
Xdcr
A
preamp
Log Strip
Det.
LPF
TGC
Additive TGC
Σ
+
+
Equalized Video

Figure 5- 13


Attenuation
0cm
3cm
6cm
12cm
depth
f
Transmission vs. freq. of media
Transmission
depth zero means original passband of acoustic transduction system
depth
12cm
6cm
3cm
0cm
f
Transmission
depth
12cm
5cm
3cm
0cm
f
Dynamic filter adaptation

In the RT3600, the receiver dynamically changes center frequency and bandwidth to tune itself to the echo frequency spectrum shift. This technique is called "dynamic filtering" (refer to Figure 5-14). A similar signal is TFC (Time Frequency Control) and is explained later. Refer to Section 5-4-5.

In a phased array system, proper frequency response prevents an affect called "grating sidelobe artifact". Grating sidelobe is caused by an aliasing combination of the elemental wavefront along the array.

The array geometry is designed at center frequency to avoid any grating sidelobe to appear; however, if the system passband extends beyond certain limits of center frequency, grating sidelobe will contaminate an image at high steering angles and the high frequency part of the echo signal.

This leads to a concept to suppress the high frequency component of an echo signal at high steering angles, while preserving the full bandwidth at shallow angles. This slightly reduces resolution at the edges of the echo field, but produces a contamination-free image and better over-all image quality.

A quadratic function of steering angle is digitally created and converted to an analog control signal. This signal is called SFC (Side Frequency Control) and is also dependent on probe type. In linear scanning, SFC is defeated.

In principle, TGC and TFC are dependent not only on probe type (nominal center frequency), but also to an object's acoustic characteristics- such as age, sex, and obesity. In operation, only TGC is available for operator control. Values of system gain are selected automatically upon power-up depending on probe type information sensed at the transducer connector.

Gain controls are all digitally generated and applied to analog circuits through D to A converters.

After these control signals have been applied, the ultrasound video signal is input to an A to D converter to permit digital data handling of the picture information. The dynamic range definition is carried out before A to D conversion.

For an M-mode display, signal processing such as near-zero suppression and non-linear processing (for contrast enhancement) is also carried out prior to A to D conversion.

The ultrasound picture information can now be handled digitally. The signal still must be input to sections that will apply pre-processing, scan-format conversion, post-processing, readout, and TV style display .

5-2 Scanning Scheme of RT3600

The RT3600 performs linear scanning using an electronically switched array method. There are several styles of display format available for linear scanning. They are as follows:

(1) B-mode Imaging
(2) M-mode Imaging
(3) Simultaneous B/M-mode Imaging

These image styles are available to all transducers, regardless of beam forming and steering methods. In any case, a scan line number (SLN) is assigned to each acoustic beam used to scan an object field.

5-2-1 Linear Scanning

In linear scan, SLN=0 is the first scan line from element number 0 in an unshifted, full aperture. The shifted scan line from the same aperture is defined as SLN=1.

The unshifted scan line appears at channel A in the Log Assy, and the shifted line appears at channel B.

A dynamically controlled aperture method is used to reduce aperture size at the edges of the linear transducer array. This shifts the center of the aperture (That is, the start point for a scan line) in step with a full aperture scan field. Although image quality of aperture edges is somewhat reduced, this method allows a full expansion of the scan field to the entire aperture of the acoustic array. For these smaller aperture scan lines, SLN's are continuously defined to underflow or overflow the binary numbering system. An SLN consists of a 9 bit word. An underflow of the binary word forces a virtual negative SLN. This creates two scan lines from an individual element. Although the total number of elements is dependent upon probe type, the total allowable SLN's is 512 for 256 transducer elements.

5-2-2 M-mode and B/M-mode

M-mode is defined as a time-sampling observation of a particular scan line that is kept stationary in an object field. Steering of the beam may or may not be required depending on what part of the object field is being monitored.

Simultaneous B and M-mode imaging with a single transducer has proven to be very helpful in medical diagnosis. Such imaging is called B/M-mode. A periodic interruption of the B-mode image is made to obtain a time-sampled video signal of a certain scan line. Typically this B-mode interruption occurs every 4 or 8 milliseconds which provides an M-mode image every 1 to 2 seconds.

The specific scan line monitored in an M-mode image is operator selected from the B-mode image by manually placing a marker over the desired area. M-mode requires different signal conditioning in order to obtain images useful in a clinic.

5-3 RT3600 Block Diagram

Refer to Figure 5-15 for a block diagram of the RT3600 system. The system can be broken down into three functional areas: the digital section, the analog section, and the system controller microprocessor section. Power supplies and CRT monitors are part of the system, but it is the intent of this chapter to explain the operation of the three functional areas unique to the RT3600.

5-3-1 Echo Signal Flow

The image information signal is used in three forms, as shown in Figure 5-15. The white arrow shows this signal in analog form; the gray arrow is used to show the signal in digital form. The black arrow represents the signal in its standard TV composite video form.

5-3-2 Control Signal Flow

Control signals are shown in the block diagram by thin black lines. Most of these lines in the figure are internal I/O lines of the control microprocessor.

5-3-3 Circuit Board Nomenclature

The following table lists the circuit boards included in the RT3600 system. The switching power supply, CRT monitors, and cameras are not included in the list.

5-4 The R/T Module

The R-T module is not a physical unit, but instead is a functional area of circuit cards that process the analog echo signal. The circuit boards that comprise the R-T are listed blow:

A0	RT Controller
A1 and A2	T/R Boards No. 1 and 2
A3 to A6	Crosspoint Switches No. 0 to 3
A7	Log Amplifier
A14	Connector Board

Figure 5-16 is a block diagram of the R-T module. The R-T module contains 64 transceivers for up to 64 transducer elements in an array. These elemental signals are phase delayed to form the desired scanning scheme.

RT3600 System Configuration

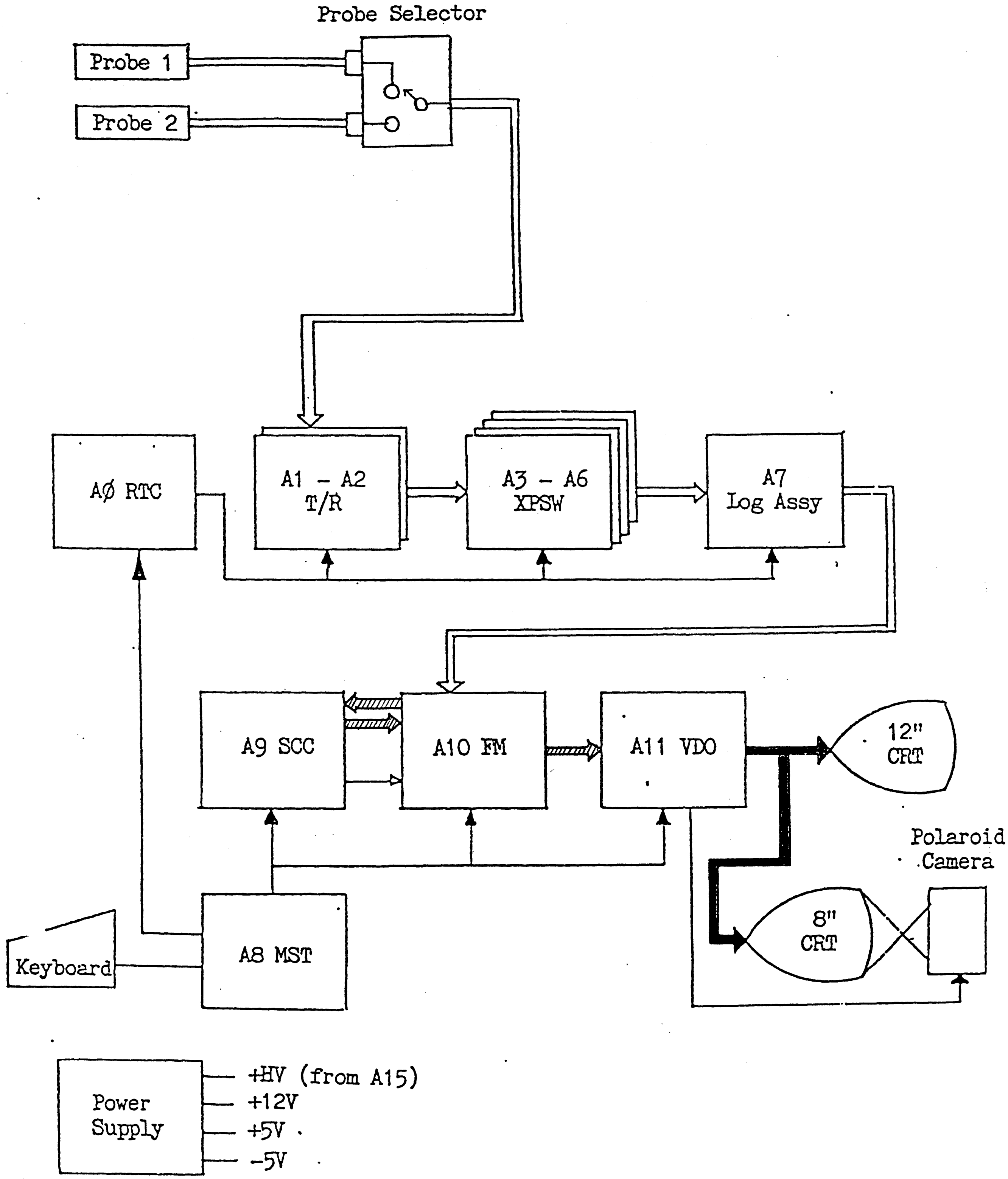
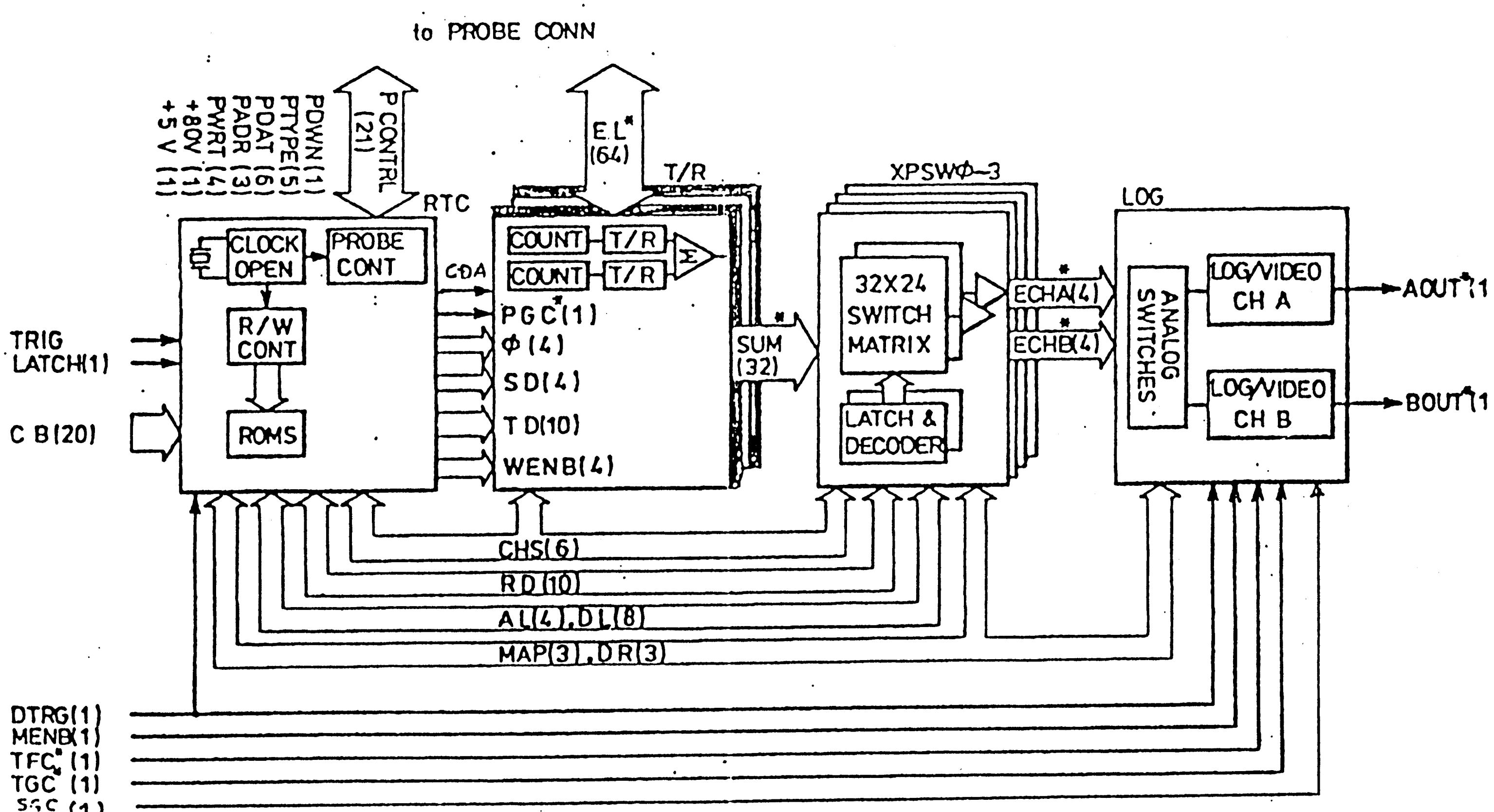


Figure 5-15



RT-MODULE BLOCKDIAGRAM

Fig.5-16

The outputs of the R-T module are two echo signals (A-out and B-out) which are simultaneously available from each scan line. 64 delay maps are included here for proper time delay requirements for each element's signal. Information coming to the module include probe identification and focal zone switching signals.

A complete random access capability for acoustic scan lines is guaranteed in order to permit simultaneous B/M-mode imaging. Also, special signal processing is applied for M-mode to optimize its image on the display.

5-4-1 RT Controller

Figure 5-17 is a block diagram of the RT Controller. It contains a generator for all necessary timing and control signals in the R-T module and in the transducer. The circuit has its own high frequency clock (U16A), input latches (U8E to U15E), scan control data PROMs (U2K, U3K), and other logic circuits for control.

The major function of this circuit is to transfer control data information from the PROMs to the Crosspoint Switch Board, to the transducer, and to the transmission delay counters (TX-delay) on the T/R board. This transfer must take place before pulser firing along each scan line.

Control input to this board comes from the Master Controller (A8) to the input latches (U8E to U15E). Information for probe type is determined by contacts in the probe connector and sent to the Master Controller.

The RT Controller is essentially a high speed data exchange station, because all data must be transferred between pulser firings.

The high frequency clock signal generated on this board by U16A is tapped at different points by delay line U10F and supplied to every TX-delay counter in the T/R board. This determines pulser firing along a given delay map.

5-4-2 TX delay and T/R Circuits

Figure 5-18 is a block diagram of the T/R circuit.

Two uninterchangeable T/R boards are used. Each board contains 16 integrated dual T/R circuits (U4/B9713SL) and 8 integrated quad TX counters (U00/B9713SK). Thirty-two T/R circuits exist on each board. Two boards are used to contain 64 T/R circuits- one for every element in a 64 element transducer array.

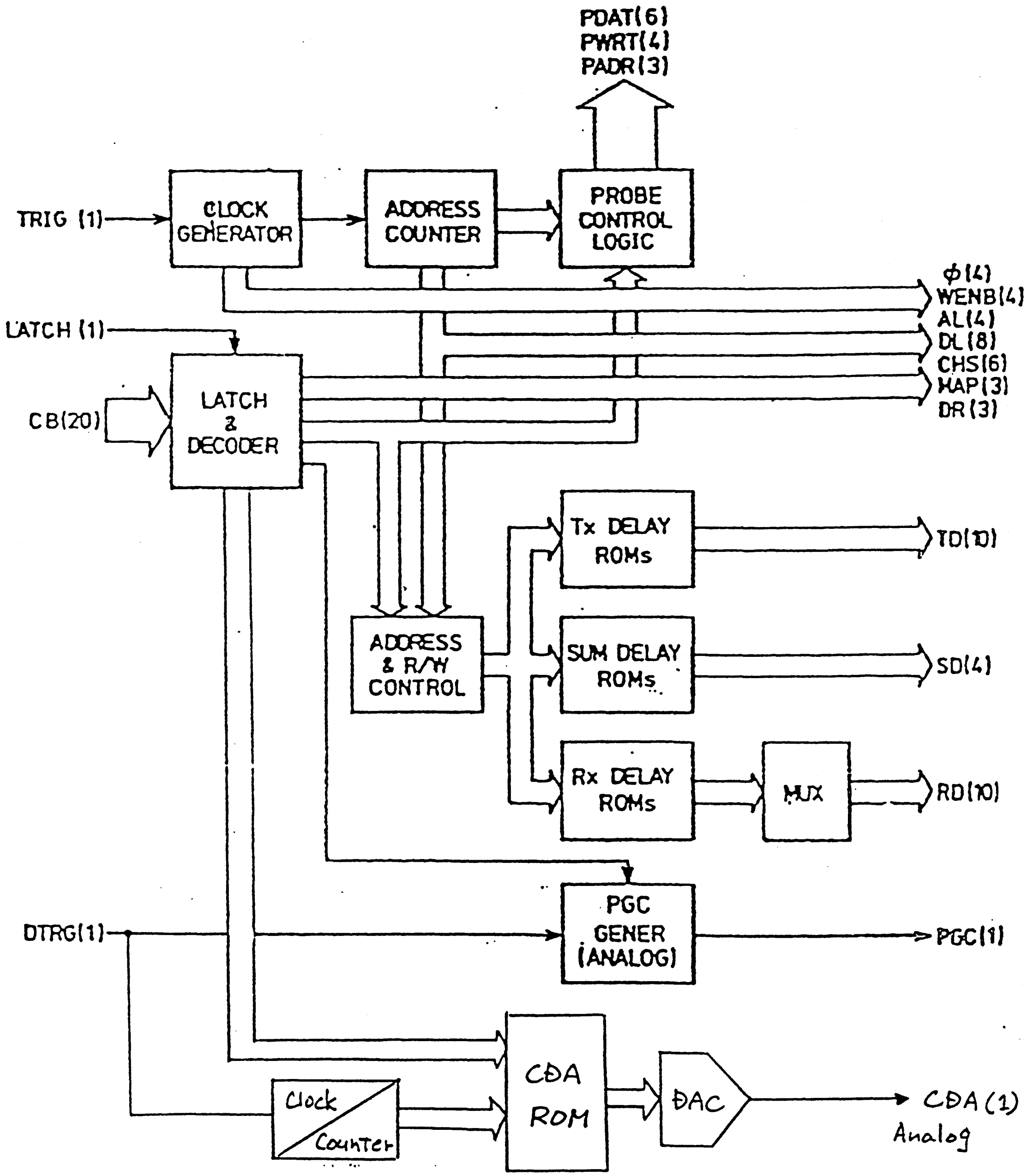
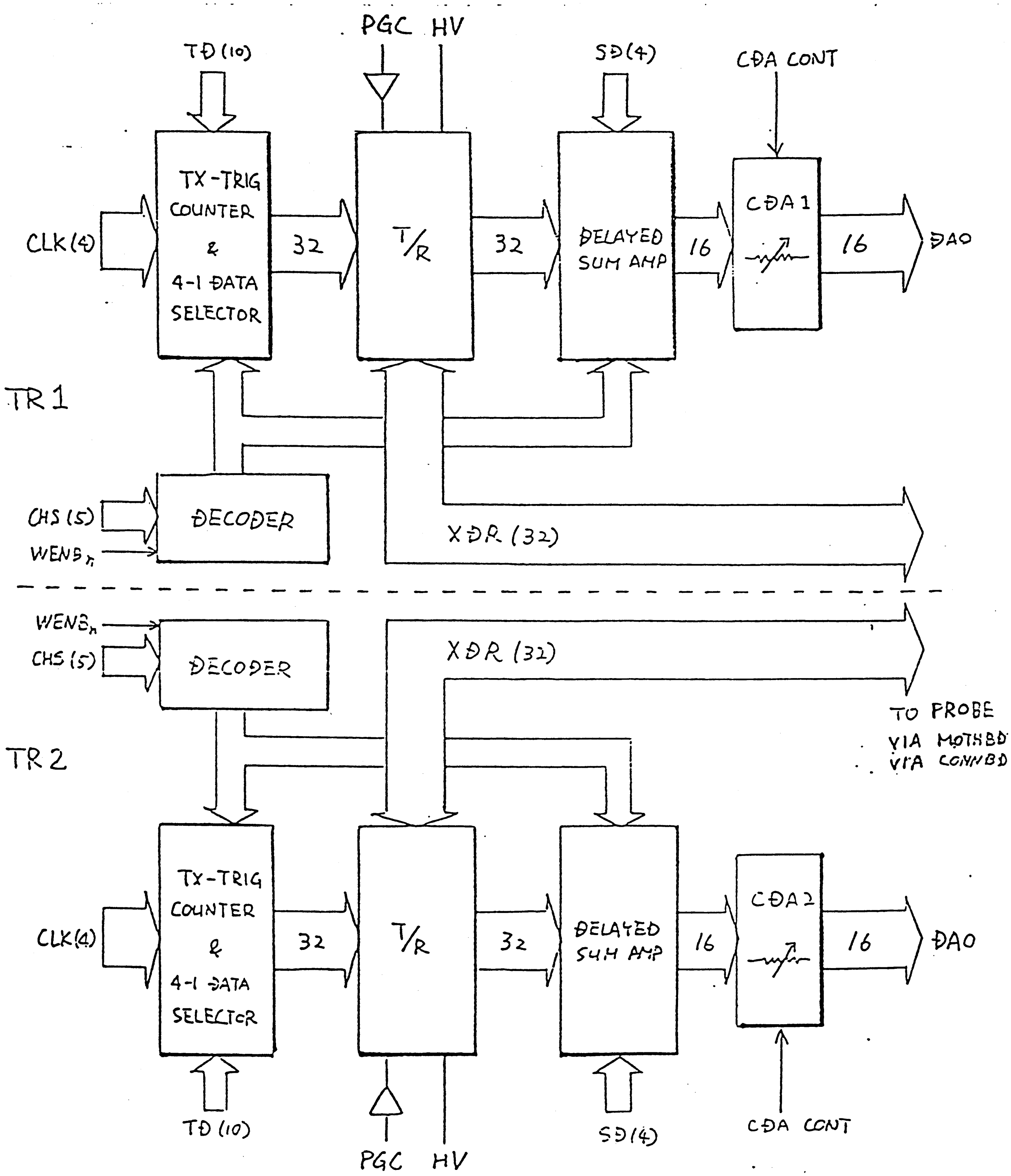

PDAT(6)
PWRT(4)
PADR(3)
TRIG (1)
CLOCK GENERATOR
ADDRESS COUNTER
PROBE CONTROL LOGIC
φ(4)
WENB(4)
AL(4)
DL(8)
CHS(6)
MAP(3)
DR(3)
LATCH (1)
CB(20)
LATCH & DECODER
Tx DELAY ROMs
TD(10)
ADDRESS & R/W CONTROL
SUM DELAY ROMs
SD(4)
Rx DELAY ROMs
MUX
RD(10)
PGC GENER (ANALOG)
DTRG(1)
PGC(1)
CDA ROM
DAC
CDA (1) Analog
Clock Counter

Figure 5-17



TR ASSY Figure 5-18

TX delay counters are reset prior to every transmission. The clock signal is counted to set the transmission delay required for beam steering and focusing. Phase-split clocks are used for a more precise delay map. Quadrature phase resolution of 20 nanoseconds is obtained using a four-phase 12.5 MHz (80 nanoseconds) clock.

Using the TRIG pulse as a common reference, the outputs of the counters are used to fire the pulsers. Reset data from the RT Controller is sent to 16 counters at a time in a digit-parallel, word-serial form. TX counters for every four channels are integrated into a custom designed monolithic IC chip. This chip, plus two T/R circuits, a pulser, pulser driver, and amplifier are integrated into a custom designed hybrid IC.

The high voltage supply for the pulsers is available through a four-position switch. This switch is located next to the main power switch on the front panel. A maximum of 80 volts for linear or 160 volts for sector is available. The switch allows pulser power to be completely turned off, so scanning can be continued without ultrasound radiation. Pulser power control is performed in the A15 HVPS.

Firing of the pulsers creates a high voltage step pulse at the transducer's terminals and an ultrasound wave is generated. After transmission, a controlled attenuation is applied to the receiver to prevent strong near field echoes from saturating the receiver. This attenuation signal is called PGC (Pre-gain Compensation). PGC is **generated from the Master Controller signal DTRIG.**

At this point, every two adjacent echo signals are combined (after required delays). This creates 32 signals from the 64 signals from the transducer elements. This reduction of channels accounts for the configuration of the Crosspoint Switches.

The RT3600 T/R boards also use, CDA (Continuous Dynamic Aperture) for sector scanning. This controls the aperture size continuously. The aperture size is at minimum near the transducer face and expands to a full aperture size by mid field. The RTC CDA control circuit has a 128K E-PROM, 6TTLs, D/A and other associated circuitry.

The CDA allows the transducer to maintain a more optimized receive focus throughout the entire depth of field while providing an improved transmit focus in the far field. This use of dynamic aperture control results in better far field resolution without sacrificing near to mid field performance. Required CDA waveform data is read out from CDA ROM and, that data is converted to an analog control signal by DAC 08 (in U15B). This signal is then used for A1 and **A2 CDA control**. Refer to Figure 5-19.

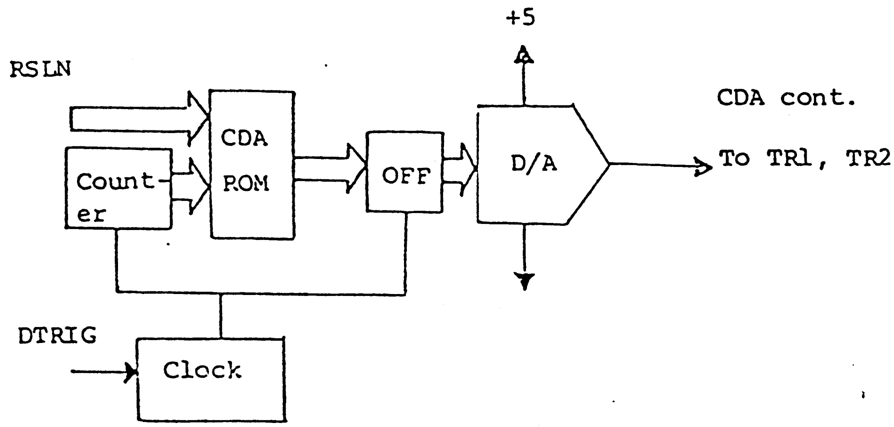


Figure 5-19

5-4-3 Crosspoint Switch and Delay Map

Figures 5-20 and -21 are block diagrams of the crosspoint switch matrix and delay map. Four identical boards (A3 - A6) make up the complete swith matrix. The boards are interachangeable within the card cage. Analog input and output signals, as well as digital control signals are connected through the motherboard.

The complete switch matrix is made up of eight submatrices having 32 rows x 24 columns of crosspoints. Two of these submatrices are included on each board for a total matrix of 32 x 192 crosspoint switches.

The 32 bielemental signals from the T/R boards (SUM 0-31) are fed throuigh all 32 row inputs of the crosspoint matrix. The column outputs are bufferfed and merged with the signal traveling across the delay lines (DL0,1,2 can be found on A3-A6 schematic page 1 of 2; DL3, 4, 5 on page 2 of 2).

The delay line chip has an electric length of 320 nanoseconds. Seven equally spaced taps create eight subsections - each having a delay of 40 nanoseconds. NOTE: The first subsection is comprised of the input signal and is not delayed. Seven taps make up the remaining seven subsections. The last section of the delay line provides a delay for the input to the next delay line. Three delay lines are cascaded for each submatrix. This provides 24 entry points with 40 nanoseconds spacing. The entry points accept column outputs through isolators Q0 through Q47.

In switched array linear scanning, several independent delay maps can be applied to obtain different delay synthesized outputs. In this way, different focal depths and beam axis are formed.

In the RT3600, two sets of shifted beam axis are applied for linear scanning.

Intermediate amplifiers between delay lines serve as gain and frequency response equalizers. These compensate for the frequency dependent attenuation in the delay line. In addition, the amplifiers make the overall delay line unidirectional and prevent refletions.

Control signals for the crosspoint switch boards come from the RT Controller (A0). Each crosspoint has its own static control memory. The crosspoints are accessed in a row serial, column parallel mode. Each new entry of data purges the old data in memory. Thirty-two column data entries (one for each row) are made prior to every pulser firing.

The delay synthesized outputs are input to the A7 Log Amplifier. Figure 5-24 shows how the delay maps are organized for each scanning scheme. Higher data rates are acheived when multiple delay maps are established for multiple scan lines and focal lengths.

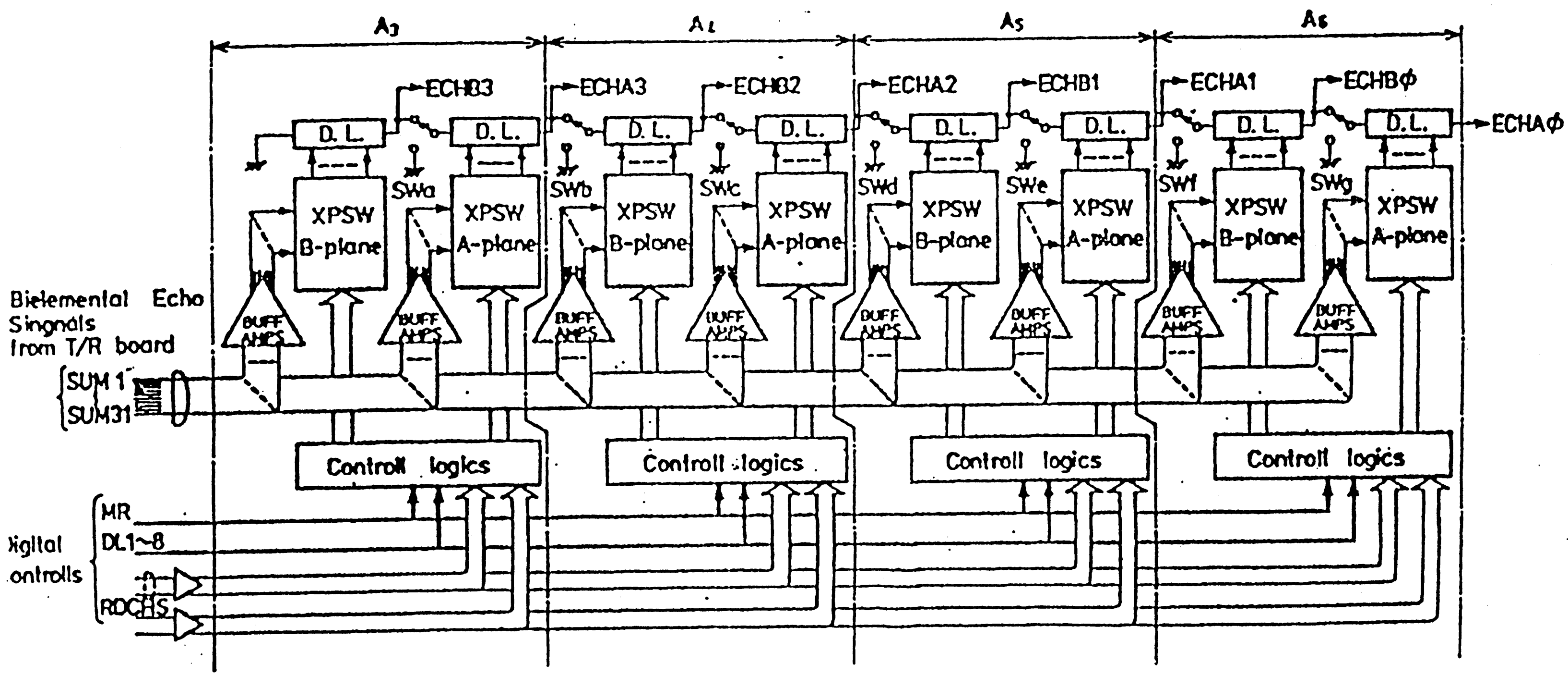


Figure 5-20

Overall Block Diagram of XPSW system

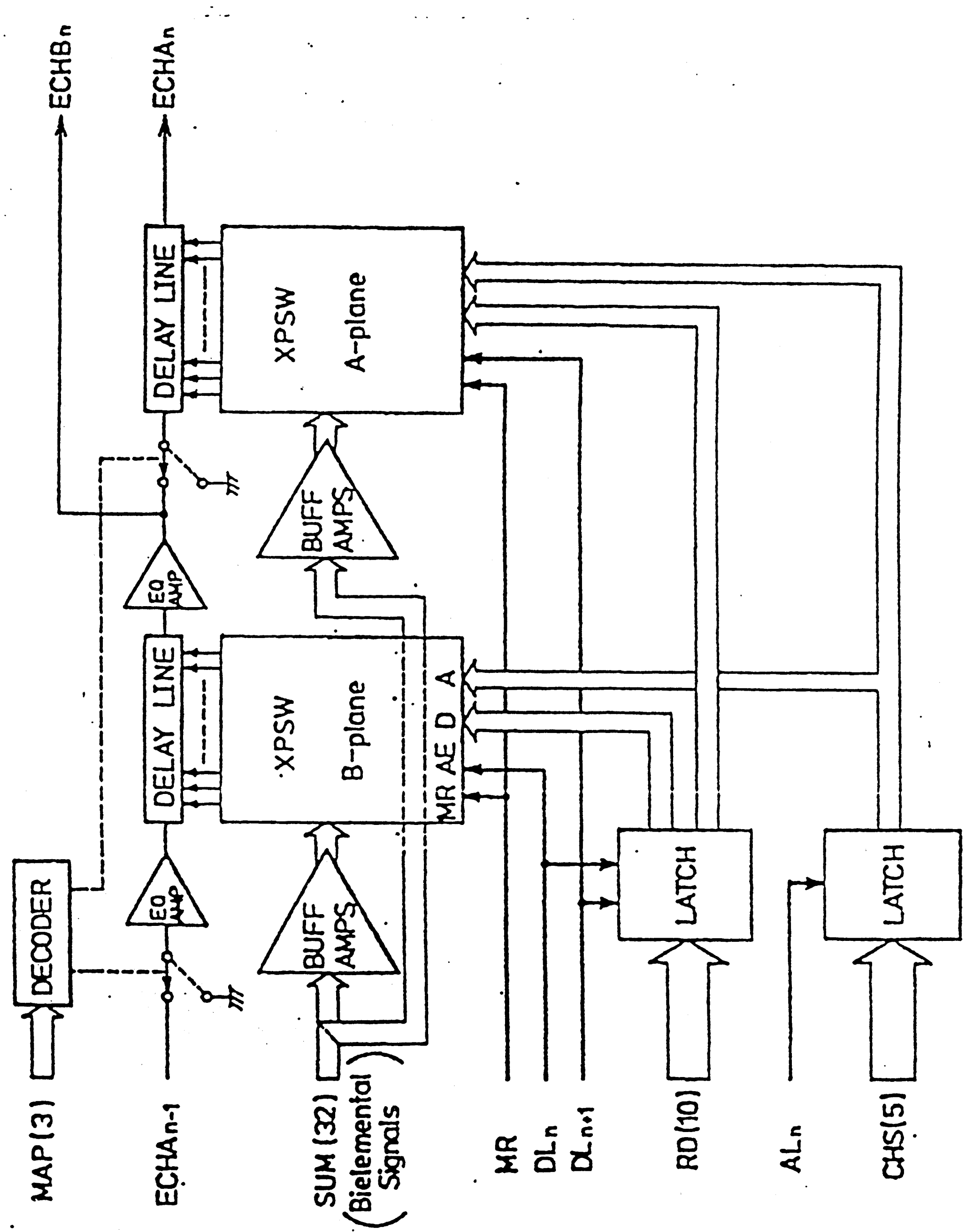

MAP(3)
ECHAn-1
SUM(32)
(Bielemental Signals)
MR
DLn
DLn+1
RD(10)
ALn
CHS(5)
DECODER
EQ AMP
EQ AMP
BUFF AMPS
BUFF AMPS
DELAY LINE
DELAY LINE
XPSW
B-plane
MR AE D A
XPSW
A-plane
LATCH
LATCH
ECHBn
ECHAn

Figure 5-21

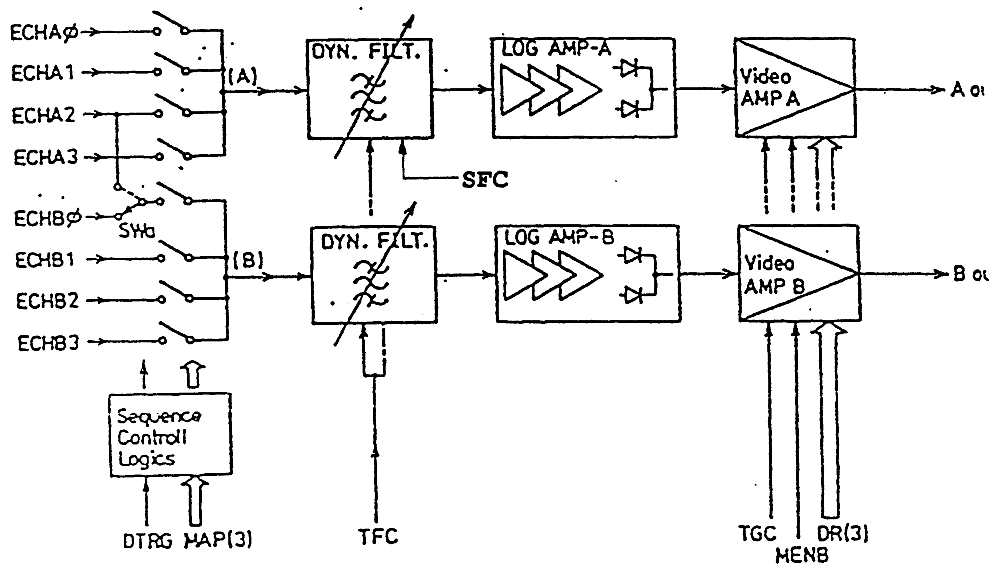

ECHAØ
ECHA1
ECHA2
ECHA3
ECHBØ
SWa
ECHB1
ECHB2
ECHB3
(A)
(B)
DYN. FILT.
DYN. FILT.
SFC
LOG AMP-A
LOG AMP-B
Video AMP A
Video AMP B
A ou
B ou
Sequence Controll Logics
DTRG
MAP(3)
TFC
TGC
MENB
DR(3)

Fig.5－22

5-4-4 Log Amp Assembly

Eight buffer amplifiers, Q0a, b through Q3a, b (refer to A7 schematic page 1 of 3) serve four selectable focal zones in the log video chain. Signal switching J FETs Q4a, b through Q11a, b (A7 schematic page 1 of 3) commutate the dynamic filter inputs for a minimum of spikes caused by focal zone switching. Refer to Fig.5-22.

Time based (in effect, depth based) focal zone switching is performed automatically. Four monostable timers (U110, U111 each having two sections- see A7 schematic page 3 of 3) determine the timing for focal zone switching. RV106 through RV111 (A7 schematic page 3 of 3) are used to trim the timing signals of the monostable timers. Focal zone switching sometimes causes spikes, so RV3a, b through RV6a, b (see A7 schematic page 1 of 3) are used to provide a spike reduction adjustment. RV0a, b through RV2a,b are adjusted for signal level equalization throughout the focal zones.

Switching patterns and an apply/defect control are provided from the system CPU located on the master controller board (A8). When the Sector defeat control on A8 is enabled, ECHA0 and ECHB0 are selected and the monostable timers are inhibited to prevent spikes. The focal zone switching scheme is shown in Figure 5-23.

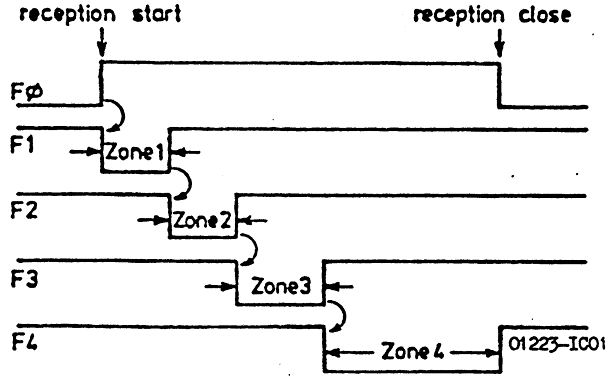
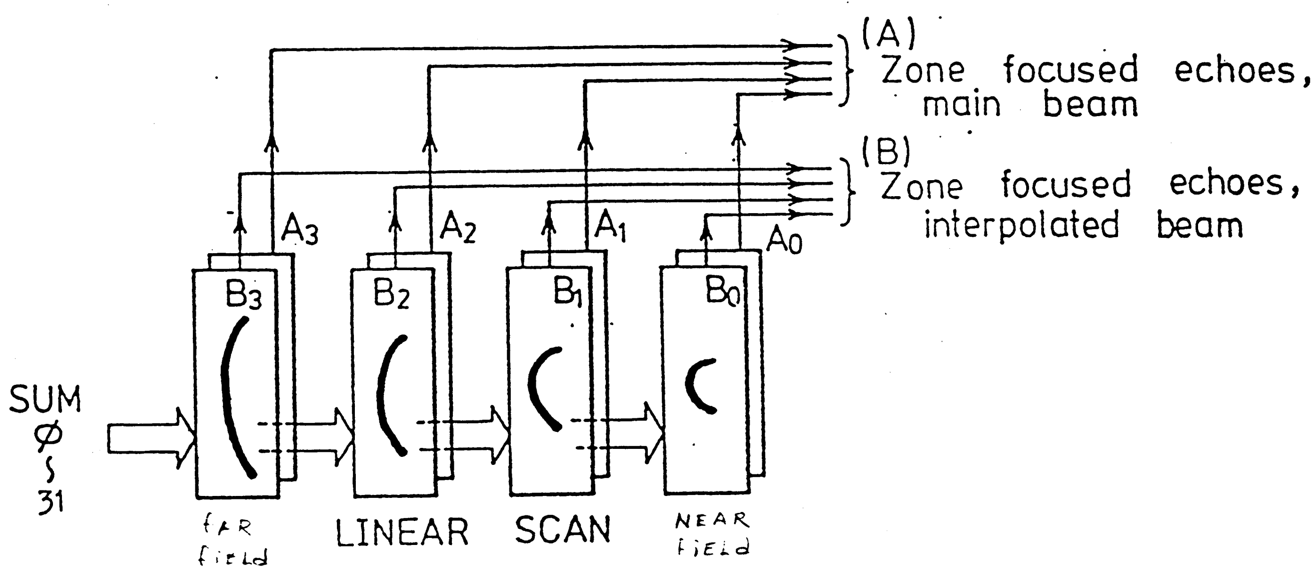
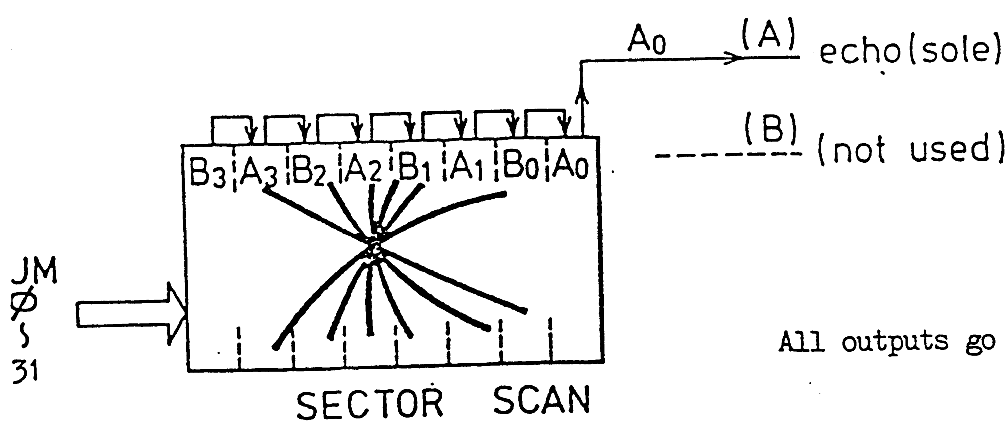


Figure 5-24





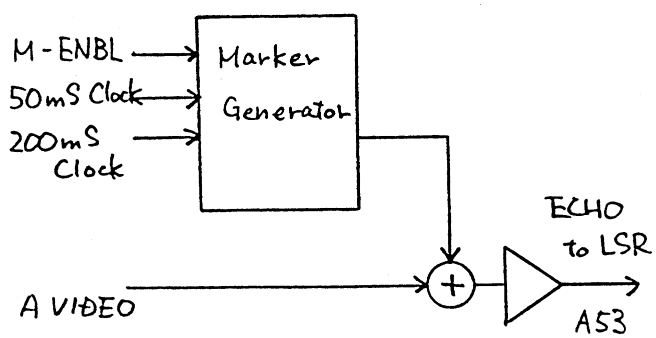
All outputs go to A7.

Fig.5-24

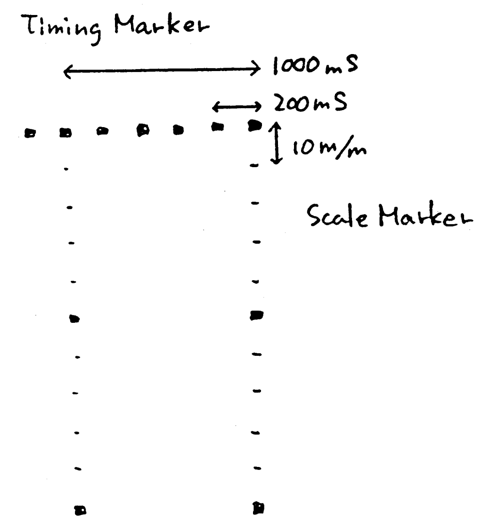
Delay map Organization sketch

LSR-M

Line Scan Recording of M-mode utilizes an LSR-M (Line Scan Recorder-Marker) board on A7 LOG assembly. LSR-M generates scale markers and timing markers which are added to M-mode video recording.



A7 Marker board

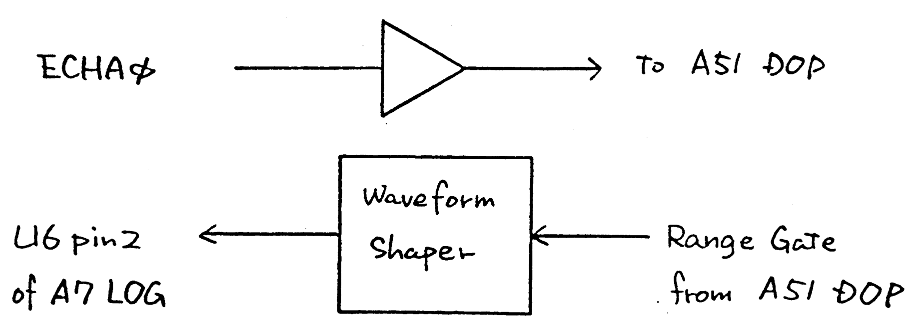


Marker Format

DOP-I

PD video output and sample volume range gate input are interfaced to the A7 LOG through a DOP-I board.

DOP-I (DOP-Interface) board is on the A7 LOG assembly. There is a buffer amp for A51 DOP and a waveform shaper for range gate. The range gate is added to M-mode for display presentation only.



Dop-I board

5-4-5 Dynamic Filtering

The dynamic filters are very important in obtaining the best image quality over various depths. A passive low cut-off filter is cascaded with an LC ladder high cut-off filter and located between the focal zone switches and the log amplifier (see Figure 5-25).

Da through Dd (Figure 3-25) are varactor diodes whose capacitance is controlled by the applied voltage. These diodes were selected for their relatively high capacitance and for their well regulated characteristic curves.

The lower cut-off frequency of the receiver is controlled by TFC which is time dependent. The high cut-off frequency is controlled by SFC which is dependent upon the steering angle and is applied only in sector.

TGC control voltage for varactor diodes is provided by operational voltage translators, U103, 104, and U105. Analog inputs for the TGC and TFC control voltage come from the master controller where they are digitally generated and D/A converted.

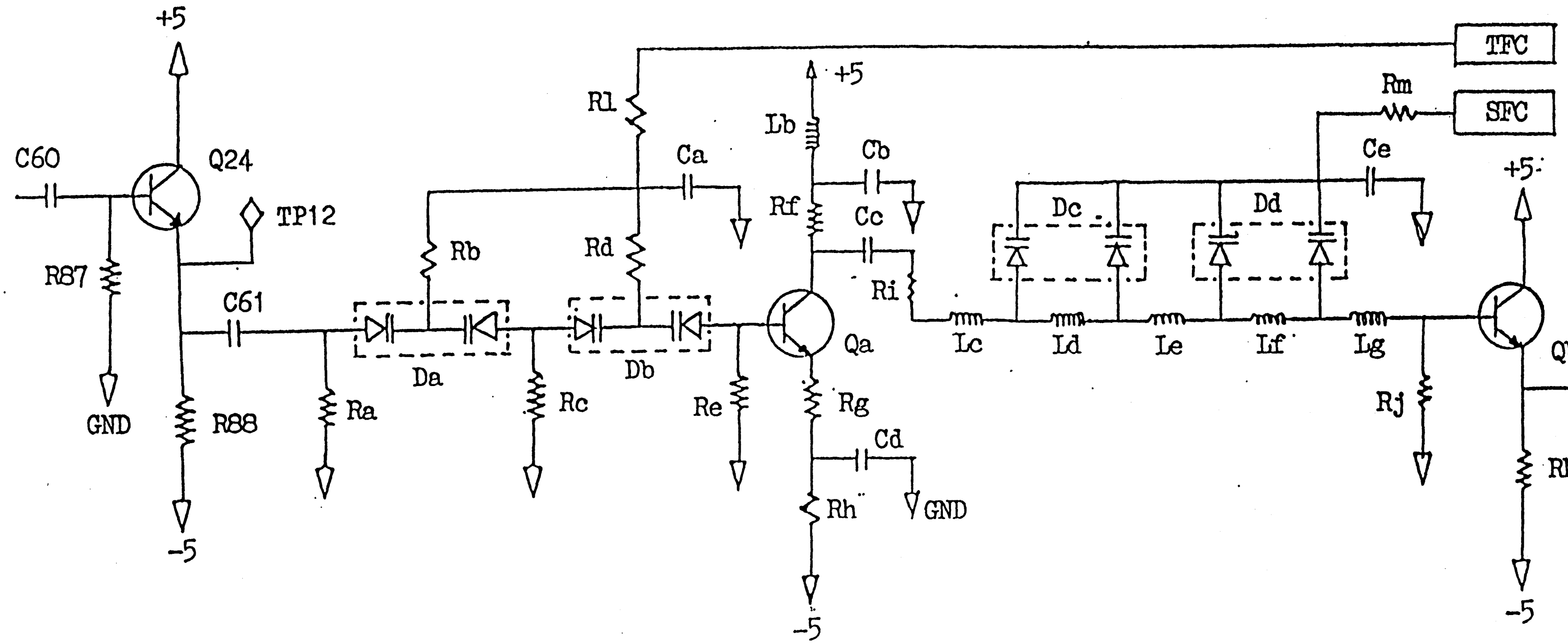


Figure 5-25
Dynamic Filter

5-4-6 Log Amplifier

The log amplifier used here is referred to as a successive saturation bipolar type. This type of log amplifier processes input signals within a predetermined level and frequency range, and converts the instantaneous input voltage into a log-compressed output. The bipolar design guarantees a good level translation without d.c. offset or drift. The log amplifier has a nominal 120 dB compression range from a few hundred KHz up to 10 KHz.

Actual compression is performed by U12A (see A7 schematic page 2 of 3). Two cascaded 30 dB amplifiers provide three inputs to U12A, each 30 dB apart. This technique provides a more ideal log-compression curve over a wider dynamic range.

Two 30 dB amplifiers, U10A and U11A, provide a 90 dB conversion range input to U12A. R75A causes an additional 30 dB attenuation at another input- so the total conversion range of U12A is 120 dB.

The 30 dB amplifiers have a slight but characteristic delay in signal propagation. Delay lines U7A and U8A are used to make the level shifted inputs to U12A always in phase. D13A through D20A are limiters to prevent the amplifiers from saturating.

The log-compressed output of U12A is amplified by Q19A through Q22A and then rectified by video detectors D11A and D12A. D10A serves as a temperature compensating, zero output reference. RV7A and RV8A provide gain and offset adjustments for the log-video detection circuit. Video amplification is performed by U9A. The specified echo level vs. U9A output is 0.5V/20 dB (see Figure 3-26).

5-4-7 Video Signal Preconditioning

For a B-mode display, the U9A output goes to U10A (A7 schematic pages 2 of 3) where TGC and SGC are applied. Dynamic range definition is a scale factor selection applied to the video signal.

LOG Amp Conformity Specification

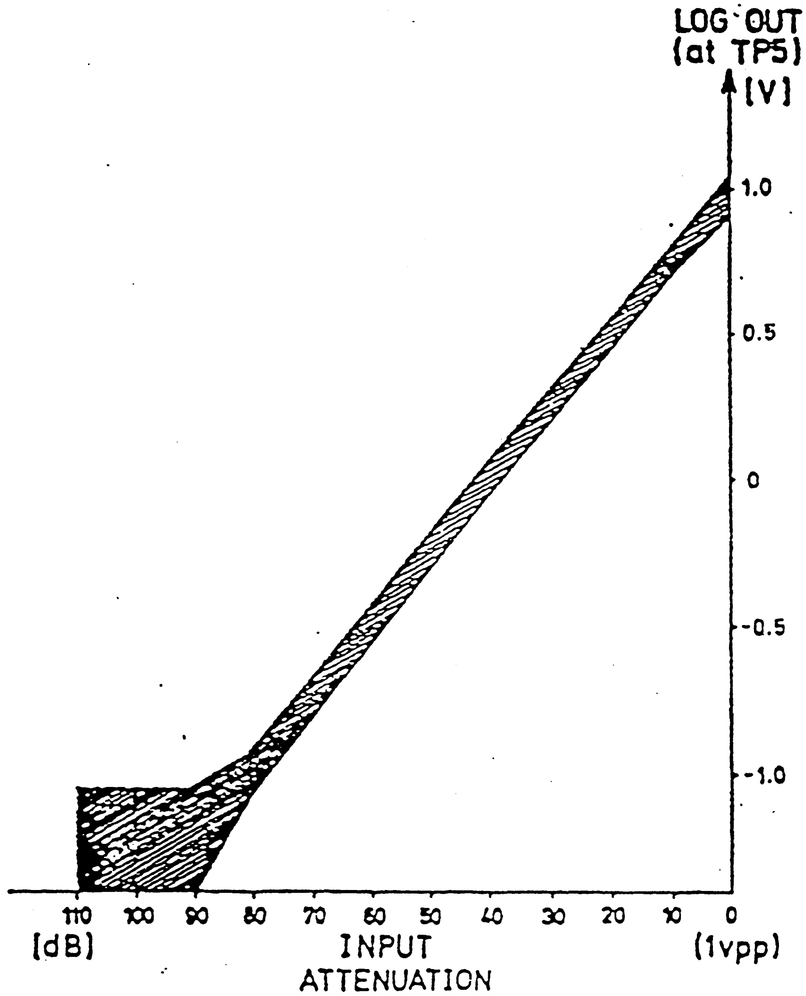


Fig.5-26

For an M-mode display, a signal path through U1A, U2A, and U3A is selected. Near-Zero rejection and non-linear processing is applied at U1A. U2A is an inverter with an offset, and U3A is a summing amplifier where TGC is added. RV112 and RV113 (A7 schematic page 3 of 3) provide bias set-up for the special M-mode signal conditioner.

The output of this section, through U6A, is defined and scaled as shown in Figure 5-36. RV114 (A7 schematic page 3 of 3) sets up the pedestal for this signal.

while this explanation has only referred to the A-channel, an identical operation occurs for the B-channel. The B-channel signal is available at U6B.

The final outputs of the board are present at U108 and U109 (A7 schematic page 3 of 3) which act as buffers for the U6A and U6B outputs. switches U101 and U102 allow Aout and Bout to be selected and provides for a service software routine which measures TGC, TFC, +5V, -5V,+12V. +80V, and variable high voltage by using A/D converters in the next board normally used for video data acquisition. The items to be checked are listed in the following table:

	U101		U102	
Control Word	Subject	Typ. Value	Subject	Typ. Value
0	A-video	0 - 1.5V	B-video	0 - 1.5V
1	GND	0V	GND	0V
2	+5V	1.5V	-5V	1.5V
3	VCC0	1.5V	VCC1	1.5V
4	+80V	1.5V	+HV	1.5V
5	+12V	1.5V	GND	0V
6	TFCV	0 - 1.5V	TGCV	0 - 1.5V
7	B-video	0 - 1.5V	A-video	0 - 1.5V

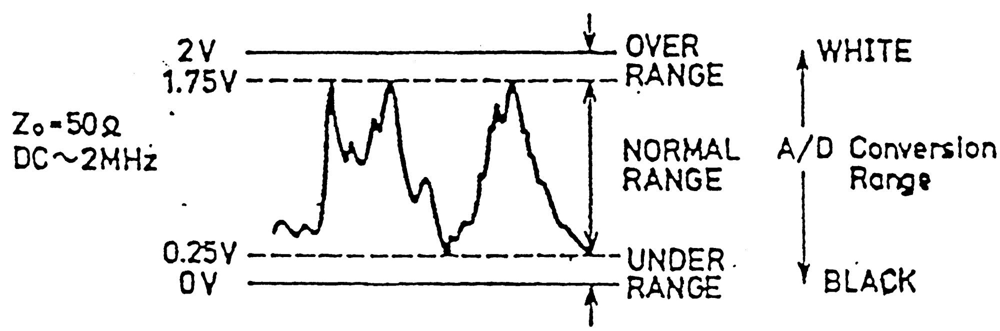


Fig.5-27

Aout, Bout specification

5-4-8 Connector Board

To relay the necessary signals, an interconnecting board (A14) is placed between the motherboard and the transducer connector. A logic circuit detects a connection at the transducer receptacle.

When a transducer is connected or disconnected, the logic circuit enables an interrupt to the system controller which acknowledges the **change in connections but only on the Front Panel solected connecter**

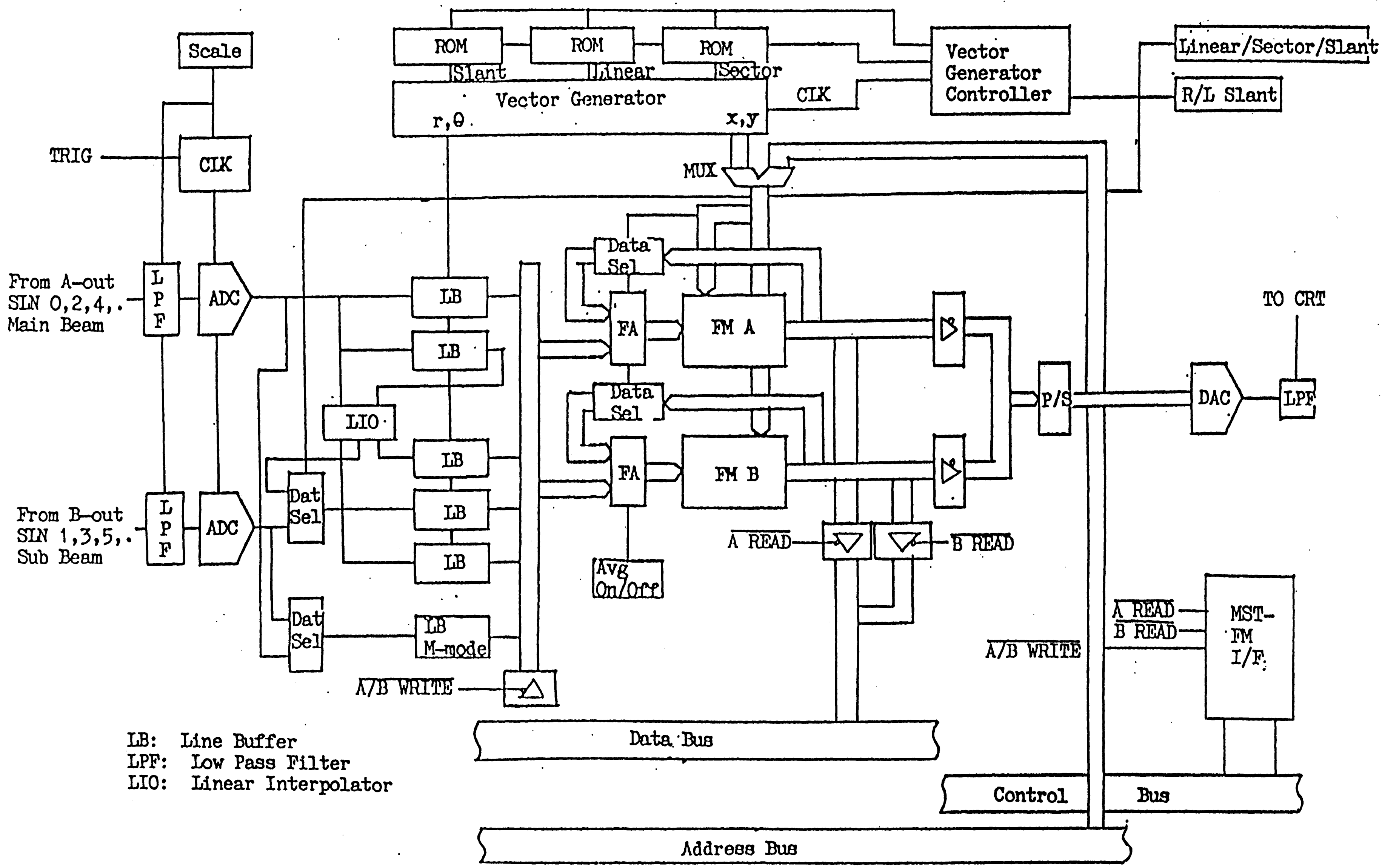
Probe identification is performed by a wiring scheme in the probe and receptacle connectors. Buffer gates are used to sense the wired code information.

A transducer receptacle is used for quick transducer connections Two 156-pin, zero insertion force connectors are used.

5-5 Frame Memory and Digital Scan Converter

For a proper CRT display, the ultrasound video signal form the A7 Log Amplifier must be scan converted. This task is performed by three digital boards: A9 SCC (scan converter controller), A10 FM (Frame Memory), and A11 Video board. A block diagram for these boards is shown in Figure 5-28.

The function of scan conversion is to define a pixel address when the data for that pixel is acquired. the digital scan converter maintains a Frame Memory address that directly corresponds to the displayed raster scan picture. The Frame Memory row and column are equivalent to the display screen pixel row and column. An "interweaved" read/write is continuously performed on the Frame Memory.


Scale
TRIG
CLK
From A-out
SIN 0,2,4,..
Main Beam
From B-out
SIN 1,3,5,..
Sub Beam
L P F
ADC
ROM
Slant
ROM
Linear
ROM
Sector
Vector Generator
r,θ
x,y
CLK
Vector Generator Controller
Linear/Sector/Slant
R/L Slant
MUX
LB
LIO
Dat Sel
LB M-mode
A/B WRITE
Data Sel
FA
FM A
FM B
Avg On/Off
A READ
B READ
P/S
DAC
LPF
TO CRT
MST-FM I/F
A/B WRITE
Data Bus
Control Bus
Address Bus
LB: Line Buffer
LPF: Low Pass Filter
LIO: Linear Interpolator

ure 5-28

Calculating the write address for video data is fairly simple when in linear scan. The original ultrasound scan geometry lends itself to a relatively basic row to column conversion (see Figures 5-29 and -30).

However, in a sector scan acoustic scan lines are no longer parallel and row to column conversion is more difficult, A predetermined look-up table finds the write address string for the video from each pulse.

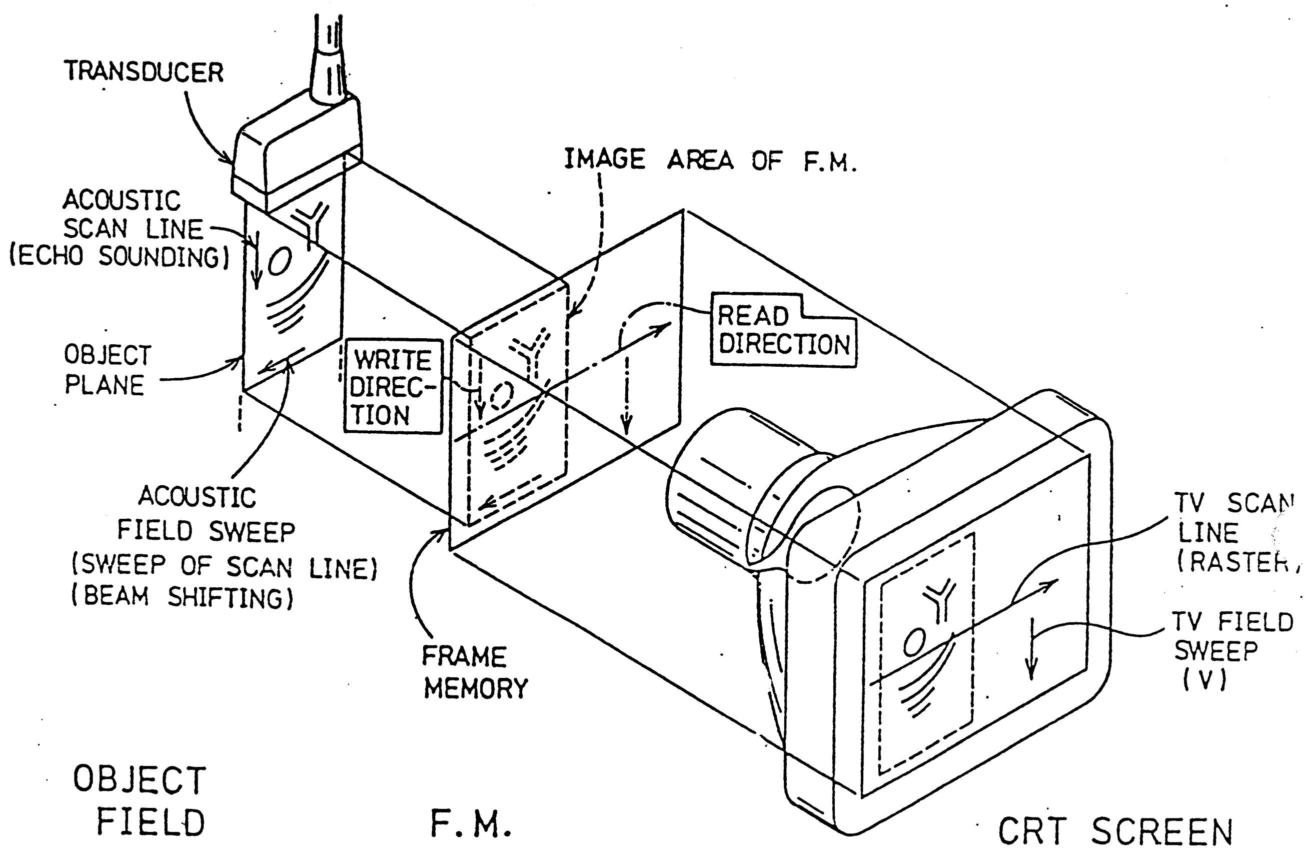
It is also the task of the scan converter to produce a display the represents the transmitted acoustic scan field, regardless of the scan style. Again, this is more difficult for sector scanning because of its geometry. An interpolation between scan lines is required to fill in information missing as the scan lines diverge. This is called "pixel filling" and it is used any time the scan scheme does not lend itself to direct row to column conversion for the data display. (Refer to Figures 5-31 an 5-32).

Besides difining pixel addresses, the digital scan converter can "hold" an image and maintain it for constant display. This is what happens when the FREEZE switch is selected on the front panel. The scan converter is also able to display the scan field in a desired direction of view, to display a magnified image, and to display various depths of a a scan field (through the LINEAR SCROLL switches on the front panel).

The scan converter can also place a combination of images on the display. Simultaneous B/M-mode displays are a necessary function of the scan converter. An "overlay" can also be displayed over the image. The overlay function is provided in the Frame Memory to display desired characters and patterns. A gray scale appears in the display as a reference for pixel levels.

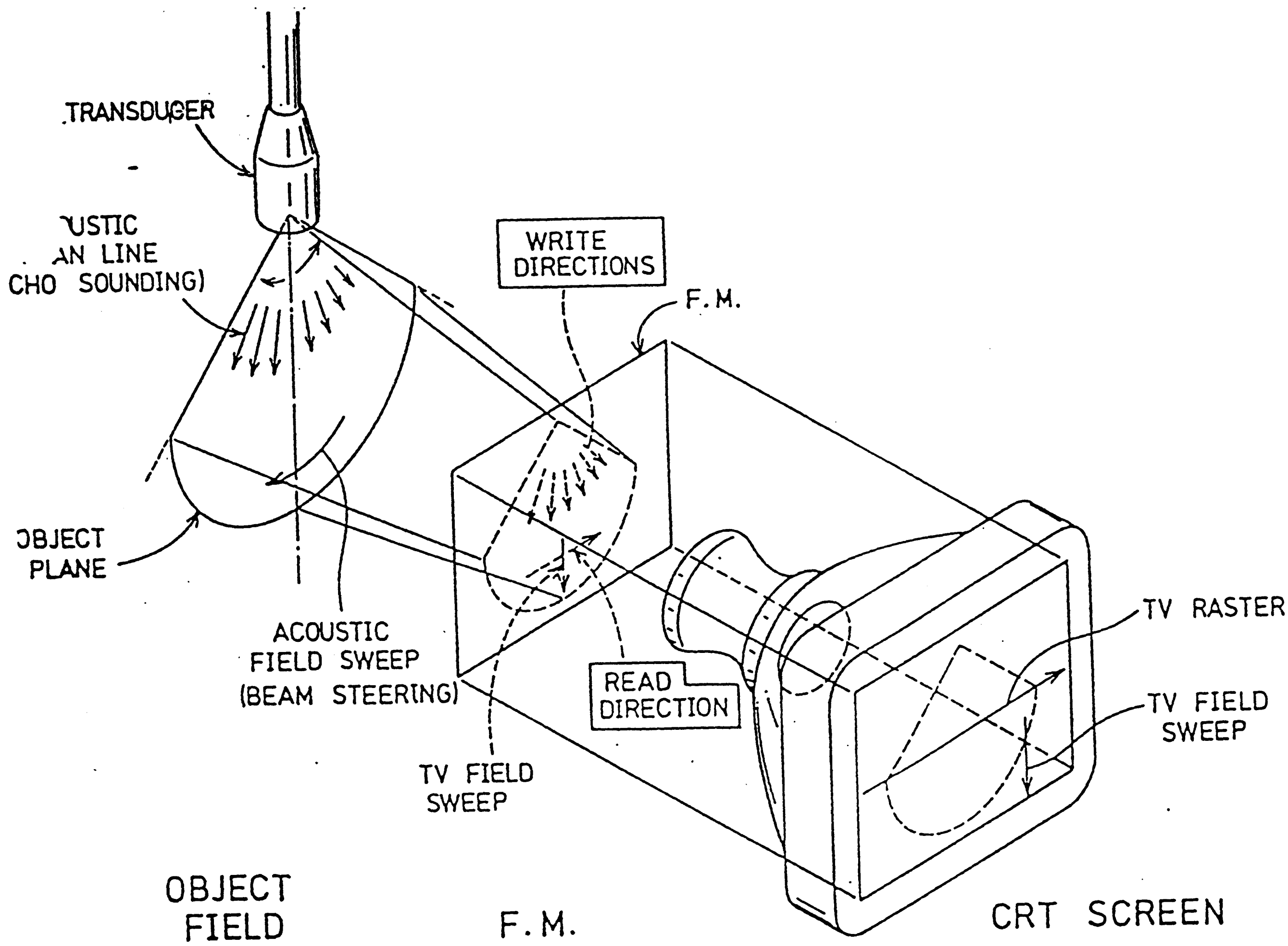
5-5-1 Video Data Acquisition

Figure 5-28 is a block diagram of the digital scan converter system. Ultrasound video signals form the A7 Log Amplifier are input to the A10 Frame Memory where they are low-pass filtered before being A/D converted. The low-pass filters are for anti-aliasing. Four cutoff filters are available; the choice depends upon the image scale factor which also determines the A/D conversion rate. A10U3H and A10U3E are the filter selectors. A10U8F and A10U6F are the A/D converters.



TRANSDUCER
ACOUSTIC
SCAN LINE
(ECHO SOUNDING)
OBJECT
PLANE
ACOUSTIC
FIELD SWEEP
(SWEEP OF SCAN LINE)
(BEAM SHIFTING)
IMAGE AREA OF F.M.
WRITE
DIREC-
TION
READ
DIRECTION
FRAME
MEMORY
TV SCAN
LINE
(RASTER)
TV FIELD
SWEEP
(V)
OBJECT
FIELD
F.M.
CRT SCREEN

Fig.5 – 29



TRANSDUCER
USTIC
AN LINE
CHO SOUNDING)
WRITE
DIRECTIONS
F.M.
OBJECT
PLANE
ACOUSTIC
FIELD SWEEP
(BEAM STEERING)
READ
DIRECTION
TV FIELD
SWEEP
TV RASTER
TV FIELD
SWEEP
OBJECT
FIELD
F.M.
CRT SCREEN

Fig.5-30

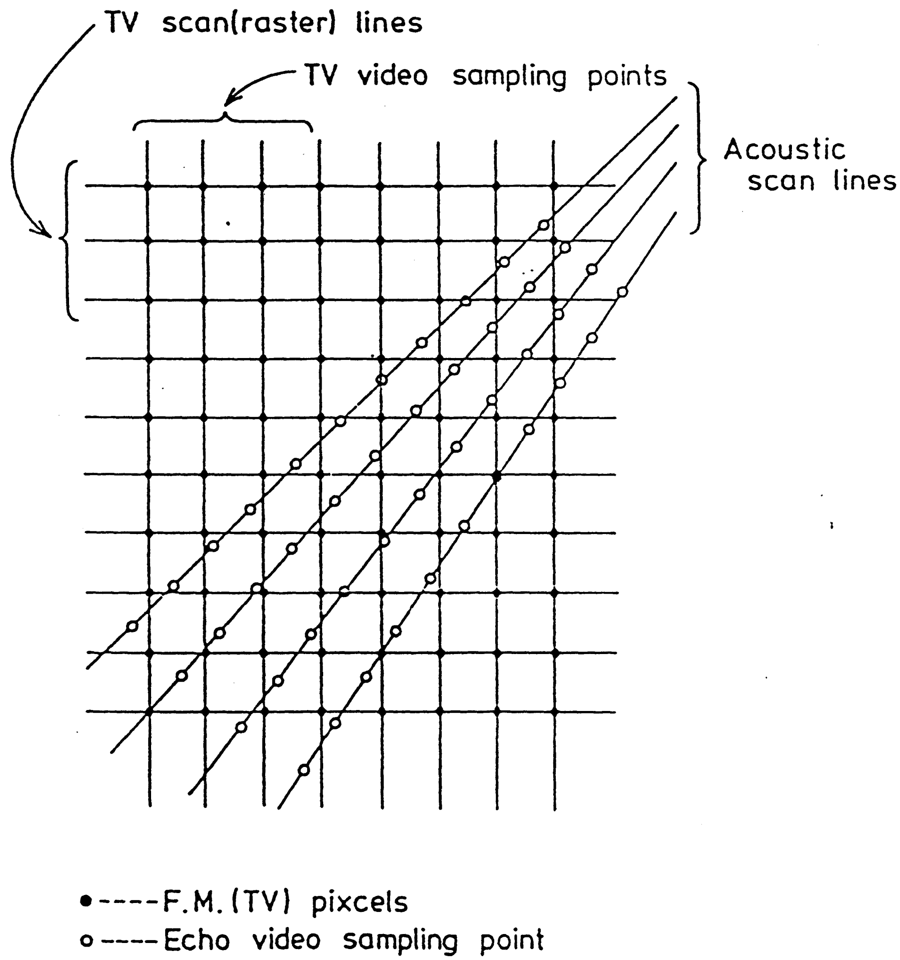

TV scan(raster) lines
TV video sampling points
Acoustic scan lines
●----F.M.(TV) pixcels
o----Echo video sampling point

Fig.5-31

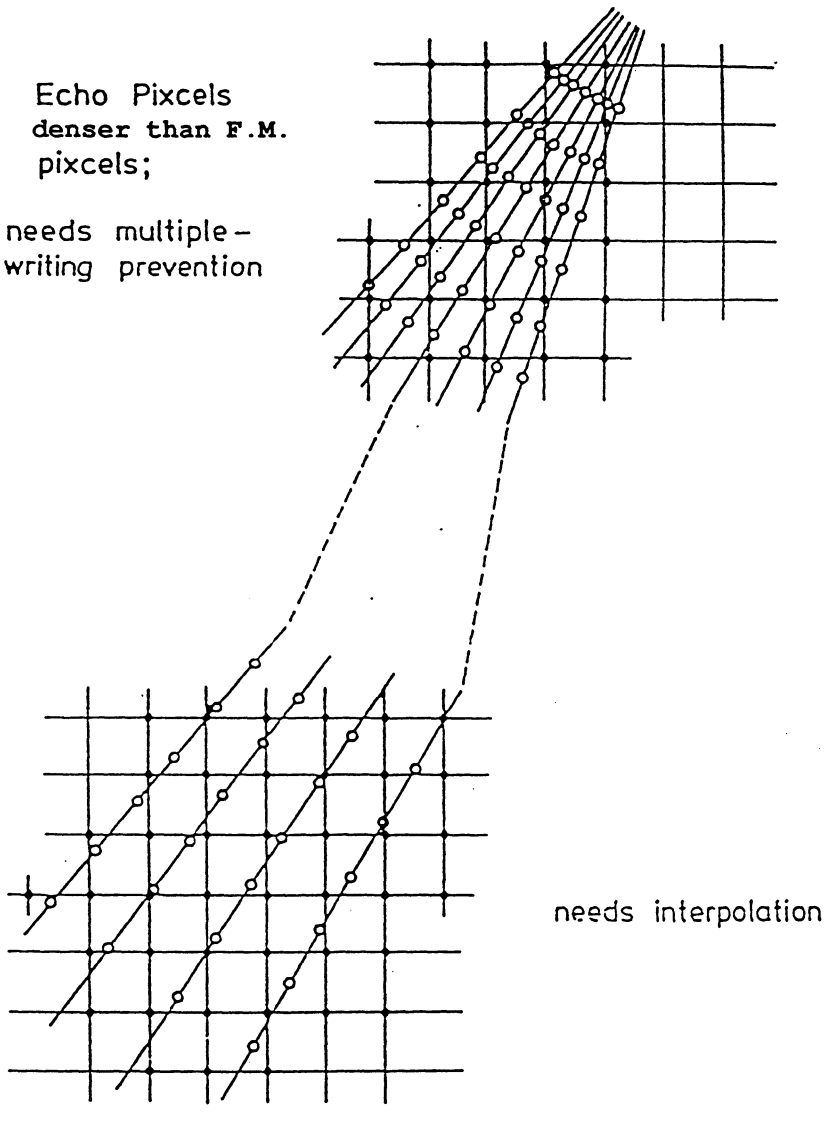

Echo Pixcels
denser than F.M.
pixcels;
needs multiple-
writing prevention
needs interpolation

Fig.5-32

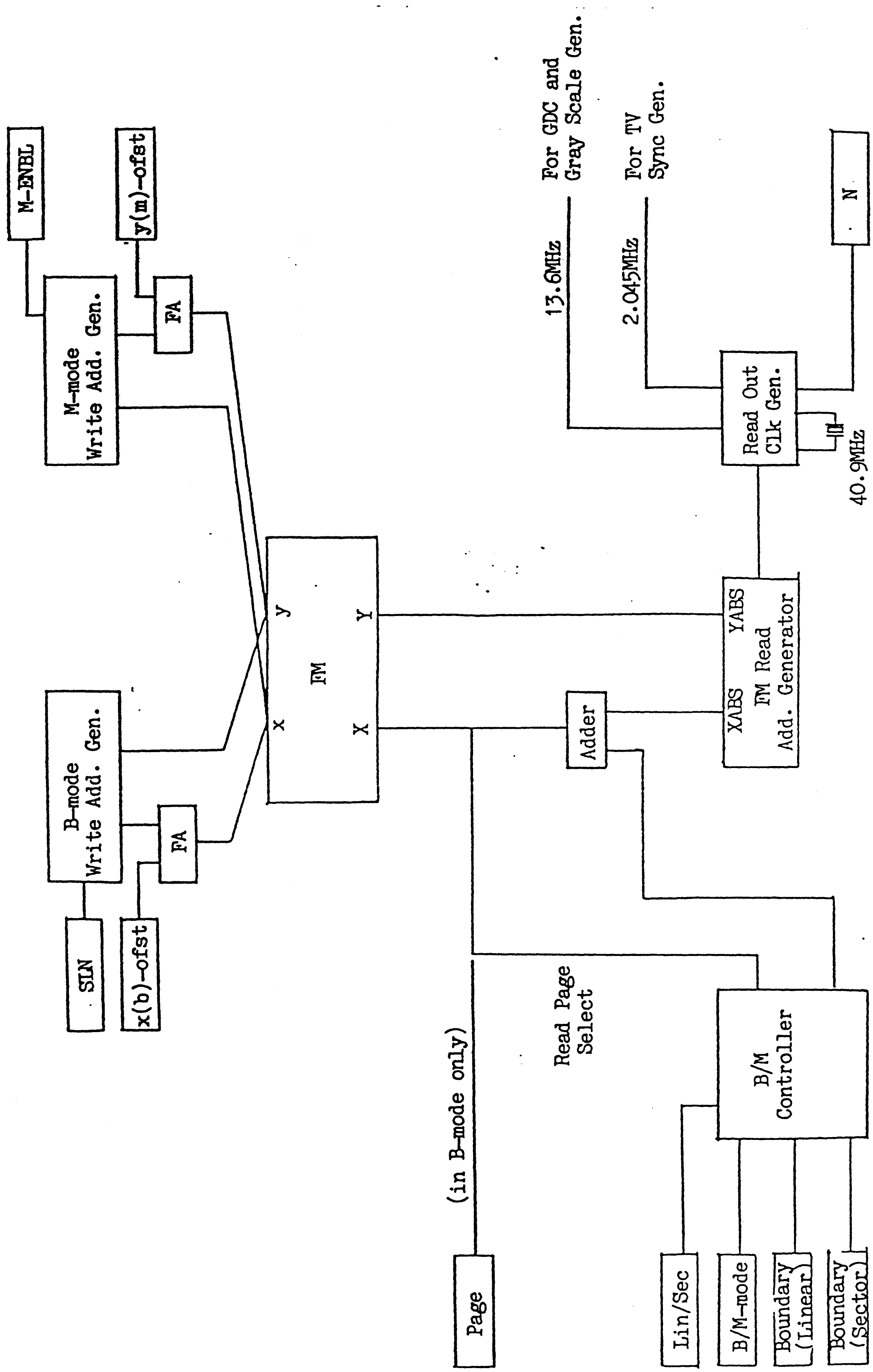

M-ENBL
y(m)-ofst
M-mode
Write Add. Gen.
FA
B-mode
Write Add. Gen.
FA
SLN
x(b)-ofst
FM
x
y
X
Y
Adder
XABS
YABS
FM Read
Add. Generator
Read Out
Clk Gen.
40.9MHz
13.6MHz
For GDC and
Gray Scale Gen.
2.045MHz
For TV
Sync Gen.
N
(in B-mode only)
Read Page
Select
Page
B/M
Controller
Lin/Sec
B/M-mode
Boundary
(Linear)
Boundary
(Sector)

Figure 5-33

The digitized video is now under control of the scan converter controller. The video is stored in a line buffer and then sent to Frame Memory. Two sets of line buffers are used to interweave the buffering operation. While one set is accepting the new video data, the other set is fowarding its data to Frame Memory.

A counter is used as a line buffer write address generator. The counter counts the A/D conversion clock. A "scroll" operation (sets the B-mode image to start at a depth other than the transducer surface) is controlled by a preset word to the counter.

For an M-mode display, an extra line buffer is used for simultaneous B/M-mode data acquisition. In this way, the B-mode information is not degraded. A "scroll" is performed in the same manner as for a B-mode only image. However, the RT3600 in the B/M mode display, can scroll. B-Mode and M-mode simultaneously.

In the combination focusing mode, the displayed image is a combination of the 3 focal zones obtained over 3 images. The image is edited through the line buffer by selectively updating the data for each zone as determined by the focusing delay maps. Until each update is completed, the scan line number is fixed. The Scan line number increments with each update and the video data for each scan line is passed to the Frame Memory.

For this data transfer, the line buffers are coupled to an internal data bus which is also coupled to the system microprocessor's data bus. This allows the system microprocessor to write data into the Frame Memory.

Acoustic scan line interpolation is also carried out at this stage. A digital interpolator (a weighted adder) synthesizes two "virtual" scan lies between actual scan lines. This feature is selected automatically when in sector scan. It is also used in linear scan when scale factors X1, X1.5, or X2 are selected.

5-5-2 Pixel Address Generation and Pixel Handling

After the scan line video has been set in the line buffer, the next step is to find adequate pixel addresses in the Frame Memory to store the video data. Figures 5-33 and -34 show the read/write address generators connected to the Frame Memory. Digital integrators are used to restore X-Y pixel addresses in order to track the acoustic scan line in an object field.

A ROM table provides X and Y incremental displacement data to the integrator. The table also provides scan format and scale factor assignments.

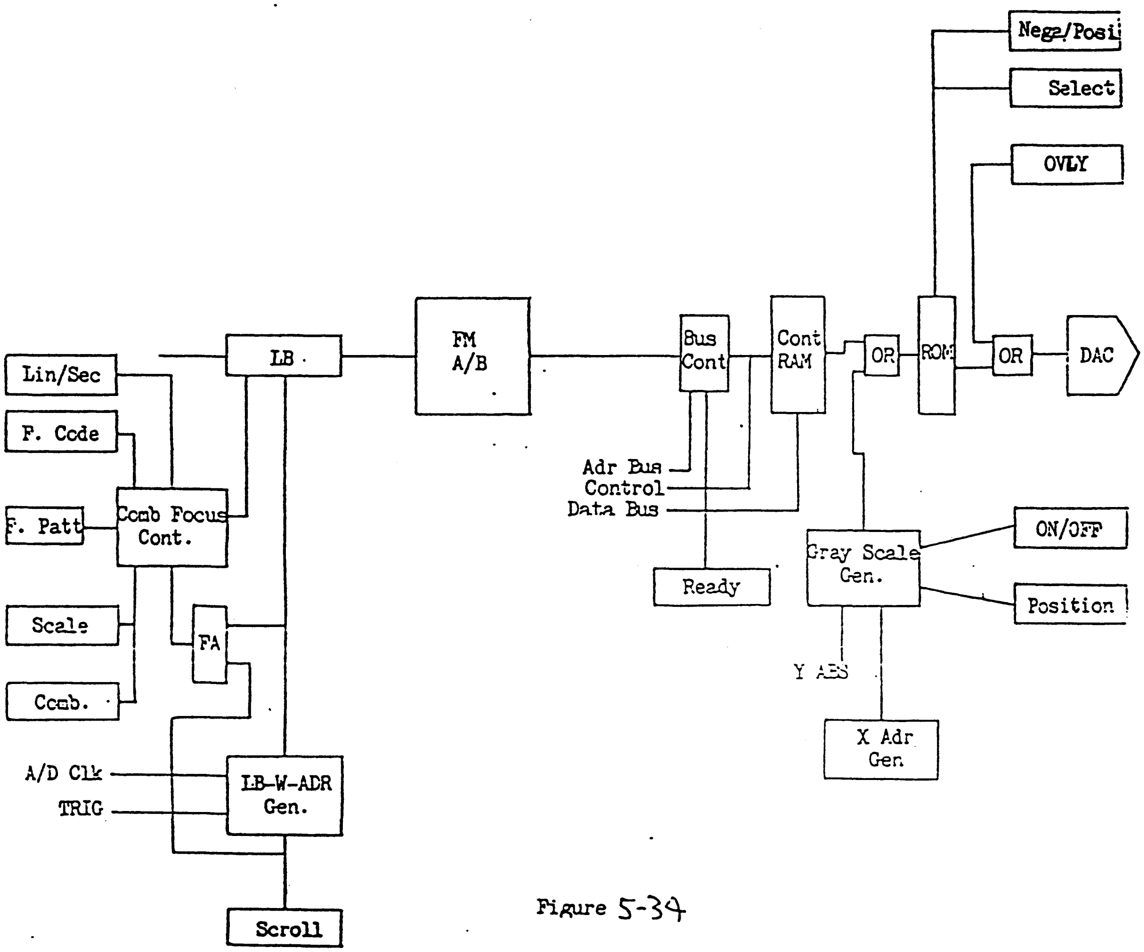


Figure 5-34

The incremental displacement table ROM requires 100KB for sector scan and 2KB for linear scan. The ROM for each scanning scheme is independently installed.

The Frame Memory is made up of two identical planes, A and B. Each plane is 256 x 1024 x 6 bits. Each plane is divided into two pages (A1 and A2, B1 and B2) of 256 x 512 bits that represent two independent TV fields (not the same as a TV frame). The contents of A1 and B1 make an entire TV frame, as do the contents a of A2 and B2. The planes of memory have independent read/write **circuits** so that while one field is being written to the other field can be read. This allows essentially continuous read/write access for video data input and TV data output.

The readout frequency of the Frame Memory is set up by scale factor requirements. The readout address generator counts a selectable frequency determined by scale factor. Vertical scale factor (Z-axis in object field, Y-axis on display) is determined by video sampling rate; horizontal scale factor (X-axis in object field and display) is determined by Frame Memory readout clock frequency. Timing for both scale factors is derived form a quarts crystal oscillator and a programmable frequency divider.

Readout data from the Frame Memory planes is multiplexed to form a digital video data stream. This data stream then undergoes parallel to serial conversion, D/A conversion. and post-processing (contrast conditioning).

The data and address bus of the system microprocessor are indirectly coupled to the internal read/write bus and address bus of the Frame Memory. When either plane or both planes are in a "freeze" status, the system microprocessor can set up its own read/write requirements to the selected Frame Memory plane.

5-5-3 Output Digital Processing

The digital video signal from the fame memory has a TV style format in digital form. This signal now undergoes post-processing and gamma correction before the video D/A conversion. Figure 5-35 represents this part of the digital scan converter system.

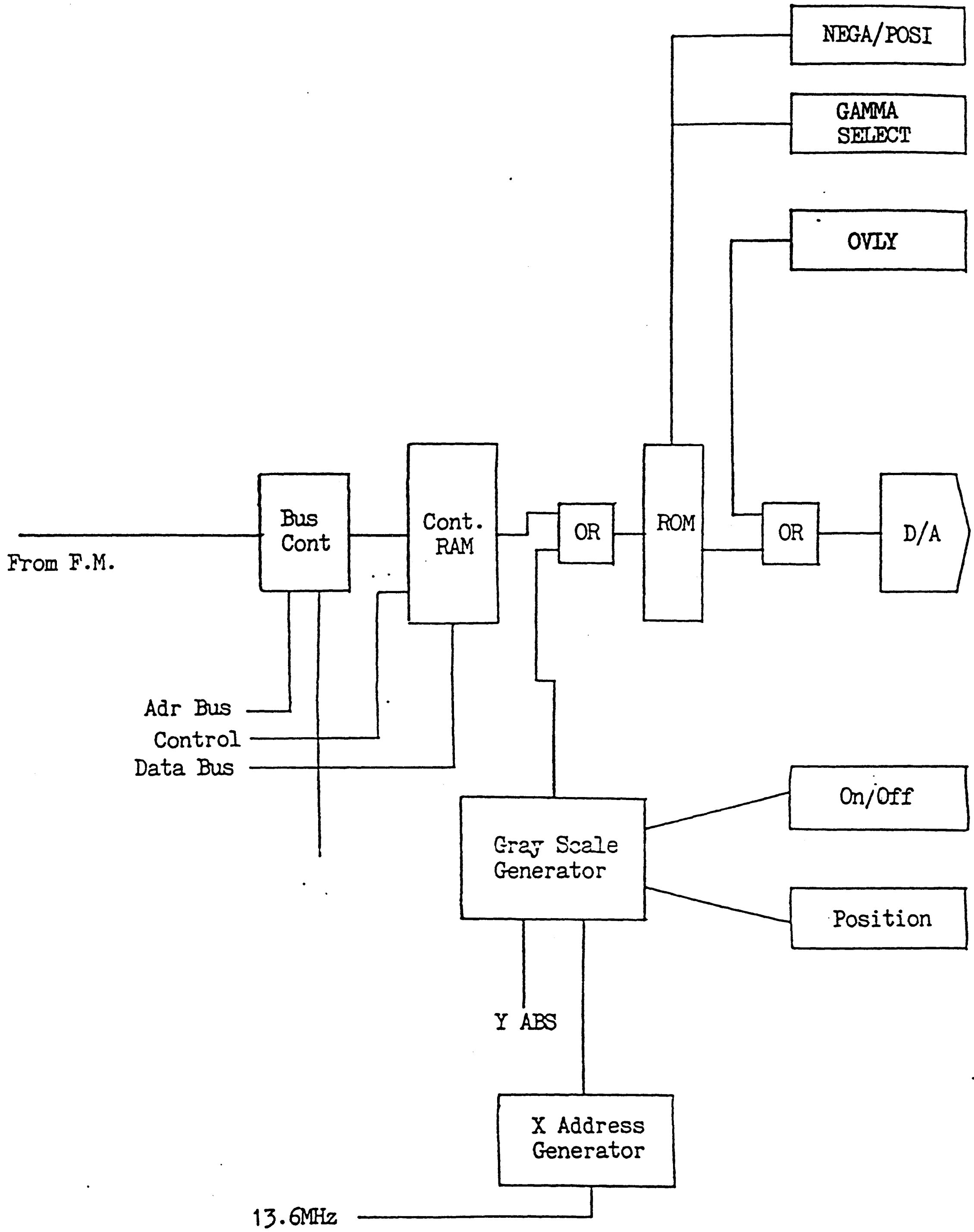

NEGA/POSI
GAMMA SELECT
OVLY
From F.M.
Bus Cont
Cont. RAM
OR
ROM
OR
D/A
Adr Bus
Control
Data Bus
On/Off
Gray Scale Generator
Position
Y ABS
X Address Generator
13.6MHz

Figure 5-35

Post-processing is also known as contrast conditioning. It is carried out in a direct conversion from values stored in a high speed RAM. Gamma correction is performed through a software selected menu stored in a ROM table. Gamma correction depends on the selected display style, white on black, or black on white. The software determines the display style and selects the applicable gamma correction curve.

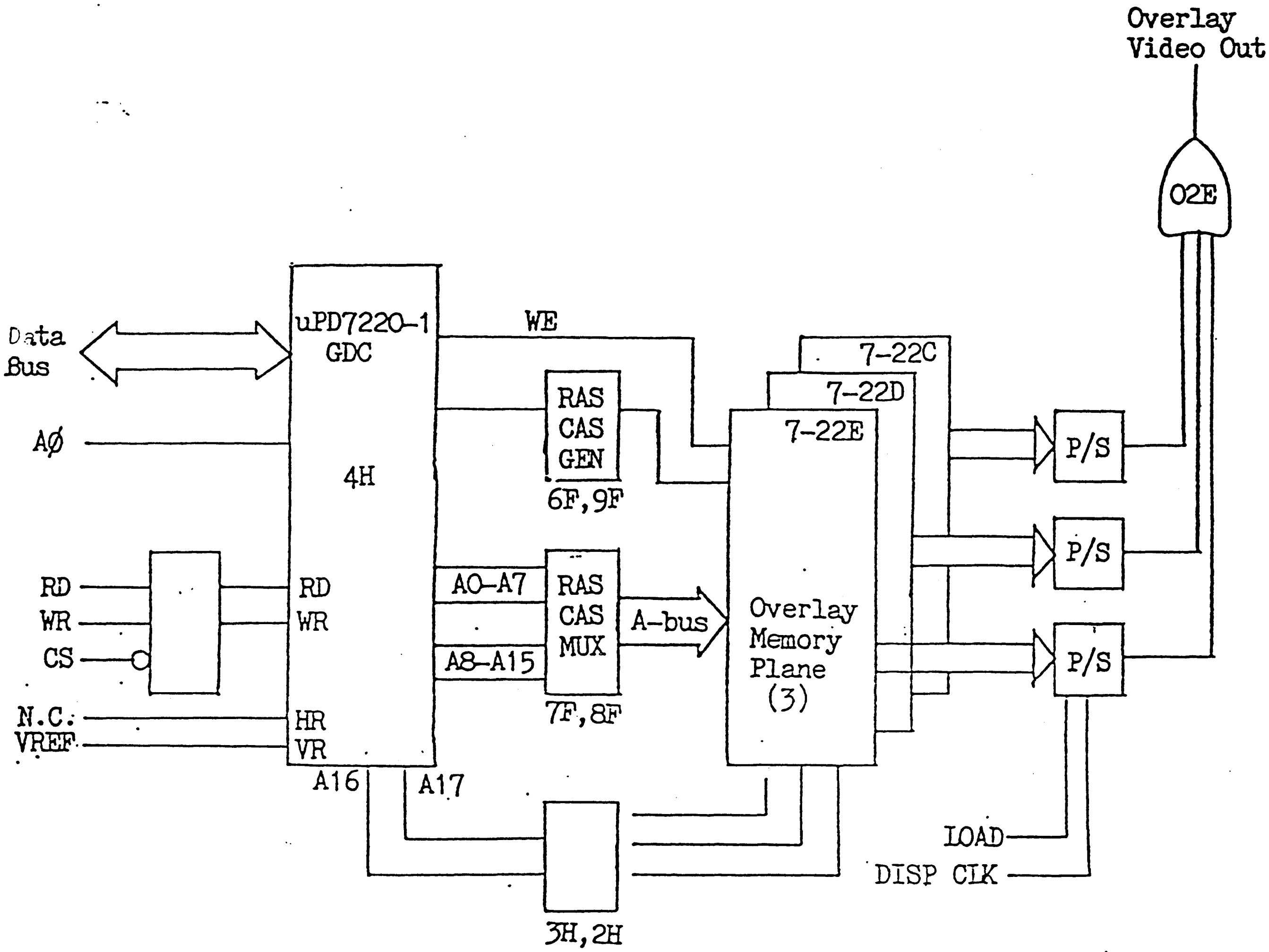
The gray scale reference bar is generated by a special logic array A10U23A. This signal is merged with the digital video data after post-processing, but before gamma correction.

The gamma correction menu includes curves for the monitor display and for the Polaroid camera. The Polaroid gamma correction includes compensation for photosensitive paper and for the monochrome CRT used for the Polaroid monitor. The menu is automatically switched as software tells the system when a Polaroid photograph is taken.

5-5-4 Overlay System

Figure 5-36 is a block diagram of the overlay system. The overlay system is made up of three planes of 1024 x 1024 x 1 bits. Each plane is divided into two pages of 1024 x 512 bits. An area of 656 x 480 bits from each page is the actual area to be displayed. Pages from the same plane are selectively displayed, they cannot be simultaneously displayed. Up to three pages (one from each plane) can be superimposed and displayed simultaneously.

A graphic display controller (GDC) chip A11U4H does all the access to the memory. The write cycle is performed during the TV vertical retrace interval; readout is done continuously during the actual vertical field duration. The GDC also controls the read and write addresses.



P/S: Parallel
to Serial
Converter

Graphic Display Block Diagram

Figure 5-36

Write and erase instructions and the write data is sent to the GDC from the system microprocessor through the data bus and chip select signal. The readout data from the overlay memory planes is parallel to serial converted and merged with the video signal. When the overlay bit is high, the video output is set at the maximum white level.

Synchronization of the overlay system output and the video output is maintained by the GDC's internal countdown circuitry. This circuit divides a clock identical to that used to define sync signals. The vertical sync signal is the trigger for the GDC readout sequence. The GDC's countdown ratio is software controlled.

5-5-5 Video Output Circuit

The digital video data is converted to an analog signal by U26E1 (see A11 schematic page 13 of 14). Before entering the D/A converter, the signal has passed through a variable transverse filter. The filter is made up of delay lines U29F1, U29H1 and tap selectors U28F1 and U28H1. The purpose of the filter is to average the signal respective to the readout clock rate of the Frame Memory. Remember, the readout clock rate depends on the display scale factor.

Transistors Q26H6, Q26H7, and Q27H8 form a differential amplifier. Q27H3 through Q26H1 are constant current sources. The values of these sources are predetermined, but they do share a common base bias scaling circuit. The scaling circuit includes Q27H4 for temperature compensation and R27F1 for an overall scale factor adjustment.

Tap coefficients of the transverse filter are determined by R25F5 through R26F7. A differential current is applied to Q26H5 through Q25H4 (A11 schematic page 14 of 14). This differential current is directly proportional to video intensity. R24H1 and R24H2 provide a overlay character above the display's maximum brightness. This ensures the legibility of the overlay image throughout the brightness range of the display.

Current switches Q26H5 through Q25H4 transfer the differential signal to Q26J4 and Q26J2 in parallel when no overlay is present. However, when white overlay is selected, Q25H4 is turned on, Q25H5 is turned off and the signal only goes to Q26J4. The positive maximum voltage is present at R25J7, the video intermediate output.

U27J1 (A11 schematic page 14 of 14) selects the positive or negative style of CRT display. It also selects an external video signal to be displayed. When select bit B is high (regardless of bit A status), the final stage amplifier is switched to an external video input.

Q28K2 through U26K1 makes up current gain video operational amplifier capable of driving four 68 ohm loads.

Q28J1, Q28J8, and D28J6 are used to determine the video pedestal and to insert the composite sync signal. Q28J1 clamps the video line to zero when the composite sync signal is blank. Q28J8 pulls down D28J6 to a negative value at the same time. Gates in U23H1 (U24A1 on B97132Q assemblies) defeat these function when an external video signal is applied. In either case, the output is video compatible when terminated into a 75 ohm load.

The four outputs are for the visual CRT monitor, the Polaroid CRT monitor, a multiformat camera, and a video recorder. All outputs have an independent source resistor to match 75 ohm coax cables.

5-5-6 Control of the Digital Scan Converter

The most important control signals for the scan converter are scan line number (SLN) and transmission trigger (TRIG).

SLN is updated prior to TRIG. SLN is supplied to the scan converter through an output port of the system microprocessor. The A0 RT Controller, A3 - A6 Crosspoint Switches, and the digital scan converter require continuous SLN information.

TRIG is also generated on A8. A programmable divider counts down the horizontal sync signal. In this way, TRIG and horizontal sync are always synchronous.

5-5-7 EIA vs. CCIR Scan Formats

There are two major scan formats: the EIA Standard RS-170 (used in the U.S. and Japan), and the CCIR standard (used in Europe).

In both formats, the TV scanning method uses horizontal linear scanning in an interlaced pattern. The horizontal scan lines are interlaced to provide two views of the image for each picture frame. A frame consists of two fields.

In the EIA standard format, the field rate is 60 Hz and the frame frequency is 30 Hz. There are 525 horizontal scan lines or sweeps (approximately 63.5 microseconds long) per frame. The horizontal sweep frequency is 15,750 Hz. Each horizontal sweep corresponds to a line in the picture and represents the time for the electron beam to sweep from left-to right on the CRT face and then return.

In the CCIR standard format, the field rate is 50 Hz, and the frame frequency is 25 Hz. There are 625 horizontal lines (approximately 64 microseconds long) per frame. The horizontal sweep frequency is 15,625 Hz.

TV sync generation is performed by a crystal oscillator on the A11 VDO assembly. The clock is generated in U11U21F (A11U18F on B9713ZQ) from a master clock (4.09091 MHz for EIA, 4.40625 for CCIR).

5-6 Master Controller

The A8 Master controller is the core of the **RT3600**. It controls nearly every part of the console. It maintains interfaces that respond to inputs from the keyboard, the panel, and the footswitch. It provides the commands and controls to obtain the ultrasound image.

The Master Controller (MST) generates and distributes the most important control signals scan line number (SLN) and transmission trigger (TRIG). Controls are also provided for the Polaroid camera, the line scan recorder, and a **multi image camera**. The MST provides analog control signals for TGC and TFC, and generates a definition for dynamic range (that is, video amp gain).

A Self-check capability is available as well as software diagnostics.

Figure 5-37 shows the role of the MST in overall machine operation. Figure 5-38 is a block diagram of the MST.

5-6-1 The Microprocessor systems

The MST has two microprocessors located on the board. One (U02H1) is the actual system controller, the other (U18F1) is dedicated to the ultrasound scan controller. Both microprocessors are coupled together through I/O port chip U17J1. A flip-flop, U17E1, is used as a data available/busy/done flag for the microprocessor interface.

The system controller maintains 112KB of address space for program ROM, and 8KB for data and work area RAM. There is battery backup for the RAM. This is to preserve user defined conversion tables and for preset system parameters.

An interrupt controller chip, U15C1, manages and priorities all the interrupts to the system controller. Interrupt sources and priorities are given in the following table:

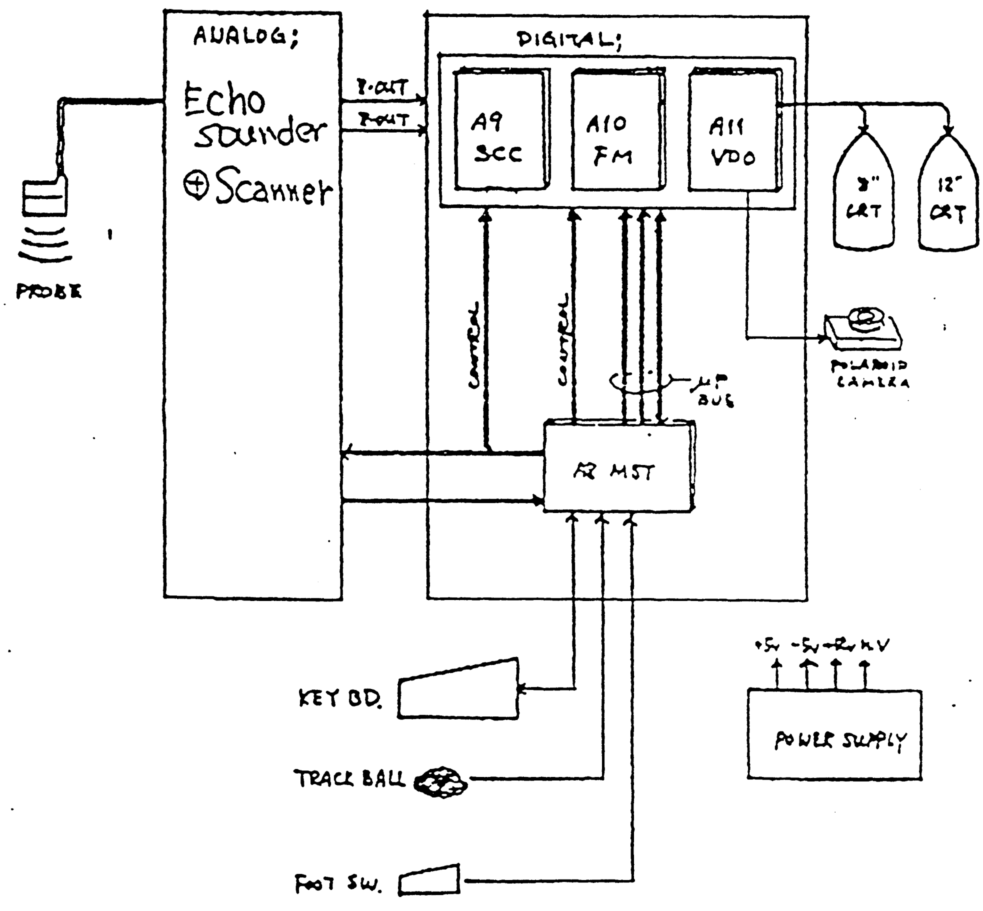
IREQ0 (highest)	4 Hz interval Timer
IREQ1	Footswitch
IREQ2	Keyboard
IREQ3	Probe open
IREQ4	Probe close
IREQ5	unused
IREQ6	Trackball
IREQ7 (lowest)	Freeze request

Figure 5-39 shows interrupt control, ROM, RAM, and address decoding for the system controller. Figures 5-40 and 5-41 introduce memory and I/O mapping.

5-6-2 Internal I/O Interfaces and Controls

The interrupt controller chip (U15C1) manages all the interrupts to the system controller. A peripheral interface adapter (PIA), U17K1, provides an interface between the keyboard subsystem and the system controller.

The trackball sensing circuit at the keyboard provides four signals (direction information) to another PIA (U21B1) through U20C1. The appearance of any directional signal causes an interruption at U15C1.



RT2600 BLOCK DIAGRAM

Figure 5-37

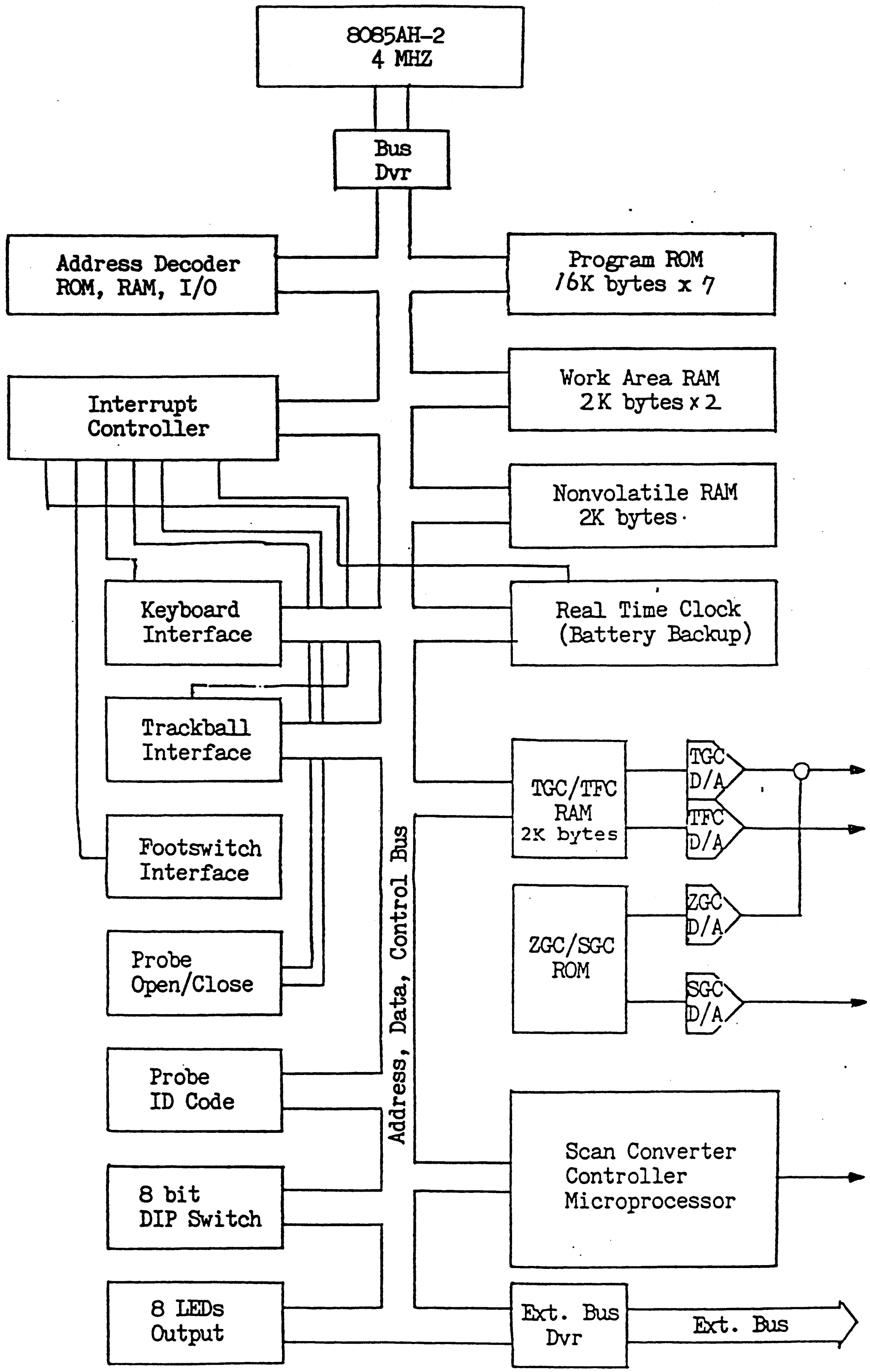
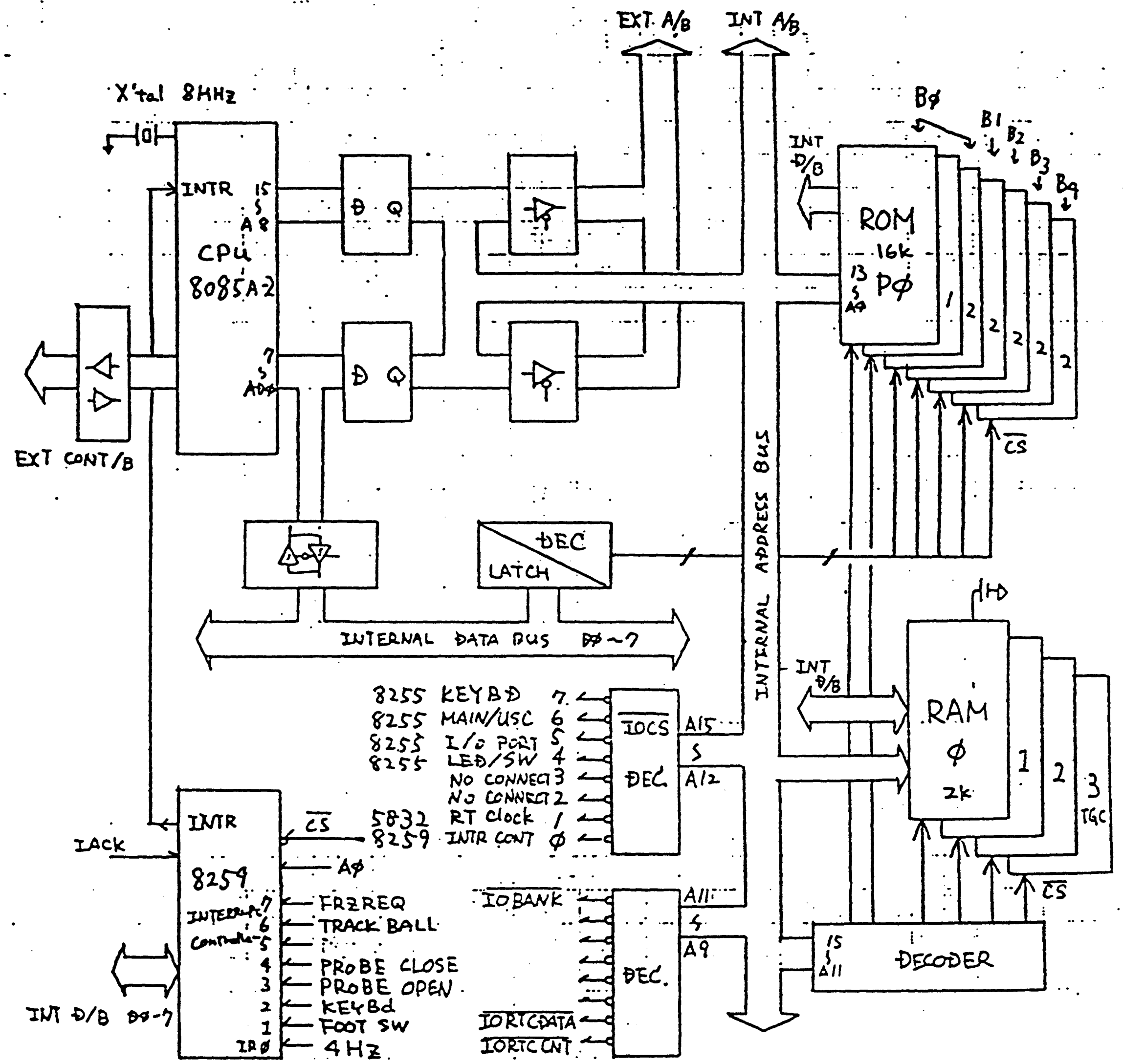
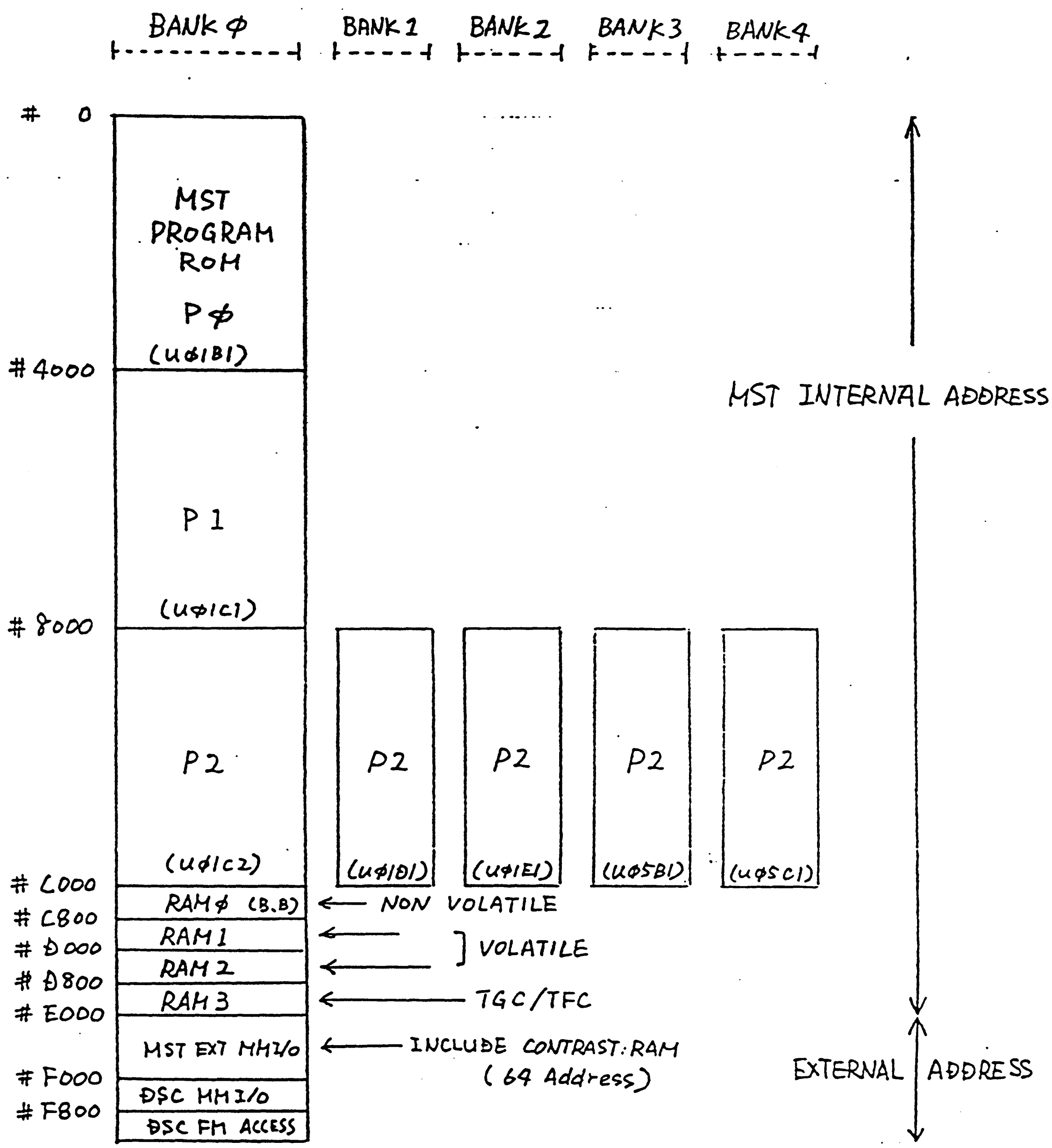

8085AH-2
4 MHZ
Bus
Dvr
Address Decoder
ROM, RAM, I/O
Program ROM
16K bytes x 7
Interrupt
Controller
Work Area RAM
2K bytes x 2
Nonvolatile RAM
2K bytes
Keyboard
Interface
Real Time Clock
(Battery Backup)
Trackball
Interface
TGC/TFC
RAM
2K bytes
TGC
D/A
TFC
D/A
Footswitch
Interface
Address, Data, Control Bus
ZGC/SGC
ROM
ZGC
D/A
SGC
D/A
Probe
Open/Close
Probe
ID Code
Scan Converter
Controller
Microprocessor
8 bit
DIP Switch
8 LEDs
Output
Ext. Bus
Dvr
Ext. Bus

Figure 5-38



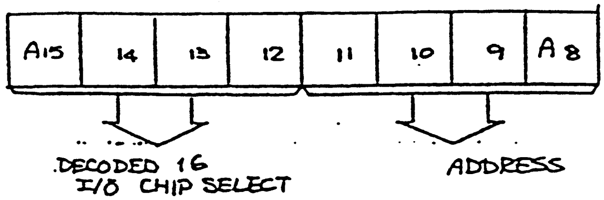
CPU & INTERRUPT CONTROLLER

Figure. 5-39



MEMORY MAP

Figure 5-40



A15	14	13	A12	I/O ADDRESS	USED ADDRESS	DESCRIPTION
0	0	0	0	#ΦΦ ~ ΦF	A_8	8259 INTERRUPT CONTROLLER
0	0	0	1	#1Φ ~ 1F	$A_9 A_8$	5832 REAL TIME CLOCK
0	0	1	0	#2Φ ~ 2F		
0	0	1	1	#3Φ ~ 3F		
0	1	0	0	#4Φ ~ 4F	$A_9 A_8$	8255 PORT
0	1	0	1	#5Φ ~ 5F	$A_9 A_8$	8255 PORT
0	1	1	0	#6Φ ~ 6F	$A_9 A_8$	8255 PORT
0	1	1	1	#7Φ ~ 7F	$A_9 A_8$	8255 PORT
1	0	0	0	#8Φ ~ 8F	$A_0 A_9 A_8$	7220 GDC & GDC PORT
1	0	0	1	#9Φ ~ 9F	$A_{10} A_9 A_8$	8291 GPIB TALKER/LISTNER
1	0	1	0	#AΦ ~ AF	$A_{11} A_{10} A_9 A_8$	9517 DMAC
1	0	1	1	#BΦ ~ BF		
1	1	0	0	#CΦ ~ CF		
1	1	0	1	#DΦ ~ DF		
1	1	1	0	#EΦ ~ EF		
1	1	1	1	#FΦ ~ FF		

I/O MAPPING

Fig 5-4)

Another PIA, U15B1, senses the digit switch (U14B1) to establish system configuration. U15B1 drives the on-board LED's (D5A2 through D18A3). One of these LED's is a watchdog to indicate software operation; the others are used to indicate system status.

TGC and TFC are digitally generated and converted to analog signals before being sent to the A7 LOG amplifier. Because these waveforms are required at a high data rate (every ultrasound pulse), a special RAM buffer is used (TGFC-RAM).

Figure 5-42 is a block diagram for this portion of the MST. Figure 5-43 shows the timing sequence for the data transfer.

A 2K x 8 bit RAM (U10H1) contains both TGC and TFC data. This data is read out for every transmitted pulse. Each waveform requires 128 data points in an entire echo reception sequence. The data is multiplexed as it leaves the RAM. It is demultiplexed before reaching the D/A converters. U11J1 converts the TGC signal; U13J1 converts the TFC signal.

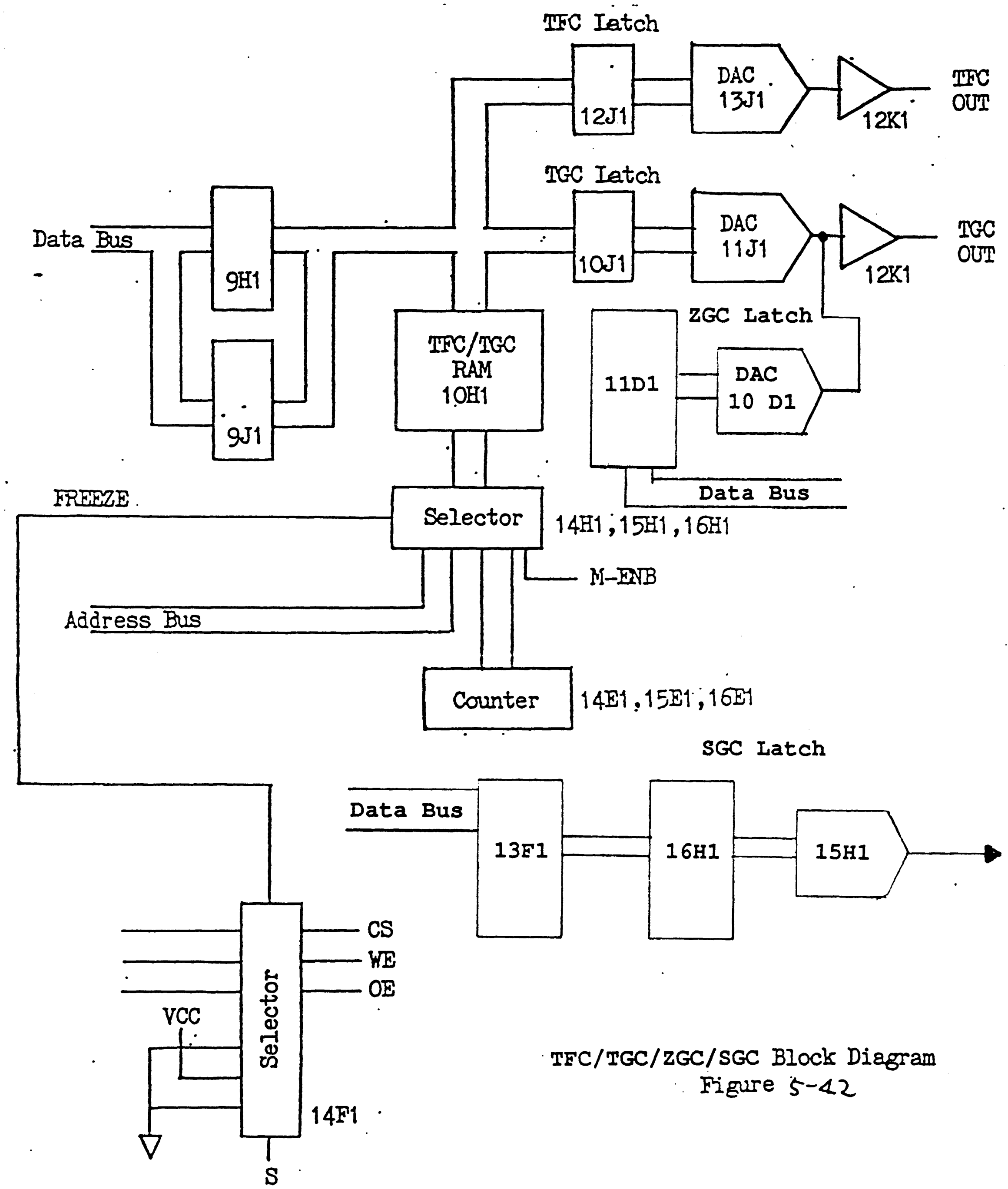
U12E1, U13E1, and U14E1 are range counters used for synchronous read out of the data in the TGFC-RAM. U09F1, U10F1, U11F1, and AU12F1 are address demultiplexers for read/write switching. Write access is available only when in "FREEZE" state. M-mode uses an independent set of TGC and TFC data.

The system controller establishes the required TGC and TFC control curves by a calculation involving system gain, far gain, near gain, and probe type. The calculation is carried out upon every interruption to alter one of these parameters.

The output levels are defined so that a system gain of 0 to 100 dB is covered throughout a TGC range of -1 to +1 V. The dynamic filter's center frequency range of 2 to 10 MHz is covered in a TFC range of -1 to +1 V.

Read access to the TGFC-RAM can be done during a freeze state to the monitor or the RAM. Typical TGC and TFC waveforms are shown in Figure 5-44.

The shutter control signal for the multiformat camera is provided from a contact on relay K15J1. The relay is driven by PIA U21B1 through a power driver (U14J1).



TFC/TGC/ZGC/SGC Block Diagram
Figure 5-42

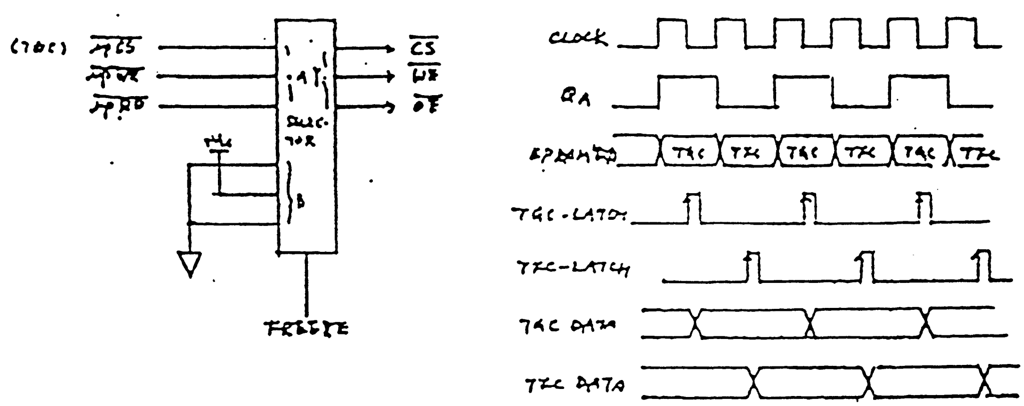


Figure 5-43

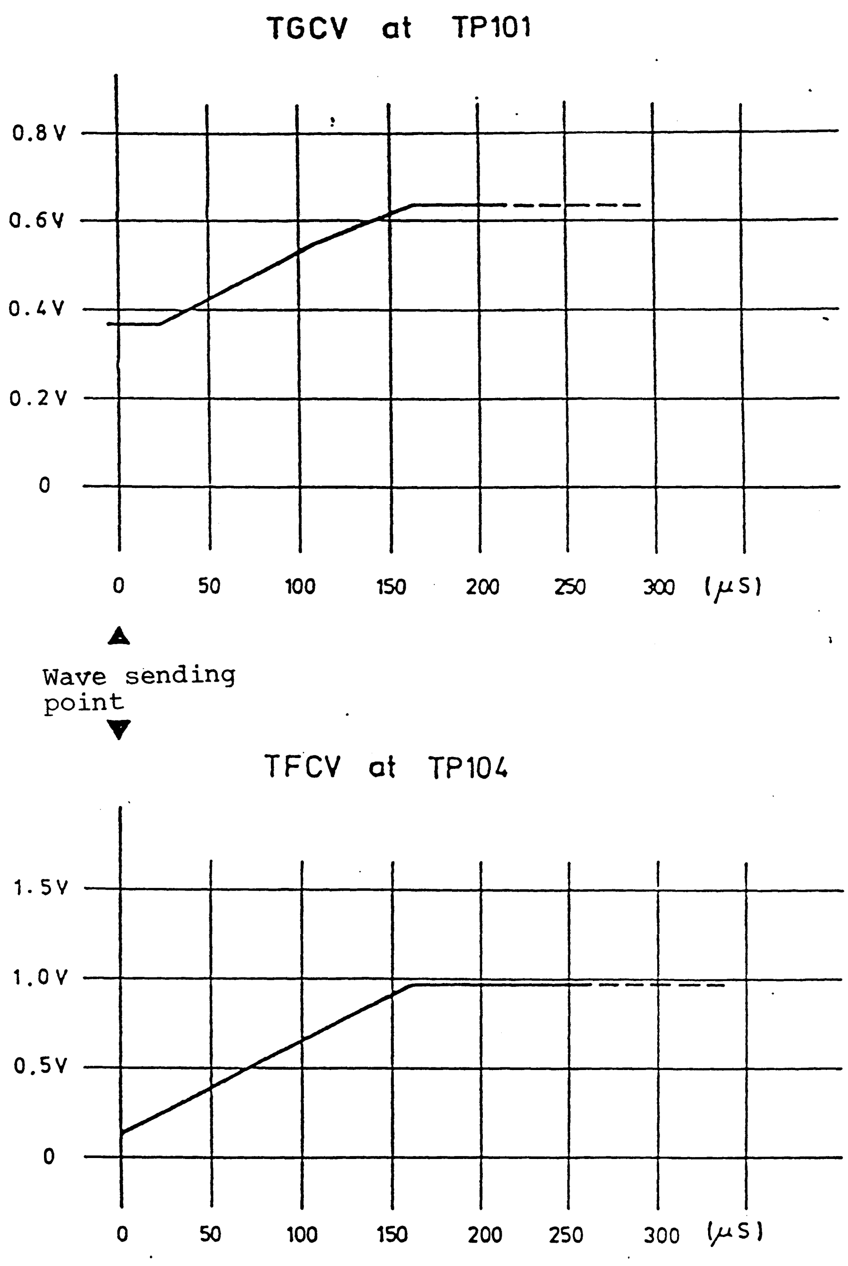
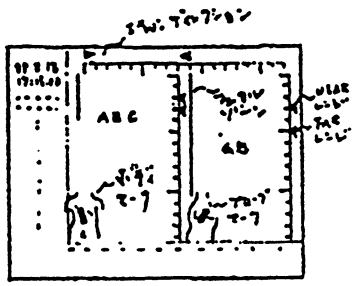
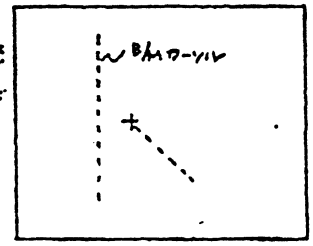

TGCV at TP101
0.8V
0.6V
0.4V
0.2V
0
0 50 100 150 200 250 300 (μS)
Wave sending point
TFCV at TP104
1.5V
1.0V
0.5V
0
0 50 100 150 200 250 300 (μS)

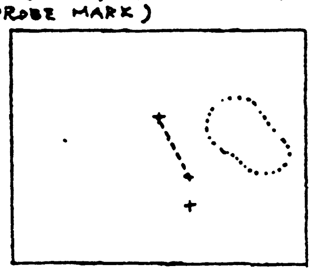
Fig.5-44



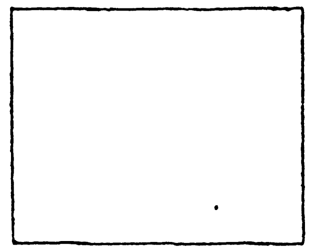
CHARACTER & SCALE PLANE
(CHARACTER, SCALE, NEAR/FAR GAIN FOCUS ZONE, SCAN DIRECTION, B/M CURSOR PROBE MARK)

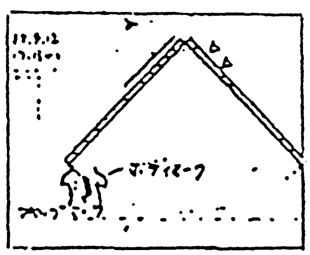


CURSOR PLANE



FIXED CURSOR PLANE





CHARACTER & SCALE PLANE
INCASE OF SECTOR SCAN

Figure 5-45

Switching for the camera monitor video is derived from the vertical sync pulse to expose a set number of TV frames. This is controlled by the system controller; however, the address decoder is on the Video board. Counter A11U12J is set (by the system controller) for a certain number of TV frames. This information comes from the system microprocessor data bus through latch A11U04J. Polaroid shutter control is performed in a similar manner. A power driver (A11U09J1)enables the shutter solenoid driver circuit located in the camera assembly.

Probe type information, along with probe connection sensing, is performed by PIA U21B1 through buffer U20C1 which receives the digital ID code wired into the probe connector. Every connection or disconnection causes an interrupt request that updates the information in the system controller.

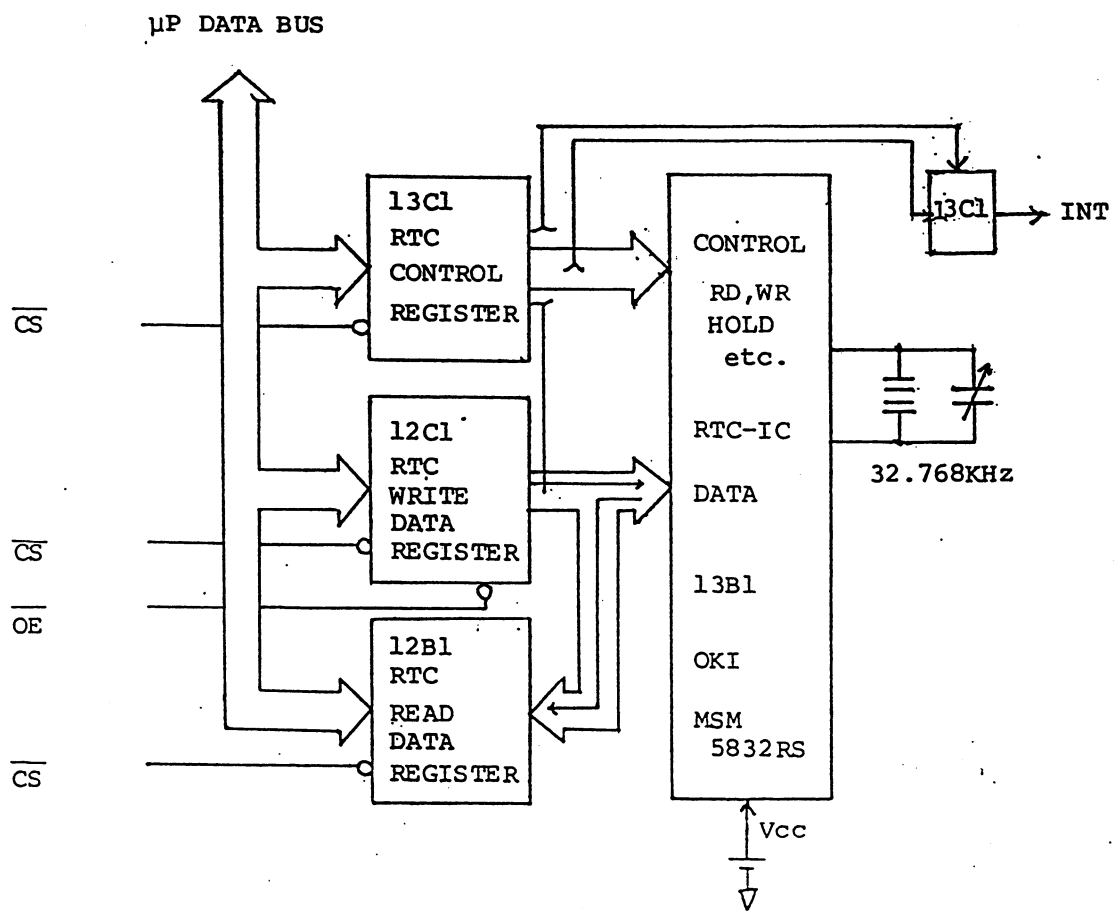
The interface to the graphics display controller is of a higher level than other I/O interfaces. This reduces the tasks the system controller performs in order to place characters on the screen. GDC controlled images are shown in Figure 5-54. As explained previously, the GDC controls three planes (or six pages) of overlay Frame Memory. The GDC and Frame Memory chips are located on the A11 Video board.

5-6-3 Real Time Clock

The real time clock allows the monitor to continuously display and update year, month, day, hours, minutes, and seconds. This facility includes battery backup and preset capabilities. The real time clock chip (U13B1) uses a special quartz crystal oscillator at a frequency of 32.768 KHz. The oscillator maintains an accuracy of 50ppm (2 minutes/month). A bus interface (U12B1, U12C1, U13C1) with the system controller is used for readout and preset.

A 4 Hz (250 milliseconds) interval timer is obtained from the real time clock and a frequency divider (U14E1). The interval timer is required to determine shutter opening times for the cameras.

Figure 5-46 is a block diagram of the real time clock. The battery backup is the same as that used for the system controller RAM.



REAL TIME CLOCK BLOCK DIAGRAM

Figure 5-46

5-6-4 Scan Control Microprocessor System

The other microprocessor located on the MST is U18F1. It is dedicated to provide controls for the RT module. Figure 5-47 is a block diagram of the scan control microprocessor system. This microprocessor, upon command from the system controller, provides control signals for every transmission trigger (TRIG). The following is a list of signals defined by the scan control microprocessor:

a. Duration of TRIG
Derived from the Horizontal Drive (HD) signal. A programmable divider is used to calculate n x HD, where n can equal 2 to 7. However, n = 2, 3, 4, and 5 are all that are used. (See Figure 5-48). Retrace duration can also be controlled.

b. Freeze/Real Time Control
Provides immediate FREEZE command, or FREEZE at end of frame.

c. Scanning Scheme
Provides controls that determines whether scanning scheme is interlaced, even/odd, B/M-mode, reverse direction, and random scan.

d. Control for B/M-mode
This signal is also synchronous to TRIG. Provides scan line number (SNL) and M-mode enable (MENB) signal. Line rate for M-mode is either 4 or 8 milliseconds.

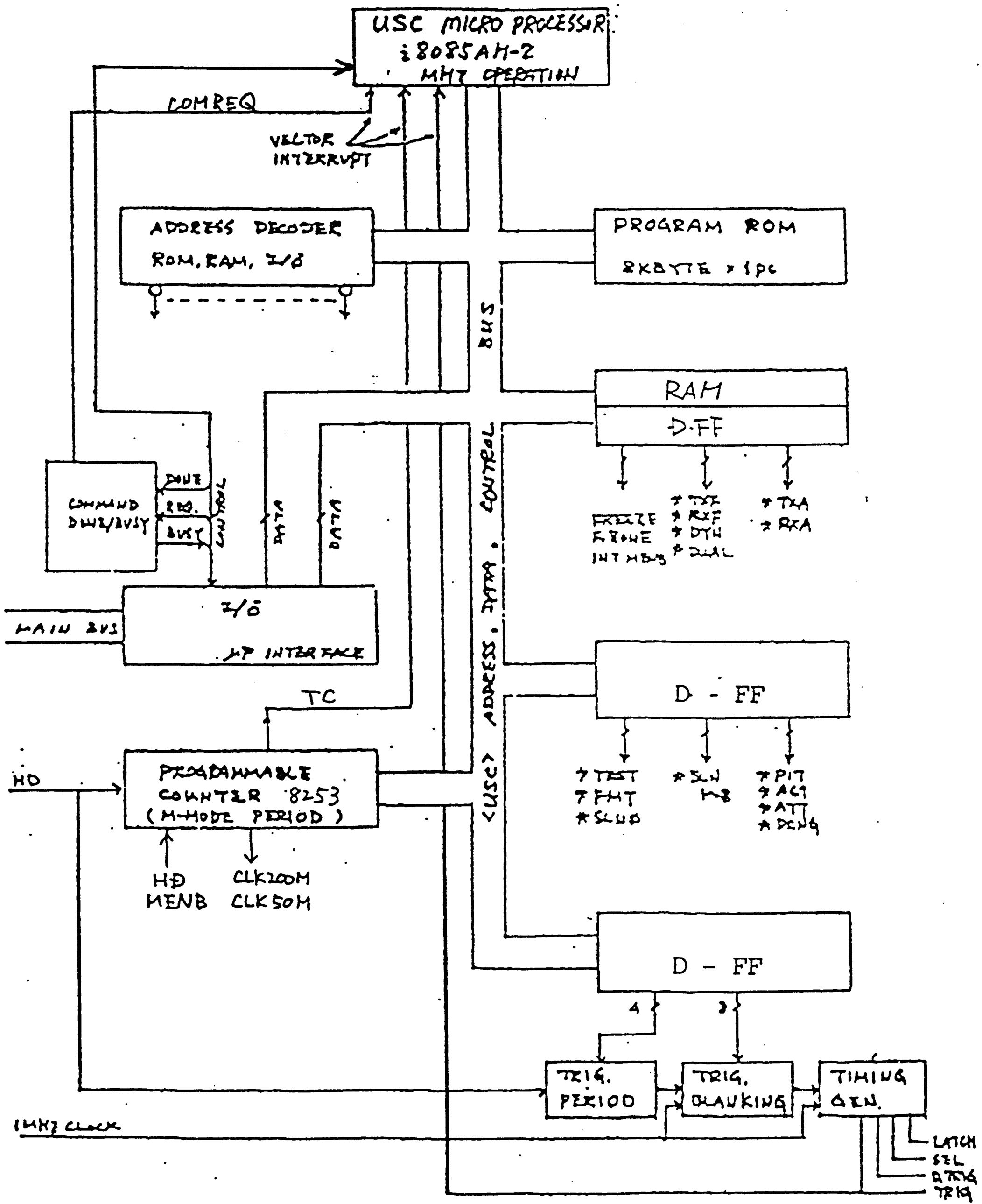
e. Scan Format Control (FMT)

Determines whether scan format will be linear, or sector, FMT is a three bit word as defines in the following table.

000	Linear
001	(Unused)
010	(Unused)
011	(Unused)
100	Sector
101	(Unused)
110	(Unused)
111	(Unused)

f. Scan Line Number (SLN)

SLN is defined and updated continuously during B-mode scanning. In B/M-mode, a particular SLN is repeatedly sampled from the B-mode video data.



USC MICRO PROCESSOR
i8085AH-2
MHz OPERATION
COMREQ
VECTOR INTERRUPT
ADDRESS DECODER
ROM, RAM, I/O
PROGRAM ROM
2KBYTE × 1pc
BUS
RAM
D-FF
COMMAND DONE/BUSY
DONE
REQ.
BUSY
CONTROL
DATA
DATA
FREEZE
F.ZONE
INT HBS
TXF
RXF
DYN
DUAL
TXA
RXA
MAIN BUS
I/O
μP INTERFACE
<USC> ADDRESS, DATA, CONTROL
D - FF
TC
HD
PROGRAMMABLE
COUNTER 8253
(M-MODE PERIOD)
TEST
FMT
SCLD
SCN
PIT
ACT
ATT
HD
MENB
CLK200M
CLK50M
D - FF
4
TRIG. PERIOD
TRIG. BLANKING
TIMING GEN.
1MHz CLOCK
LATCH
SEL
TRIG

Figure 5-47

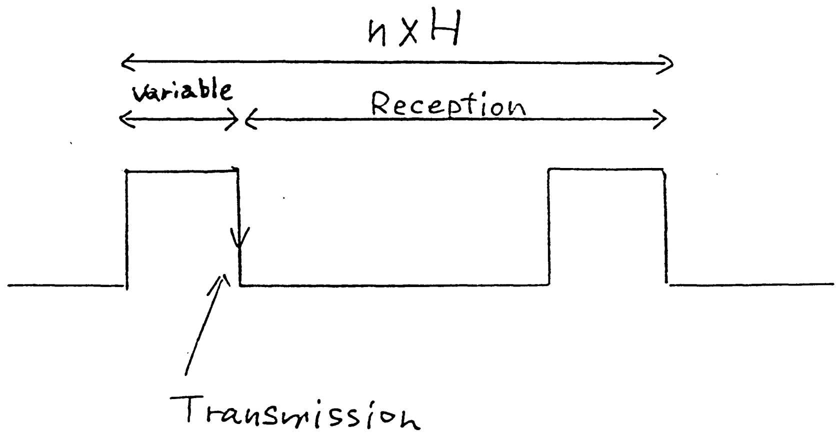


Figure 5-48

Figure 5-49 shows typical timing sequences for the control signals. Output signals are listed in the following table:

1.	TRIG	Transmission trigger.
2.	DTRIG	Delayed trigger.
3.	SLN	Scan Line Number (9 bits)
4.	DRANGE	Dynamic Range (3 bits)
5.	FMT	Scan Format.
6.	MENB	M-mode Enable.
7.	FRZ	Freeze.
8.	FZONE	Focal Zone (2 bits)
9.	PATTERN	Focusing Pattern (5 bits)
10.	LSRENB	Line Scan Recorder Enable
11.	PSEL	Probe Select
12.	PWRDWN	High Voltage Control for Probe
13.	ATT	Gain Control for T/R Circuit

As mentioned earlier, TRIG is derived form Horizontal Drive. U24D1 counts down Horizontal Drive; U28B1 and U29B1 determine retrace duration. U28C1 and U29C1 derive other signals synchronous to TRIG.

The scan control microprocessor contains 8KB of program ROM and 256B of work area RAM. It is connected to four I/O ports. One, as explained previously, is for communication with the system controller; two ports are for control bits (CB) for the R-T module: and one is to manage TRIG duration.

Control bits for the R-T controller are multiplexed at data selector bank U23K1 through U27K1. This is to satisfy the data rate requirement.

On-board LED's indicate status of post outputs.

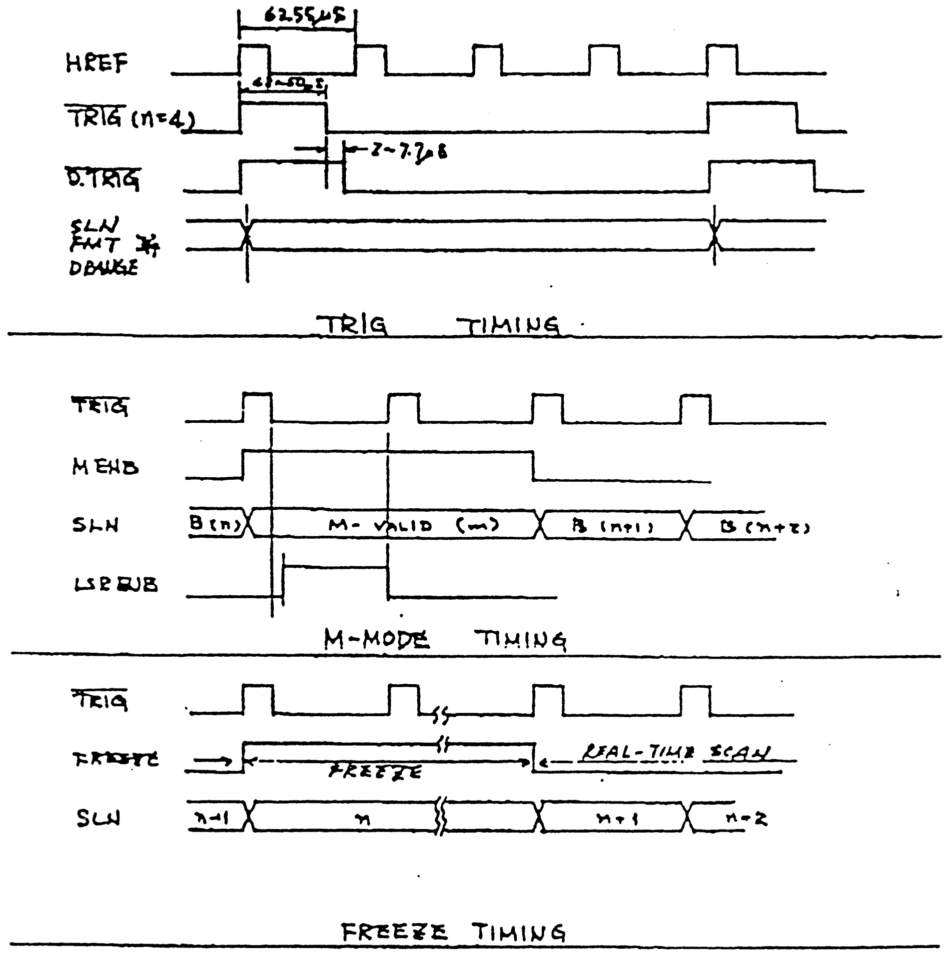

62.55μS
HREF
TRIG (n=4)
D.TRIG
SLN
TRIG TIMING
TRIG
MENB
SLN
B(n)
M-VALID (m)
B (n+1)
B (n+2)
M-MODE TIMING
TRIG
REAL-TIME SCAN
FREEZE
SLN
n-1
n
n+1
n+2
FREEZE TIMING

Figure 5-49

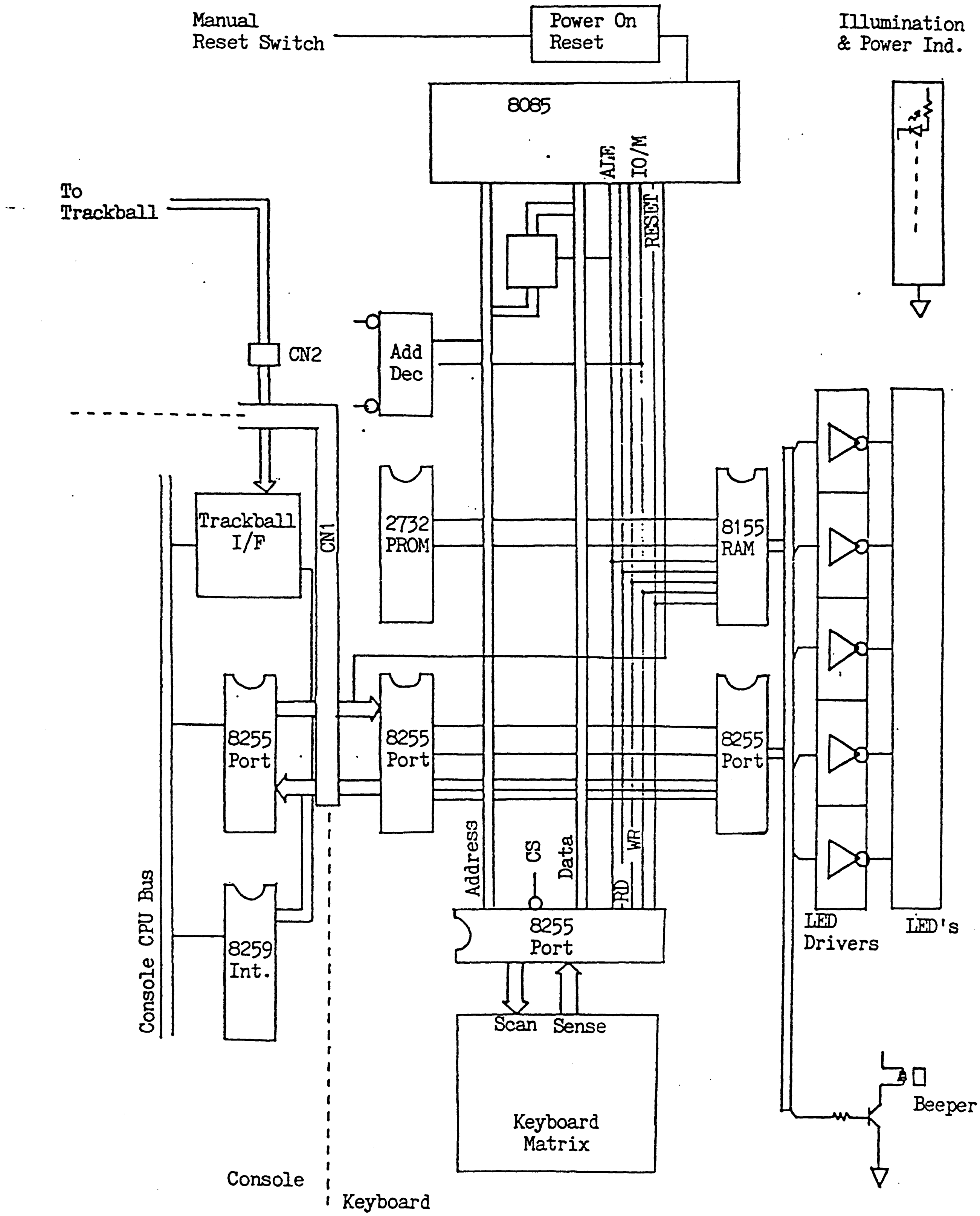

Manual
Reset Switch
Power On
Reset
Illumination
& Power Ind.
8085
ALE
IO/M
RESET
To
Trackball
CN2
Add
Dec
Trackball
I/F
CN1
2732
PROM
8155
RAM
8255
Port
8255
Port
8255
Port
8259
Int.
Console CPU Bus
Address
CS
Data
RD
WR
8255
Port
Scan
Sense
Keyboard
Matrix
LED
Drivers
LED's
Beeper
Console
Keyboard

Figure 5-50

5-6-5 Checking the MST

To facilitate checking the MST, signature analysis can be used. On board switch SW05A1 is normally in the "NORM" position; when it is placed in the "SATEST" position, both microprocessors are continuously supplied with NOP instructions. This causes a continuous count-up of the addressed.

U02J1 and U19E1 provide the NOP instruction for this test.

System status information is also available through LED's coupled to PIA U15B1. For details on interpreting the LED's, refer to 8-7 Master controller in Chapter 8 "Diagonostics".

5-7 Keyboard

The keyboard subsystem performs two major tasks: to scan and monitor key switches and to generate an interrupt to the system controller when a key is pressed; and to provide LED or alarm information on command from the system controller.

The perform these tasks, the keyboard subsystem uses its own microprocessor. Through software, the keyboard also performs other tasks:

1. An anti-chattering function.
2. A repeat control.
3. Double-keying of position keys.
4. Rollover control (recognize and foward new key selections).
5. Hardware initialization and LED/beeper test on every power-up.

5-7-1 Keyboard Microprocessor Subsystem

Figure 5-50 is a block diagram of the keyboard microprocessor subsystem. U9 is an 8085A microprocessor. External memory is provided by U16 which provides 4KB x 8 ROM and 256B RAM. Eighty-eight I/O port lines serve three PIA chips (U10, 11, 12) and one I/O-RAM-Timer chip U18.

An interrupt request (IRQ) from the console microprocessor is acknowledged by a flag flip-flop U1. An "output busy" signal is given until the keyboard microprocessor completes its command processing.

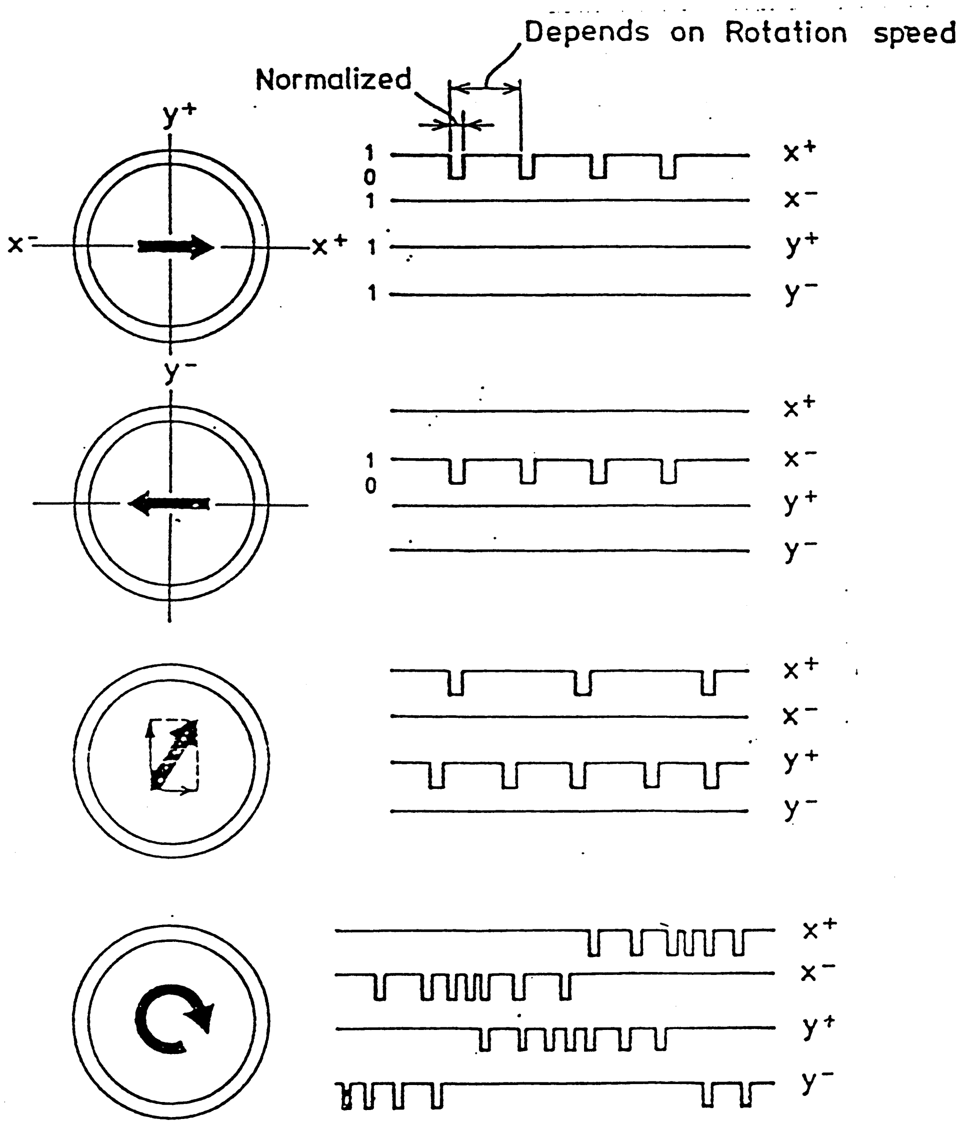

Depends on Rotation speed
Normalized
y+
x-
x+
y-
1
0
1
1
1
x+
x-
y+
y-
1
0
x+
x-
y+
y-
x+
x-
y+
y-
x+
x-
y+
y-

Fig.5-51

To scan the key switches, the microprocessor clock is counted down by the I/O-RAM-Timer U18 and discrete counter U2. This programmable pulse duration causes repeated interrupts to the keyboards microprocessor which responds with commands to scan and sense the row and column of the keyboard switch matrix.

For these interrupts, microprocessor restart pins RST6.5 and RST7.5 are used for direct access. Figure 5-51 shows the timing for the IRQs.

5-7-2 Key Switches and Trackball

The key switches are a type that aplies a conductive rubber contact to a circuit board conductor whenever it is pressed. The switch matrix is printed on the back plane to retain the pattern.

Scanning of the matrix occurs every 21.3 msec.

When a row is scanned it is pulled low. The low level appears only at the column where the corresponding switch is on. To prevent undesirable coupling, diodes are used to prevent interaction from residual connections which are kept on when a new entry is sensed.

The 8 x 16 matrix is well suited to the PIA's available 24 port terminals. Eight of the PIA's terminals are assigned as output terminals to drive the row; 16 are assigned as input terminals to sense each column. The 8 x 16 matrix allows 128 keys to be used; however, the present design uses only 80% of this capacity.

The trackball interface signals are buffered by U22. The interface signals are four binary signals form the trackball sensing circuit in the tarckball assembly.

The trackball interface signals are normalized pulse trains representing four directions. Rotary encoders in the trackball assembly are coupled to the ball through friction coupled disks. The output pulse trains can be seen in Figure 5-51.

5-7-3 LED Indicators and Alarms

As discussed previously, the LED, are driven by the PIAs through power buffers U14, 5, 6 and U23 and 24. The static drive eliminates any electrical noise.

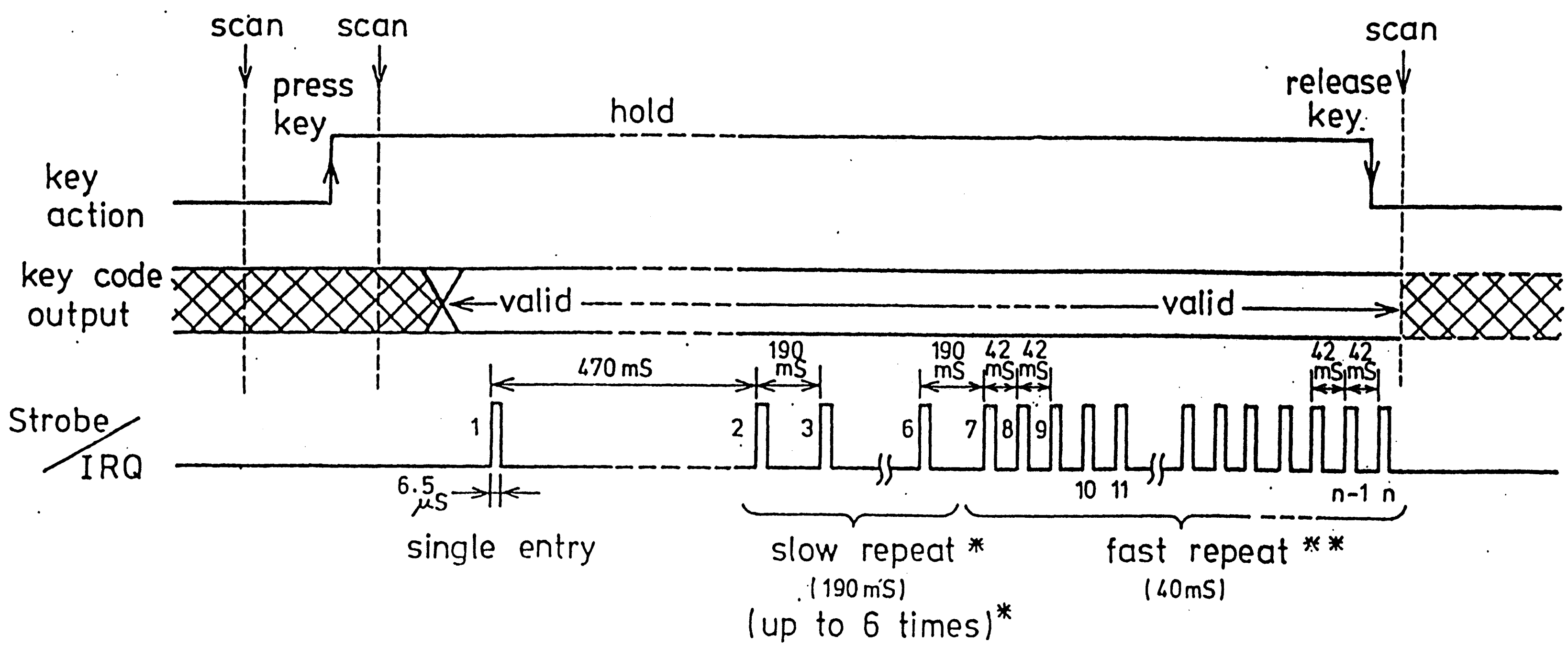
In addition to lighting when a key is selected, a series of LEDs are continuously lit for easier reading of the keyboard.

The beeper is driven in an identical manner as the LEDs. The occurrence and length of the beeper alarm are determined by software.

5-7-4 Key Code Processing and Host Interface

When a pressed key is sensed and the key code is ready to be input to console microprocessor, the keyboard microprocessor sends a strobe signal to the system controller, this strobe is understood as IREQ2 in the system controller interrupt controller chip.

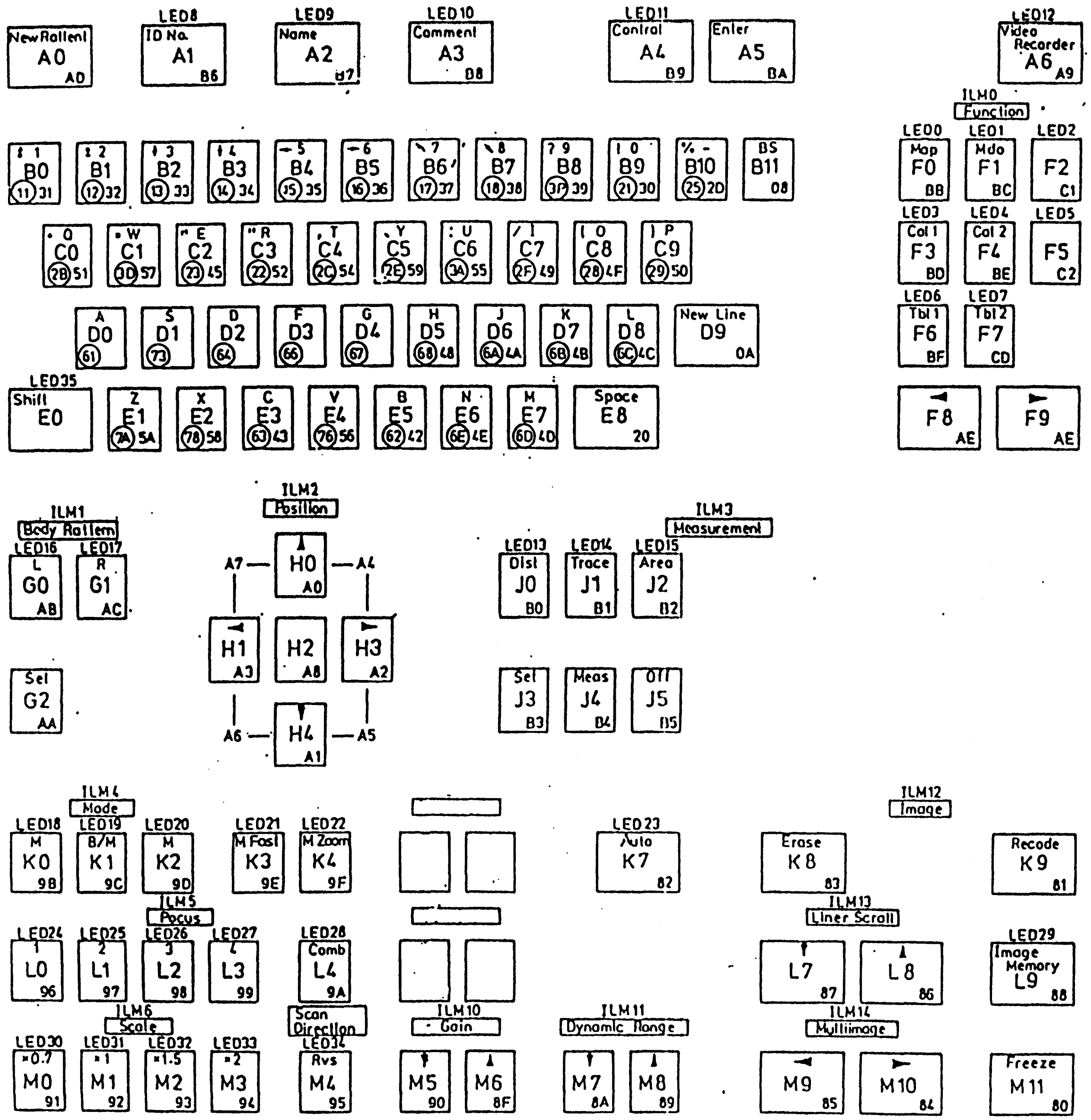
For certain keys, a repeat entry is available, the repeat entry allows the key code to be sent repetitively while the key is pressed. There are two types of repeat operation. Figure 5-52 intruduces the repeat scheme; Figure 5-53 shows which keys have the repeat function. Figure 5-54 lists the key symbols are electrical addresses as well as the key code transmitted to the main microprocessor.



* in selected keys "slow repeat" begins with 470mS late from initial strobe pulse.

** in further selected keys "fast repeat" begins after 6 times repetition of slow repeat entry.

Fig.5-52



*Alphanumeric Keys are not repeatable when shifted.

▭ Slow repeatable

▭ Fast repeatable

▭ No repeat function

Fig. 5-53

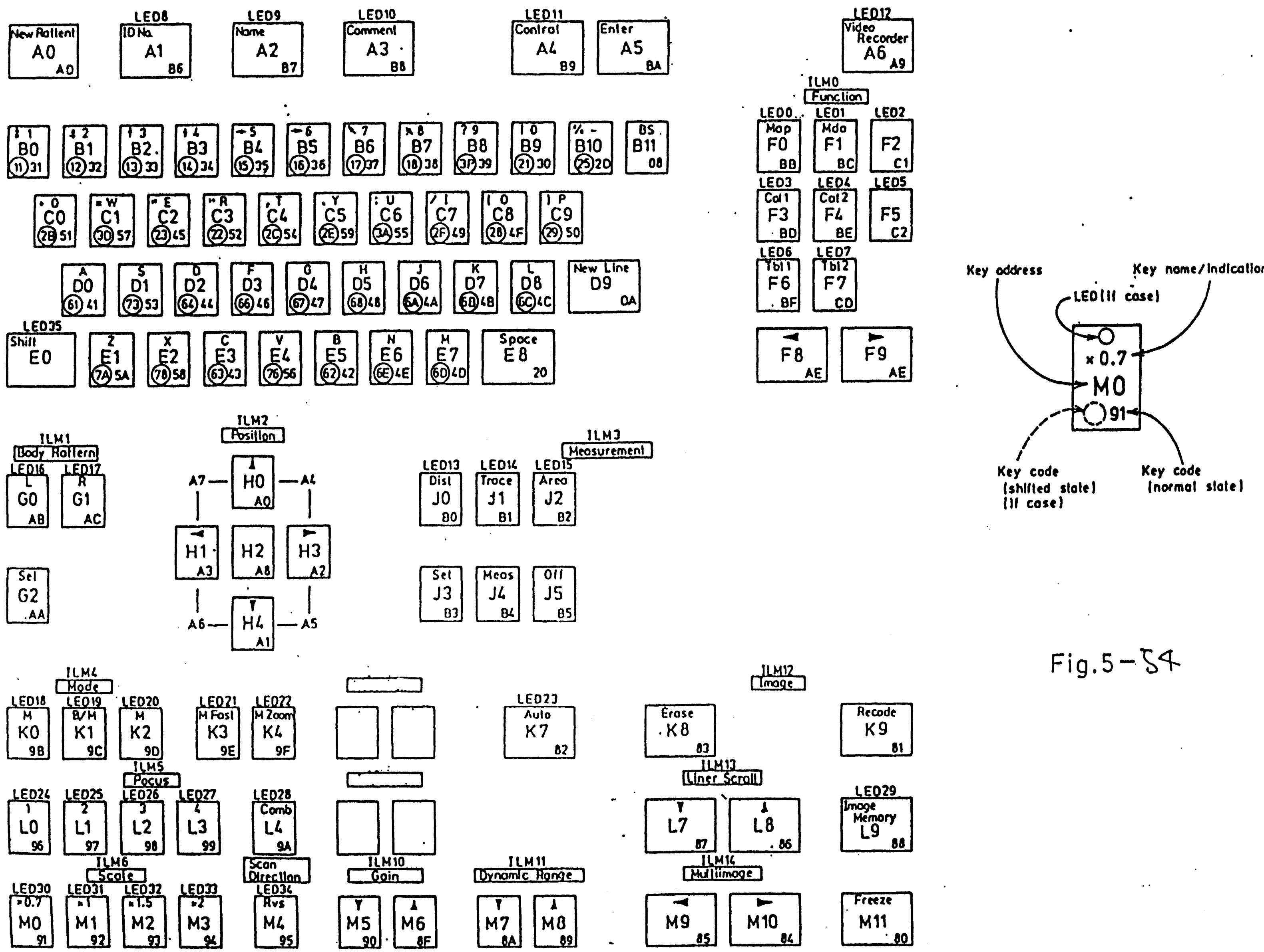

Key address
Key name/indication
LED(if case)
x 0.7
M0
91
Key code (shifted state) (if case)
Key code (normal state)

Fig.5-54

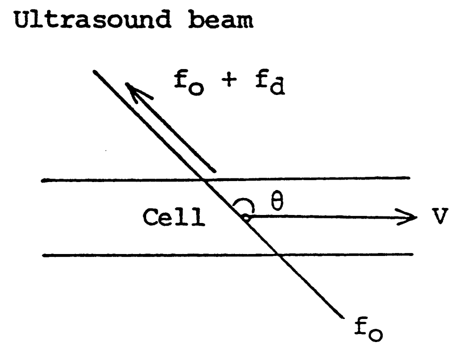
5-8 Doppler Unit

5-8-1 Abstract

The recent advent of the ultrasonic Pulse Doppler Method, has made noninvastive visualization of intravascular flow a reality and provided us with a useful means for diagnosis and assessment of various disease.

The ultrasound beam emitted into the blood flow is scattered from the surfaces of the moving blood cells. The frequencies of scattered wave alter, and these frequency shifts are proportional to the velocities of blood cells.

By picking up these scattered waves and detecting the Doppler frequency shifts (f_d), the velocity of blood flow (V) can be obtained from calculations involving the transmitting frequency (f_0), the speed of ultrasound through living tissues (c), and the angle of the Doppler ultrasound beam against flow direction(θ), receiving frequency (f_r).



$$f_r = \frac{1 + \frac{V\cos\theta}{c}}{1 - \frac{V\cos\theta}{c}} \quad f_0$$

$$f_d = f_r - f_0 = \frac{\frac{1}{c} \cdot 2V\cos\theta}{1 - \frac{V\cos\theta}{c}} \quad f_0$$

$$\doteqdot \frac{2V}{C} \quad f_0 \quad \cos\theta$$

and,

$$V = \frac{cfd}{2f_0 \cos\theta}$$

But with the continuous method, the velocities of blood cells through which the ultrasound beam passes are all detected, thus the blood flow velocity in a particular site cannot be obtained.

Since intravascular flow velocity is highly dependent upon sample site, so its measurement requires depth resolution. This can be obtained by transmitting the ultrasound in the pulse mode and picking up the reflected waves through a time gate. This is the Pulse Doppler Method.

5-8-2 Pulse Doppler Method

For obtaining time resolution, the Pulse Doppler Method is used. This is to say that obtained Doppler shift detected by PD is useful information. This section describes the Pulse Doppler Method.

In the body, when there is a moving element, the receiving spectrum will change.

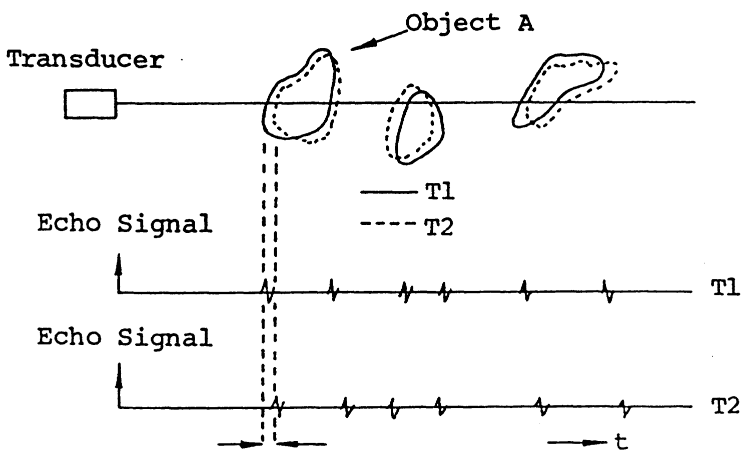
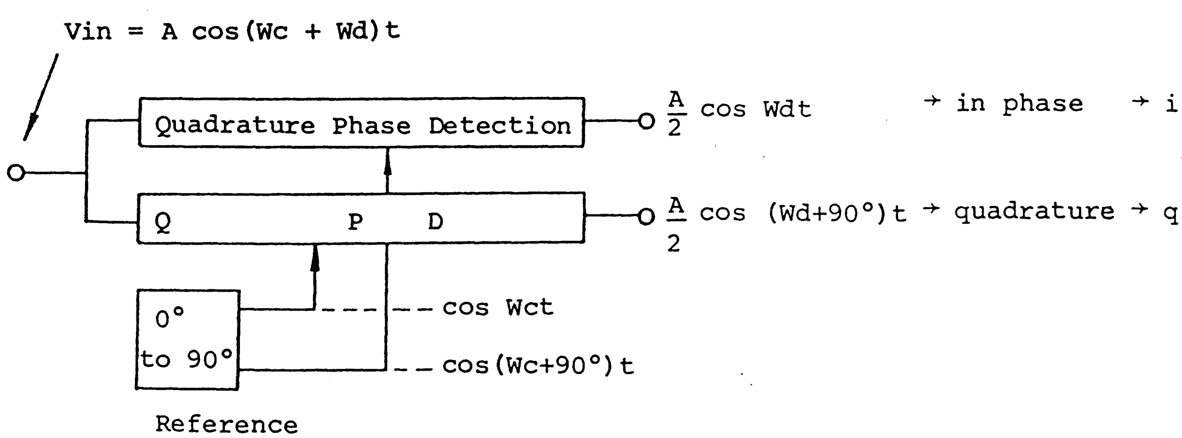


Figure 5-55

The Receiving signal has many Doppler side bands in its spectrum. So we use one of the Doppler side bands for a referance frequency.

NOTE: The repeat pulse signal has many side bands in its spectrum. So transmitting and receiving signals have many side bands in PD operation. But in CWD, there is just one.



Obtained i and q signals are gated and sampled through various filters and then go to the A12 FFT.

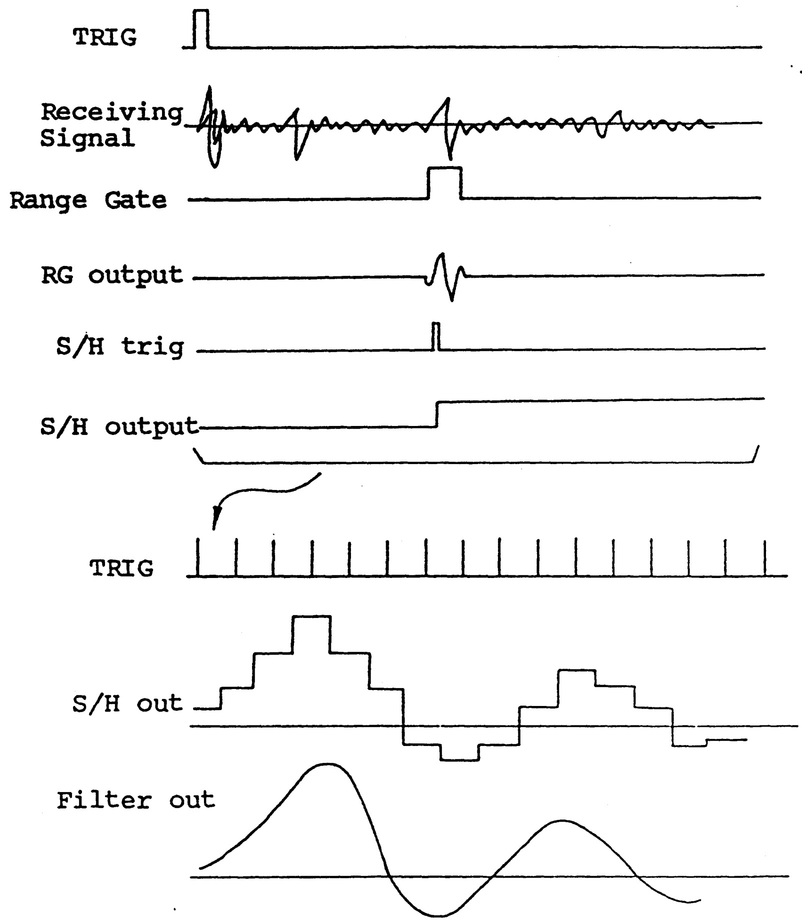


Figure 5-56

The filters are used for reduction or to cut the component of DC (echo signal of slowly moving object) and S/H distortion.

5-8-3 Doppler Unit Specification

The Doppler Unit for RT3600 has Pulse Doppler and continuous Wave Doppler .

The Doppler transducers are Sector probes **and a CW probe**. The obtained Doppler shifts are transformed by FFT and display the spectrum, mode.

Doppler Method	PD, CWD
Display Mode	B/D, D/B, B/M/D, M/D, D
Carrier Frequency	**2.5 MHZ, 3.5 MHZ, 5MHZ, 7MHZ**
PRF (PD)	1.5, 2, 2.5, 4KHz (with real time B Image) 3, 4, 5, 8KHz (B-Freeze)
Sampling Frequency (CWD)	6, 12, 24, 48KHz
Frequency Analysis Method	FFT
Wall Filter	100, 200, 300, 400, 700, 1,200 Hz
Display Function	Power Spectrum, Amplitude spectrum, Velocity Spectrum, Mode, Histogram, Spectrum width

5-8-4 Doppler Unit and RT3600 Block Diagram

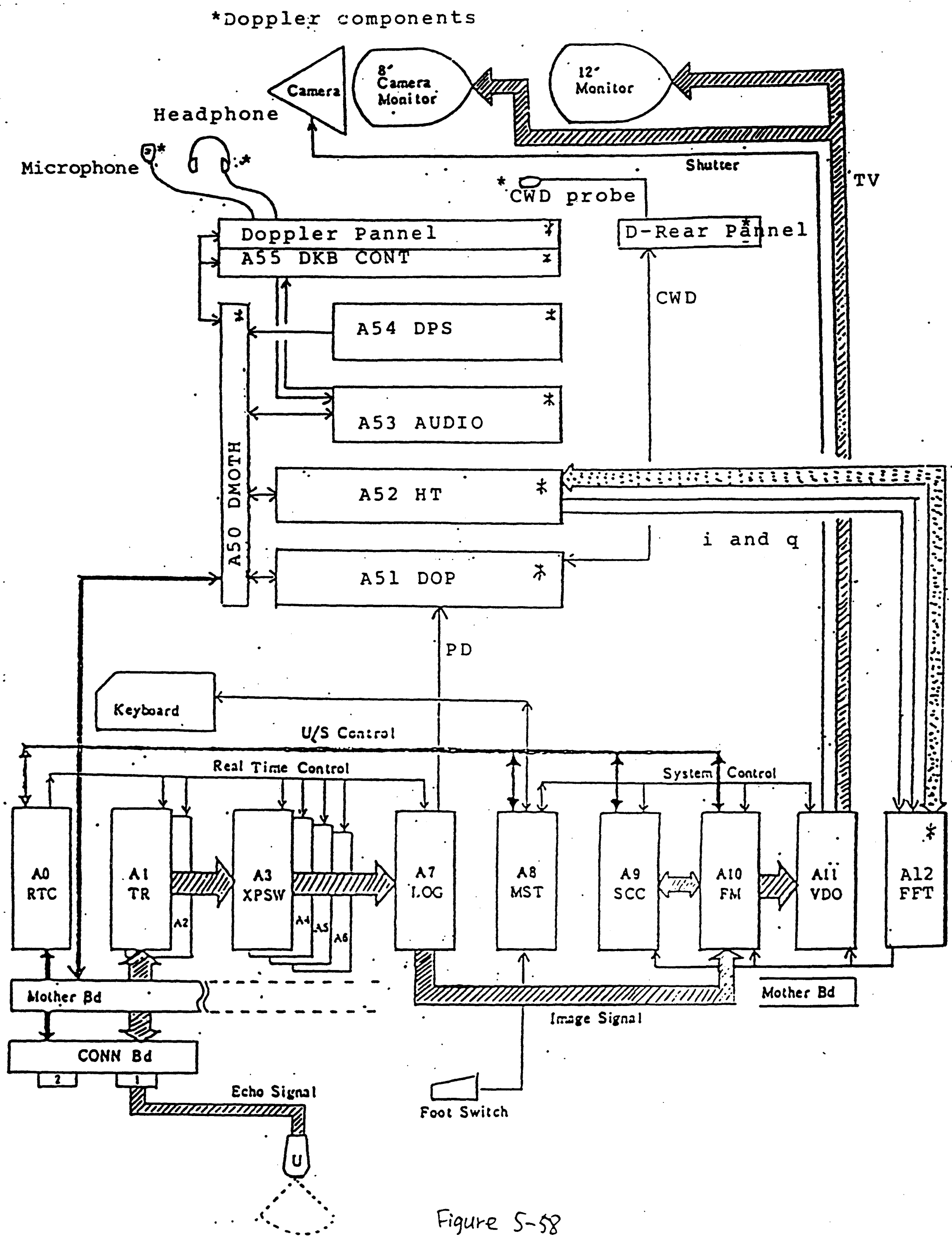
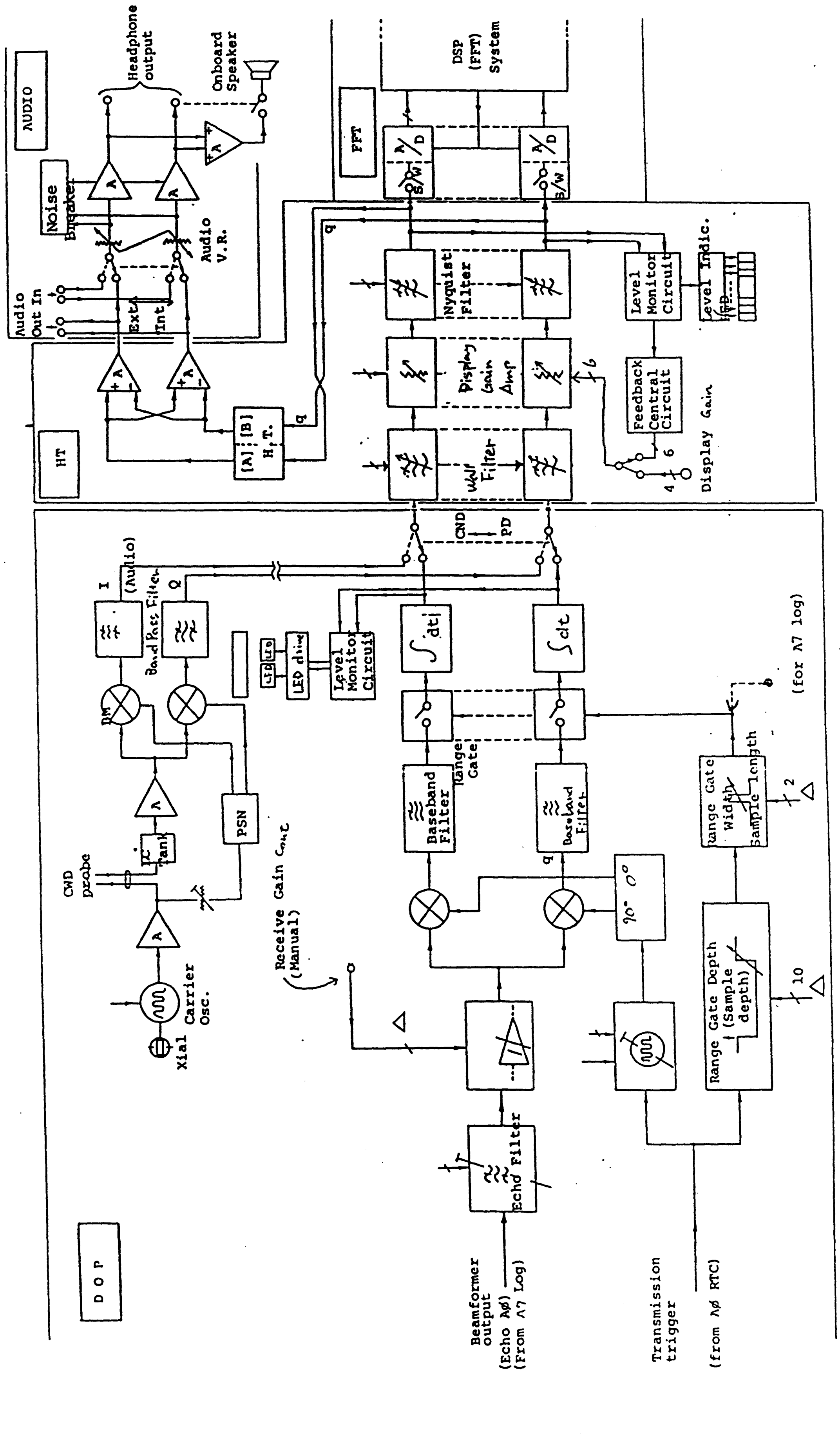


Figure 5-58



AUDIO
Headphone output
Onboard Speaker
Noise Speaker
Audio V.R.
Audio Out In
Ext
Int
FFT
DSP (FFT) System
A/D
S/W
Nyquist Filter
Level Monitor Circuit
Level Indic.
Display Gain Amp
Wall Filter
Feedback Central Circuit
Display Gain
HT
[A] [B] H.T.
CND
PD
DOP
I
Q
(Audio)
Band Pass Filter
LED drive
Level Monitor Circuit
BM
PSN
CWD probe
Tank
Xial
Carrier Osc.
Receive Gain Cont (Manual)
Range Gate
Baseband Filter
90° 0°
Range Gate Width Sample length
Range Gate Depth (Sample depth)
(for Λ7 log)
Echo Filter
Beamformer output (Echo AØ) (From Λ7 Log)
Transmission trigger (from ΛØ RTC)

Figure 5-59

5-8-5 DOP Assembley (A51)

The DOP Assembly receives CWD and PD echo signals. It then obtains baseband signals in phase and quadrature by demodulation. I(in phase) and Q(quadrature) signals are transfered to A52 HT Assembly. Refer to Figure 5-59.

(1) CWD Block

The Continuous Wave Doppler circuit block diagram is a simple one. The 3.5MHz Carrier comes from the Xtal Oscillator circuit. This Sine wave gets amplified, and sent to the Tx element of the CWD Probe. For phase detection the carrier is devided into real and imaginary parts by a phase shifter. The Rx echo signal is transfer to the Balanced Demodulator phase detector. I and Q signals are obtained. Refer to Figure 5-60, and refer to Schematics A51 DOP Page 1 of 7.

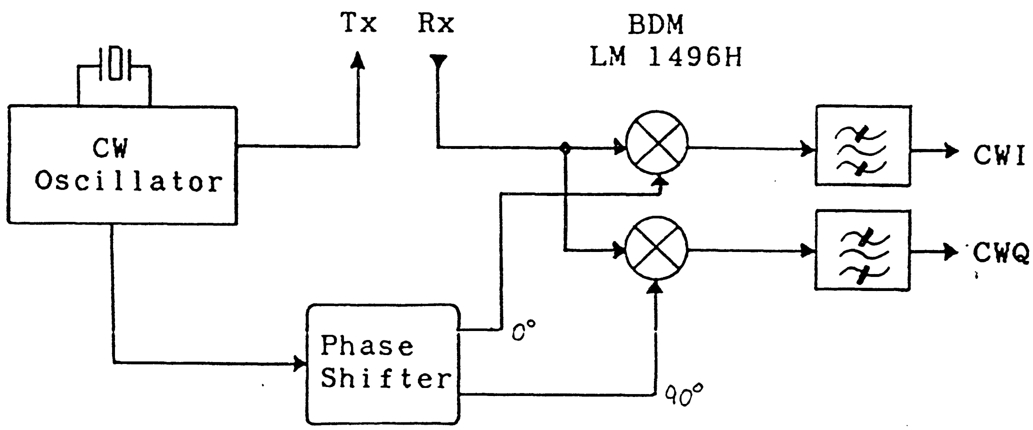


Figure 5-60

(2) PD Block

The PD block diagram is also in the A51 DOP Assembly. There are three differences from CWD. There is no Tx circuit, and there are Integrators and a S/H (Sample and Hold). But the main method is similar to CWD. Refer to Figure 5-61.

The Rx echo signal from A7 LOG amp is sent to a BDM (Balanced Demodulator) through an Echo Filter and Receive Gain Control Amplifier. The obtained I and Q signals go to the A51 HT through a Baseband Filter, Range Gate, Integrator and S/H.

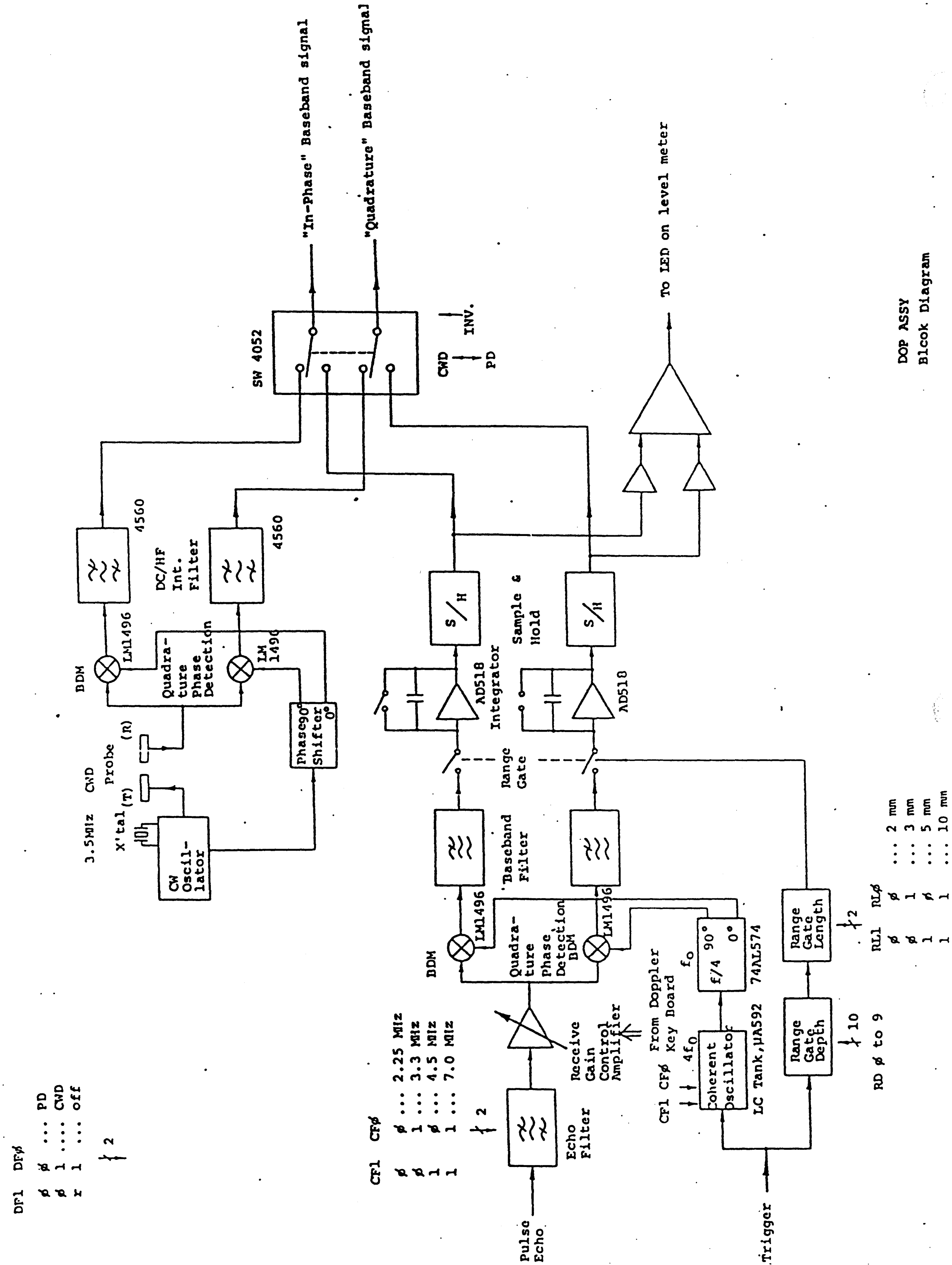
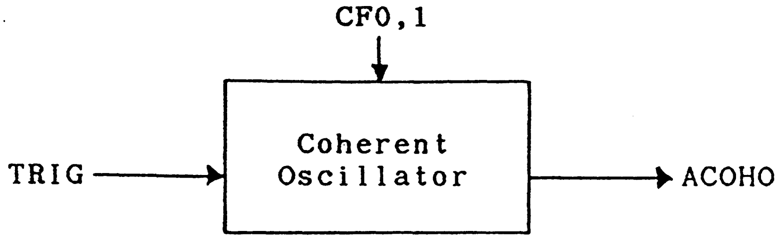

"In-Phase" Baseband signal
"Quadrature" Baseband signal
SW 4052
CWD
PD
INV.
To LED on level meter
DOP ASSY
Blcok Diagram
4560
4560
DC/HF
Int.
Filter
BDM
LM1496
LM 1496
Quadra-
ture
Phase
Detection
Phase
Shifter
90°
0°
3.5MHz
X'tal
CW
Oscil-
lator
CWD
Probe
(T)
(R)
S/H
S/H
Sample &
Hold
AD518
Integrator
AD518
Range
Gate
Baseband
Filter
LM1496
LM1496
BDM
Quadra-
ture
Phase
Detection
BDM
f/4
90°
0°
74ALS74
From Doppler
Key Board
f_o
$4f_o$
Receive
Gain
Control
Amplifier
Coherent
Oscillator
LC Tank, μA592
CF1 CFø
Range
Gate
Depth
Range
Gate
Length
RD ø to 9
10
2
RL1 RLø
ø ø ... 2 mm
ø 1 ... 3 mm
1 ø ... 5 mm
1 1 ... 10 mm
CF1 CFø
ø ø ... 2.25 MHz
ø 1 ... 3.3 MHz
1 ø ... 4.5 MHz
1 1 ... 7.0 MHz
2
Echo
Filter
Pulse
Echo
Trigger
DF1 DFø
ø ø ... PD
ø 1 ... CWD
x 1 ... off
2

Figure 5-59

(2-1) Coherent Oscillator

The Coherent Oscillator generates frequencies at 4 times that of the selected probes, (28MHz, 18MHz, 13.2MHz and 9MHz) for more precise signal sampling which needs to sync with a changing DTRIG. The specific frequency is selected by Carrier frequency control signal (CF0,CF1). Refer to Figure 5-61 and A51DOP Schematics Page 3 of 7.



CF0	CF1	Freq
0	0	9
1	0	13.2
0	1	18
1	1	28

Figure 5-61

The ACOHO output goes to a divide by four frequency divider, (U14:ALS74) one of the resultant frequencies 2.25MHz, 3.3MHz, 4.5MHz and 7MHz, is then used as the demodulation carrier. This carrier and its 90 ° phase component go to the Phase Detector.

(2-2) Range Gate

The 1.54MHz clock of Range Gate is generated by L5 and U16, (See Schematics Page 3 of 7) and triggered by DTRIG. DTRIG also loads Range Gate Depth code (RD0-9), and the 1.54 MHz clock is counted by HC193 (U18, 19, and 20). The obtained Range Gate Depth timing signal (output of counters) fires the monomulti vibrator. Time constant of the output is according to Range Gate Length code (RL0,1). See Figure 5-62 and Schematics Page 3,4 and 7 of 7.

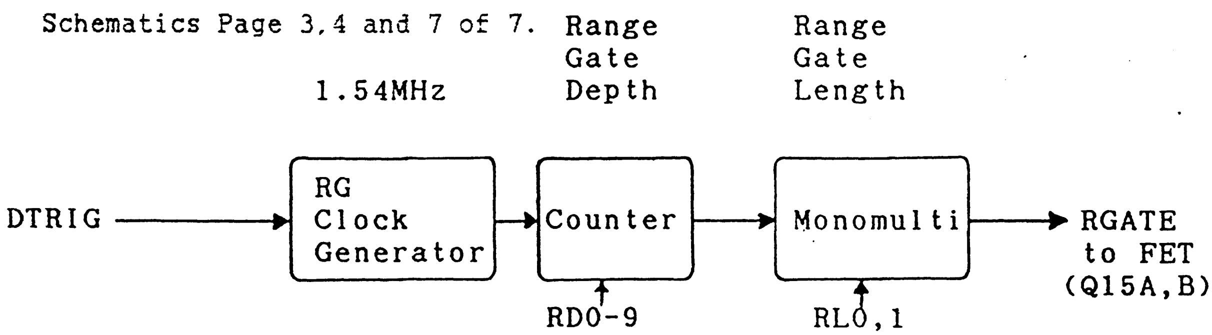


Figure 5-62

(2-3) Echo signal flow

The Echo signal from A7 LOG amp goes through a Phase Detector after the Echo Filter and Receive Gain Control Amplifier. The 4 Filters (U22, 23, 24 and 25), are selected by Carrier Frequency code (CF0,1).

The Receive Gain Control Amplifier is composed of operational amplifiers (U26 and 27).

The Phase Detection BDMs (LM1496H) are used to obtained I and Q signals which then go to an output select switch U32(4052) by way of Baseband Filters, Range Gates, Integrators and S/Hs.

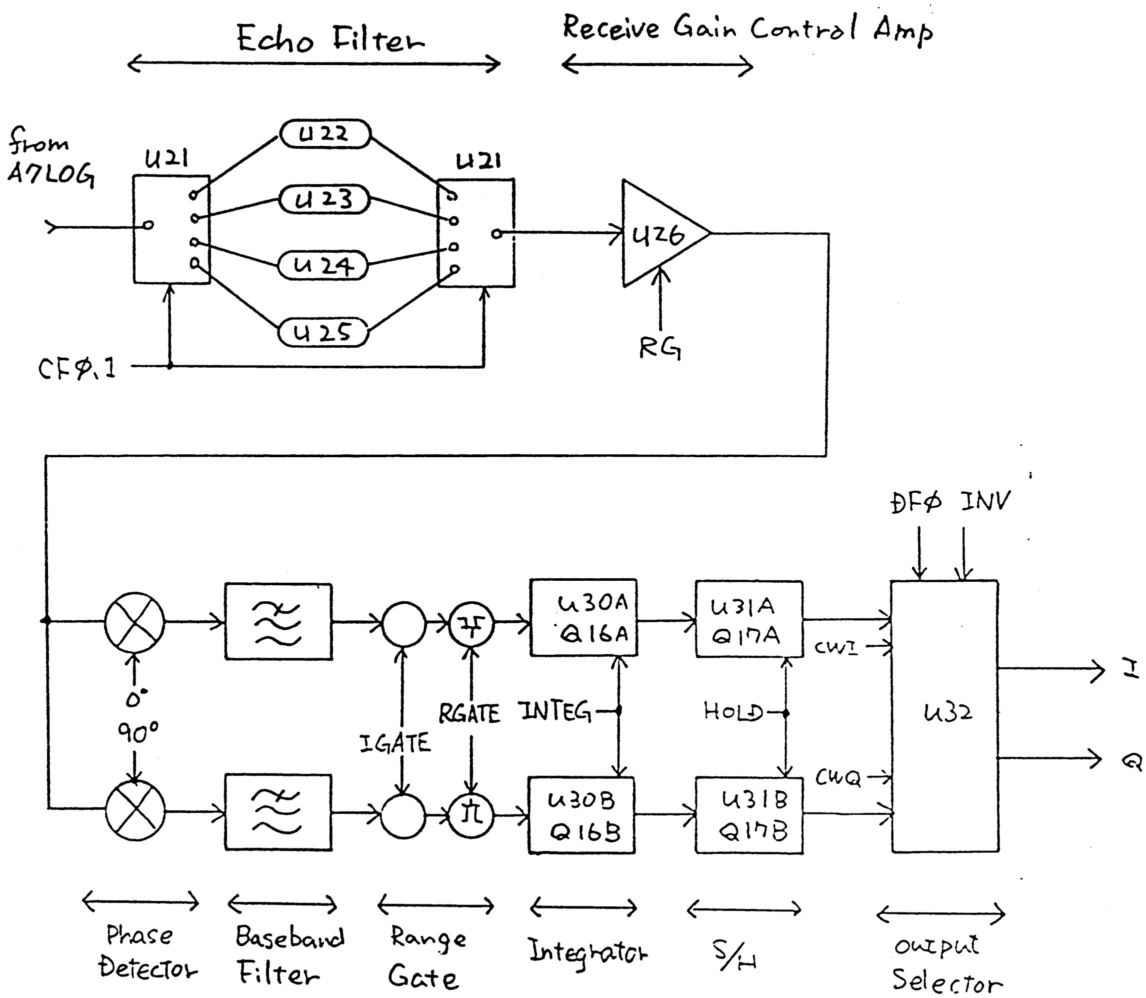


Figure 5-63

The output selector U32 selects PDI, Q or CWD I, Q from the condition of DFO, I, Q are swapped with each other as INV (Spectrum Invert) Control is activated.

See Figure 5-63 and Schematics Page 5,6,7 of 7.

5-8-6 HT Assembly (A52)

The HT Assembly receives baseband signals in phase and quadrature from A51 DOP Assembly. There are two major functions, Filters and Hilbert Transformer.

BI, BQ signals from A51 DOP go through a Wall Filter, Display Gain Control Amplifier and Nyquist Filter.

Refer to Figure 5-64. After the Nyquist filter the I and Q signal is sent to the FFT for A/D conversion and also connected to the Hilbert Transformer for decording upper and lower side band audio.

(1) Wall Filter

6 selectable filters are used as Wall Filters.

These filters are selected by Wall Filter Control code (WF0, 1 and 2). See Figure 5-65.

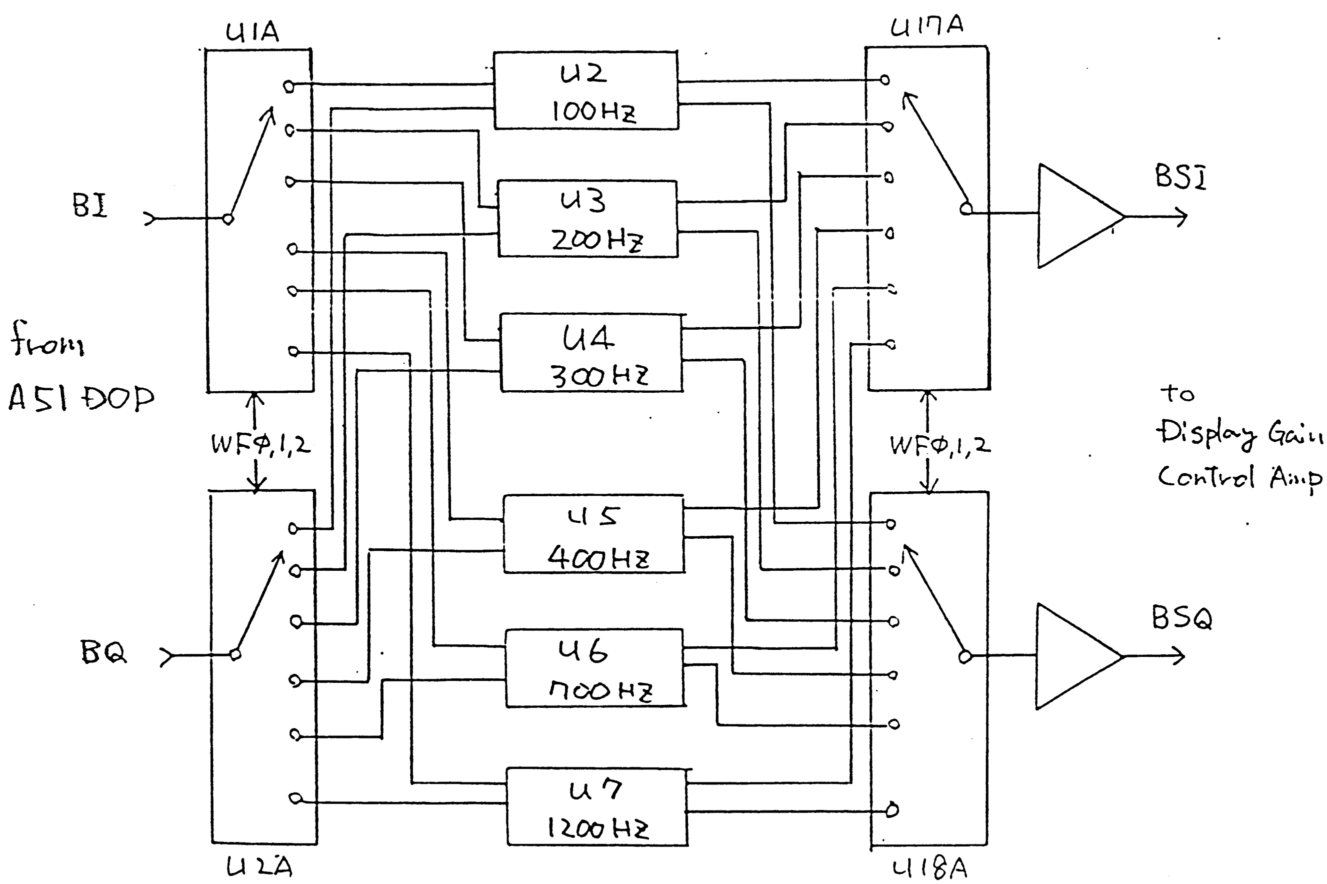


Figure 5-65

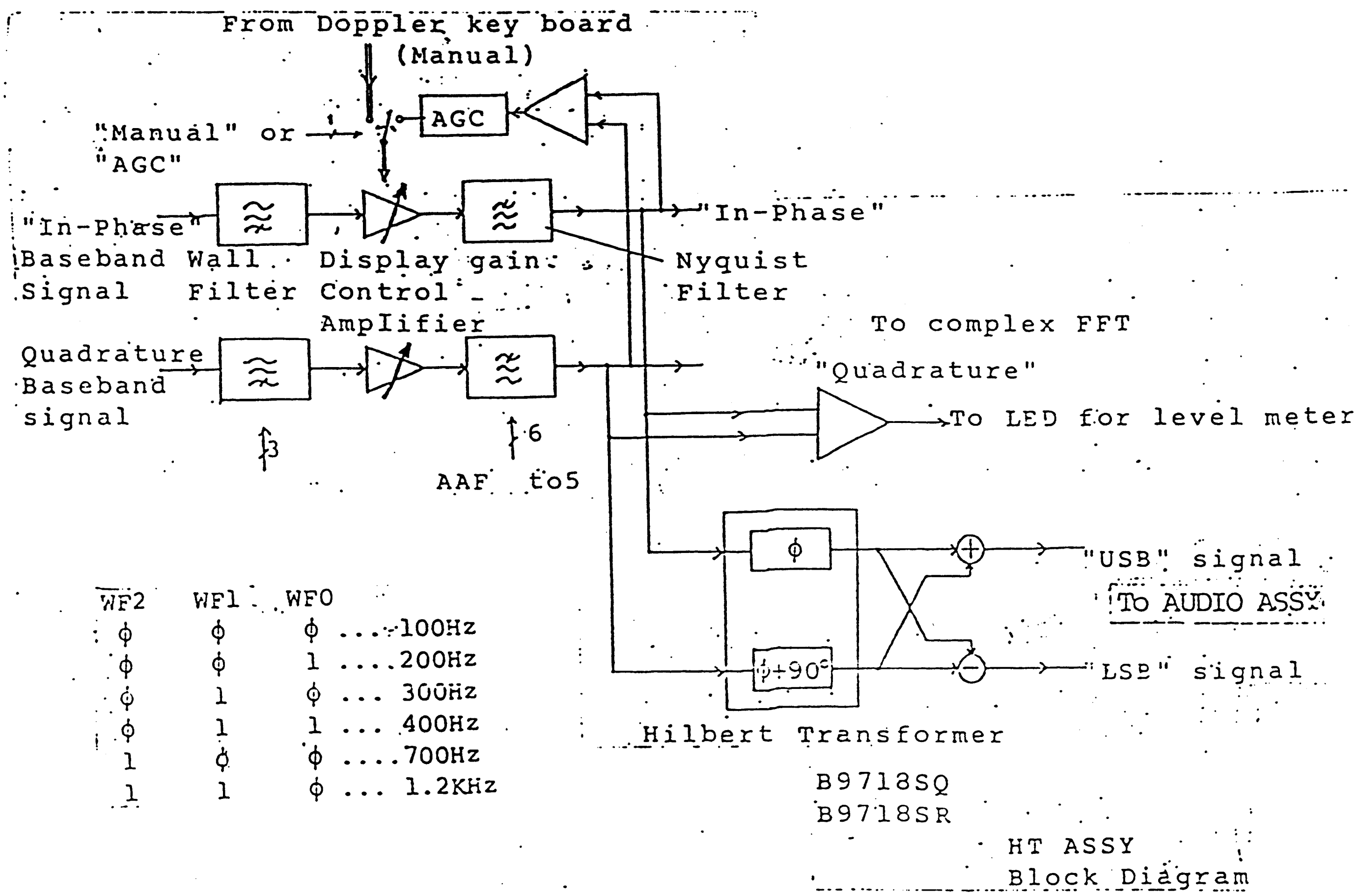

From Doppler key board
(Manual)
"Manual" or
"AGC"
AGC
"In-Phase"
Baseband Wall
Signal Filter
Display gain
Control
Amplifier
Nyquist
Filter
"In-Phase"
To complex FFT
"Quadrature"
Quadrature
Baseband
signal
To LED for level meter
3
6
AAF to5
WF2 WF1 WF0
ϕ ϕ ϕ 100Hz
ϕ ϕ 1 ....200Hz
ϕ 1 ϕ ... 300Hz
ϕ 1 1 ... 400Hz
1 ϕ ϕ 700Hz
1 1 ϕ ... 1.2KHz
ϕ
ϕ+90°
"USB" signal
To AUDIO ASSY
"LSB" signal
Hilbert Transformer
B9718SQ
B9718SR
HT ASSY
Block Diagram

Figure 5-64

(2) Display Gain Control Amplifier

The display gain circuit is a Digitally Controlled Audio Attenuator and operational amplifier. Input of OP amp (U11) is attenuated by U10 as control code (DGDATA). See Figure 5-66.

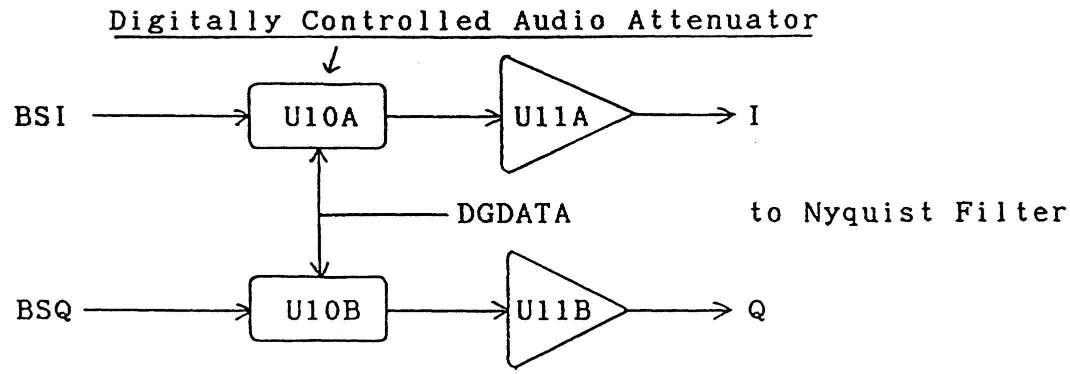


Figure 5-66

(3) Nyquist Filter

The Nyquist Filter consists of 3 kinds of filters. An anti-aliasing filter for the switched capacitor filter. The switched capacitor filter. The smoothing filter for switched capacitor filter output. See Figure 5-67.

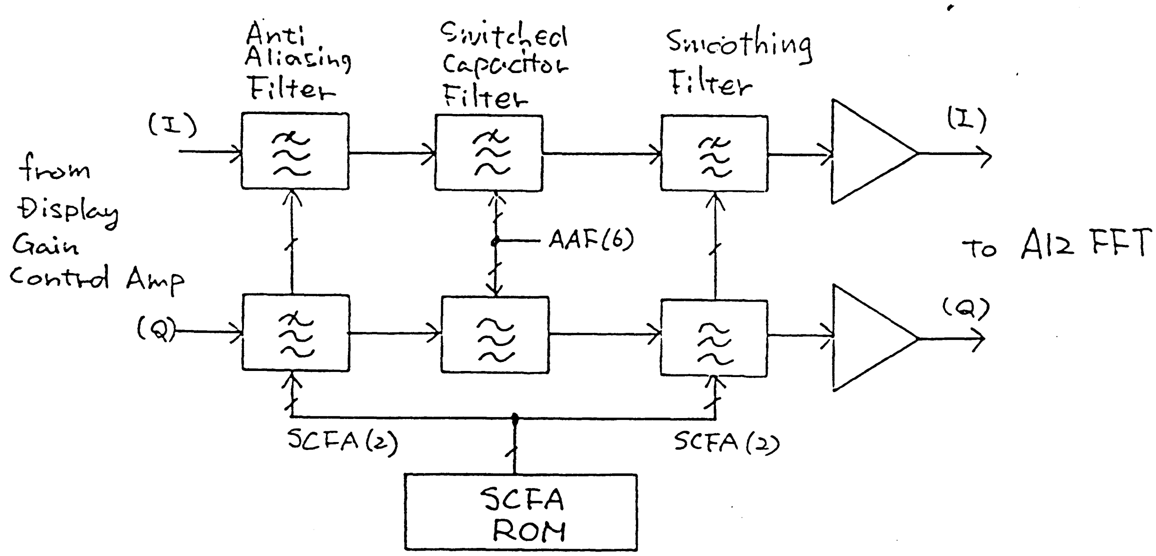


Figure 5-67

NOTE: S3528 (Switched Capacitor Filter) is one of a sample/hold device. And S3528 is uncommitted input and output for Anti-Aliasing and Smoothing Function.

* Function of each Filter *

1. Anti- Aliasing Filter

   To correct sampling error.

2. Switched Capacitor Filter

   To correct sample/hold distorsion of A51 DOP.

3. Smoothing Filter

   To correct holding error.

(4) Hilbert Transformer Block

Before input to the A53 AUDIO assembly the Hilbert Transforemr is used to get Upper Side Band Signals and Lower Side Band Signal by subtracting positive and negative side bands. See Figure 5-68.

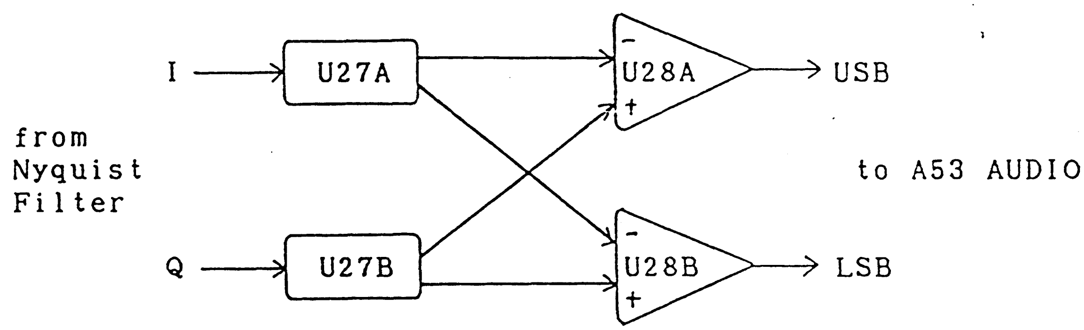
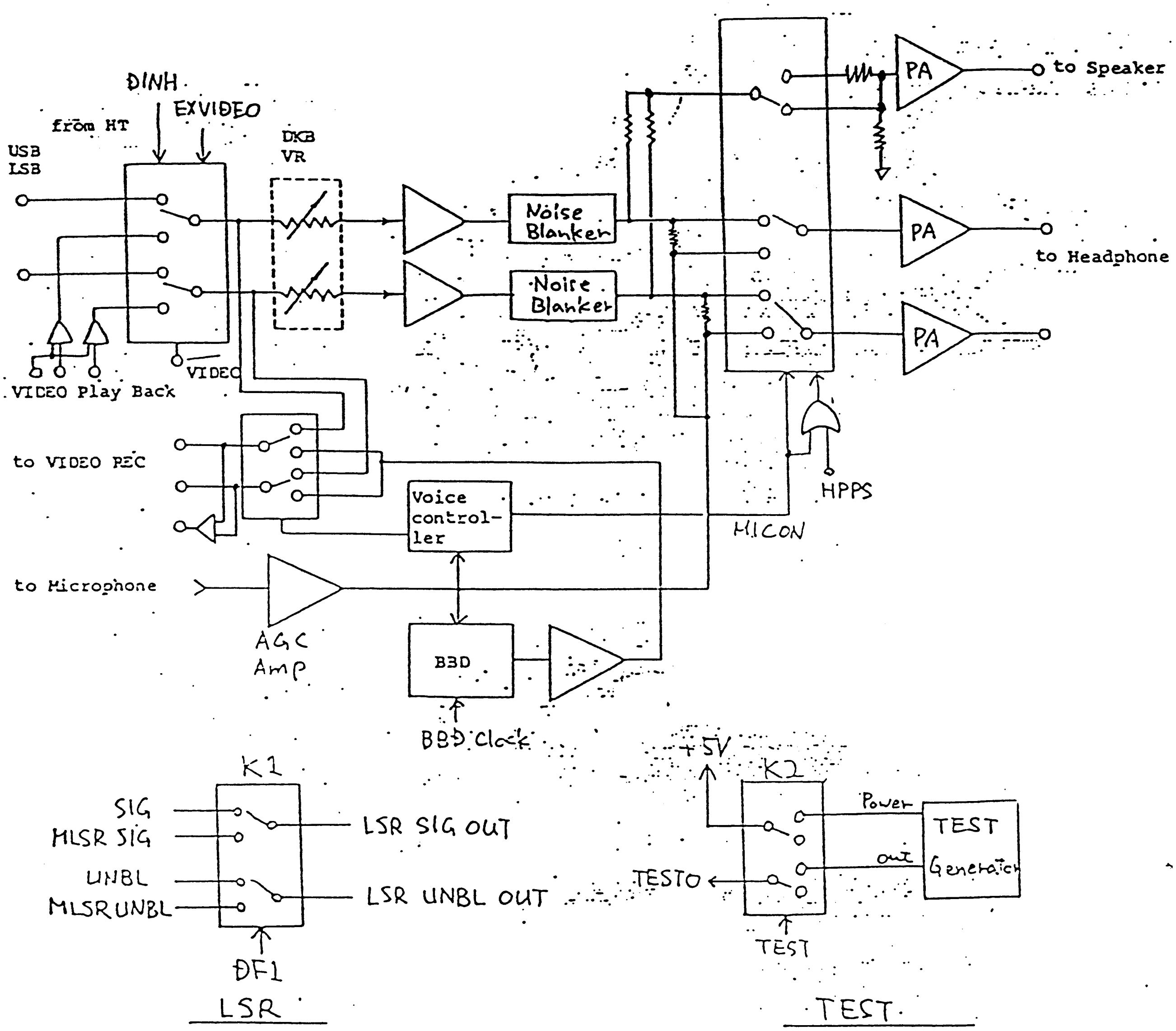


Figure 5-68

5-8-7 A53 AUDIO Assembly

The AUDIO Assembly has 5 functions ; Amplification of Doppler audio signals, microphone amplifier, control of input and output for Video cassette Recorder, output of Line Scan Recorder and Test signal generator. See Figure 5-69.


DINH
EXVIDEO
from HT
USB
LSB
DKB
VR
Noise Blanker
Noise Blanker
PA
to Speaker
PA
to Headphone
PA
VIDEO
VIDEO Play Back
to VIDEO REC
Voice controller
HPPS
MICON
to Microphone
AGC Amp
BBD
BBD Clock
K1
SIG
MLSR SIG
UNBL
MLSRUNBL
LSR SIG OUT
LSR UNBL OUT
DF1
LSR
+5V
K2
Power
out
TEST Generator
TESTO
TEST
TEST

(1) Voice Signal Flow

There are two voice signals as input signals. The microphone signal and the VCR playback signal. And also there are three voice signals as output signals. The internal speaker signal, the head phone signal and the VCR REC signal. The control signals of Ext Video, DINH, PTALK and VACT control I/O of these voice signals.
See Figure 5-70.

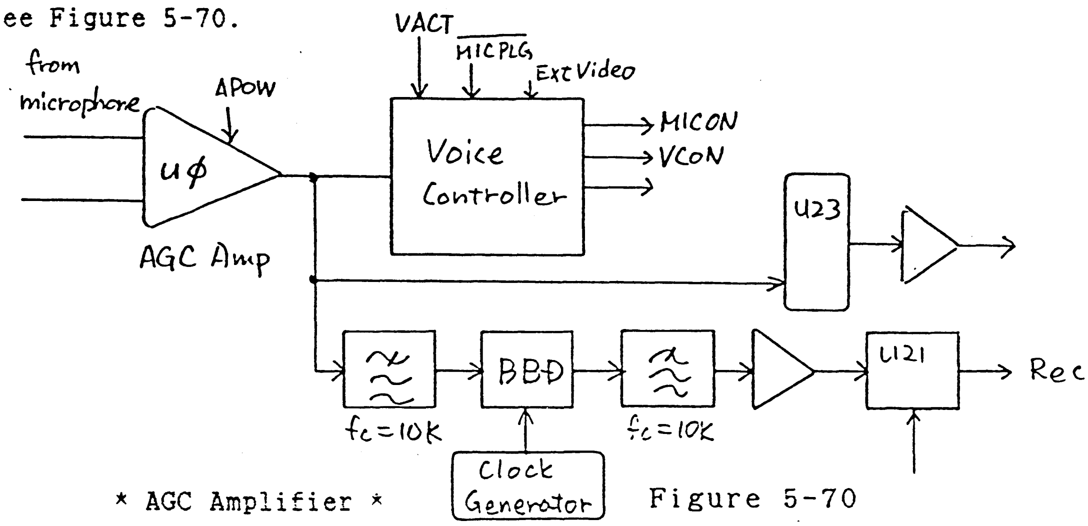


Figure 5-70

* AGC Amplifier *

The microphone signal goes **through a** AGC Amp. The amplitude is controlled **by the AGC Amp. The output of the AGC Amp goes to U23 multiplexer along with** the Doppler audio signals.

* Headphone Amplifier *

The selected signal of U23 (Doppler audio or sum of Doppler audio and voice signal) **goes to the headphone amp.** (U12 and U13).

* Noise Blanker *

The Noise Blanker detects the amplitude of the Doppler Audio signal, and fires the reset input of U8. The output of U8 controls Q3 and Q4. U8 counts BBDCLK and **generates noise blank timing.**

* Internal Speaker Amplifier *

U14 **BA532 is used as a** Internal Speaker Amplifier. Input and output signals are monoral.

* Test Generator *

The Test Generator is available under service software command SY. the output of this goes to the A51 DOP. Refer to Figure 5-71.

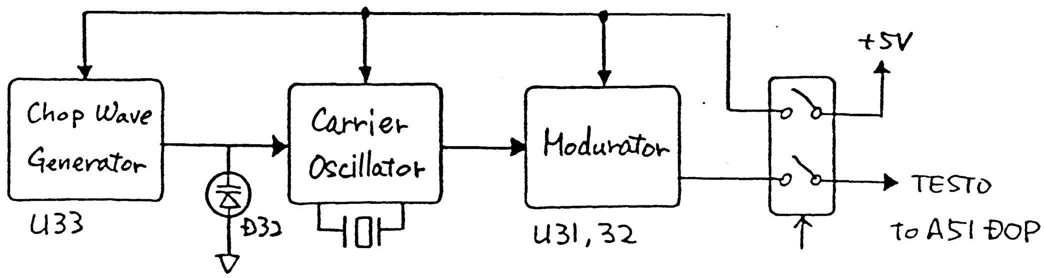
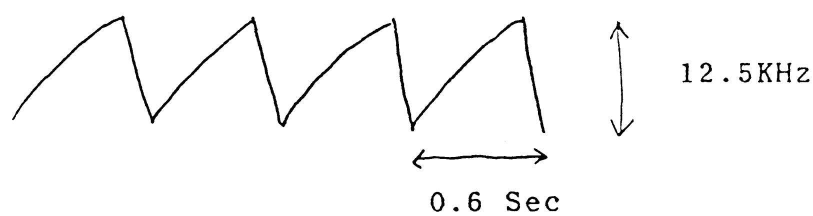


Figure 5-71

The obtained waveform on spectrum display is as follows.

Carrier Freq : 3.5MHz



5-8-8 A12 FFT Assembly

A12 FFT Assembly has 7 functions;

1 : Complex FFT
2 : Interface to Digital Scan Converter
3 : Interface to A8 MST
4 : Interface to Line Scan Recorder
5 : Doppler Data Acquisition
6 : Interface of Doppler Analog and A8 MST
7 : Interface of Doppler Keyboard and A8 MST

See Figure 5-72.

(1) Doppler Data Acquisition System

The I, Q signals from A52 HT, are received by Complex FFT Sample & Hold and A/D convertors.

Refer to Figure 5-73.

The data is then placed on the DSP data bus for storage in the wave buffers. The control signal "short" is used for 8 bit or 12 bit resolution based on scroll speed.

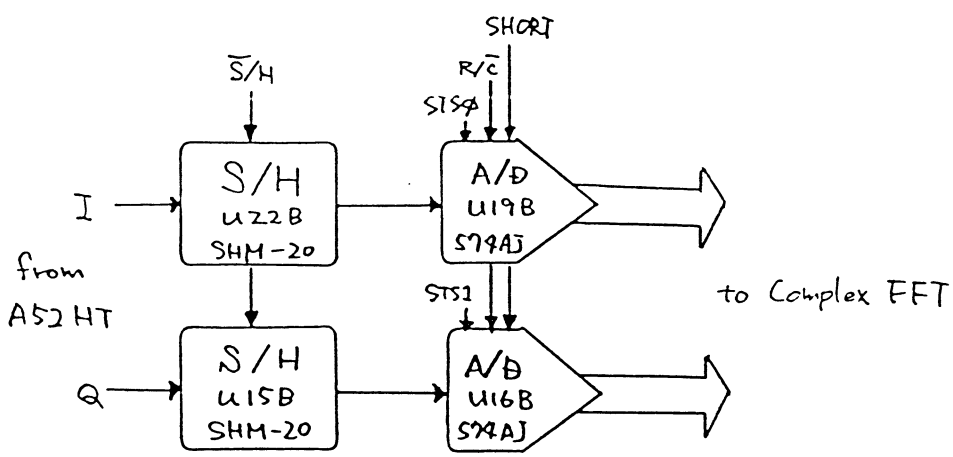


Figure 5-73

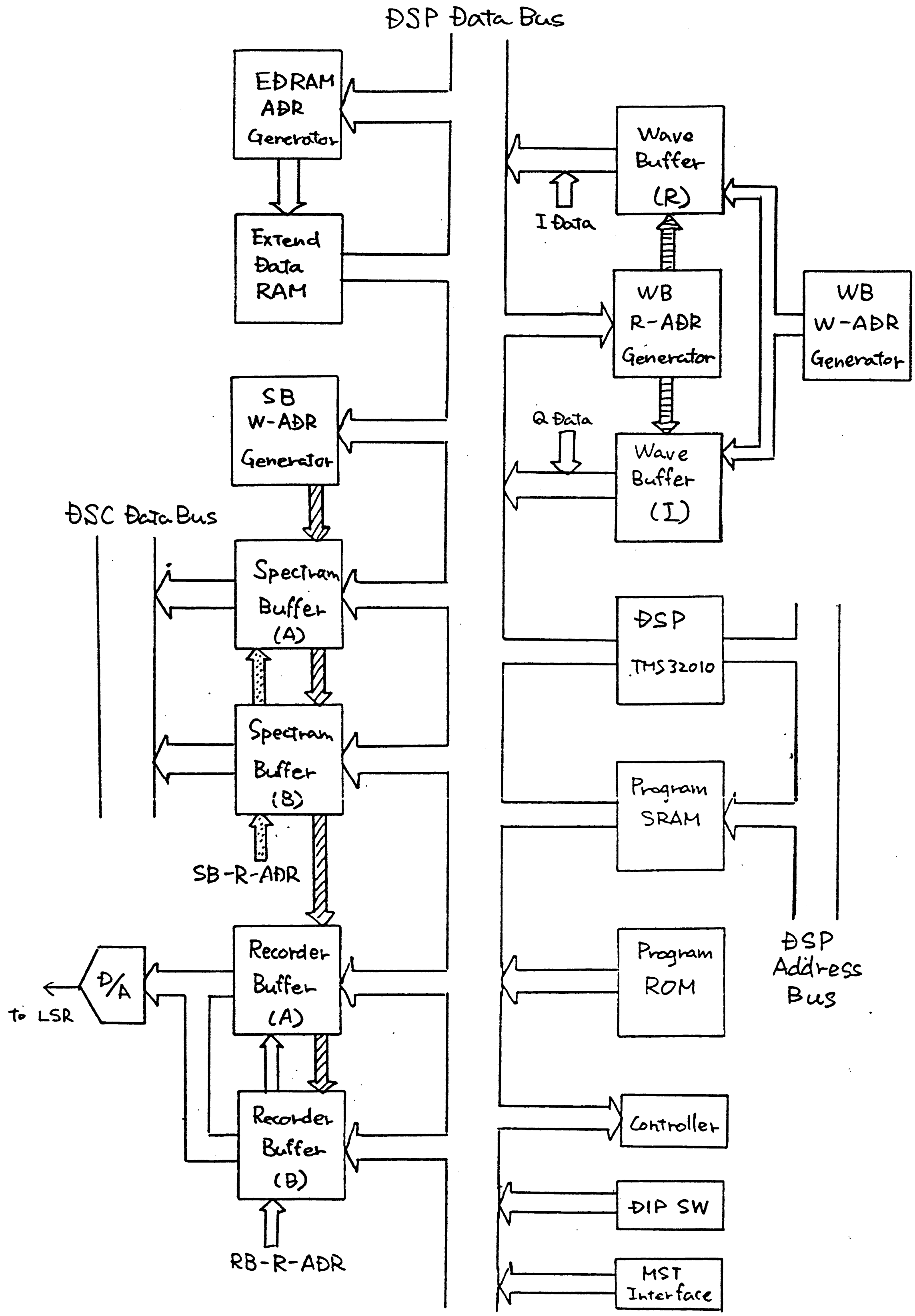

DSP Data Bus
EDRAM ADR Generator
Extend Data RAM
SB W-ADR Generator
DSC Data Bus
Spectram Buffer (A)
Spectram Buffer (B)
SB-R-ADR
Recorder Buffer (A)
Recorder Buffer (B)
RB-R-ADR
D/A
To LSR
Wave Buffer (R)
I Data
WB R-ADR Generator
WB W-ADR Generator
Q Data
Wave Buffer (I)
DSP TMS32010
Program SRAM
Program ROM
DSP Address Bus
Controller
DIP SW
MST Interface

Figure 5-72

(2) Complex FFT

This consist of a Digital Signal Processor and complex FFT. See Figure 5-74. Digitized Doppler **Data is stored in one of the** Wave Buffer **Pair**. These are similar to DSC Line Buffers.

The Data is processed by DSP, and resultant data goes to one of the Spectrum Buffers and also to one of the Recorder Buffers for LSR.

* Wave Buffer *

The I data and Q data are stored **in Wave Buffers**. The wave buffer write address is generated by U6D and U7D (binary counter). And the wave buffer read address is generated by U8H and U8F (up down counter). **U6E and U7E select the** read address or write address. Refer to Figure 5-74 and Schematics page 6 and 7 of 18.

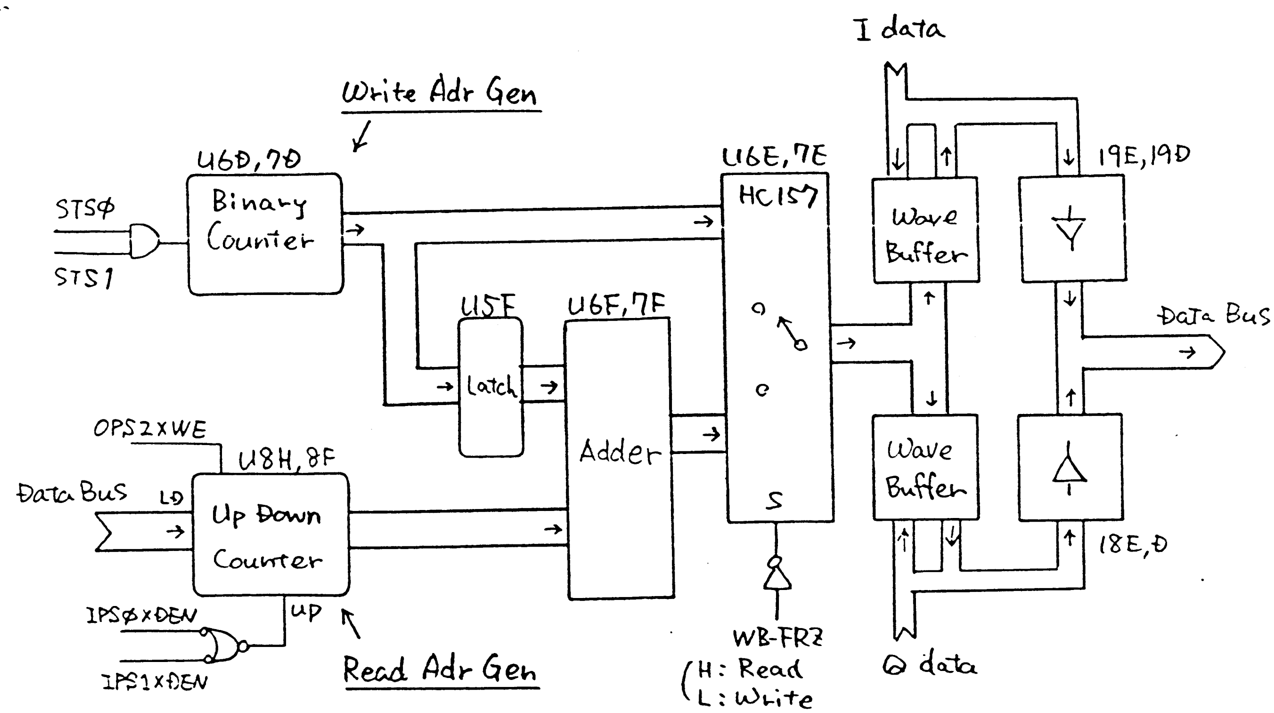


Figure 5-74

* Digital Signal Processor *

For the FFT software there are program ROM and program RAM. At first FFT software is loaded to program RAM from program ROM since this ROM has a low speed response. Refer to Figure 5-75 and Schematics page 2 and 3 of 18.

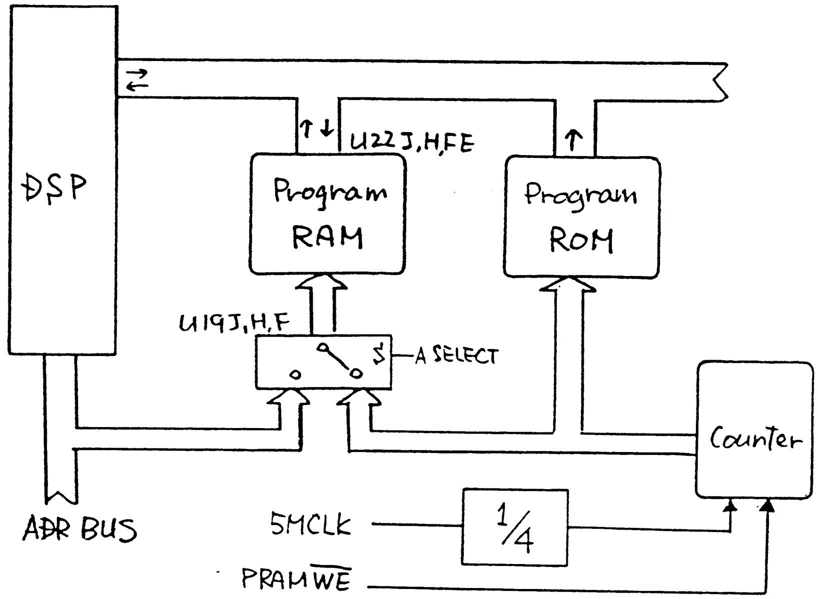


Figure 5-75

* Extended Data Memory*

Extended Data Memory is used in FFT processing. The address is generated by U15C, U15D and U16E. Refer to Figure 5-76 and Schematics page 6 of 18.

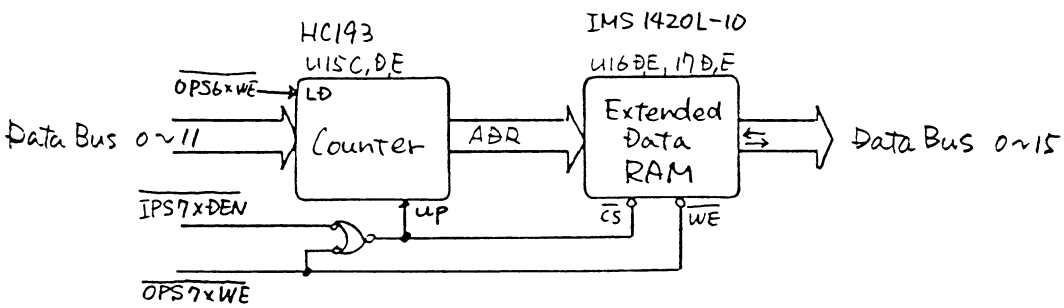


Figure 5-76

* Spectrum Buffer *

The resultant data is stored in the Spectrum Buffer. The data **is then transfered to DSC**

Refer to Figure 5-77 and Schematics page 9 and 10 of 18.

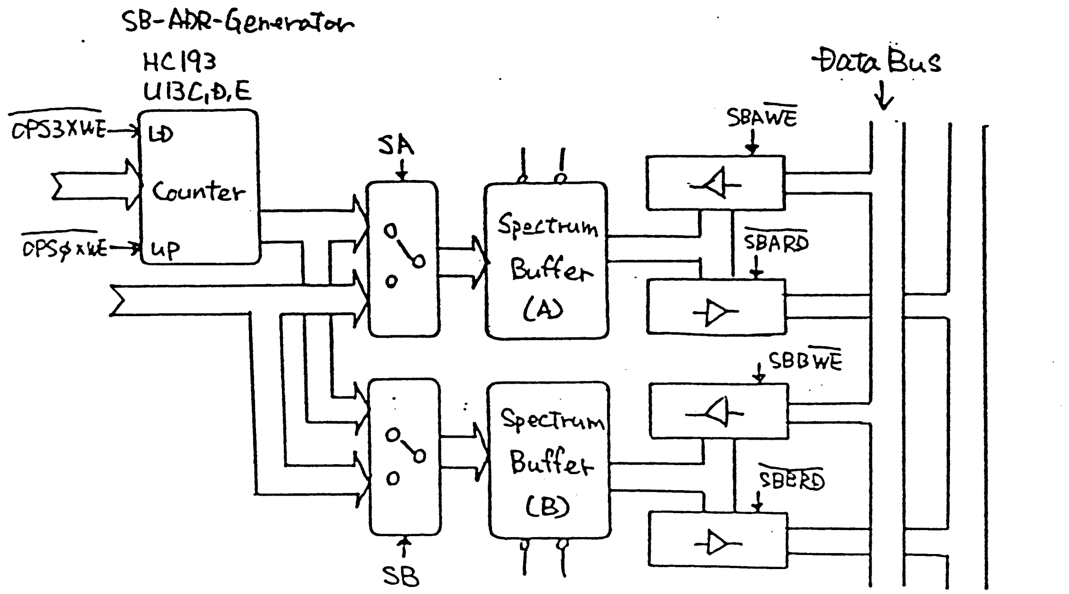


Figure 5-77

* Recorder Buffer *

For LSR, Recorder Buffers are used. The operation of this is similar to the Spectrum Buffer.

Refer to Figure 5-78 and Schematics page 11 and 12 of 18.

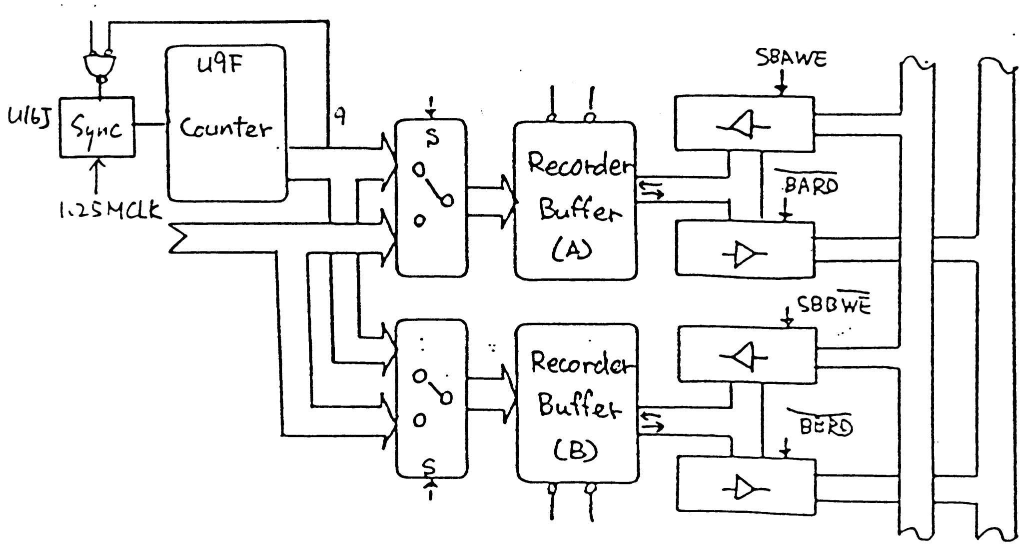


Figure 5-78

* LSR out *

The data from the Recorder Buffer is converted to digital, and **sent to the LSR** out connector through a filter and amplifier. Refer to Figure 5-79 and Schematics page 13 of 18.

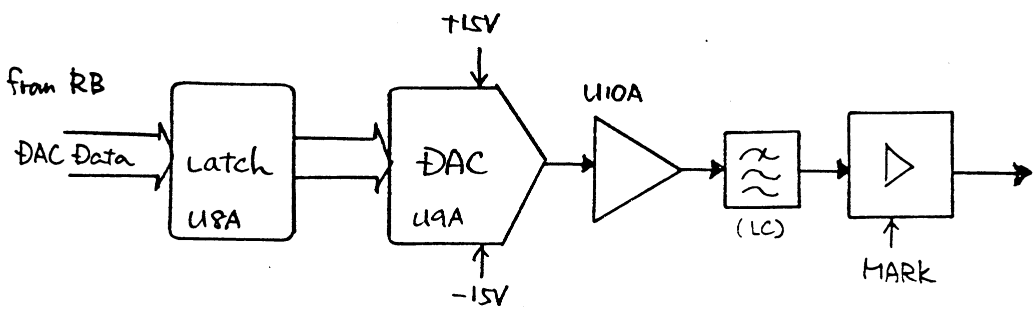


Figure 5-79

ADJUSTMENTS

Chapter 6

Adjustments

Table of Contents

NOTE

The waveforms presented are normally what is expected from production systems. Some degree of difference between documented and actual waveforms may be acceptable because of component tolerance.

In cases where specific "customer preference" adjustments are made, a deviation from the normal waveform may result and should not be mistaken as a failure.

6-2 Abstract

The chapter provides the procedures for making service adjustments to the RT3600. Adjustments should be made only when corrective action is **required**-that is, when a functional check fails or is marginal. They should be made only by qualified service personnel.

NOTE: If an adjustment cannot be made within the tolerance describes in this chapter, **proceed with Diagnostics**.

6-3 Low Voltage Power Supplies

NOTE:the + and -5v supplies (analog) must be as precise as possible.

Changing supplies will lead to total system recalibration.

To gain access to the power supplies (+5V, -5V, and +12V) the front cover must be removed. Refer to Figure 6-1. Perform the following steps:

a. Remove the two screws shown by the arrows in the figure. Pull the entire drawer towards the front of the console.

NOTE: If the drawer is at its maximum open position, it is prevented from being pulled out by stoppers on the side panels.

b. This will allow access to the lower three power supplies.

c. To reach the upper two supplies, the main power switch box must be removed.

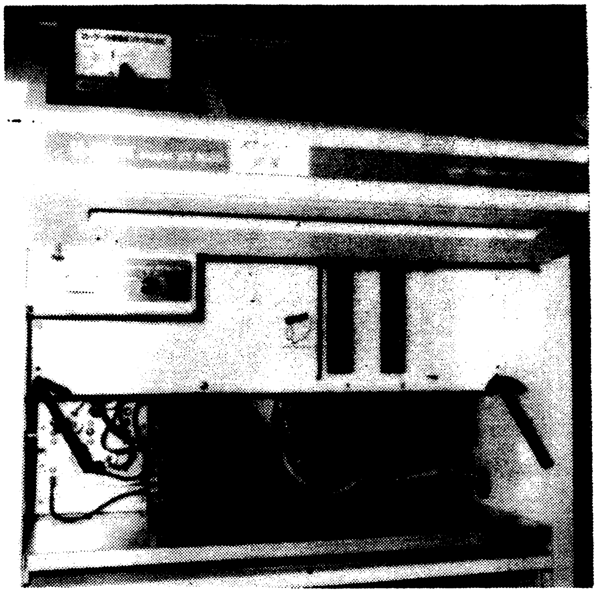


Figure 6-1

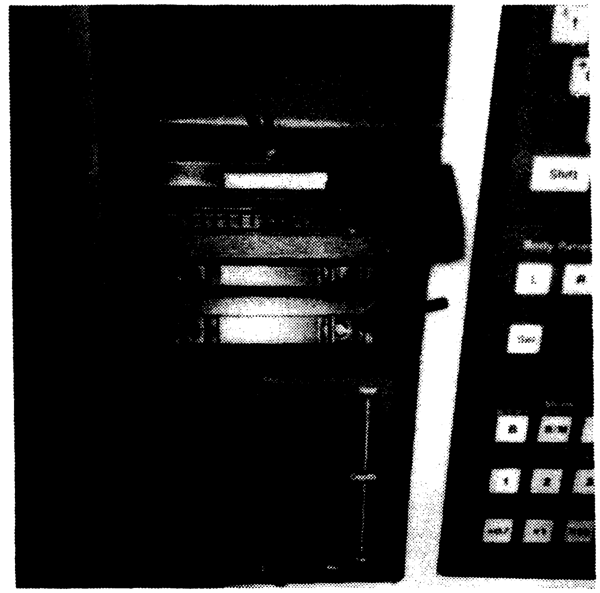


Figure 6-2

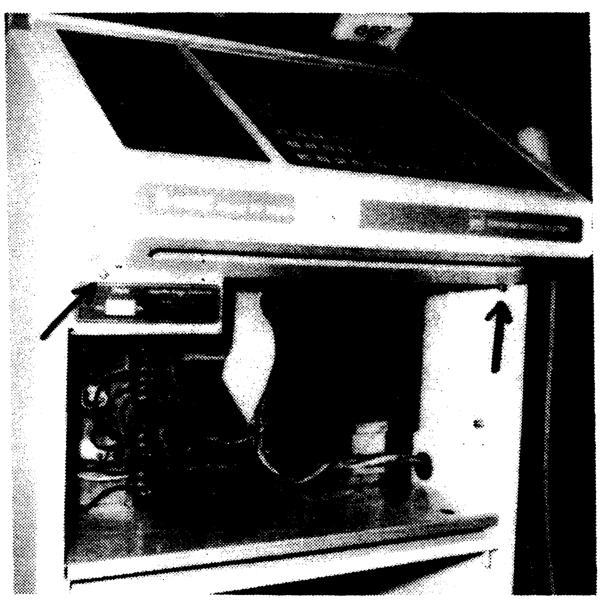


Figure 6-3

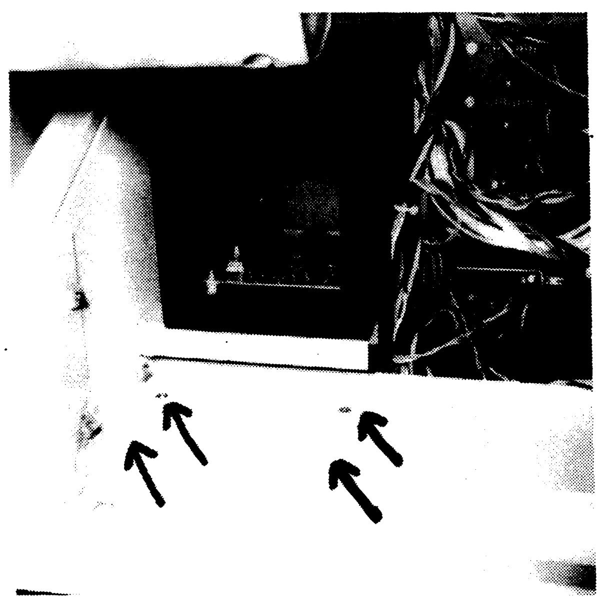


Figure 6-4

d. To remove the power switch box, first remove the TGC box and Polaroid camera by loosening the bottom screws of the TGC box and the top screw of the camera mount.
See Figure 6-2.

e. Loosen the two screws at the bottom of the panel (refer to Figure 6-3). These are captive screws.

f. Pull up the panel and lock it into place with the latching arm.

g. Remove the four screws shown in Figure 6-4 and pull out the **acustic power switch box.** The two upper power supplies can now be accessed.

h. Use the medium-small screwdriver (a pot alignment tool) to adjust the output voltages. The potentiometer is located about one inch from the power supply front panel.

When replacement of a power supply is required, perform the following steps.

a. Remove the front panel covers, Polaroid camera, TGC box and power switch box.

b. Remove all connections to the power supply.

c. Remove the four screws indicated in Figures 6-6 and 6-5.
Figure 6-5 shows which screws secure the slider assembly.

d. Pull the power supply out from the rear of the console.
The assembly weighs about 22 pounds.

To remove the switching power supplies from the power supply assembly, perform the following steps:

a. Notice that the upper supply units are attached to seperate front panels.

b. The switching power supply units are attached at the terminal boards and along the base. The ground terminal and one voltage output terminal are screwed directly to the front panel of the assembly.

c. Which DC output terminal is grounded depends on whether the unit is a positive or negative voltage supply.

d. The direct grounding of the output terminal helps to eliminate noise and leakage from the switching power supply units. The feed through RF traps prevent noise from reaching the loads. A direct connection from the output terminal to the R_F trap is required to reduce noise. Metallic plates are used to make this connection.

Rear

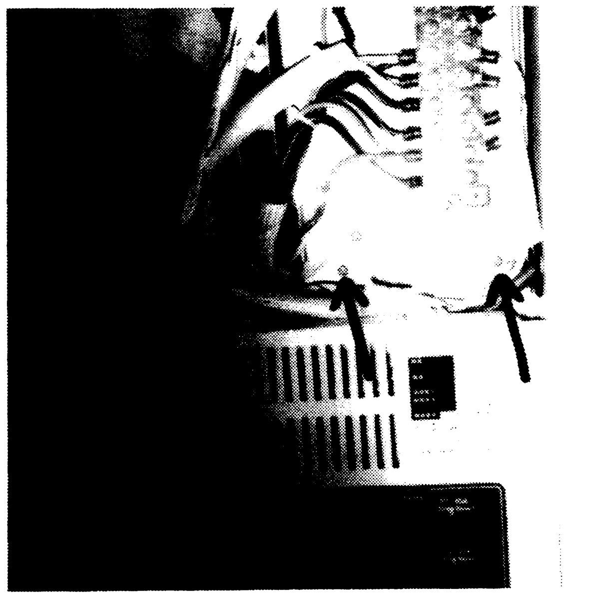


Figure 6-5

Figure 6-6

6-4 High Voltage Power Supply Adjustment **(A15)**

RV0 is used to adjust the +80V; RV1 is used to control the variable High Voltage. Adjust RV1 while in normal scanning operation with a B-type probe. With the Acoustic Power Output switch set at 100%, the High Voltage level should be +80V **for both RVO and RV1 adjustment levels.**

RV0 and RV1 are located at the rear edge of the A15 High Voltage Power Supply assembly. Refer to Figure 6-8.

To access these adjustment points, the plastic protective cover must be removed. Loosen the two screws holding the cover and the metal frame; then pull off the cover. The High Voltage Power Supply assembly can now be accessed for adjustment or removal.

Test points: +80v fuse F1
HV fuse F2
GND GND point on power supply chassis

CAUTION: Do not touch the components on the A15 board when the RT3600 is powered on. There is +300V present at some locations on the board.

Set the acoustic Power Output switch as indicated in the following table. Verify that the indicated voltages are present at **the (varible) +HV output.**

Acoustic Power Output Switch	Linear	Sector
100%	70 to 80V	157 to 161V
56%	50 to 60V	110 to 120V
25%	30 to 40V	70 to 80V
6%	10 to 20v	30 to 40v
0%	-1 to 2V	-1 to 2V

Also verify that the power output is shutdown when the transducer is disconnected from the console.

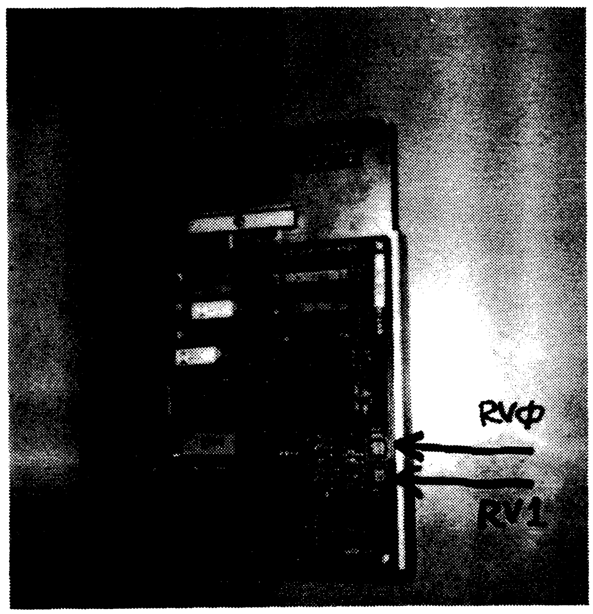


Figure 6-8

6-5 Video Chain Adjustment

The majority of adjustments for the video chain are located on the A7 Log Amplifier.

The most important factors affecting image quality (other than system sensitivity or noise) are log compression conformity and dynamic filter conformity.

6-5-1 PGC Control Adjustment

Pre-gain Compensation (PGC) is generated on the A0 RTC board by Q2 through Q5 and U14E. The PGC waveform can be seen at A0 RETC test point TP6.

a. Connect B type probe to console.

b. Connect an oscilloscope to A0 RTC TP11(TRIG) and TP6(PGC).

c. Trigger the oscilloscope on TP11(TRIG).

d. Verify that a waveform such as the one in Figure 6-9 is found.

e. Adjust A0 RTC RV2 as necessary to obtain the correct waveform.

6-5-1-1 Coda Control Adjustment

A) Connect U or Y probe type or CC

B) Connect oscilloscope to AO TP11 (TRIG) and TP9 coda.

C) Trigger oscilloscope on TP11(TRIG)

D) Verify that a waveform such as the one in figure 6-9b is found for Y probe or 6-9a for U probe.

E) Adjust RV0 for -2.55v ± .05v for Y probe

F) Adjust RV1 for 40uS ± 2uS for U + Y probe

G) Verify figures 8a+8b
amplitude 1.9v ± .05 } RV0
time 40usec ±2usec scale x 1.0 } RV1

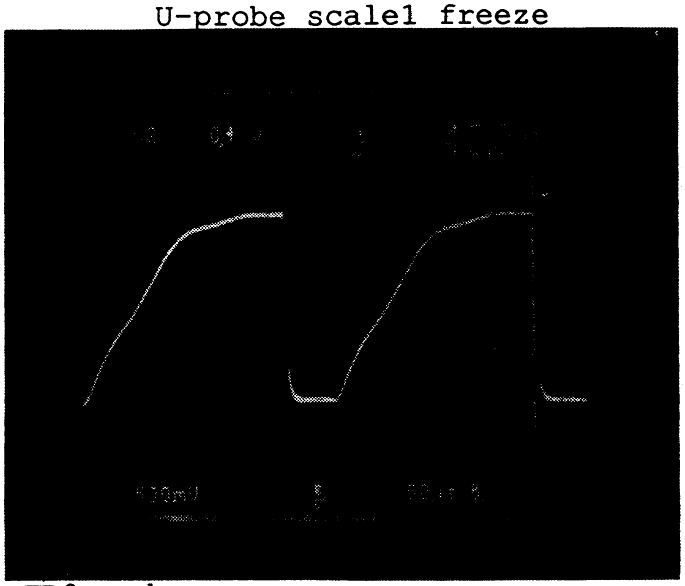
6-5-2 Focal Zone Switching Adjustment

Focal zone switching may also be referred to as dynamic focus range control.

On the A7 Log Amplifier board, U111 and U112 generate the focal zone switching signal. U110 determines what type of signal is generated. Two types of focal zone switching methods can be generated. System software determines which methods are short range and long range.

The test is to be conducted with a B-type probe connected to the console and "AUTO" selected for the scan parameters.

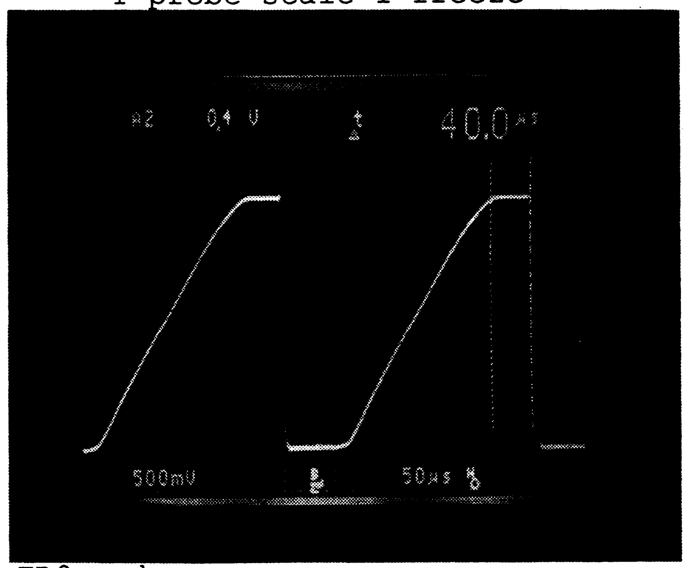
U-probe scale1 freeze



TP9-coda

Figure 6-8a

Y-probe scale 1 freeze



TP9-coda

Figure 6-8b

TP6 PGC control adjustment

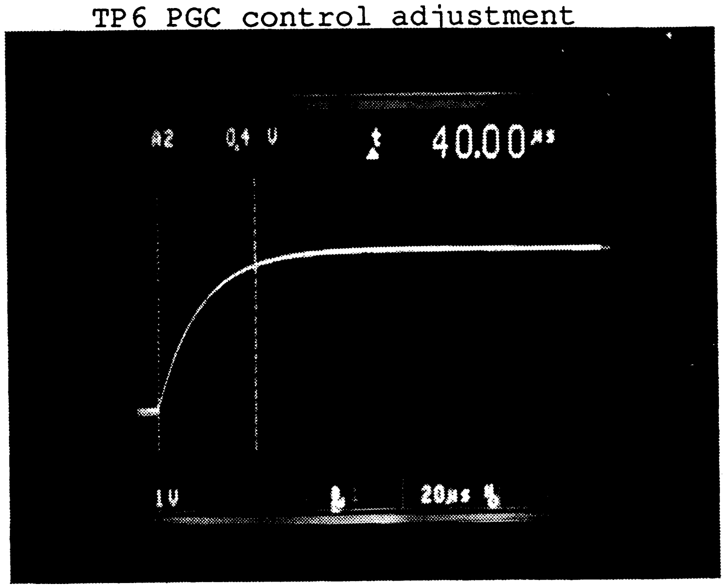
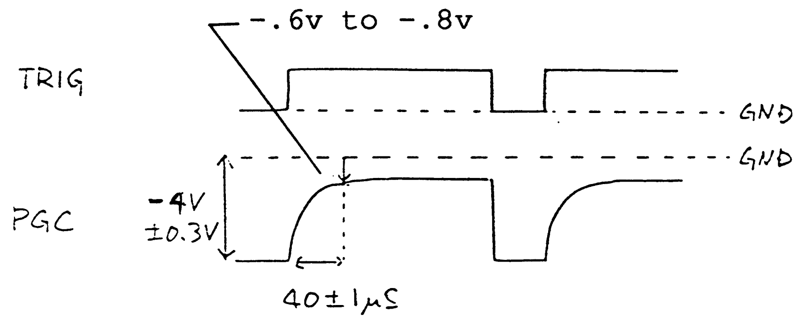
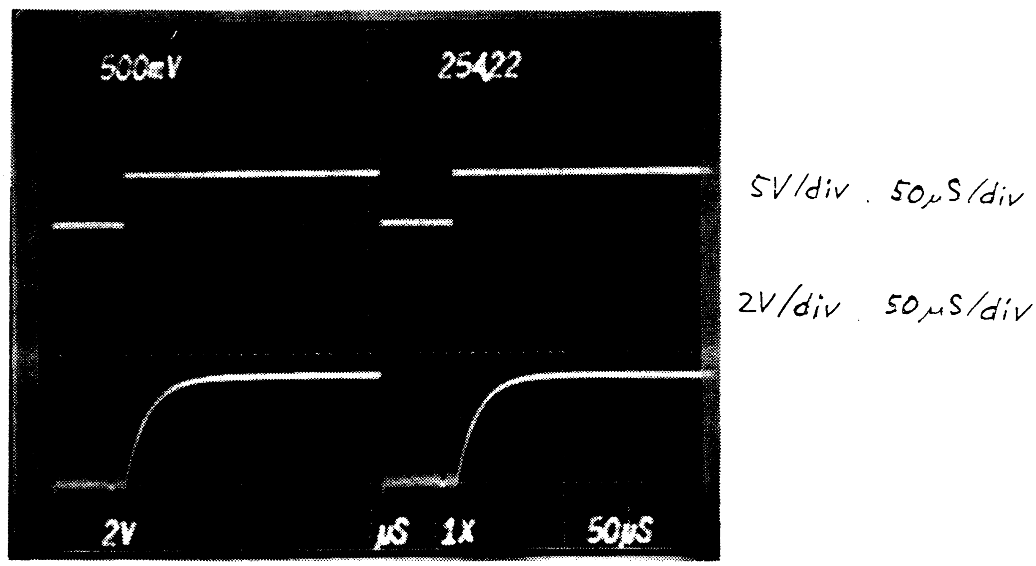


Figure 6-9a



-.6v to -.8v
TRIG
GND
GND
PGC
-4V
±0.3V
40±1μS



500mV
25422
2V
μS
1X
50μS
5V/div . 50μS/div
2V/div 50μS/div

Figure 6-9

The following table provides the test points, adjustment points, and proper waveform data for the focal zone switching signals:

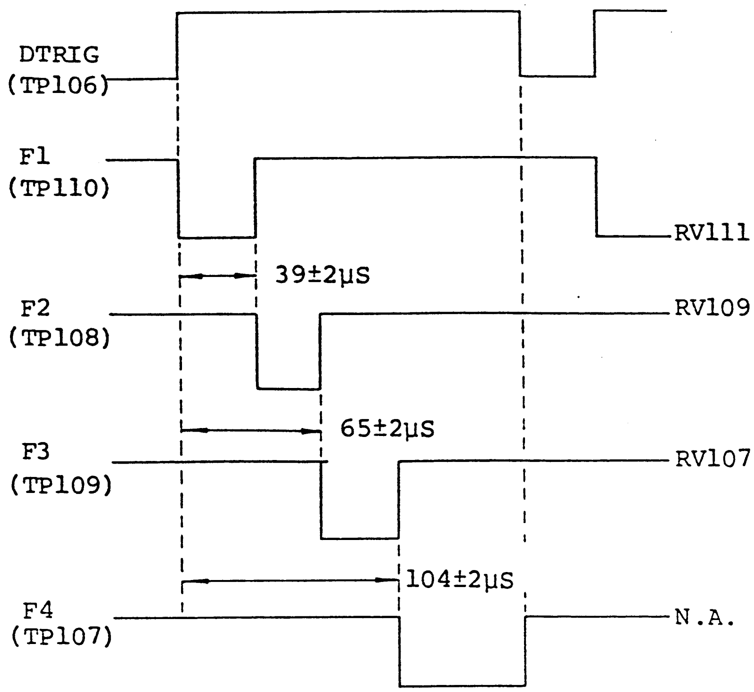


Figure 6-10S (Short Range)

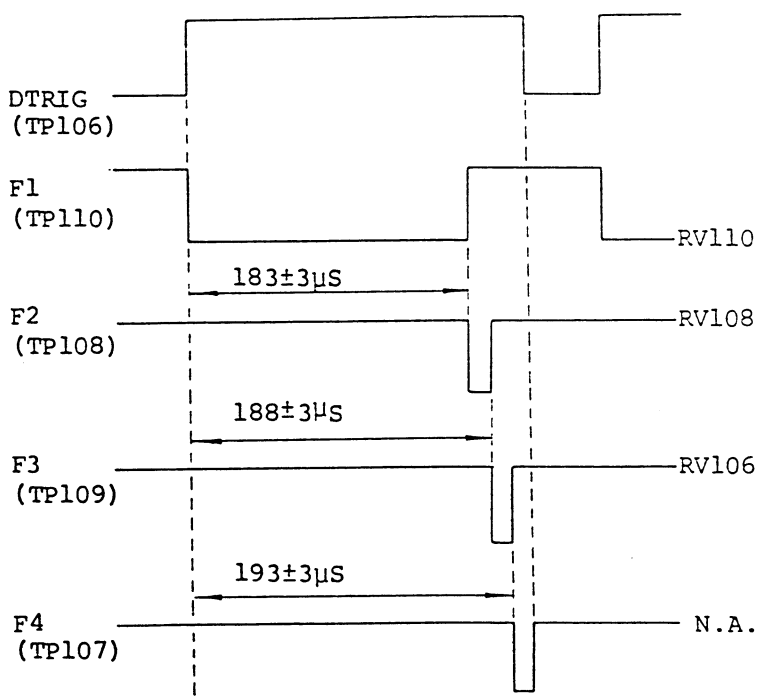


Figure 6-10L (Long Range)

Short Range (Selected when control signal MAP3 is high)

Test Point	Adjustment Points	Waveform
DTRIG (TP106)		
TP110 (F1)	RV111	
TP108 (F2)	RV109	Figure 6-10S
TP109 (F3)	RV107	
TP107 (F4)	N/A	

Long Range (selected when control signal MAP3 is low)

Test Point	Adjustment Points	Waveform
DTRIG(TP106)		
TP110 (F1)	RV110	
TP108 (F2)	RV108	Figure 6-10L
TP109 (F3)	RV106	
TP107 (F4)	N/A	

At present, the long range focusing method is used **only when operating** with the H type probe. All other probes use short range.

6-5-3 TGC, TFC, SGC, and SFC Adjustment

The signals originate digitally on the A8 MST. They are D to A converted there before being input to the A7 Log Amplifier.

For analog TGC consoles, remove the analog TGC interconnecting cable at AC8CN81. The machine can now be tested as a digital unit.

Note: Static voltage measurements and adjustments are performed first only if a new A7 log board has been installed.

If an new A7 Log board has not been installed proceed to step "**e**" before making adjustments or troubleshooting.

Static Voltage Adjustments (Linear)

a. Remove A8 from the card cage.

b. **Use B probe or system default**

c. Turn the system on.

d. Using a digital voltmeter, check the following points for the indicated voltages. Make only necessary adjustments.

Test Point	voltage	Adjustment
TP100	1.1 TO 1.2V	RV104
TP101	0.15 to 0.20V	RV105
TP102	**9.9 ± 0.25V**	**see sector adjustments**
TP103	0.0 ±0.01V	**see sector adjustments**
TP104	1.1 ±0.1V	**see sector adjustments**

Note; failure to achieve voltages indicated suggest an A7 failure.

Turn the system off and reinstall A8.

e. Use B probe or system default

f. Turn the system on and leave the front panel controls in their initialized setting. Examine the following test points with the A7 on a extender.

Test Point	Voltage	Adjustment
TP100	3.20 ±0.5V	RV104
TP101	0.55 ±0.05V	RV105
TP102	10.5 ±0.2V	**see sector adjustments**
TP103	0.10 ±0.05V	**see sector adjustments**
TP104	0.65 ±0.05V	**see sector adjustments**

Note: Failure to achieve voltage indicated suggests an A7 or A8 failure. If a failure is indicated go to step A.

Note: If the waveforms are different troubleshoot the A7/A8 assembly.

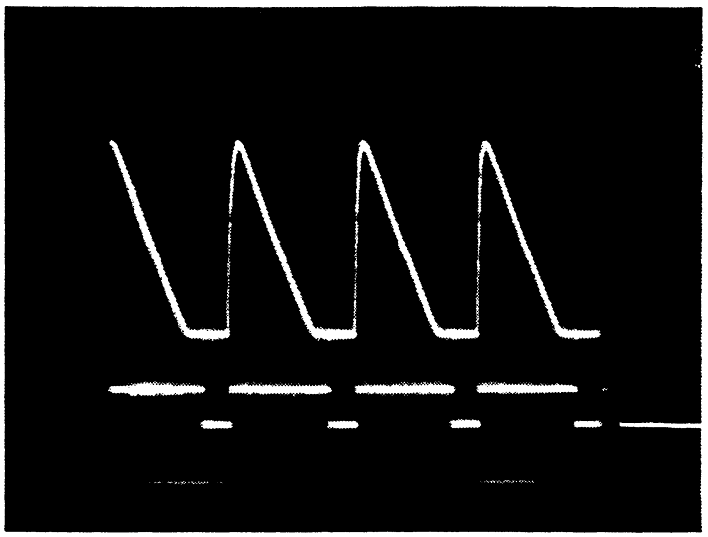
h. Connect an oscilloscope to TP100 (TFC). Obtain trigger from TP106 (DTRIG). Verify the waveform is the same as in Figure 6-10a.

i. Move the oscilloscope probe to TP101 (TFC). Verify a waveform as shown in Figure 6-10b.

j. **Proceed to sector adjustments.**

Upper Trace
1V/cm
.1ms

Lower Trace
5V/cm



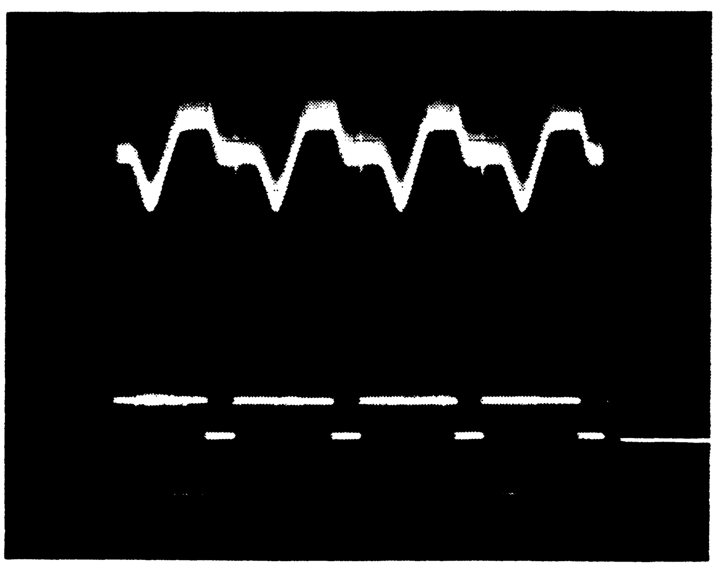
Tp 100

Gnd

Figure 6-10A

Upper Trace
.1V/cm
.1ms

Lower Trace
5V/cm



Tp101

Gnd

Figure 6-10B

There is an alternative method of checking TFC and TGC using service software. Refer to Chapter 4 of installation on entering the service software mode. The two checks are: (Set B/M mode first)

"CONTROL S G ENTER" ___________ TGC curve display

"CONTROL S F ENTER" ___________ TFC curve display

These routines graphically display the actual waveforms.

Sector adjustments (For sector operation)

a. **Connect a U-Probe or channel checker to the console.**

b. Select "AUTO" and scan.

c. Connect an oscilloscope probe to TP100 (TFC). Obtain trigger at TP106 (DTRIG).

d. Verify a waveform as shown in Figure 6-11. Closely examine the bias level of the TFC waveform. The bias level should be 1.8 to 1.9 volts above ground. Adjust RV104 for the proper bias level.

e. Move the oscilloscope probe to TP102 (SFC). Trigger with DTRIG at TP106. Refer to Figure 6-12 for the proper waveform.

f. Adjust RV100 for SFC bias level of **3V** ±0.1V.

g. Examine the "knee" of the waveform in Figure 6-12. The level of the "knee" is **6V** ±0.2V. The "knee" of the waveform is adjusted by RV101.

h. The peak of the pulse is **10V** ±0.2V above ground. Pulse amplitude can be adjusted by RV102.

i. RV101 and RV102 are interactive adjustments for the SFC waveform (that is, one adjustment affects the level of the other). If the proper SFC waveform does not appear at TF102, set RV101 and RV102 to the middle of their adjustment range. Adjust RV102 for a peak voltage of **10V** ±0.2V. If the peak cannot be reached by RV102, slowly adjust RV101 for the proper peak voltage.

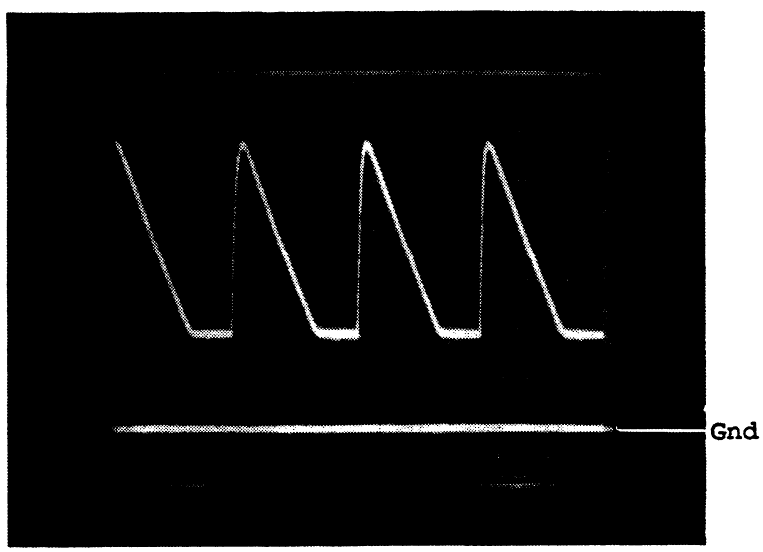
j. It may be necessary to move back and forth between RV101 and RV102 to achieve the proper values for the peak and the "knee" of the waveform.

k. Move the oscilloscope probe to TP103 (SGC). Verify a waveform appears as shown in Figure 6-14. If it appears incorrectly, perform the SGC waveform check described in Section 6-6-9.

l. Move oscilloscope probe to TP101. Adjust RV103 gain for waveform as shown in Figure 6-15 (focus 3 setting adjust RV105 for bias.)

Upper Trace

1V/cm
.1ms



1.8 to 1.9V

Figure 6-11

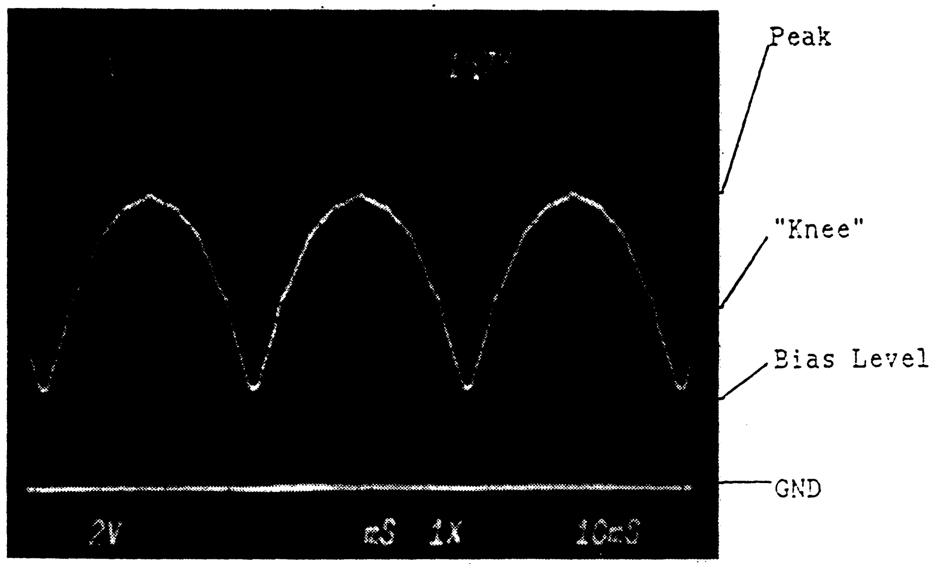


Figure 6-12: Correct SFC waveform.

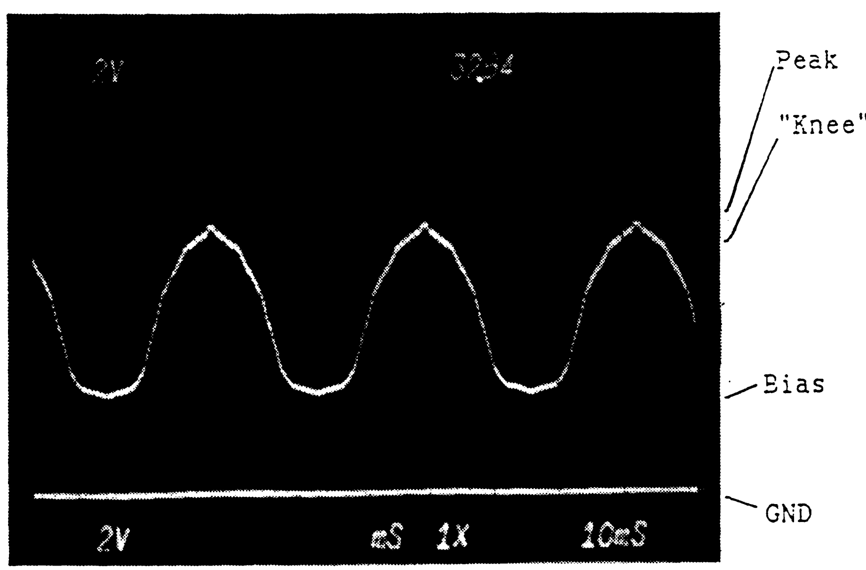


Figure 6-13: Incorrect SFC Waveform.

RV101 adjusted too high; RV102 too low.

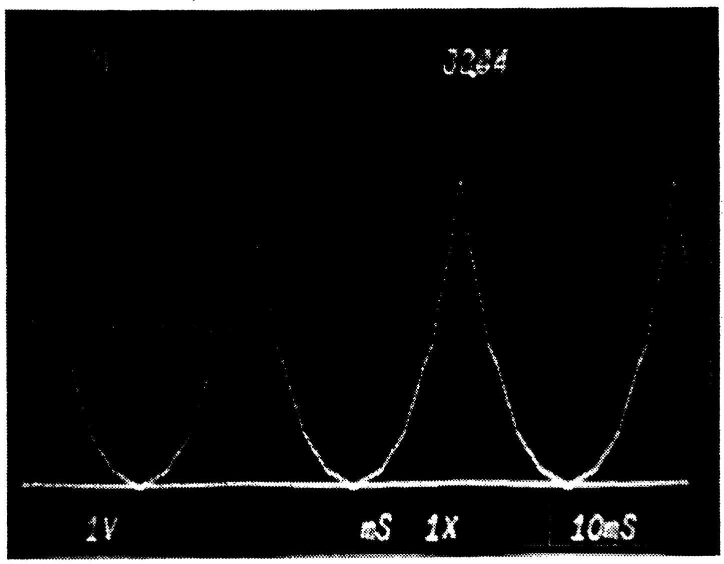


Figure 6-14

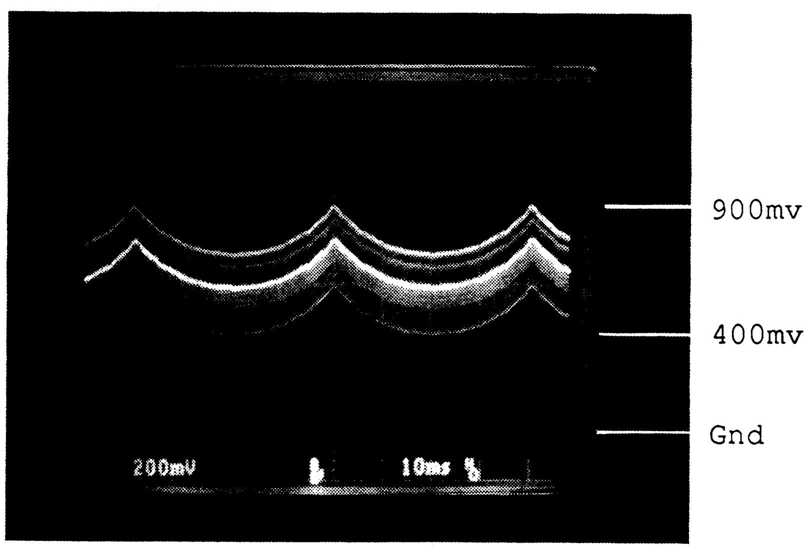


Figure 6-15

6-5-4 Focal Zone Equalization and Switching noise Reduction

Set up the RT3600 for normal operation. Connect a B-type transducer to the console. Suspend the transducer in air.

a. Disconnect the Analog TGC connector. (A8MST)

b. Turn on the system. Select "AUTO" and "SCAN".

c. **Increase systems gain to a level that will cause** noise to appear in the display **(approx.56 db)**.

d. Place the transducer in the **drawer in front of the** transducer connector and close the cover. This will minimize external noise and maintain a normal termination for the receiver.

e. Rotate the CRT unit so that it can be seen from the rear of the console.

f. Examine the noise image. Locate the focal zone boundaries from the switching spike noise lines appearing horizontally across the image.

g. In this procedure, channel A and B are treated independently but they must match each other. Disconnect jumper J5B to adjust channel A. This will produce a darker image on the screen.

h. The first step is to reduce spike noise caused by switching from one focal zone to another.

i. The faint white horizontal lines are the switching spikes. The intensity of these lines can be reduced by certain adjustments.

The adjustment points are described in the following chart:

	Zone 1 to 2	Zone 3 to 4	Zone 3 to 4
Channel A	RV3A	RV4A	RV5A and RV6A
Channel B	RV3B	RV4B	RV5B and RV6B

The most critical of the adjustments is for the Zone 3 to 4 boundary. This is where echo signals are most faint.

NOTE: RV5 and RV6 interact with each other, so adjust one than the other and return to the first to see if any improvement can be made.
This may have to be done several times. Then proceed to RV4 and RV3.

The results of the adjustment is to reduce the spikes.
It may not be possible to eliminate them, just minimize them as much as possible.

j. When Channel A and B have been adjusted, replace jumper plug J5A, **and J5B.**

NOTE: Use care in the following adjustments.

6-5-4A Sector Channel Adjustments

This is the system level adjustment to set the most appropriate value of RV11A for sector followed by zone equalization adjustments.

a. **Turn the RT3600 power off.**

b. **Remove the back panel and disconect the fan power line.**

c. **Place the A7 on an extender to allow access to Tp12 A and B.**

d. **Connect a B-Probe to the console and power on.**

e. Connect ascope to Tp12 and compare to **Figure 6-15A**

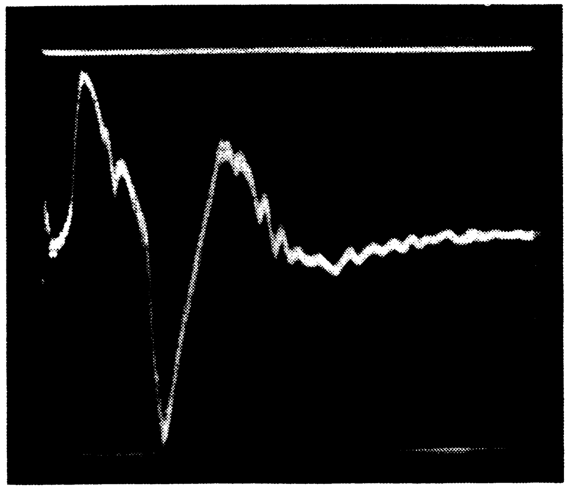


Figure 6-15A
200mv/devision

Probe 2
select
B Probe

1.5v pp

f. Measure the output of TP12A and record.

g. Adjust RV11A so that the output of TP12A is **equal to Figure 6-15a**

h. Connect a linear probe to the console and with the console in **Scale x1** scan either a phantom or air. It is possible that the linear image will have vertical lines in Focal Zone 1 due to the adjustment of RV11A. If this is the case, these lines can be reduced/eliminated by using RV11B.

NOTE: Disconnect the Analog TGC controls from the A8 MST board before doing section **i through k.**

i. Scan a phantom.

j. Adjust as follows:

1. Focus Zone 1 Equalization of Ach & Bch. **(scale x2)**.

   On an image, equalize Ach & Bch by adjusting RV11B to match RV11A.

2. Focus Zone 2 Equalization and Matching **(scale x 1.5)**.

   Equalize Ach & Bch by RV0A and RV0B, and adjust the brightness of Focus Zone 2 to Focus Zone 1 by RV0A and RV0B.

   You must adjust Equalization & Matching at the same time.

3. Adjust Focus Zone 3 and 4 same as above, by RV1A, 1B, 2A and 2B **(scale x 1)**.

6-5-5 M-Mode Adjustments

a. Disconnect transducer.

b. Select "AUTO".

c. Connect a DVM positive lead to the "plus" side of R34A; connect the negatiave lead to ground. Adjust RV112 (M-REJ) for a voltage level of +2.45 ±.05v.

d. Move the positive lead to the "plus " side of R39A. Adjust RV113 (M-BRT) for 2.0 ± .05v change

e. Connect the positive read to the "plus" side of R57A, Adjust RV114 (Bright) for 0.16 - 0.18v (0.17 ± .01v)

f. With the linear probe still connected, set the console as follows:

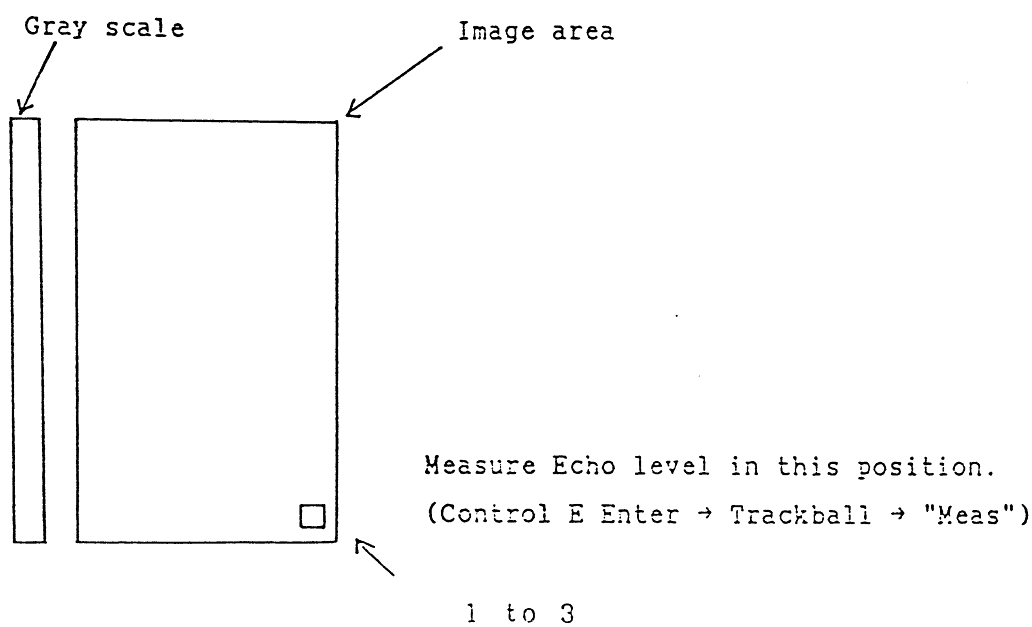
Scale	X1
Gain	50 dB
TGC	**disconected**
Focus	3

Do a free air scan, and using the CONTROL E function, do an echo level measurement at 15 cm (B probe).

If the value is 1-3, the adjustments are complete. If not, use RV114(B mode Brightness) on the A7 to set the reading to 1-3.

0.16-0.18v - R57

0.17 ± .01v



6-5-6 Analog TGC Adjustments

Remove the Analog TGC Module

a. Loosen the two screws that attach the TGC module to the console.

b. Remove the side panel of the TGC module.

c. Connect a B-type probe to the RT3600.

d. Turn system power on. Set scale to "x 0.7".

e. Allow 10 minutes for warm-up.

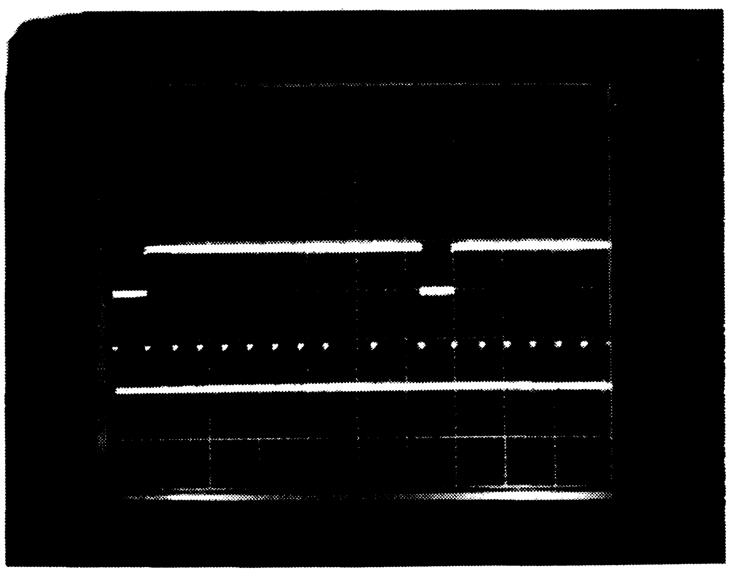
Timing Pulse Adjustment

a. Connect channel 1 of an oscilloscope to TP4.

b. Connect channel 2 to TP1.

c. Set both channels to 5V/div. and 50μ sec/div. Obtain trigger from channel 1.

d. Adjust RV1 so that ten pulses appear at channel 2 with the first pulse to coicide with the rising edge of the pulse seen on channel 1 and the tenth pulse to coicide with the falling edge of the pulse seen on channel 1.



Output DC level Adjustment

a. Move all slide potentiometers to their maximum (right hand) position.

b. Connect a digital voltmeter to TP2. Ground at TP3.

c. Adjust RV2 for -2.482 ±25mV at TP2.

6-6 A8 Master Controller Adjustment and Checks

6-6-1 General

Because the A8 card is largely digital, there are very few adjustments that can be made. If an adjustment will not bring a certain parameter within tolerance, proceed to **Diagnostics**.

6-6-2 DIP Switch Setting

a. Locate the DIP switch at board location 14B.

b. All switches should be on except 8. The off position of switch 1 provides the sector lockout ability . Switch 8 should be off for machines located outside Japan.

c. The following table lists the function of each switch:

SW. No.	Function	OFF	ON
1	Linear/Sector	Linear only	Linear/Sector
2	Self Diagnostics	Start	No action
3	Not used	___	___
4	Not used	___	___
5	Not used	___	___
6	Not used	___	___
7	Not used	___	___
8	Gestational Data Table	U.S.	Japan

6-6-3 RTC Oscilloscope Frequency Adjustment

NOTE: Perform this adjustment only after the machine has been turned on for at least 30 minutes.

a. Enter service software with the **"CONTROL S! ENTER" command**

b. Select the RTC interrupt disable routine by pressing "CONTROL S T ENTER".

c. Connect an oscilloscope to U14C1 pin 8. Measure the period of the square wave.

d. The period of the square wave should be within a range of 249.9998μ sec. to 250.0002 msec.

e. If the period is out of tolerance, adjust trimmer capacitor A8C13A1 (A8C14A1 on A8 MST) for the proper period.

6-6-4 CPU Clock Frequency

There are two microprocessors on A8. The master controller is U02H1; the ultrasound scan controller is U18F1. The following procedure will verify the proper clock frequency for these microprocessors.

a. Connect an oscilloscope to pin 37 of the microprocessor, Pin 37 is "clock out".

b. Connect the scope probe ground lead to the negative terminal of C01A1.

c. The clock frequency should be 4.000 ±0.0002 MHz (U02H1)
and 5,000 ±0.0002 MHz (U18F1)

6-6-5 MFC Shutter

a. Power up and select "CONTROL M ENTER".

b. Connect the oscilloscope to U14J1 pin 5 and the negative terminal of C01A1.

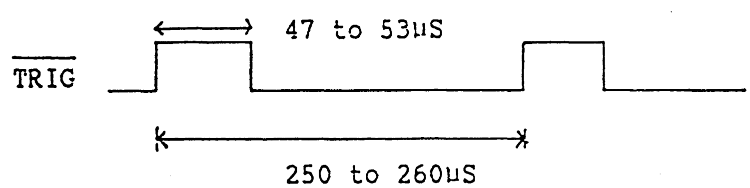
c. Press "RECORD" several times and verify the period of the waveform is 1,000 ±30msec.

6-6-6 TRIG Signal

a. Connect the oscilloscope to U29H1 pin 12. Connect the scope ground lead to the negative terminal of C01A1.

b. Turn the system on, select "SCALE X1". Connect a B-type probe.

c. Verify the TRIG signal is within the limits shown below:



6-6-7 TRIG, DTRIG, SEL, LATCH Signals

All signals are fouund on the A8 board. All components called out in this procedure can be found in the schematic drawing for A8 MST on page 15.

a. Connect a B-type probe and power up the RT3600.

b. Select "SCALE X1".

c. Connect an oscilloscope to U29H1 pin 12 (TRIG). The oscilloscope settings should be 5V/div and 50µ sec/div.

d. Verify the waveform for TRIG is an shown in Figure 6-28.

e. Connect the Channel 2 of the scope to U29J1-10 (DTRIG).

Trigger on TRIG. See Figure 6-28 for the proper waveform.

f. Move the Channel 2 probe to U29J1-3 (LATCH). Change sweep rate of the oscilloscope to 1 μsec/div. See Figure 6-30 for the proper waveform.

g. Move the Channel 2 probe to U29J1-6 (SEL). See Figure 6-30 for the proper waveform.

1 TRIG

2 DTRIG

3 SEL

4 LATCH

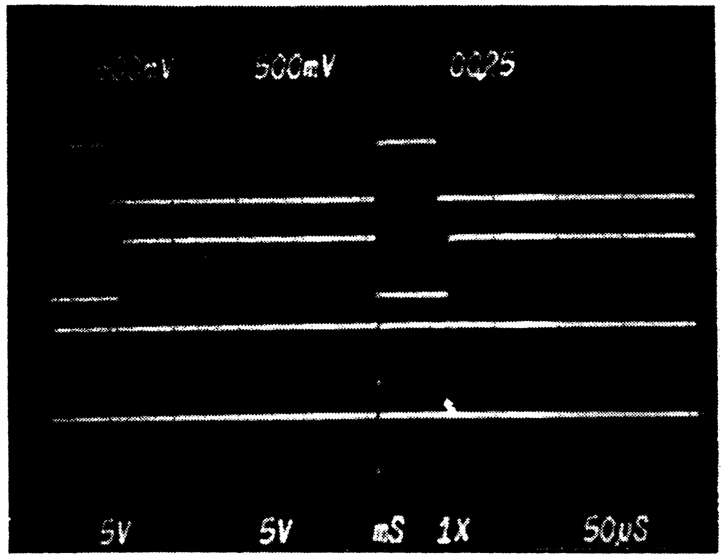


Figure 6-28

1 TRIG

2 DTRIG

3 SEL

LATCH

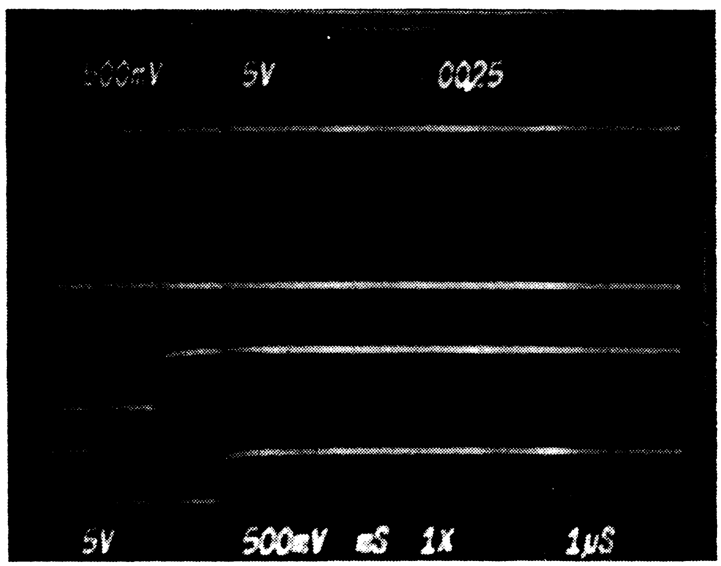


Figure 6-30

6-6-8 D/A Reference Voltage

Refer to schematic A8 MST, page 11.

a. Connect a digital voltmeter to U09K1-2. Connect to the negative terminal of C01K1.

b. Verify the voltage level is 2.5v ±0.025V.

6-6-9 TGC, TFC, and SGC

a. Connect channel 1 of the oscilloscope to U29H1 -12 (This signal is TRIG. Refer to the A8 schematic drawing page 15). Set the vertical scale to 5V/div.

b. Connect channel 2 of the oscilloscope to U12K1-7(refer to A8 schematic page 11). Set the vertical scale to 0.5V/div.

c. Set the horizontal scale to 50µsec/div. and trigger on channel 1.

d. Connect a B-type probe and power up. Select "SCALE X1".

e. Verify that a TFC waveform appears.

f. Move the channel 2 probe to U12K1-7 refer to A8 schematic page 11). Set the vertical scale to 0.2v/div.

g. Select "FOCUS" 1 through 4. For each FOCUS, verify a waveform as seen in Figure 6-34 through 6-37.

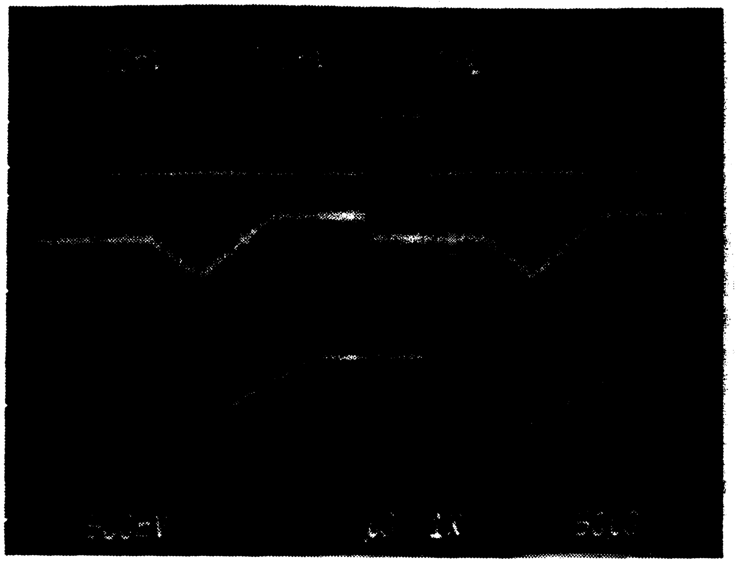
h. Select COMB focus. Verify a waveform as seen in Figure 6-38.

NOTE: Perform the following steps if the console is set up for sector operation .

i. Remove the B-type probe and connect a sector probe.

j. Leave channel 1 of the scope on TRIG. Connect channel 2 to U15H1-4. Trigger on channel 1 (schematic page 11).

k. Verify the SGC waveform appears as shown in Figure 6-39.



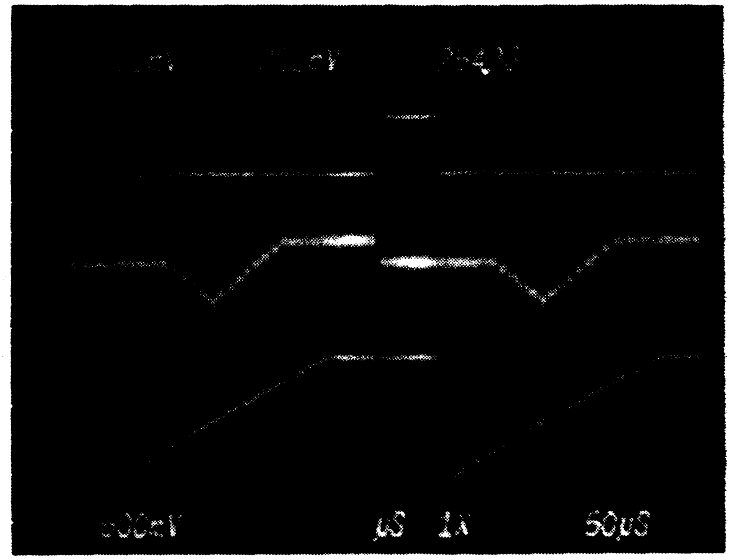
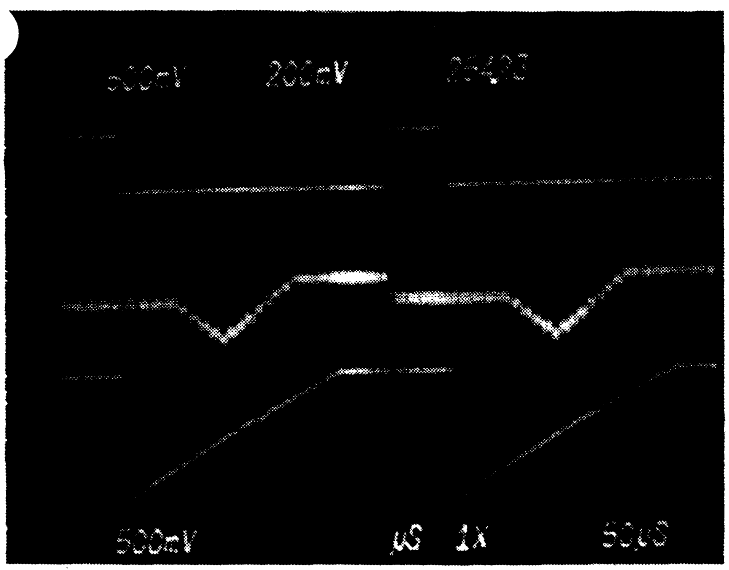


Figure 6-34 Figure 6-35



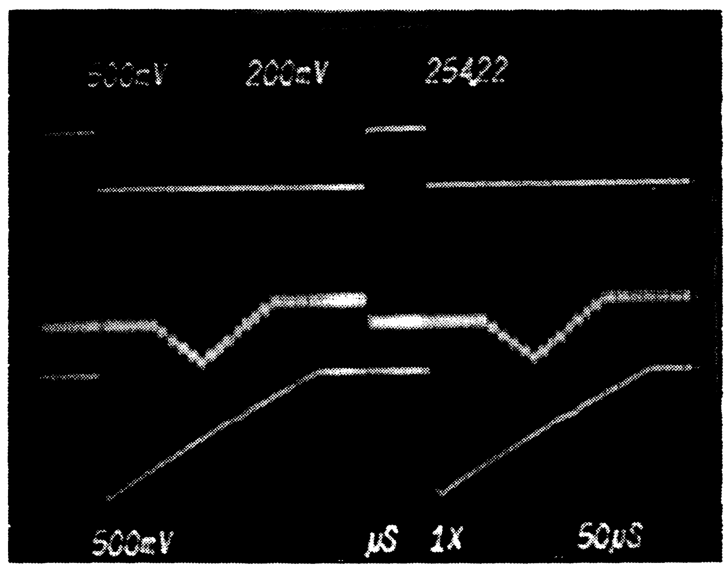


Figure 6-36 Figure 6-37

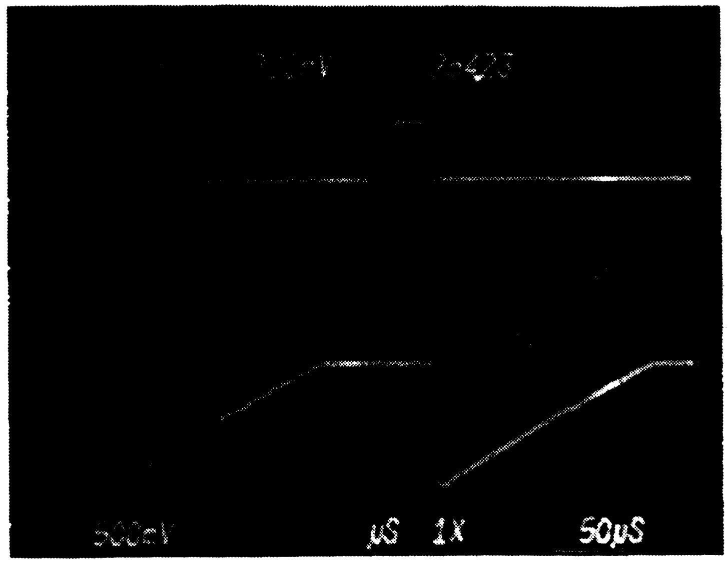


Figure 6-38

6-7 Frame Memory Video Output Circuit Adjustment

6-7-1 General

The digital scan converter used in the RT3600 is under control of the master controller CPU. The scan converter has its own set of control ROM. There are very few adjustmetns in the scan converter system. The exception is the video ouitput circuit which follows the D/A converter.

6-7-2 A/D Reference Voltage Adjustment

All Components called out in this procedure can be found in the schematic drawing of A10 Frame Memory on page 2 of 25.

a. Connect a digital voltmeter to A10U7H pin 3 for Ach or pin 5 for Bch.

b. The proper voltage level is 2.75 $\pm$0.25V

c. If out of tolerance, adjust R7F2 while chekcing A10U7H-3, adjust R7F4 while checking A10U7H-5.

6-8 Visual Monitor Adjustment and Replacement

6-8-1 Disassembly

The monitor can be adjusted when it's covers are removed.

a. Remove the rear panel screws. Pull the top cover back and up. See Figure 6-76.

NOTE: If replacing a Monitor follow step b. and c. If not, proceed to adjustment.

b. To remove the bottom cover, the wires entering the monitor from the console must be disconnected. The connector is beneath the monitor. See Figure 6-77.

c. Turn the monitor 90°. Pull the monitor up and away from the mount.

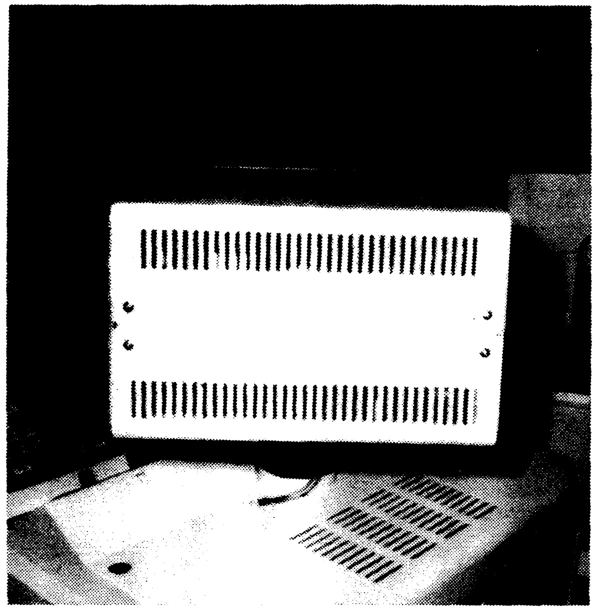


Figure 6-76

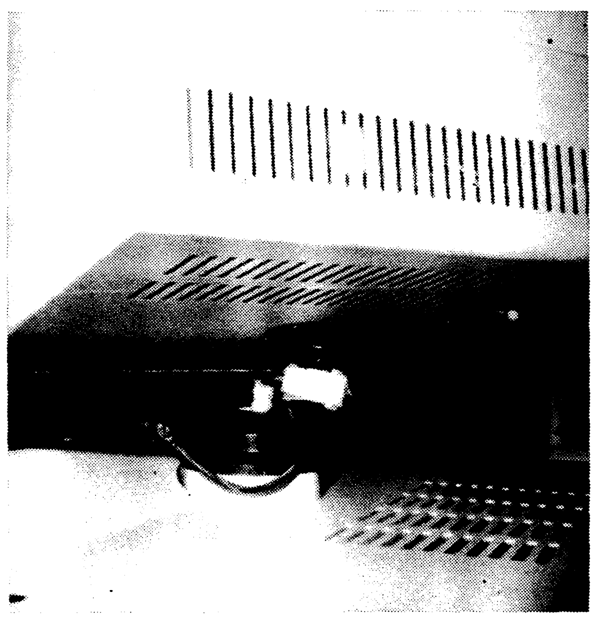


Figure 6-77

Adjustments should be done after selecting the grid test pattern through service software. (Control SL Enter)

d. V-SIZE (Vertical deflection amplitude)

e. V-LIN (Vertical deflection linearity)

These values interact with each other and with V-HOLD. The method of adjusting them is identical to H-WIDTH and H-LIN.

f. V-HOLD (Vertical deflection synchronization)

The vertical deflection oscillator is not phase locked (as the horizontal deflection circuit), but instead is a more simple triggered type. The effect of the V-HOLD control is to maintain the interlacing accuracy of the RS170 system.

Poor interlace accuracy causes a "pairing up" of adjacent video scan lines.

Precise V-HOLD control prevents any pairing and allows uniform scan density to be achieved.

g. SUB-BRIT (supplemental brightness control)

The control limits the range of the operator accessible "Brightness" control. When properly set, a faint overlay image can still be seen when the external brightness control is at its most minimum setting.

6-8-2 Electrical Adjustment of Monitor

The monitor is actually a high quality versioin of a typical black and white television receiver without the audio receiver section. Common TV technology will apply to the monitor.

1. H-HOLD (horizontal sweep synchronization

H-HOLD determines the free-run frequency of the horizontal deflection master oscillator circuit. It establishes the static phase relationship between incoming sync signals and the internal deflection drive. This phase relationship results in a left or right shift of the displayed image. H-HOLD must be kept at a precise level to maintain the synchronism and to achieve correct timing of deflection of the video signal.

To determine if H-HOLD is correct, lower the contrast and turn up the brightness to view the raster edge and video field. Make sure the image field is centered in the displayed horizontal deflection trace area.

2. H-WIDTH (Horizontal deflection amplitude)

3. H-LIN (Horizontal deflection linearity)

These parameters interact through variable inductors connected in series with the deflection yoke. They should be adjusted as necessary to obtain proper amplitude of the deflection and the optimum linearity.

4. FOCUS

Adjust FOCUS so that the raster lines at the center of the screen are distinct thin lines. The brightness level should be 50% or less of the maximum level when FOCUS is being adjusted.

5. Centering Magnets

The centering magnets are a pair of ring magnets behind the deflection yoke. When properly adjusted, the video field will be centered and correctly aligned with the screen.

The magnets provide minimum effect when their tabs are aligned; maximum effect when the tabs are 180° apart. See Figure 6-79.

6. **Yoke Angel**

If the image appears skewed within the screen, the yoke angle requires adjustment. To accomplish this, perform the following steps:

a. Loosen the screw clamping the tail of the yoke assembly.

b. Rotate the yoke for the correct orientation.

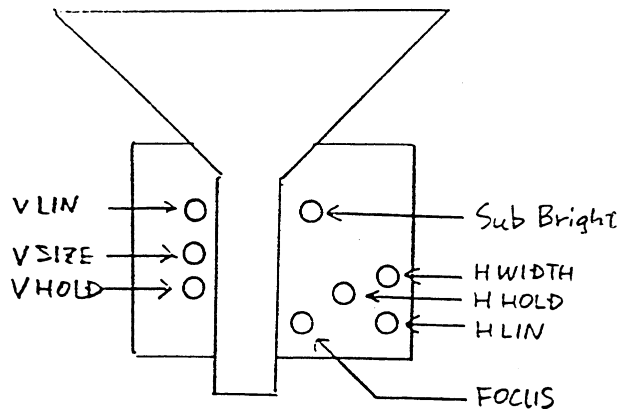
c. Retighten clamping screw.

NOTE: Make sure the yoke touches the funnel of the CRT valve.

DO NOT overtighten the clamping screw.

NOTE: DO NOT move the tiny magnets on the yoke assembly.

They are factory aligned for edge distortion compensation.



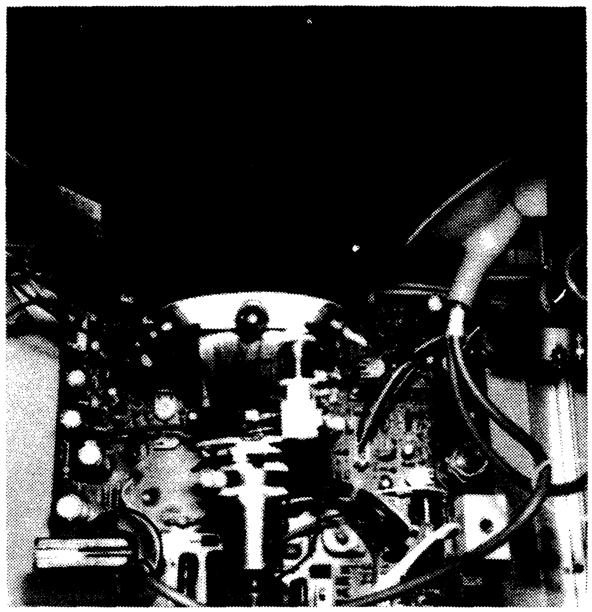


Figure 6-79

6-9 Polaroid Monitor and Camera adjustments

6-9-1 General

The CRT monitor used with the Polaroid camera is very similar to the viewing monitor except for size. The adjustments are nearly identical.

6-9-2 Disassemlby

To remove the camera, remove the analog TGC box and loosen the screw at the top of the camera mount. While carefully removing the camera from the mount, disconnect the shutter actuator cable.

To remove the Poraroid monitor :

a. Remove the two screws holding the keyboard panel assembly. These are captive screws. Raise and latch the keyboard panel assembly.

b. Remove the left (as seen from the front) side panel.

c. Remove the screws holding the monitor to the console frame.

NOTE: The monitor will not drop when the screws have been loosened . A plate underneath the monitor will support it.

f. Pull the monitor out from the front of the console.

To replace the monitor, first attach the monitor housing to the side panel of the console. Then attach the hood to the bottom wall of the keyboard panel assembly. Tighten all screws gradually to prevent strain on the monitor and hood.

6-9-3 Polaroid CRT Monitor Adjustment

The procedure for adjusting the Polaroid **monitor is very similar to** those for the viewing monitor. Adjustment points are on a circuit board within the monitor mount. Refer to Figure 6-79a.

NOTE: The Polaroid monitor is designed for use with the Polaroid camera and NOT direct viewing. Verification of correct or inadequate adjustment should be based on Polaroid print- not visual observation.

6-9-4 Adjustment of Camera Optics

Polaroid shutter control is performed by electronics in the main console. The only adjustment to be done to the camera itself is to the iris opening. Typical settings are as follows:

Polaroid type 667 film 16

Polaroid type 611 film 8

If these settings do not provide optimum prints, perform the following:

a. Set the Polaroid monitor contrast setting at 5.

b. Enter service software and select the gray scale test pattern.

c. Take a photo.

d. Keep contrast constant. Vary the iris opening and take a photo at each new setting.

e. Examine each photo for the best density. The iris opening for the picture with the best density should be used.

6-10 Rear Panel Replacement

6-10-1 General

The RT3600 includes a hospital guide isolation transformer inside the console. It is possible to wire the transformer to accomodate any input power line voltage. However, because different connectors are used with the different input voltages, the rear panel and power cord must be change when modifying the RT3600 for various voltages.

6-10-2 Rear Panel Disassembly

The rear panel can be removed when the four screws indicated in Figure 6-111 are removed. To completely separate the rear panel from the console, it is necessary to disconnect the signal cables coming from the motherboard. To access the motherboard, the transducer connector and cosmetic cover must be removed .

Each version of the rear panel includes a nondetachable power cord and plug.

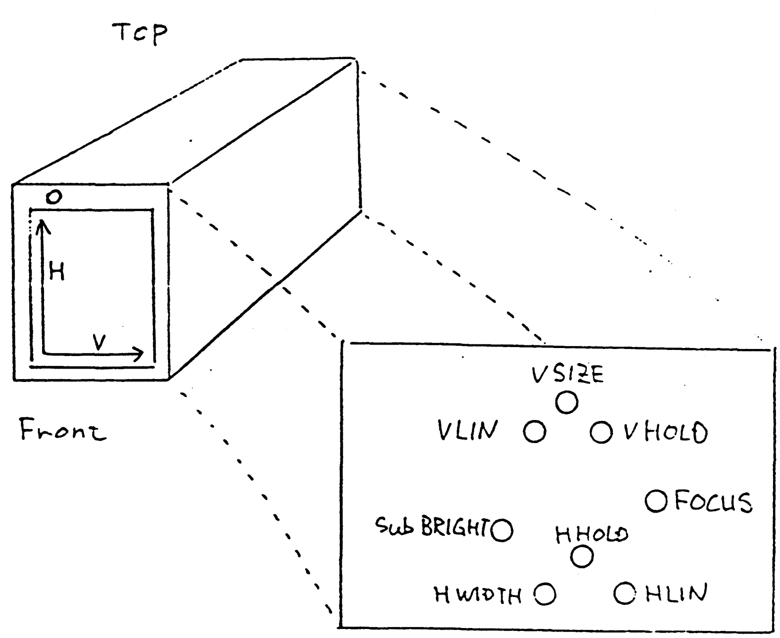
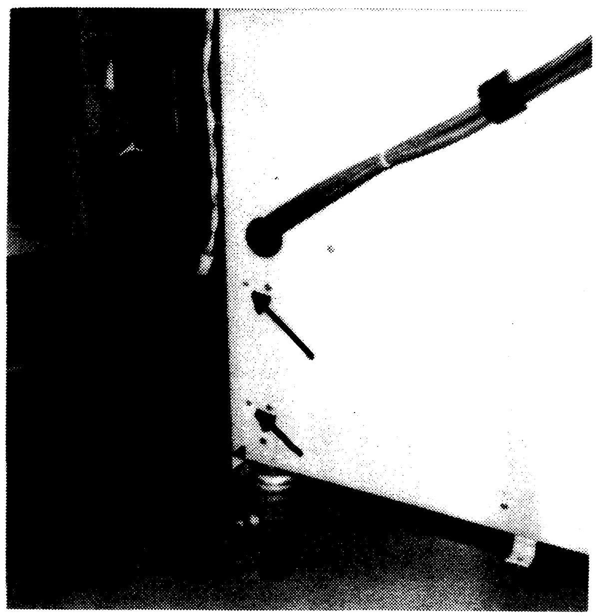


Figure 6-79a



(Two screws each end)

Figure 6-111

6-11 Keyboard Replaclement

To remove the keyboard from the mainframe, perform the following:

a. Remove the TGC box.

b. Remove the Polaroid camera from the mount .

c. Loosen the two captive screws along the bottom of the keyboard.

d. Raise and latch the keyboard.

e. Loosen the 8 screws indicated in Figure 6-101.

f. Two circuit boards and the touch panel sheet can be removed as an assembly.

g. To separate the two boards, remove the 9 screws indicated in Figure 6-102.

h. To remove the trackball assembly, loosen the 2 screws holding it to the circuit board. Remove the trackball only after removing the two circuit boards.

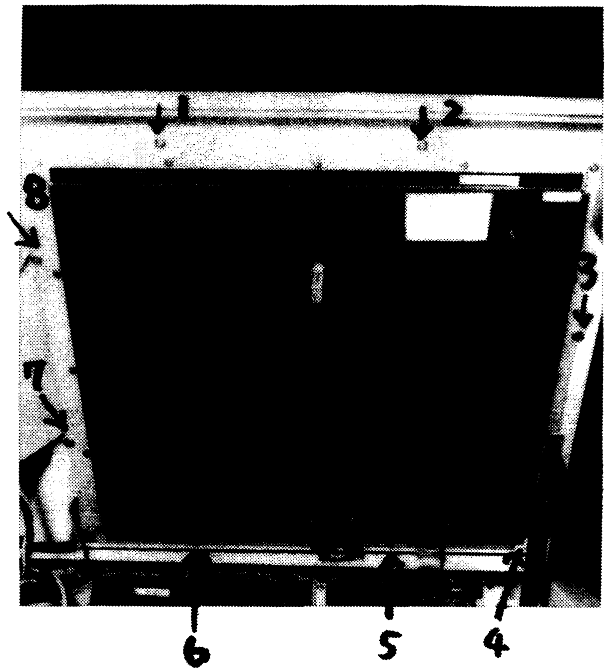


Figure 6-101

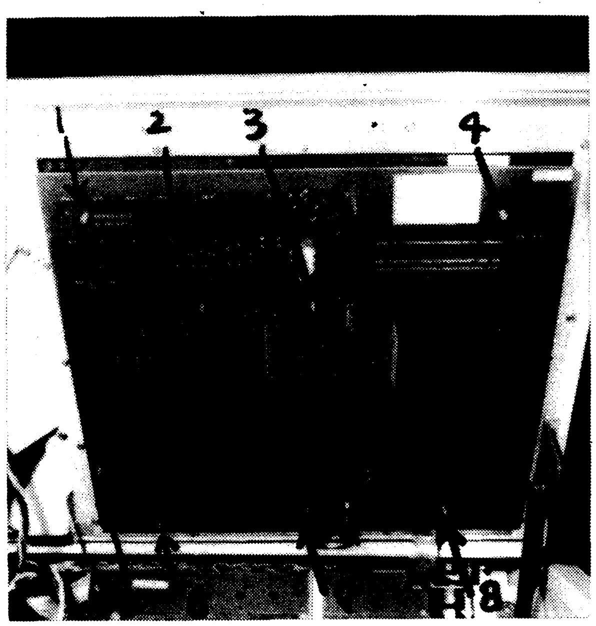


Figure 6-102

6-12 Doppler Unit

Abstract

The Doppler Unit has 16 adjustable devices; however the A51 adjustments require access to a frequency counter if they are to be successfully completed in the field.

Assy	P.N.	Adjustment
A51 DOP	*T1 L1 L2 L3 L4 L5	Rec Tank 7MHz Tank 5MHz Tank 3MHz Tank 2MHz Tank RG CK Tank
A52 HT	RV1	AGL Gain
A53 AUDIO	RV1 RV2 RV3 RV4	SPK Gain ACT Sense BBD Gain RV Attach
A12 FFT	R6A6 R22A4 R22A3 R18A5 R18A4	10V Ref.LSR Gain A/D I Offset A/D I Gain A/D Q Offset A/D Q

* Not adjustable in the field.

6-12-1 A51 DOP Adjustments

The Coherent Oscillator Frequency adjustments and Range Gate Clock adjustment can be made as follows:

a. Preparation

1. Frequency Counter (HP5308A or equivalent)

2. Extender Board (System and Doppler)

3. Core Adjustment Driver

4. Channel Checker

b. Procedure

1. Remove either lead of D29 on A51 DOP.

2. Connect the A51 DOP through Extender Board.

3. Connect the Channel Checker.

4. Connect the probe of Frequency Counter to TP7 for L1, L2, L3 and L4 adjustment and TP12 for L5 adjustment.

5. Adjust required value by Core Driver tool.

NOTE: must be in doppler PD mode.

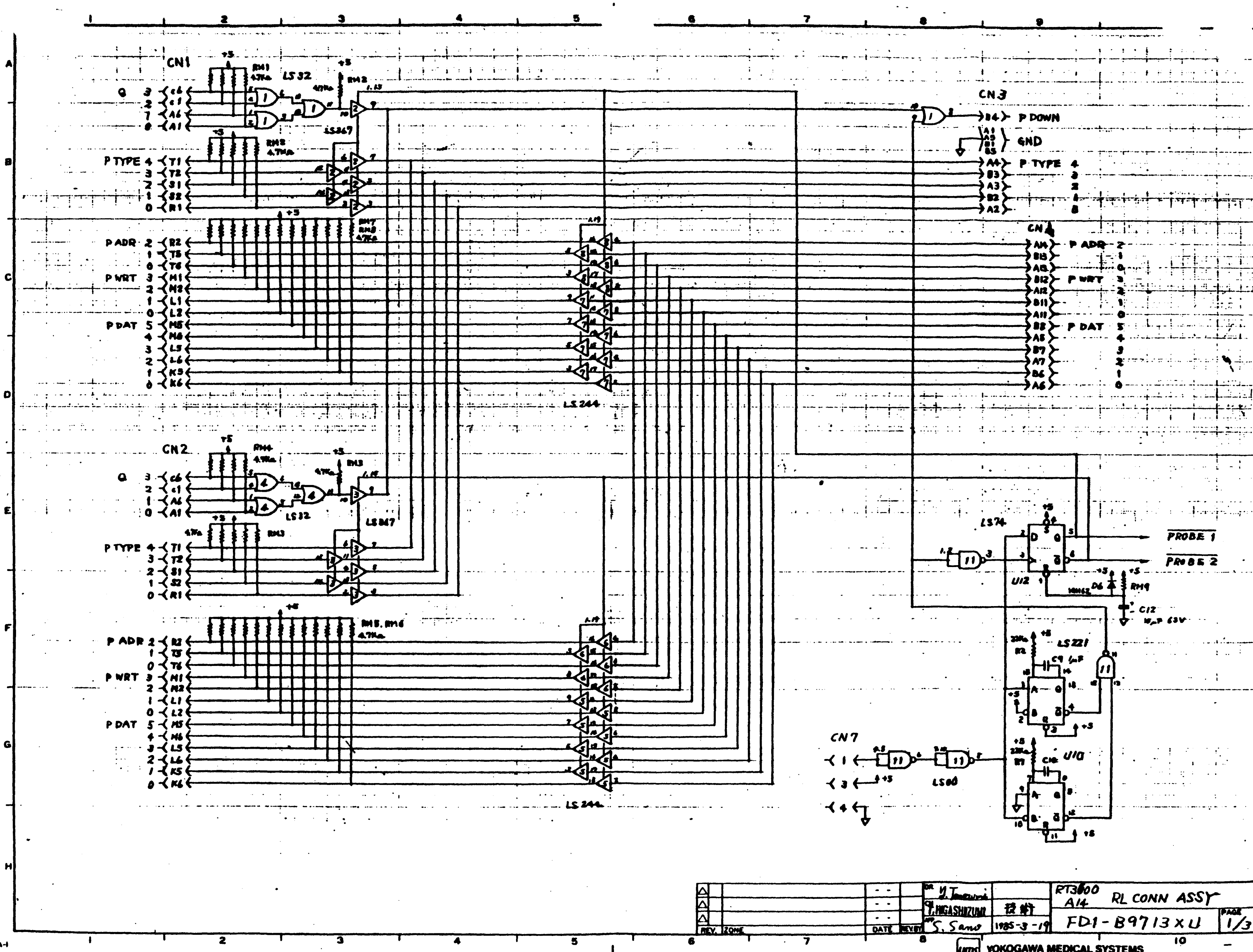
Probe/code	P.N.	Value	TP
Z/00010	L1	7.0MHz ±0.1%	TP7
V/00110	L2	4.5MHz ±0.1%	TP7
U/00111	L3	3.3MHz ±0.1%	TP7
W/00101	L4	2.25MHz ±0.1%	TP7
V/00110	L5	1.54MHz ±0.1%	TP12

6. Reconnect the one lead of D29 on A51 DOP.

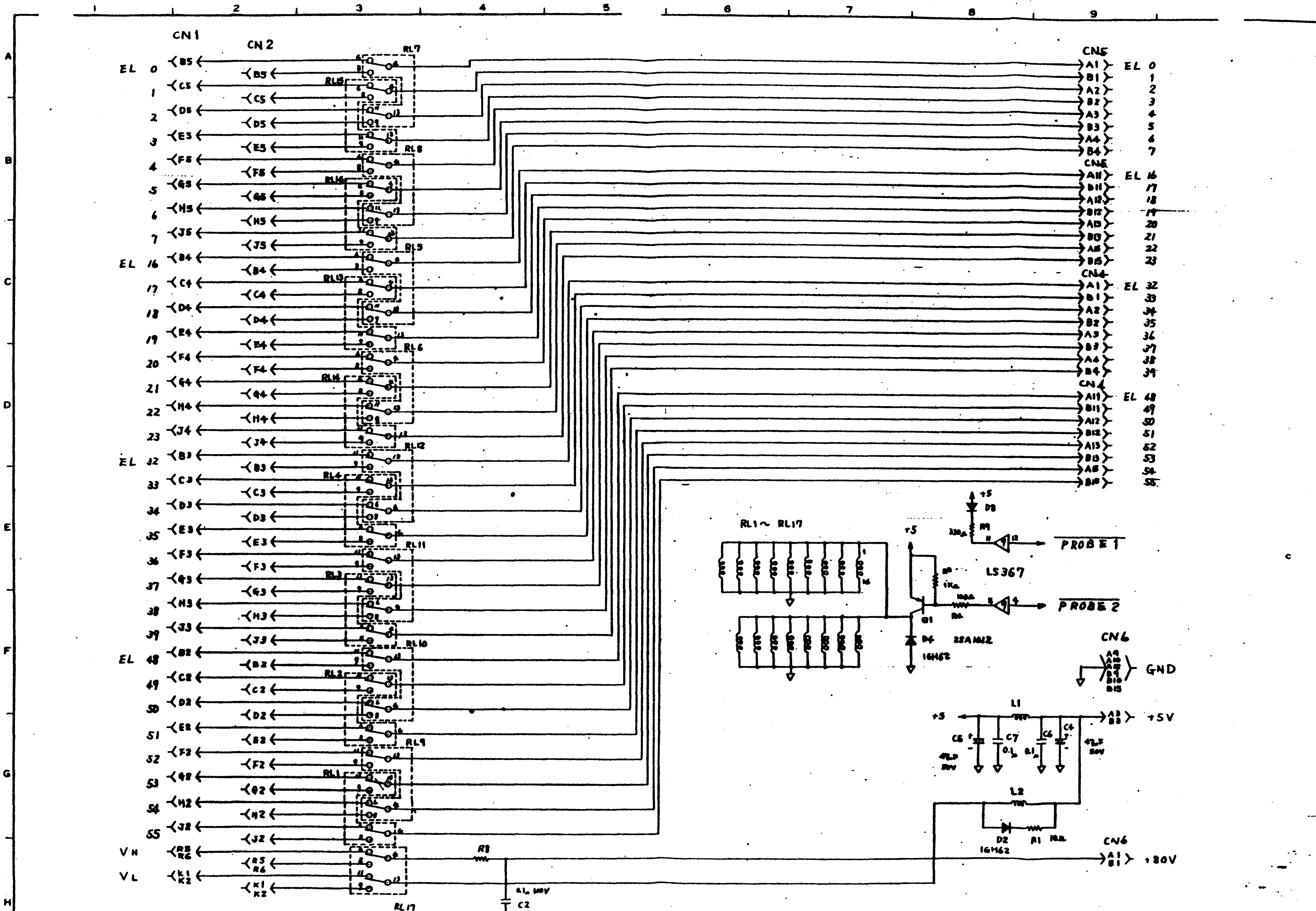
SCHEMATICS

Chapter 7

Schematics

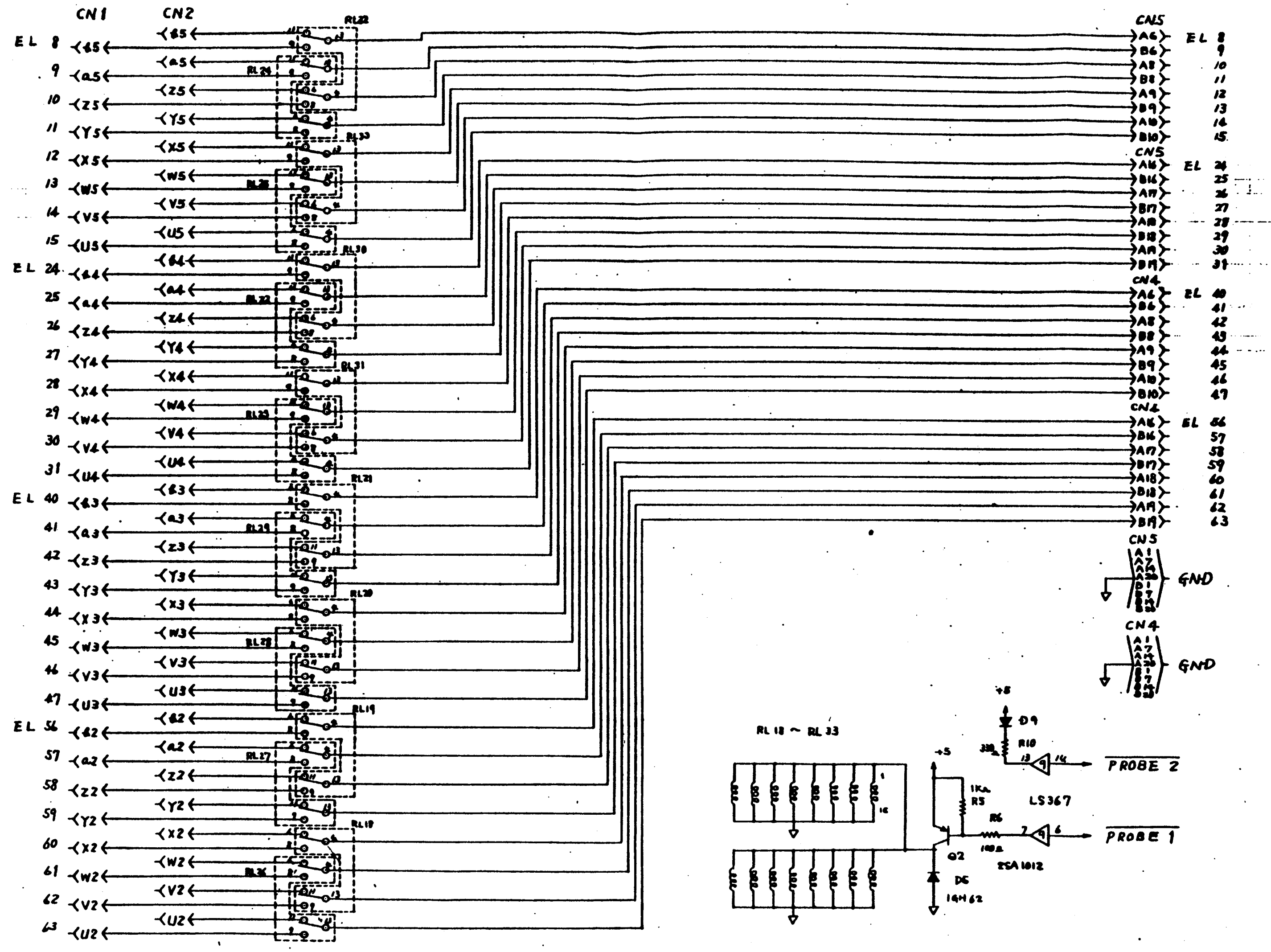


CN1
CN2
CN3
CN4
CN7
Q
P TYPE
P ADR
P WRT
P DAT
P DOWN
GND
PROBE 1
PROBE 2
LS32
LS367
LS244
LS74
LS221
LS00
U12
U10
RT3000
A14
RL CONN ASSY
FD1-B9713XU
1/3
T. HIGASHIZUMI
1985-3-19
YOKOGAWA MEDICAL SYSTEMS

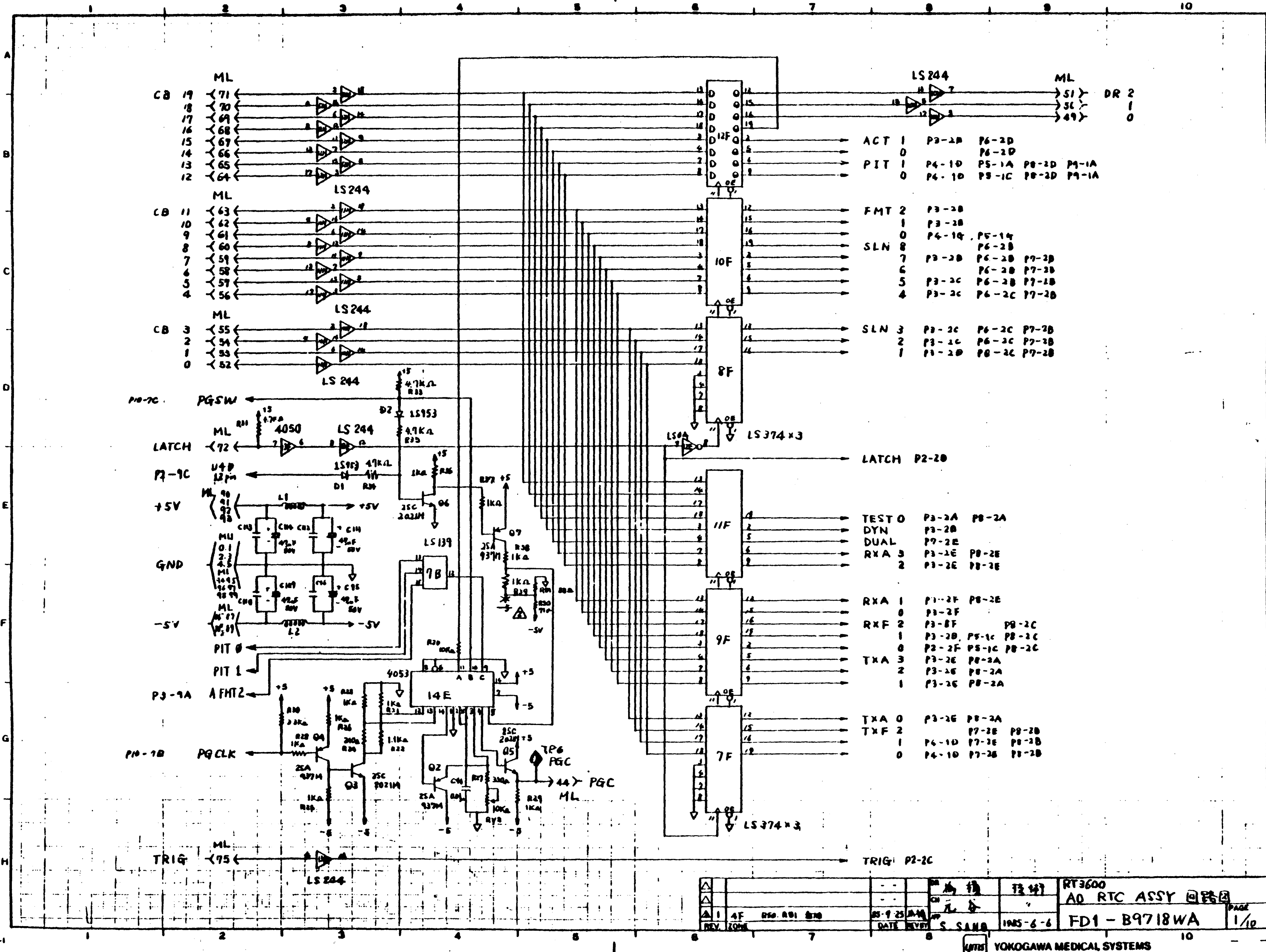


REV	ZONE	DATE	REVBY	DR Y. Tanezumi		RT3600 A14	RL CONN ASSY
				CH T. HIGASHIZUMI			
				AP S. Sano	1985-3-19	FD1-B9713XU	PAGE 2/3

YOKOGAWA MEDICAL SYSTEMS



RT3600 AM
RL CONN ASSY
FD1- B9713 X U
PAGE 3/3
DR Y. Tamezumi
CH T. HIGASHIZUMI
APP S. Sano
1985-3-19
YOKOGAWA MEDICAL SYSTEMS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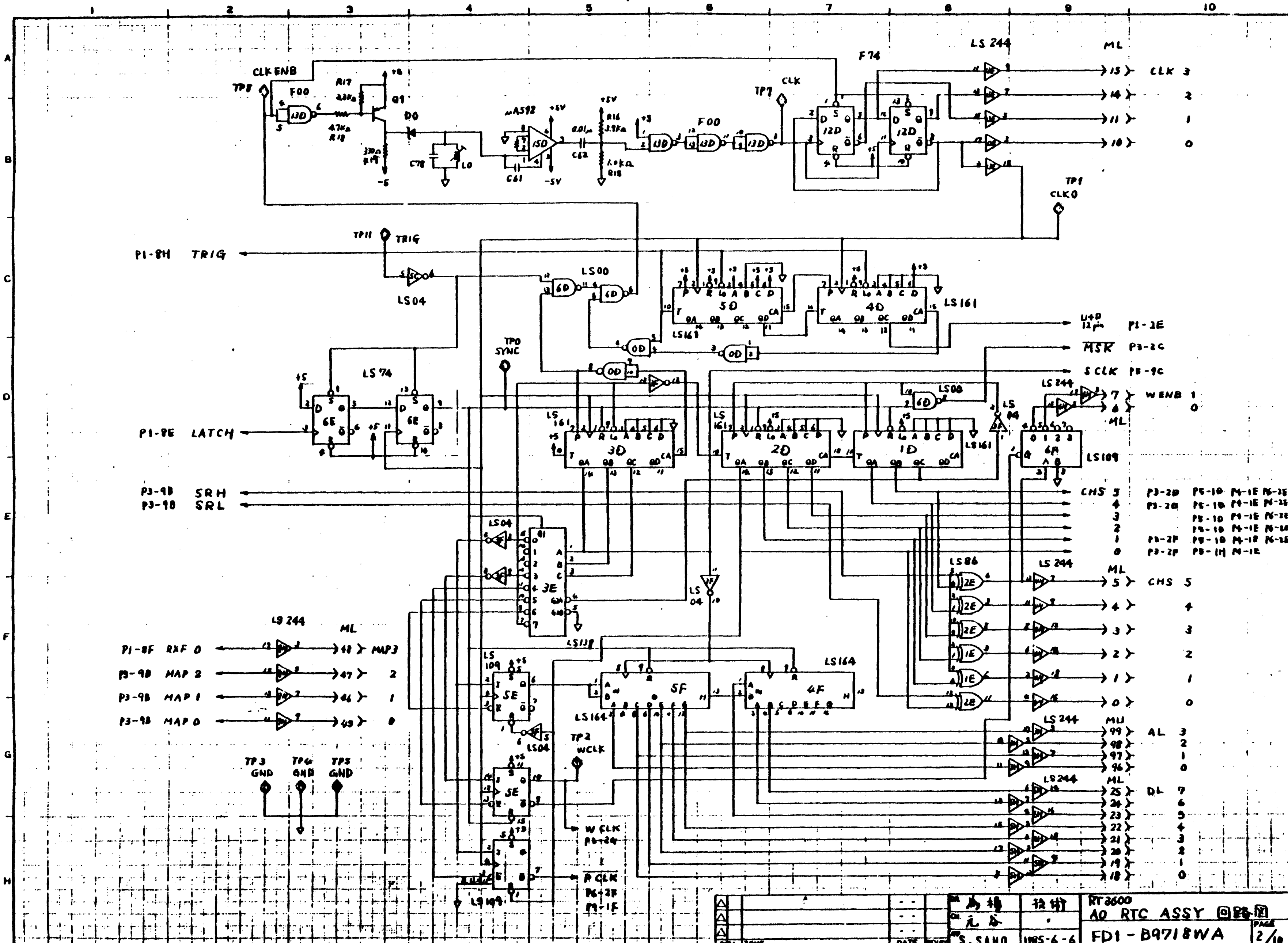
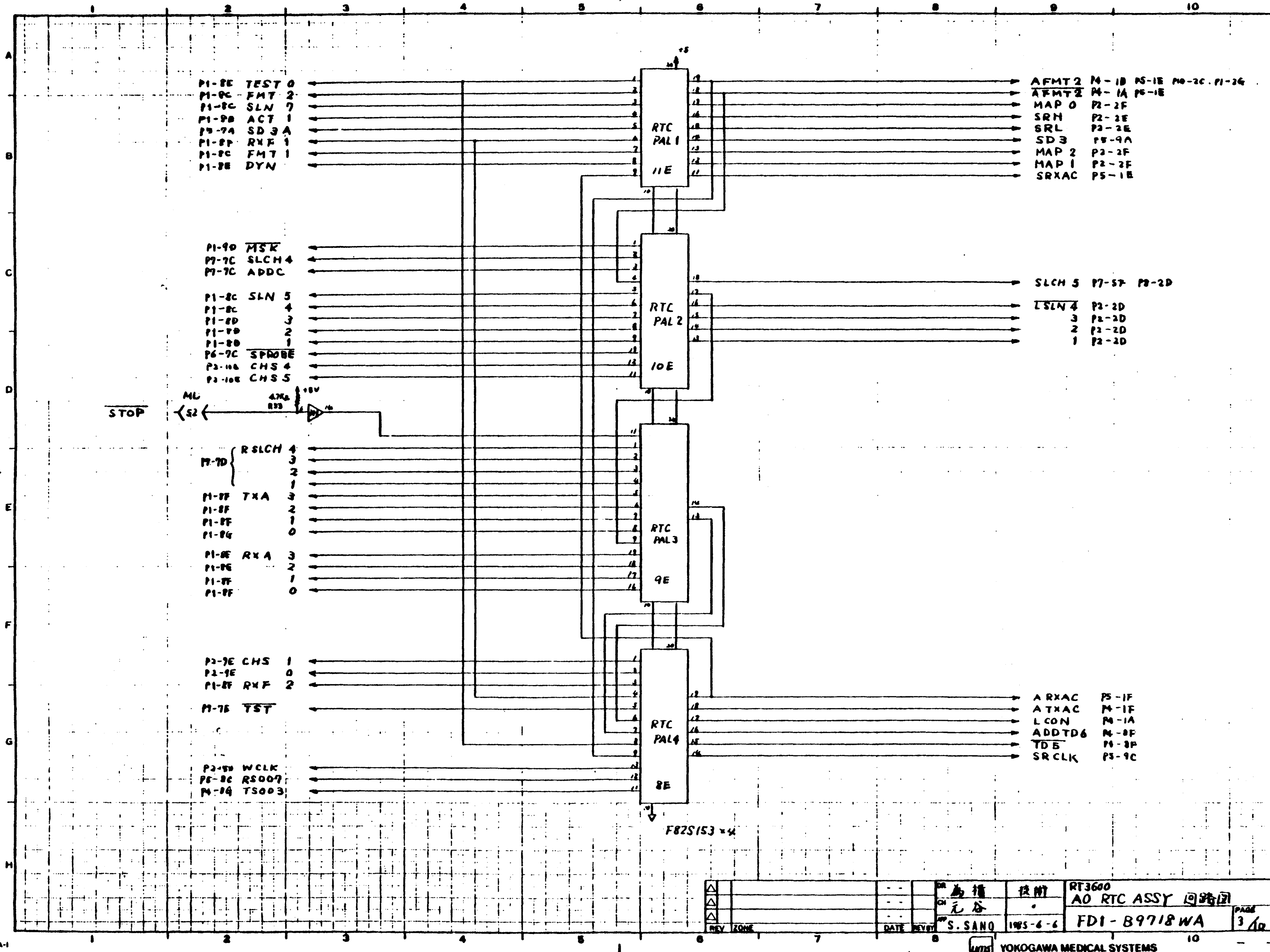
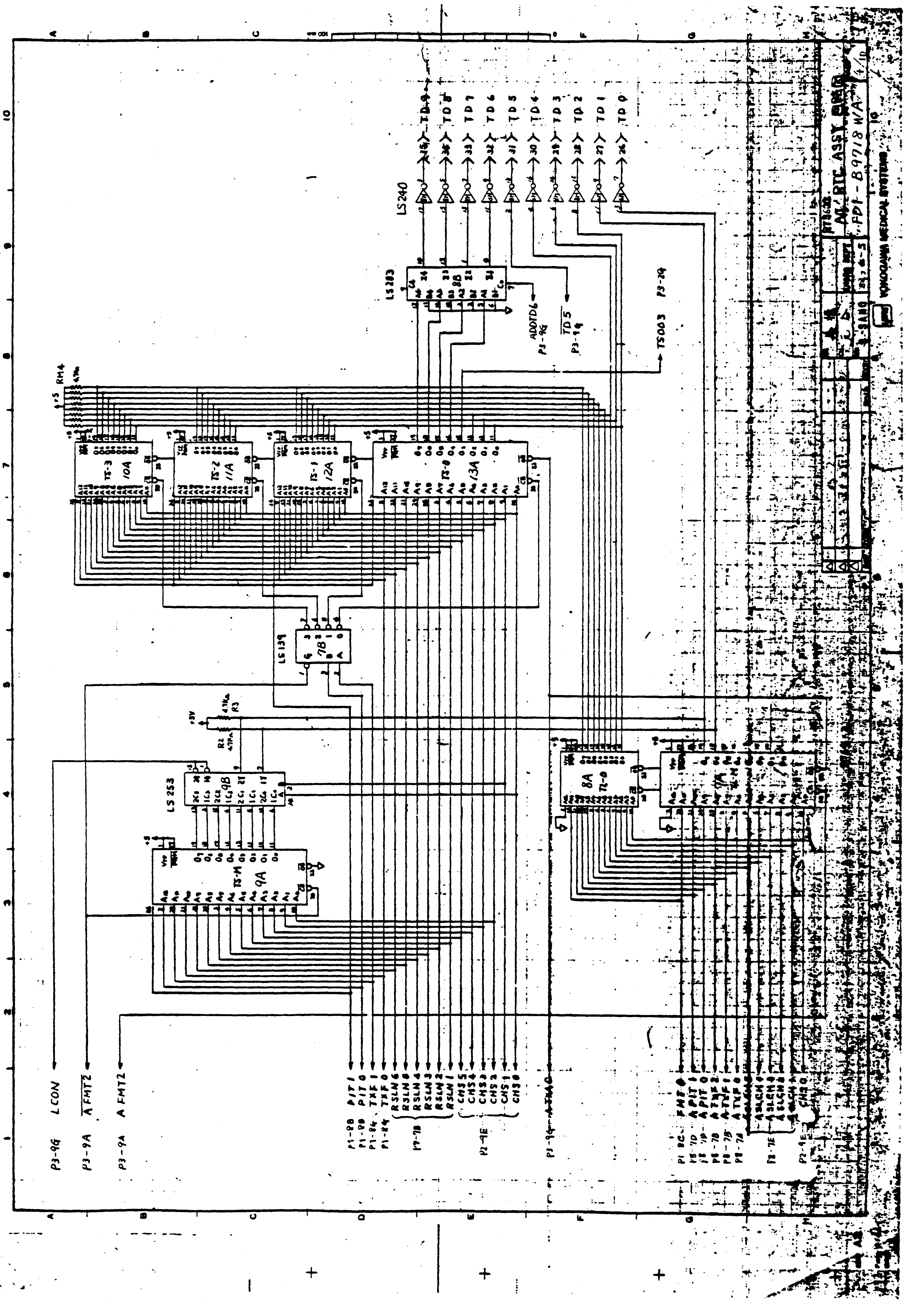
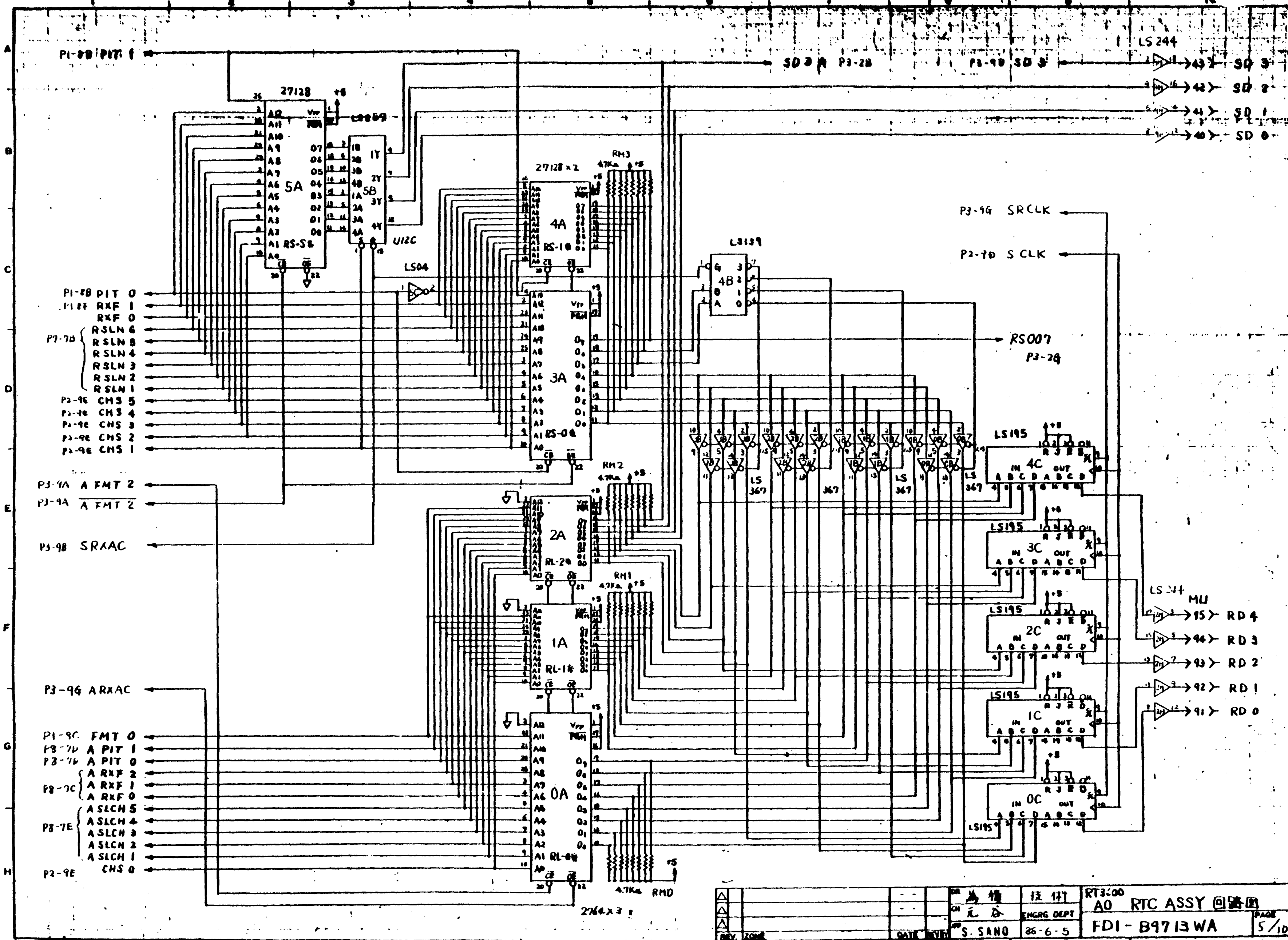
ML 71 70 69 68 67 66 65 64
LS 244
CB 11 10 9 8 7 6 5 4
ML 63 62 61 60 59 58 57 56
CB 3 2 1 0
ML 55 54 53 52
PGSW
LATCH
+5V
GND
-5V
PIT 0
PIT 1
P3-9A
A FMT 2
PG CLK
TRIG
ML 75
4050
LS 139
7B
4053
14E
12F
10F
8F
11F
9F
7F
LS 374 x 3
TP6 PGC
44 PGC
ML
ML 51 50 49
DR 2 1 0
ACT 1 P3-2B P6-2D
0 P6-2D
PIT 1 P4-1D P5-1A P8-2D P9-1A
0 P4-1D P5-1C P8-2D P9-1A
FMT 2 P3-2B
1 P3-2B
0 P4-1Q, P5-1Q
SLN 8 P6-2B
7 P3-2B P6-2B P7-2B
6 P6-2B P7-2B
5 P3-2C P6-2B P7-2B
4 P3-2C P6-2C P7-2B
SLN 3 P3-2C P6-2C P7-2B
2 P3-2C P6-2C P7-2B
1 P3-2D P8-2C P7-2B
LATCH P2-2B
TEST 0 P3-2A P8-2A
DYN P3-2B
DUAL P7-2E
RXA 3 P3-2E P8-2E
2 P3-2E P8-2E
RXA 1 P3-2F P8-2E
0 P3-2F
RXF 2 P3-2F P8-2C
1 P3-2D, P5-1C P8-2C
0 P2-2F P5-1C P8-2C
TXA 3 P3-2E P8-2A
2 P3-2E P8-2A
1 P3-2E P8-2A
TXA 0 P3-2E P8-2A
TXF 2 P7-2E P8-2B
1 P4-1D P7-2E P8-2B
0 P4-1D P7-2E P8-2B
TRIG P2-2C
RT3600
A0 RTC ASSY 回路図
FD1 - B9718WA
1/10
1985-6-6
S. SANO
YOKOGAWA MEDICAL SYSTEMS
SIZE A2

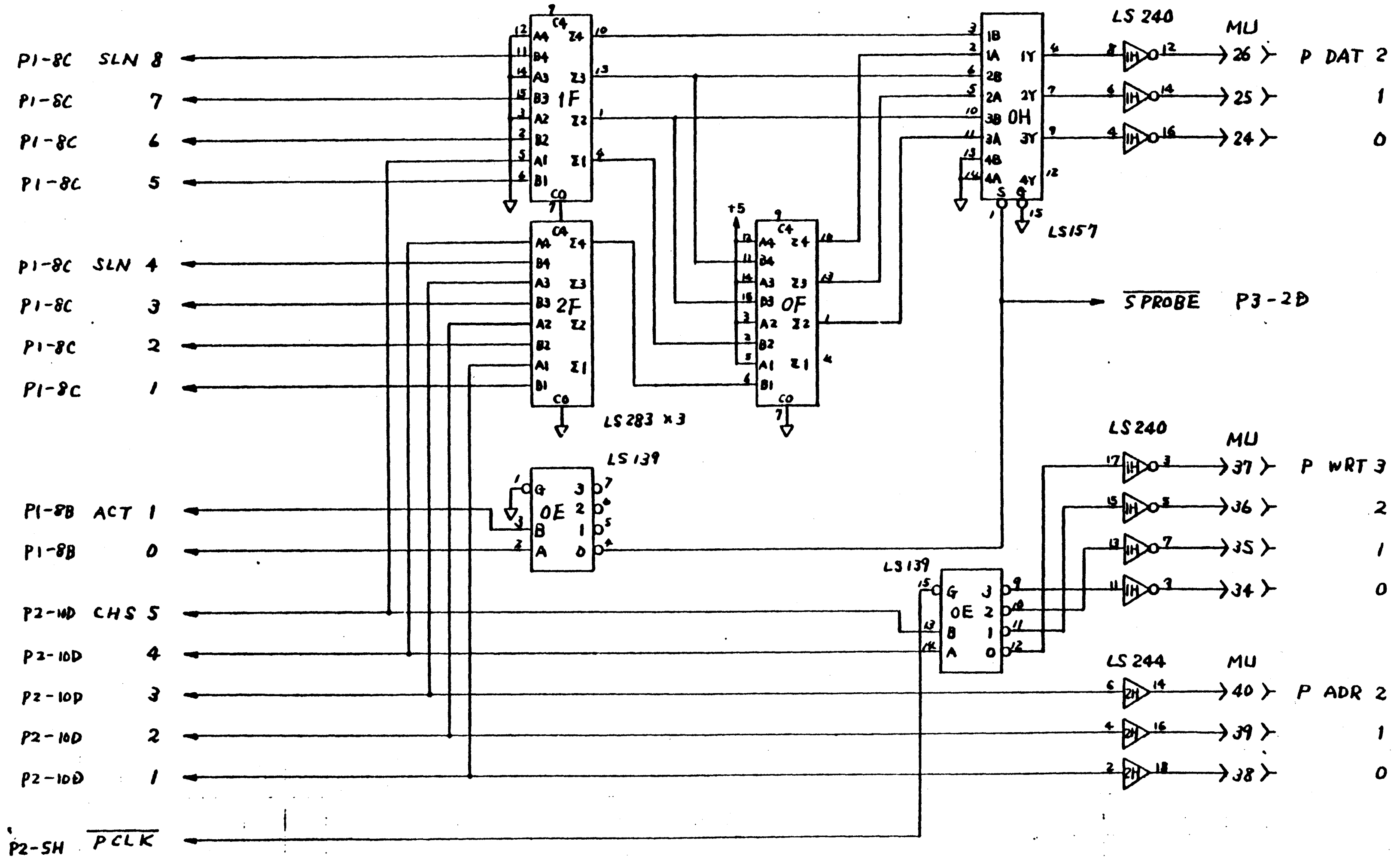


RT3600
A0 RTC ASSY
FD1-B9718WA
S. SANO
1985-6-6
PAGE 2/10
YOKOGAWA MEDICAL SYSTEMS
SIZE A2


RTC PAL1 11E
RTC PAL2 10E
RTC PAL3 9E
RTC PAL4 8E
F82S153 ×4
TEST 0
FMT 2
SLN 7
ACT 1
SD 3 A
RXF 1
FMT 1
DYN
MSK
SLCH 4
ADDC
SLN 5
SPROBE
CHS 4
CHS 5
STOP
RSLCH
TXA
RXA
CHS
RXF 2
TST
WCLK
RS007
TS003
AFMT 2
MAP 0
SRH
SRL
SD3
MAP 2
MAP 1
SRXAC
SLCH 5
LSLN 4
ARXAC
ATXAC
LCON
ADDTD6
TD5
SRCLK
RT3600
AO RTC ASSY 回路図
FD1-B9718WA
S. SANO
1985-6-6
PAGE 3/10
YOKOGAWA MEDICAL SYSTEMS
SIZE A2


LS240
LS283
LS139
LS253
RM4
TD 0
TD 1
TD 2
TD 3
TD 4
TD 5
TD 6
TD 7
TD 8
TD 9
ADDTD6
TS003
LCON
A FMT2
PIT 1
PIT 0
TXF 1
TXF 0
RSLN 6
RSLN 5
RSLN 4
RSLN 3
RSLN 2
RSLN 1
CHS 5
CHS 4
CHS 3
CHS 2
CHS 1
CHS 0
YOKOGAWA MEDICAL SYSTEMS


P1-8B PIT 1
SD 3 P3-2B
P3-9B SD 3
LS244
SD 3
SD 2
SD 1
SD 0
27128
5A
RS-58
5B
U12C
LS04
27128 x 2
4A
RS-18
3A
RS-08
RH3
RH2
RH1
RH0
4.7Kx
LS139
4B
P3-9G SRCLK
P2-7D S CLK
RS007
P3-2G
P1-8B PIT 0
P1-8F RXF 1
RXF 0
P7-7B
RSLN 6
RSLN 5
RSLN 4
RSLN 3
RSLN 2
RSLN 1
CHS 5
CHS 4
CHS 3
CHS 2
CHS 1
P3-9A A FMT 2
P3-9A A FMT 2
P3-9B SRXAC
2A
RL-28
1A
RL-18
0A
RL-08
2764 x 3
LS 367
LS195
4C
3C
2C
1C
0C
LS 244
MU
RD 4
RD 3
RD 2
RD 1
RD 0
P3-9G ARXAC
P1-9C FMT 0
P8-7D A PIT 1
P3-7D A PIT 0
P8-7C
A RXF 2
A RXF 1
A RXF 0
P8-7E
A SLCH 5
A SLCH 4
A SLCH 3
A SLCH 2
A SLCH 1
P2-9E CHS 0
RT3600
A0 RTC ASSY 回路図
FD1-B9713WA
PAGE 5/10
S. SANO
ENGRG DEPT
85-6-5
REV. ZONE
DATE
YOKOGAWA MEDICAL SYSTEMS
A2

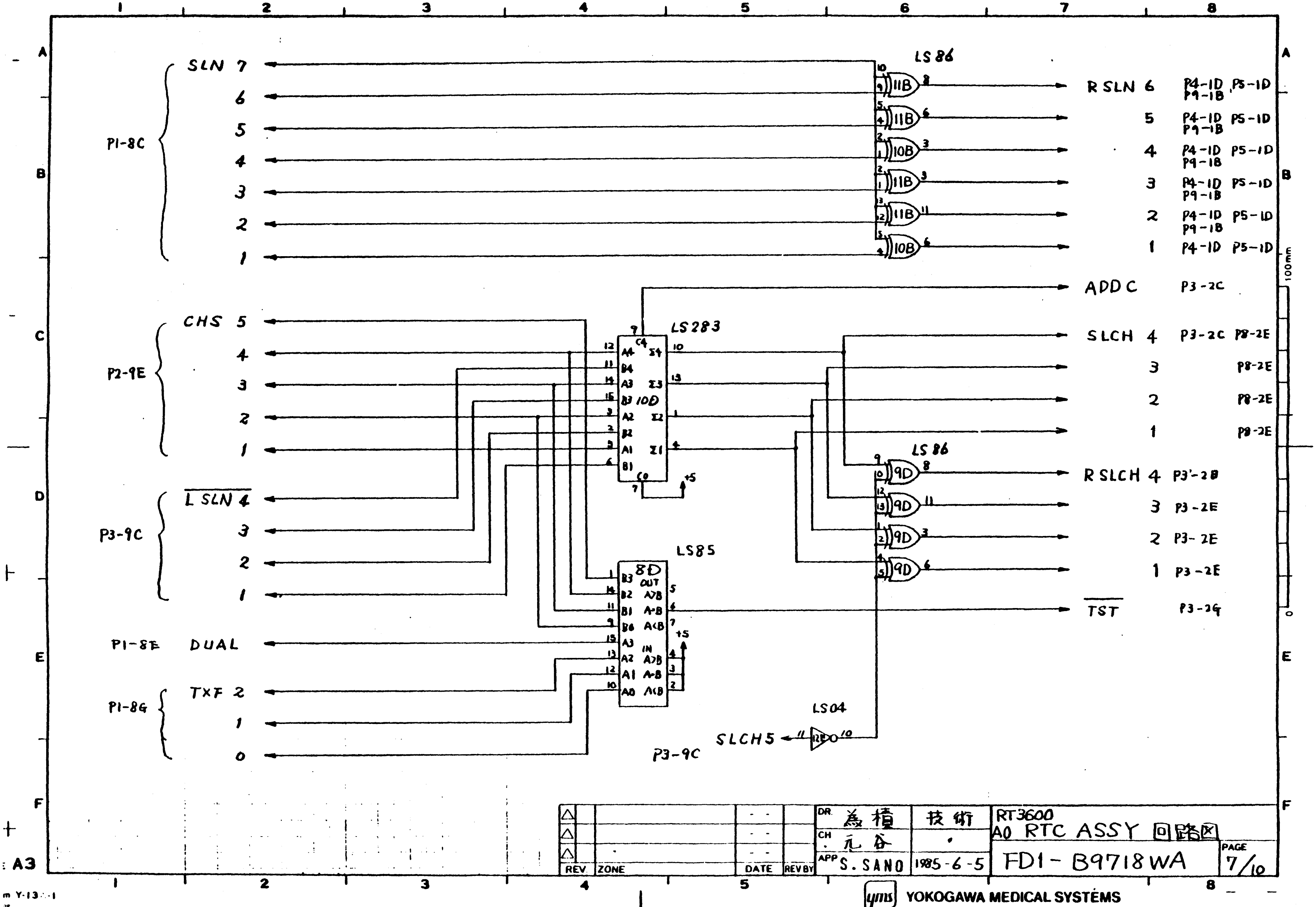


DR. 為積	技術	RT3600		
CH. 元谷	〃	A0 RTC ASSY 回路図		
APP. S. SANO	1985-6-5	FD1-B9718WA	PAGE 6/10	

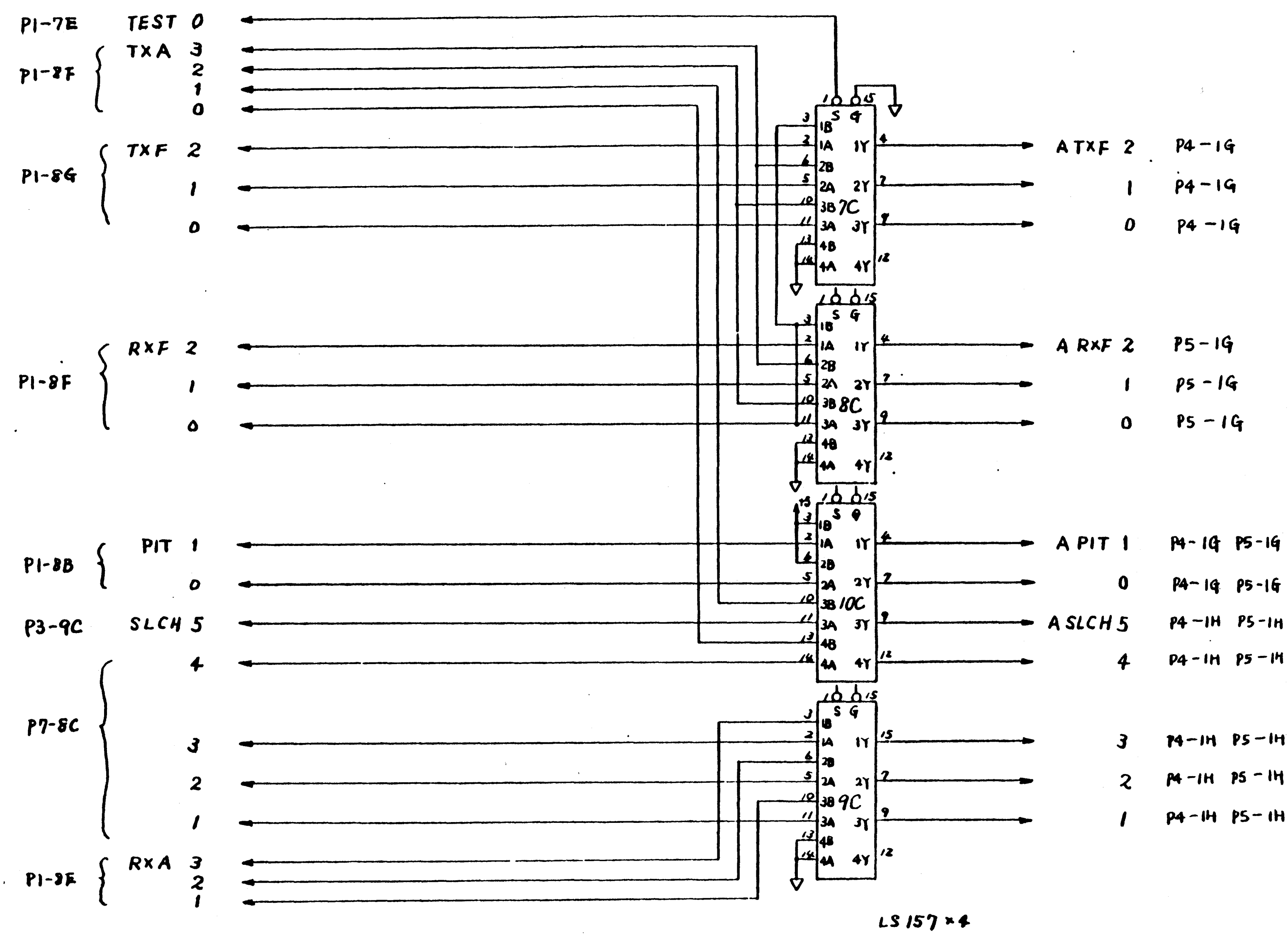
REV ZONE DATE REVBY

YOKOGAWA MEDICAL SYSTEMS

A3



SLN 7 6 5 4 3 2 1
P1-8C
CHS 5 4 3 2 1
P2-9E
LSLN 4 3 2 1
P3-9C
P1-8E DUAL
TXF 2 1 0
P1-8G
LS86
LS283
LS85
LS04
SLCH5
P3-9C
RSLN 6 5 4 3 2 1
P4-1D P9-1B P5-1D
ADDC P3-2C
SLCH 4 3 2 1 P3-2C P8-2E
RSLCH 4 3 2 1 P3-2B P3-2E
TST P3-2G
RT3600
A0 RTC ASSY 回路図
FD1-B9718WA
PAGE 7/10
DR. 為槙
CH 元谷
APP S. SANO
技術
1985-6-5
REV. ZONE DATE REV BY
YOKOGAWA MEDICAL SYSTEMS
A3

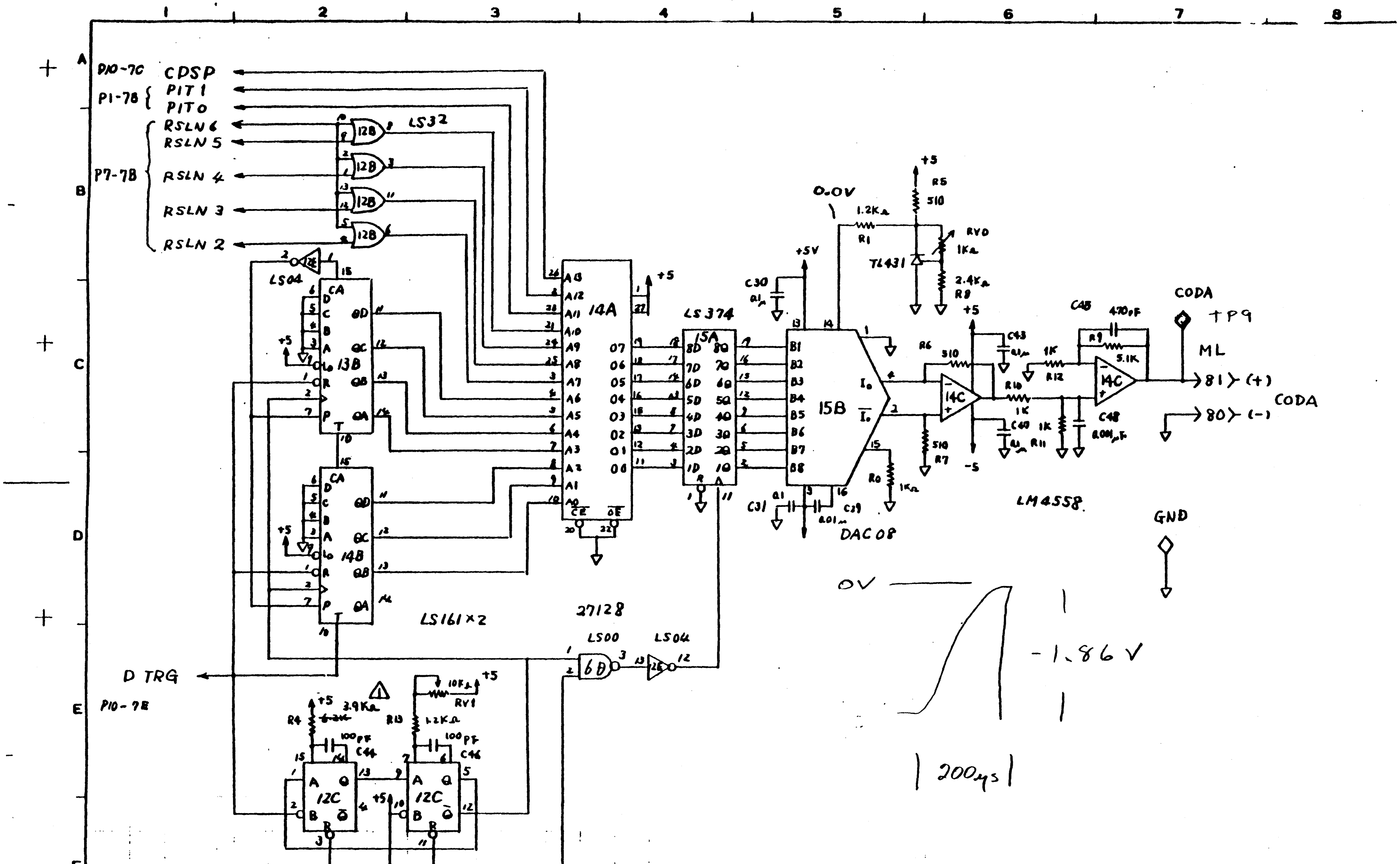


REV	ZONE	DATE	REV BY			
DR	為積	技術	RT3600			
CH	元谷	•	A0 RTC ASSY 回路図			
APP	S. SANO	1985-6-5	FD1-B9718WA	PAGE 8/10		

SIZE A3

Form Y-13 -1

YOKOGAWA MEDICAL SYSTEMS

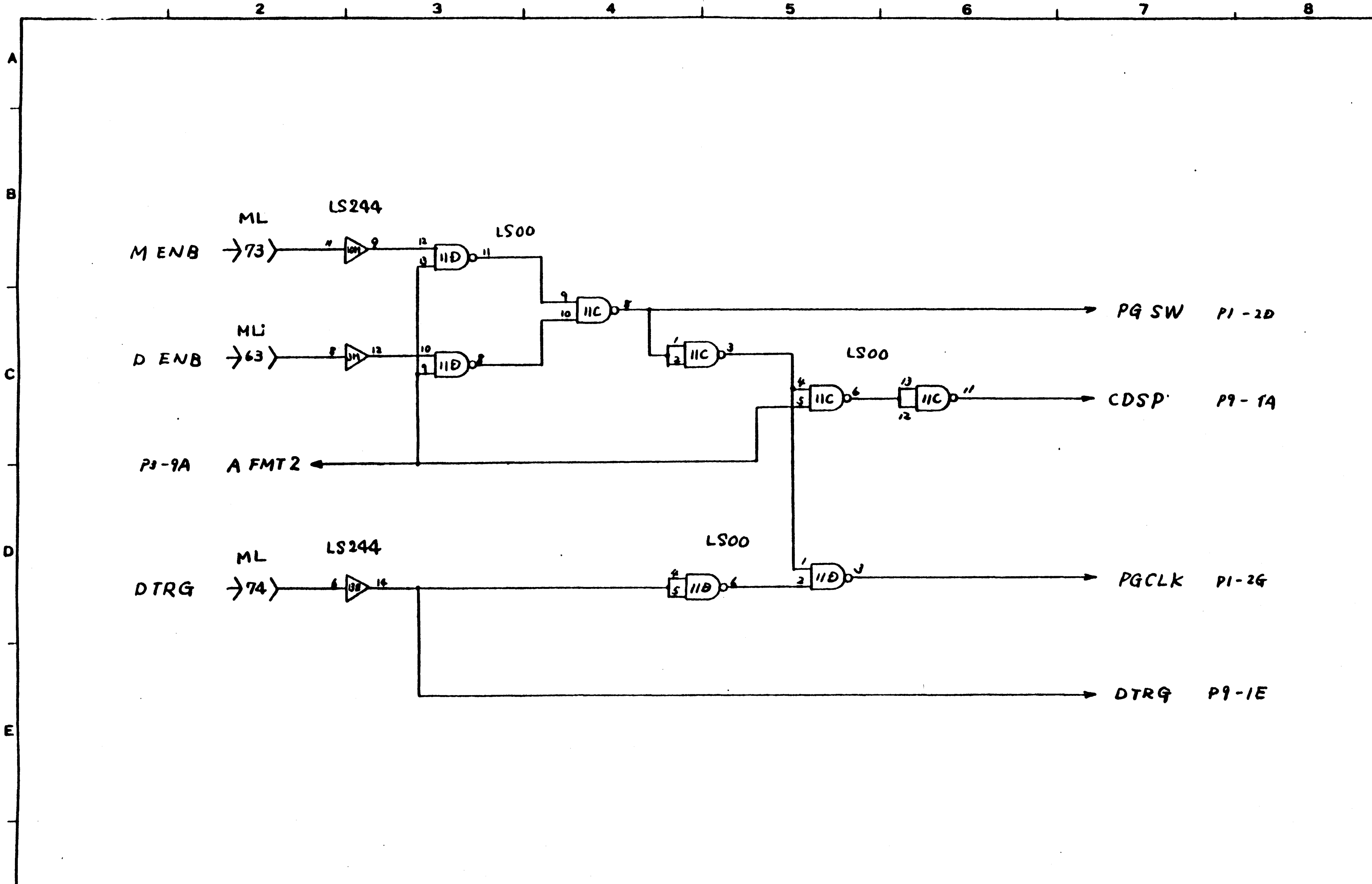


REV	ZONE		DATE	REV BY		
1	2E	M.M. 時定数変更	85-9-6	為積		
DR	為積	技術	RT3600			
CH	元谷	〃	AO RTC ASSY 回路図			
APP	S. SANO	1985-6-6	FD1-B9718WA	PAGE 9/1		

SIZE A3

Form Y-13A-1

yms YOKOGAWA MEDICAL SYSTEMS



REV	ZONE	DATE	REV BY
△		· ·	
△		· ·	
△		· ·	

DR
CH
APP S. SANO
技術
1985-6-6

RT3600
AO RTC ASSY 回路図

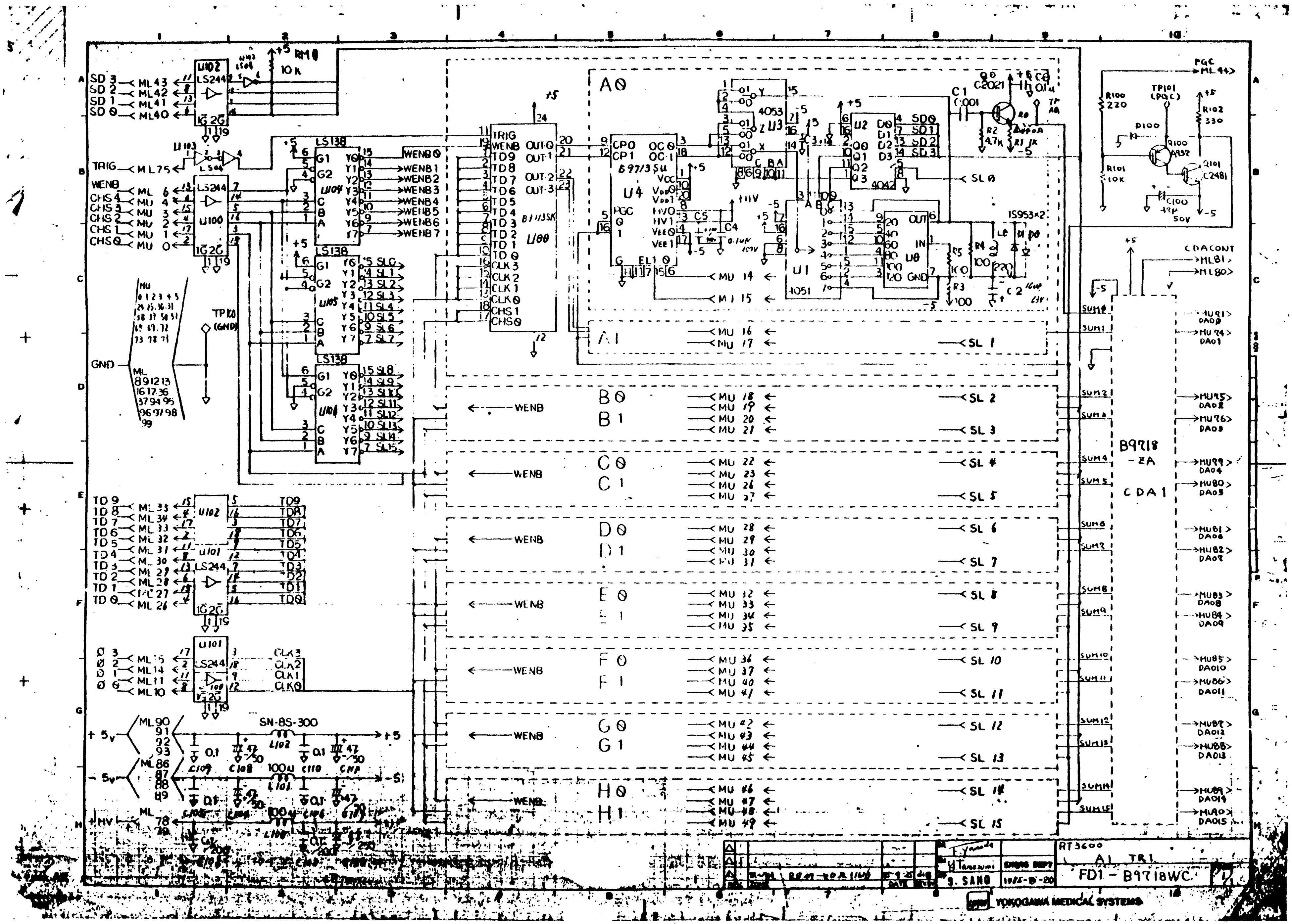
FD1-B9718WA

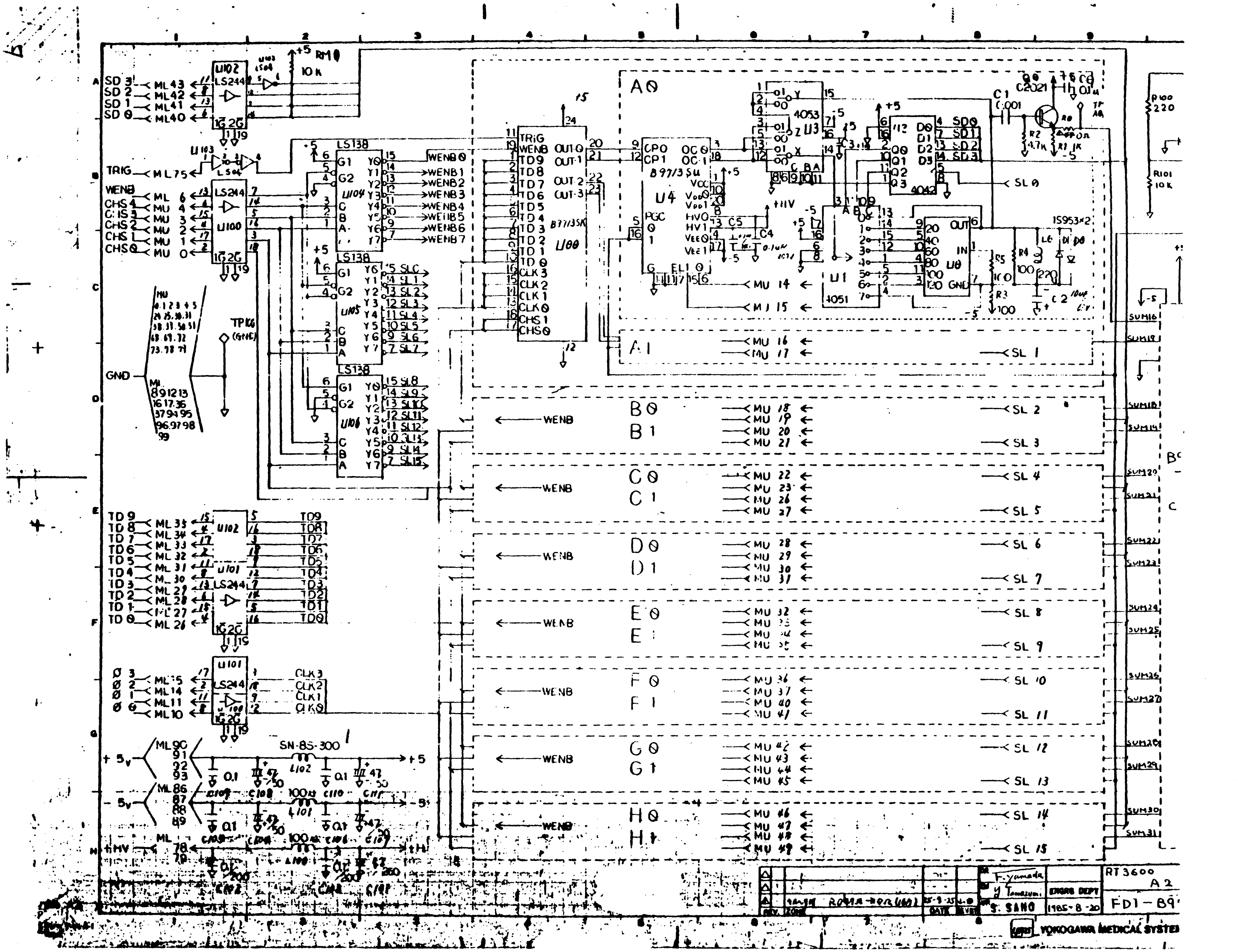
PAGE 10/10

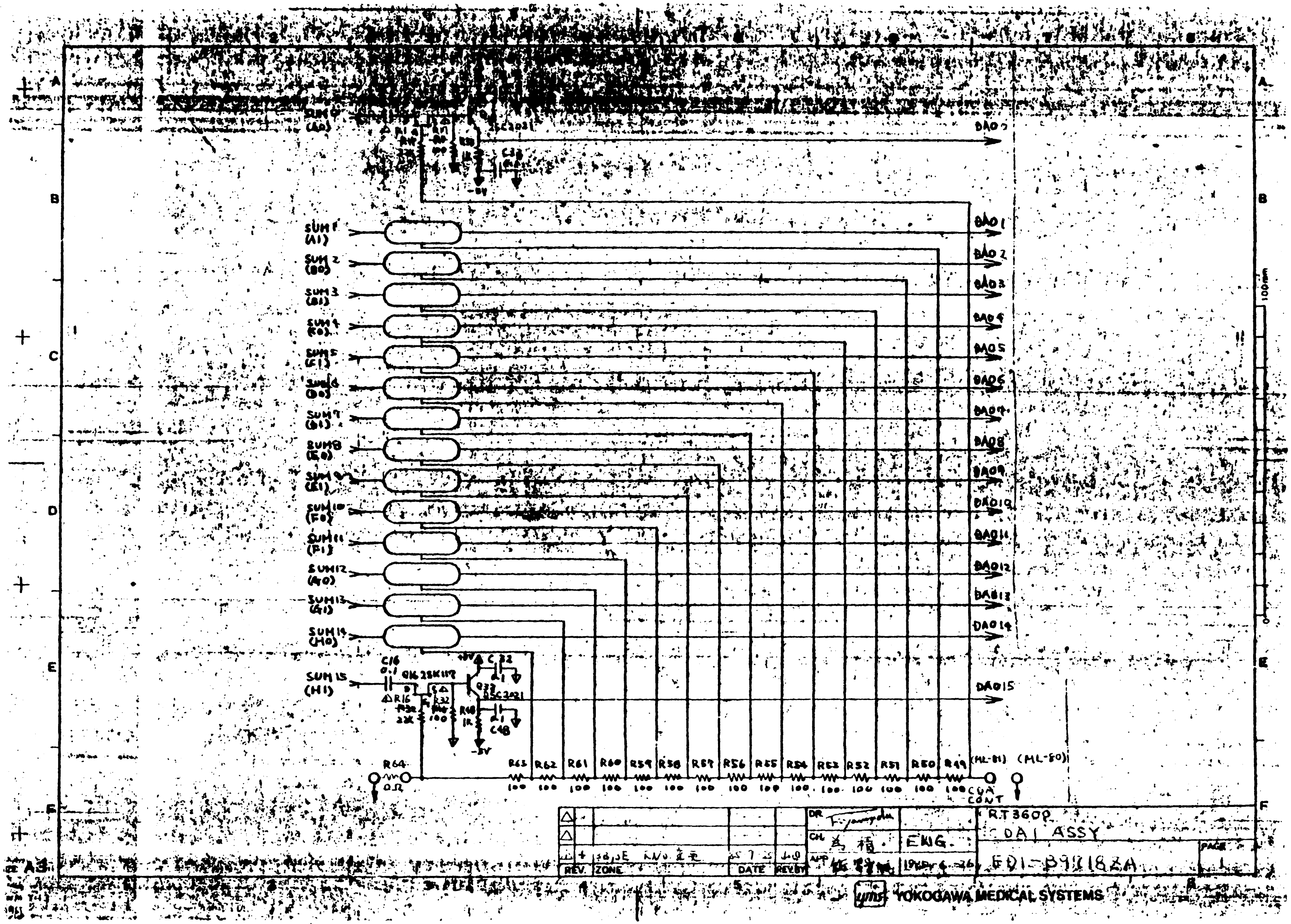
YMS YOKOGAWA MEDICAL SYSTEMS

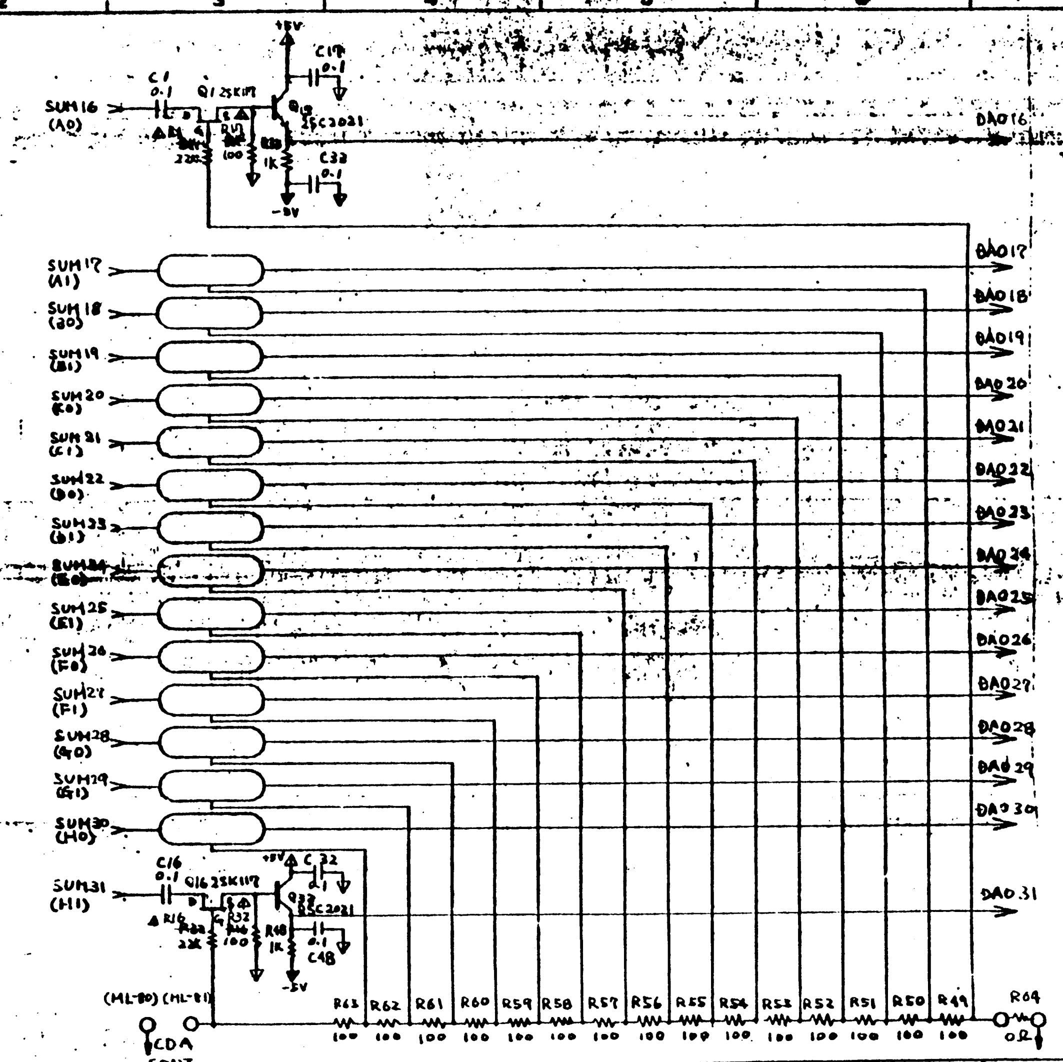
SIZE A3

Form Y-13 -1


RT3600
A1 TR1
FD1 - B9718WC
YOKOGAWA MEDICAL SYSTEMS
S. SANO
1985-8-20
B9718 -ZA
CDA1
U4
U1
U3
U8
U100
U102
U101
LS244
LS138
LS04
4053
4042
1051
B9713SU
B1135K
SN-8S-300
CDACONT
TP101 (PGC)
TP100 (GND)
A0
A1
B0
B1
C0
C1
D0
D1
E0
E1
F0
F1
G0
G1
H0
H1
WENB


RT3600
A2
FD1 - B9
YOKOGAWA MEDICAL SYSTEM


SUM 0 (A0)
SUM 1 (A1)
SUM 2 (B0)
SUM 3 (B1)
SUM 4 (C0)
SUM 5 (C1)
SUM 6 (D0)
SUM 7 (D1)
SUM 8 (E0)
SUM 9 (E1)
SUM 10 (F0)
SUM 11 (F1)
SUM 12 (G0)
SUM 13 (G1)
SUM 14 (H0)
SUM 15 (H1)
DAO 0
DAO 1
DAO 2
DAO 3
DAO 4
DAO 5
DAO 6
DAO 7
DAO 8
DAO 9
DAO 10
DAO 11
DAO 12
DAO 13
DAO 14
DAO 15
C16 0.1
Q16 2SK117
Q32 2SC2021
C32 0.1
C48 0.1
R16 22K
R32 100
R48 1K
-5V
R64 0Ω
R63 R62 R61 R60 R59 R58 R57 R56 R55 R54 R53 R52 R51 R50 R49
100 100 100 100 100 100 100 100 100 100 100 100 100 100 100
(ML-81) (ML-80)
CUA CONT
R.T 3600
DA1 ASSY
ENG.
FD1-B99182A
REV. ZONE DATE REV.BY
DR CH APP
PAGE
YOKOGAWA MEDICAL SYSTEMS



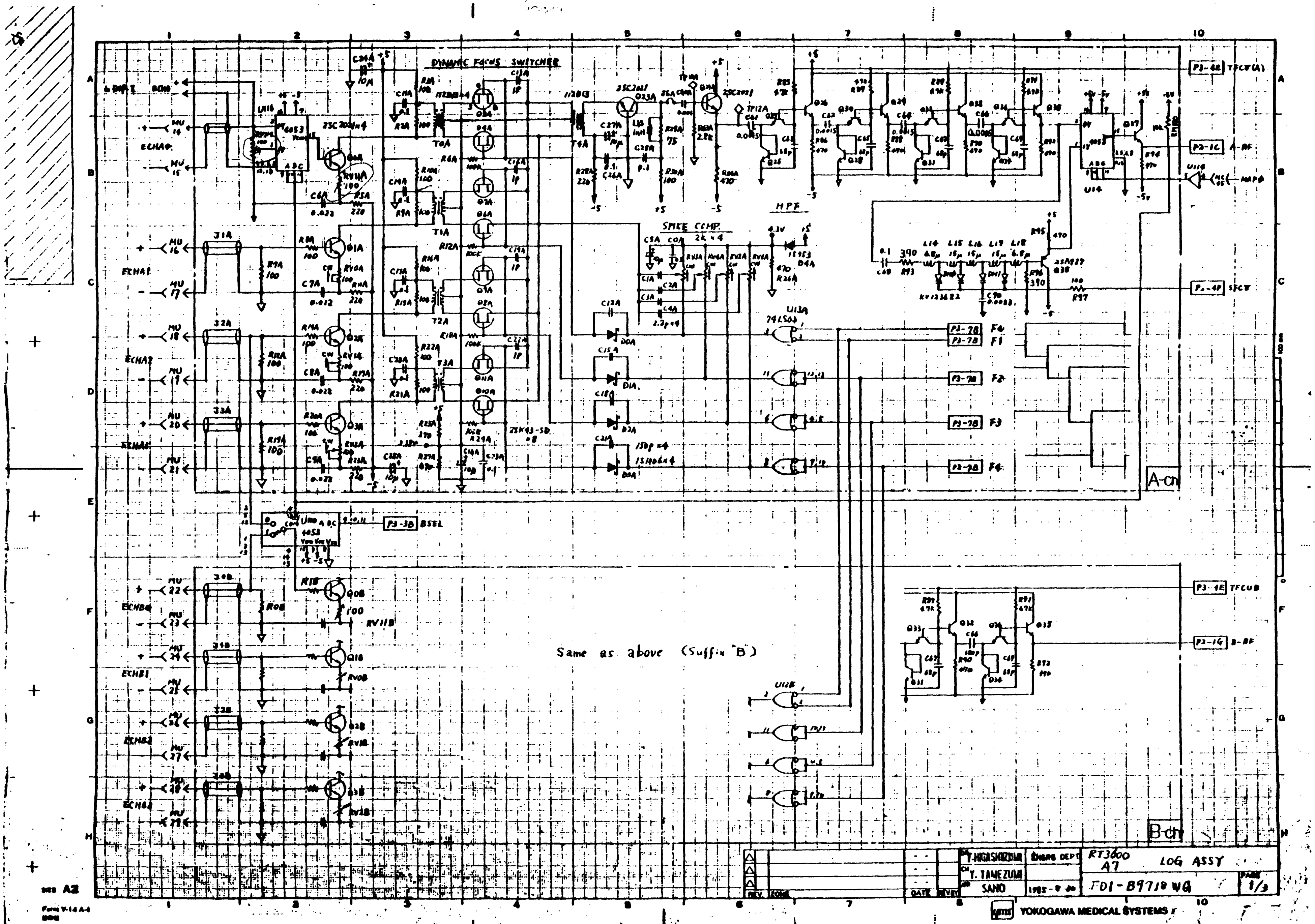
REV	ZONE		DATE	REV BY
4	3B, 3E	RNO 変更	85-9-25	

DR: T. Yamada
CH
APP
ENG.
1985-6-26

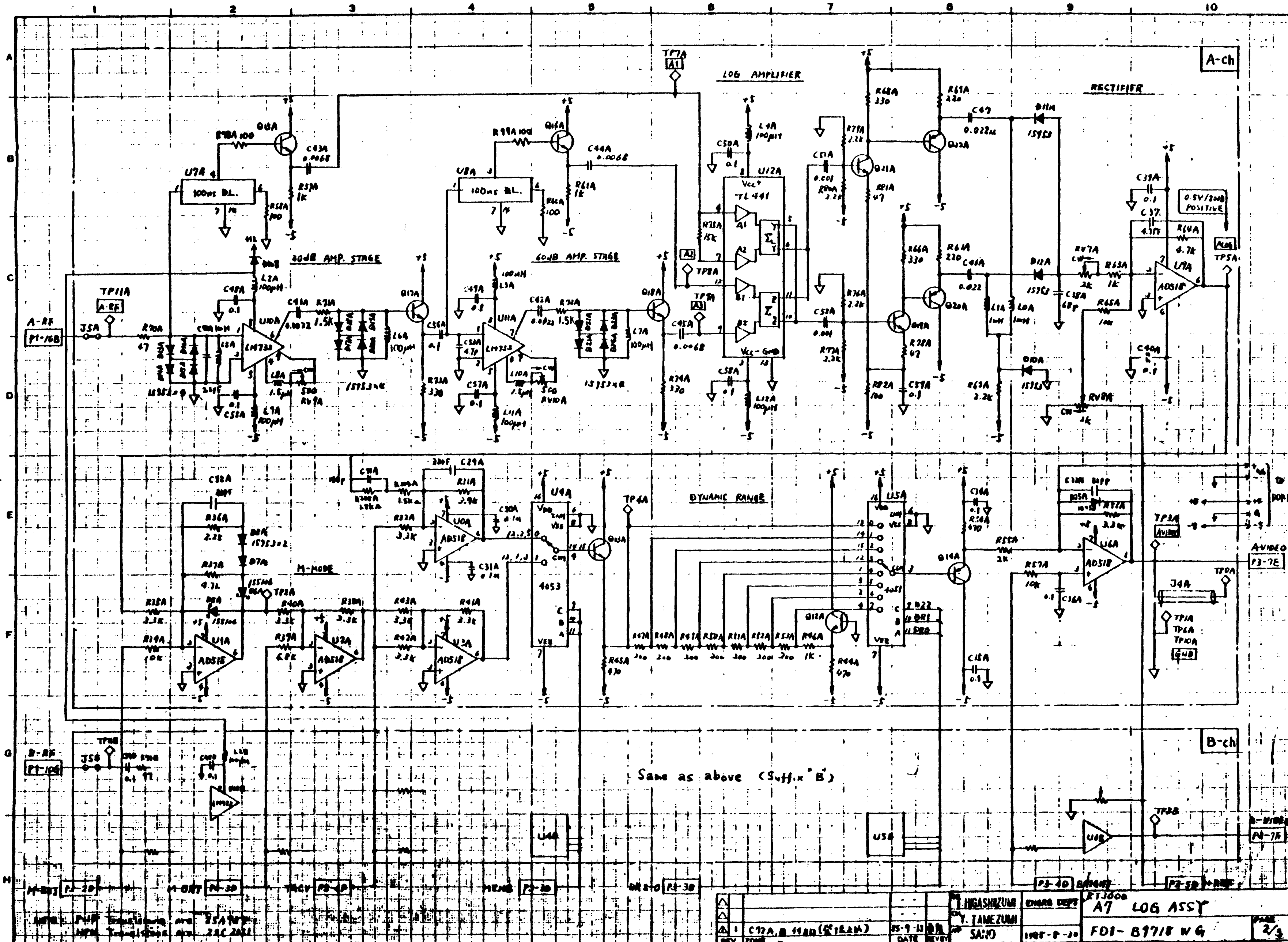
RT3600
CDA2 ASSY
FDI-B9718ZG
PAGE 1

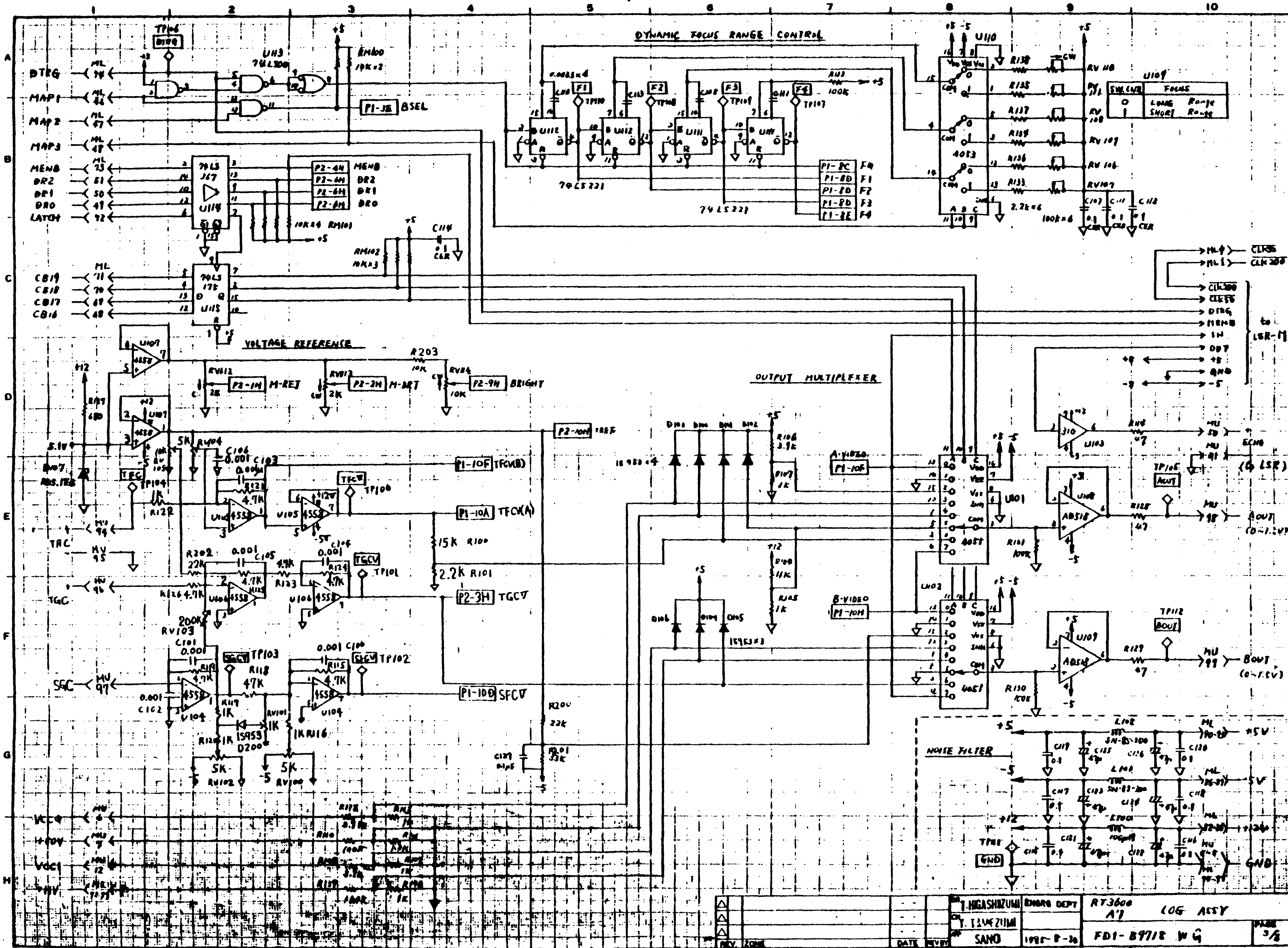
SIZE A3

YOKOGAWA MEDICAL SYSTEMS

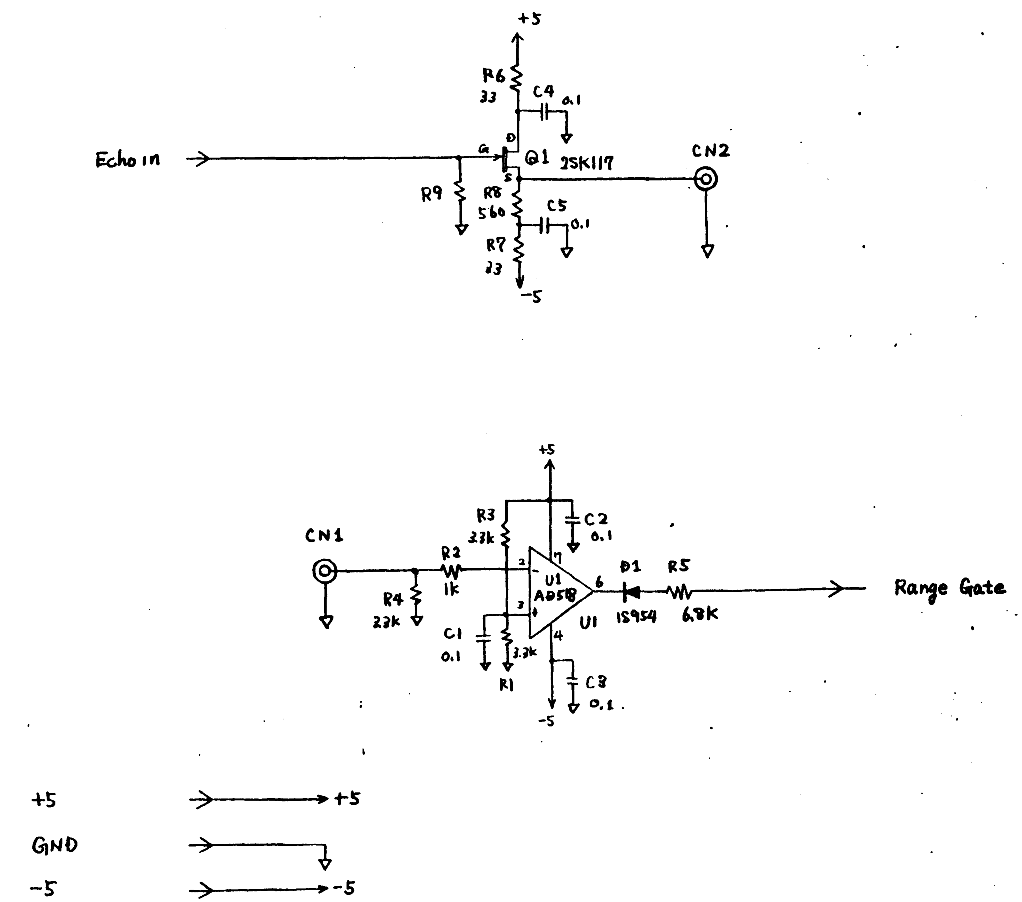


DYNAMIC FOCUS SWITCHER
SPIKE COMP.
HPF
Same as above (Suffix "B")
A-ch
B-ch
T.HIGASHIZUMA
Y. TAMEZUMI
SANO
RT3600 A7
LOG ASSY
FD1-B9718 WG
1/3
YOKOGAWA MEDICAL SYSTEMS
A2


A-ch
B-ch
LOG AMPLIFIER
RECTIFIER
20dB AMP. STAGE
60dB AMP. STAGE
DYNAMIC RANGE
M-MODE
100ns DL.
TL441
LM733
AD518
4053
0.5V/20dB POSITIVE
A-RF
B-RF
A-VIDEO
Same as above (Suffix "B")
RT3000
A7 LOG ASSY
FD1-B9718 WG
2/3
YOKOGAWA MEDICAL SYSTEMS
HIGASHIZUMI
Y. TAMEZUMI
SAITO



DYNAMIC FOCUS RANGE CONTROL
VOLTAGE REFERENCE
OUTPUT MULTIPLEXER
NOISE FILTER
DTRG
MAP1
MAP2
MAP3
MENB
DR2
DR1
DR0
LATCH
CB19
CB18
CB17
CB16
BSEL
M-REJ
M-ADJ
BRIGHT
TFCV(B)
TFCV(A)
TGCV
SFCV
TGC
SGC
A-VIDEO
B-VIDEO
AOUT
BOUT
to LSR-M
T.HIGASHIZUMI
ENGRG DEPT
RT3600
LOG ASSY
FD1-B9718
YOKOGAWA MEDICAL SYSTEMS



REV	ZONE		DATE	REV BY
△			- -	
△			- -	
△			- -	

DR T.HIGASHIIZUMI 技術

CH Y. TAMEZUMI

APP S. SANO 1985-8-30

DOP-I

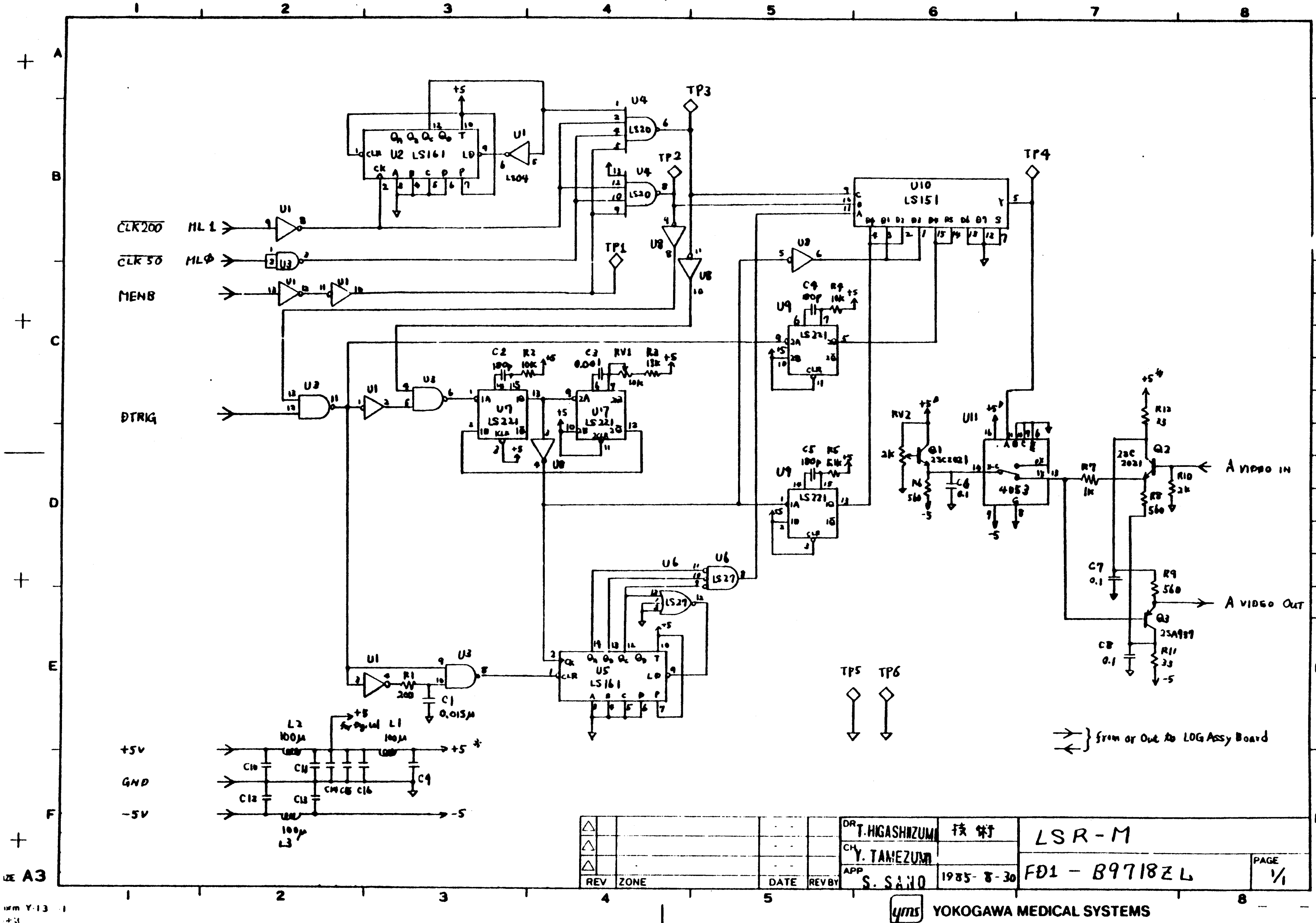
FD1 - B9718 ZN

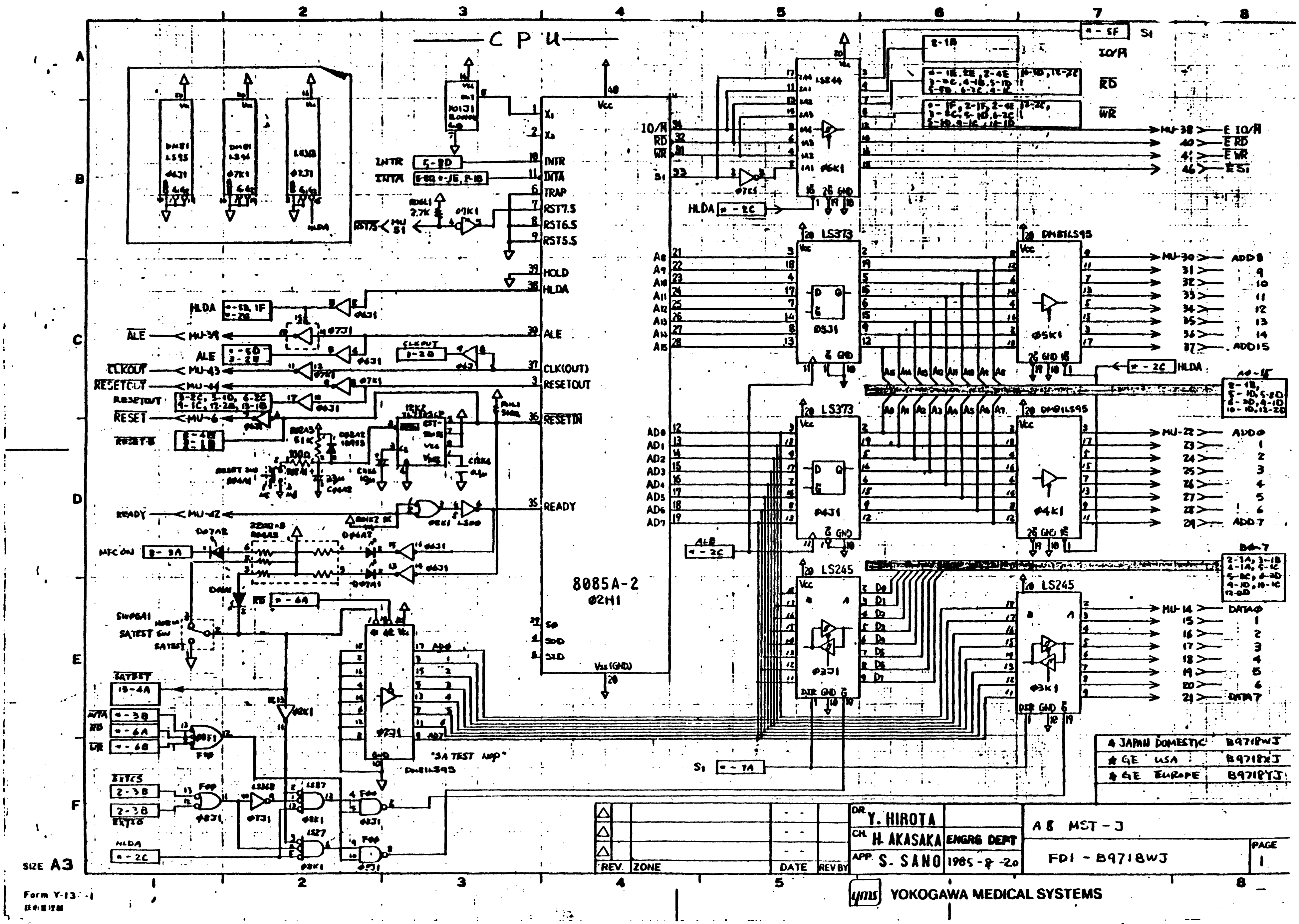
PAGE 1/1

YOKOGAWA MEDICAL SYSTEMS

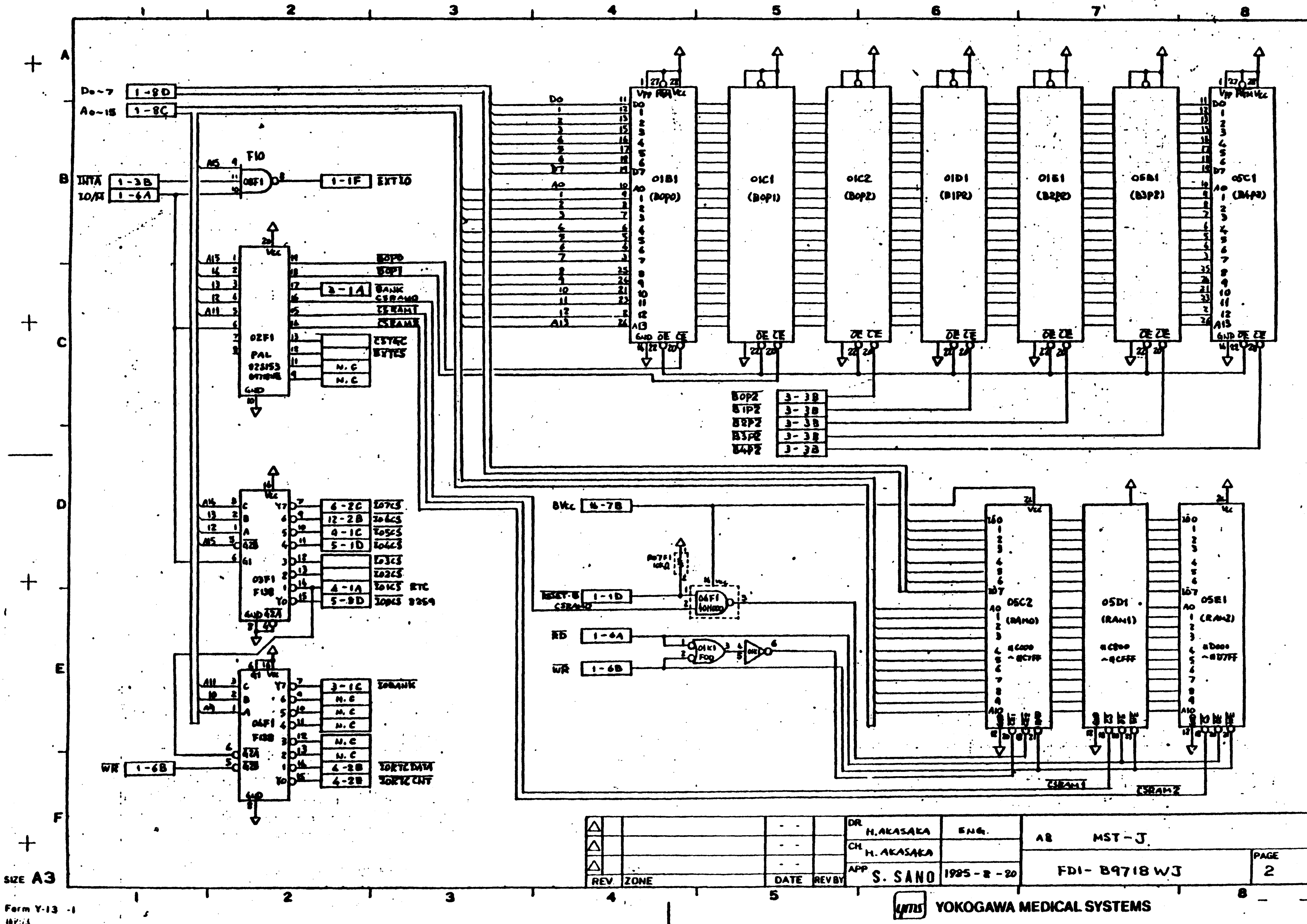
SIZE A3

Form Y 13 -1

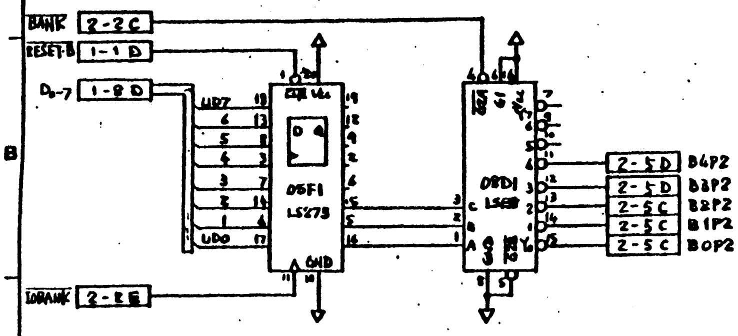

CLK200 ML1
CLK50 MLΦ
MENB
DTRIG
+5V
GND
-5V
U2 LS161
U4 LS20
U10 LS151
U9 LS221
U17 LS221
U5 LS161
U6 LS27
U11 4053
TP1
TP2
TP3
TP4
TP5
TP6
A VIDEO IN
A VIDEO OUT
} from or Out to LOG Assy Board
DR T.HIGASHIIZUMI
CH Y. TAMEZUMI
APP S. SANO
1985-8-30
LSR-M
FD1 - B9718ZL
PAGE 1/1
REV ZONE DATE REVBY
YOKOGAWA MEDICAL SYSTEMS



CPU
8085A-2
Ø2H1
LS244
LS373
DM81LS95
LS245
"SA TEST MP"
JAPAN DOMESTIC B9718WJ
GE USA B9718XJ
GE EUROPE B9718YJ
DR. Y. HIROTA
CH. H. AKASAKA
APP. S. SANO
ENGRG DEPT
1985-8-20
A8 MST-J
FDI - B9718WJ
PAGE 1
REV. ZONE DATE REV BY
SIZE A3
Form Y-13
YOKOGAWA MEDICAL SYSTEMS



D0~7
A0~15
INTA
IO/M
EXTIO
01B1 (B0P0)
01C1 (B0P1)
01C2 (B0P2)
01D1 (B1P2)
01E1 (B2P2)
05B1 (B3P2)
05C1 (B4P2)
02F1 PAL
03F1
06F1
05C2 (RAM0)
05D1 (RAM1)
05E1 (RAM2)
B0P2
B1P2
B2P2
B3P2
B4P2
BVcc
RESET-B
RD
WR
CSRAM1
CSRAM2
IOBANK
IORTC DATA
IORTC CNT
8259
RTC
N.C
DR H. AKASAKA
CH H. AKASAKA
APP S. SANO
ENG.
1985-8-20
A8 MST-J
FDI-B9718WJ
PAGE 2
REV
ZONE
DATE
REV BY
SIZE A3
Form Y-13
YOKOGAWA MEDICAL SYSTEMS

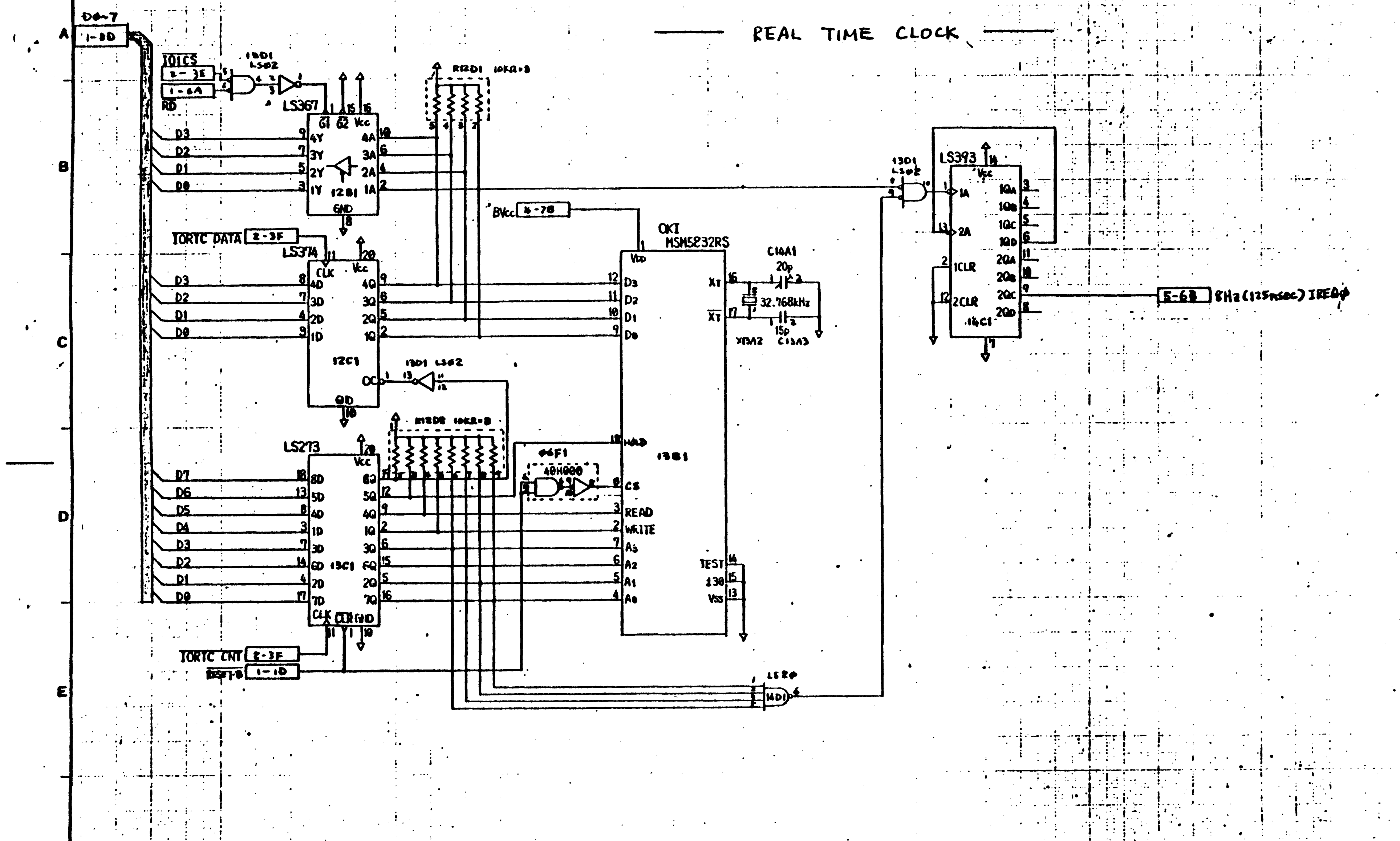


REV.	ZONE	DATE	REV BY				
△		- -		DR. H. AKASAKA	ENG.	A8 MST-J	
△		- -		CH H. AKASAKA			
△		- -		APP. S. SANO	1985-8-20	FD1-B9718WJ	PAGE 3

YMS YOKOGAWA MEDICAL SYSTEMS

A3

Y-13 -1

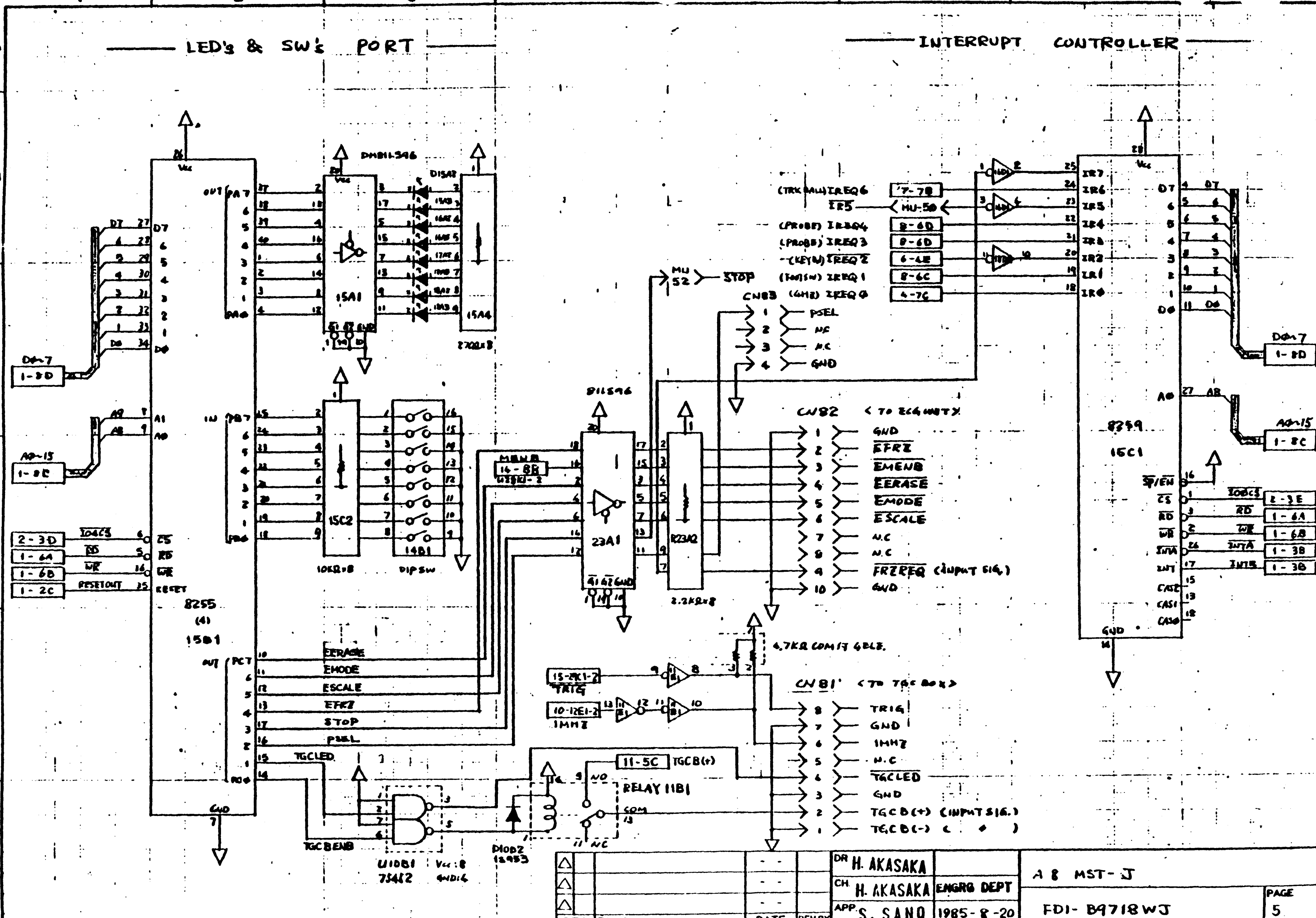


REV	ZONE	DATE	REV BY			
DR	Y. HIROTA			A 8 MST- J		
CH	H. AKASAKA	ENGRG DEPT				
APP	S. SANO	1985-8-20		FDI-B9718WJ	PAGE	4

YOKOGAWA MEDICAL SYSTEMS

SIZE A3

Form Y-13-1



DR	H. AKASAKA
CH	H. AKASAKA
APP	S. SANO
ENGRG DEPT	1985-8-20

A 8 MST-J

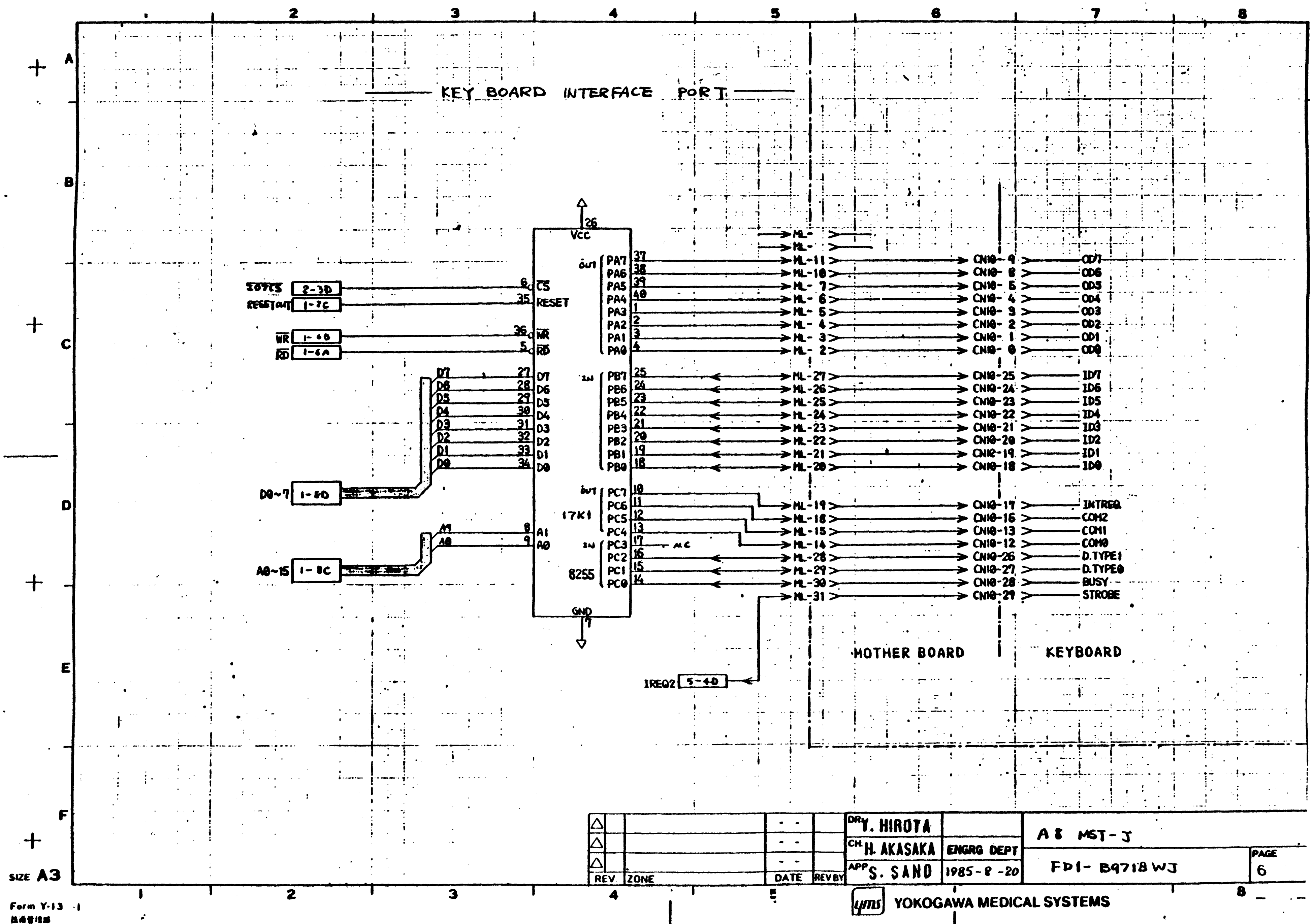
FDI-B9718WJ

PAGE 5

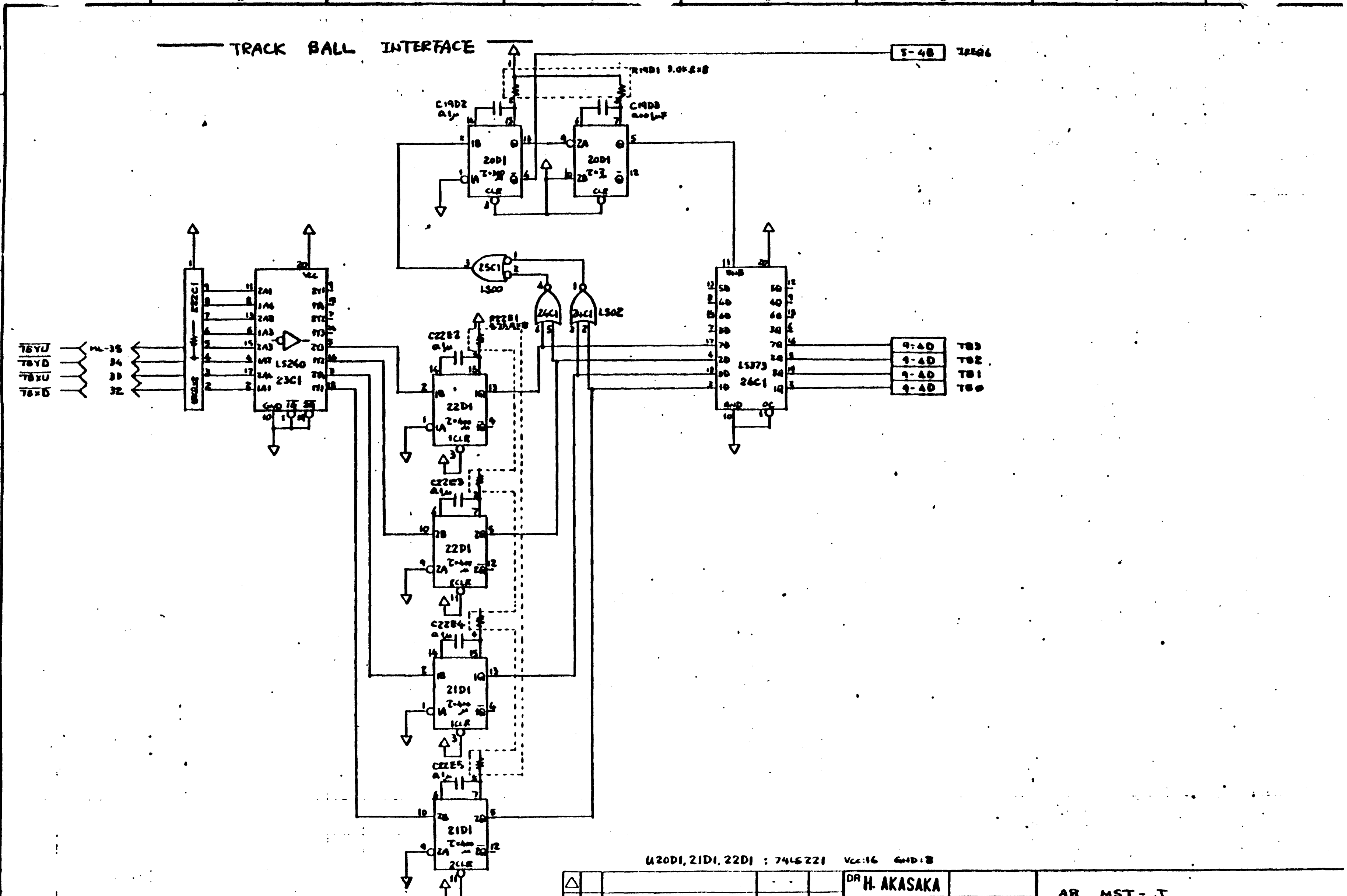
SIZE A3

YOKOGAWA MEDICAL SYSTEMS

Form Y-13-1



KEY BOARD INTERFACE PORT
VCC
GND
8255
17K1
CS
RESET
WR
RD
D7 D6 D5 D4 D3 D2 D1 D0
A1 A0
PA7 PA6 PA5 PA4 PA3 PA2 PA1 PA0
PB7 PB6 PB5 PB4 PB3 PB2 PB1 PB0
PC7 PC6 PC5 PC4 PC3 PC2 PC1 PC0
OUT
IN
NC
2-3D
1-7C
1-6D
1-6A
1-5D
1-8C
D0~7
A0~15
IREQ2
5-4D
OD7 OD6 OD5 OD4 OD3 OD2 OD1 OD0
ID7 ID6 ID5 ID4 ID3 ID2 ID1 ID0
INTREQ
COM2
COM1
COM0
D.TYPE1
D.TYPE0
BUSY
STROBE
MOTHER BOARD
KEYBOARD
DR Y. HIROTA
CH H. AKASAKA
APP S. SANO
ENGRG DEPT
1985-8-20
A8 MST-J
FD1- B9718WJ
PAGE 6
REV
ZONE
DATE
REV BY
SIZE A3
Form Y-13 -1
YOKOGAWA MEDICAL SYSTEMS



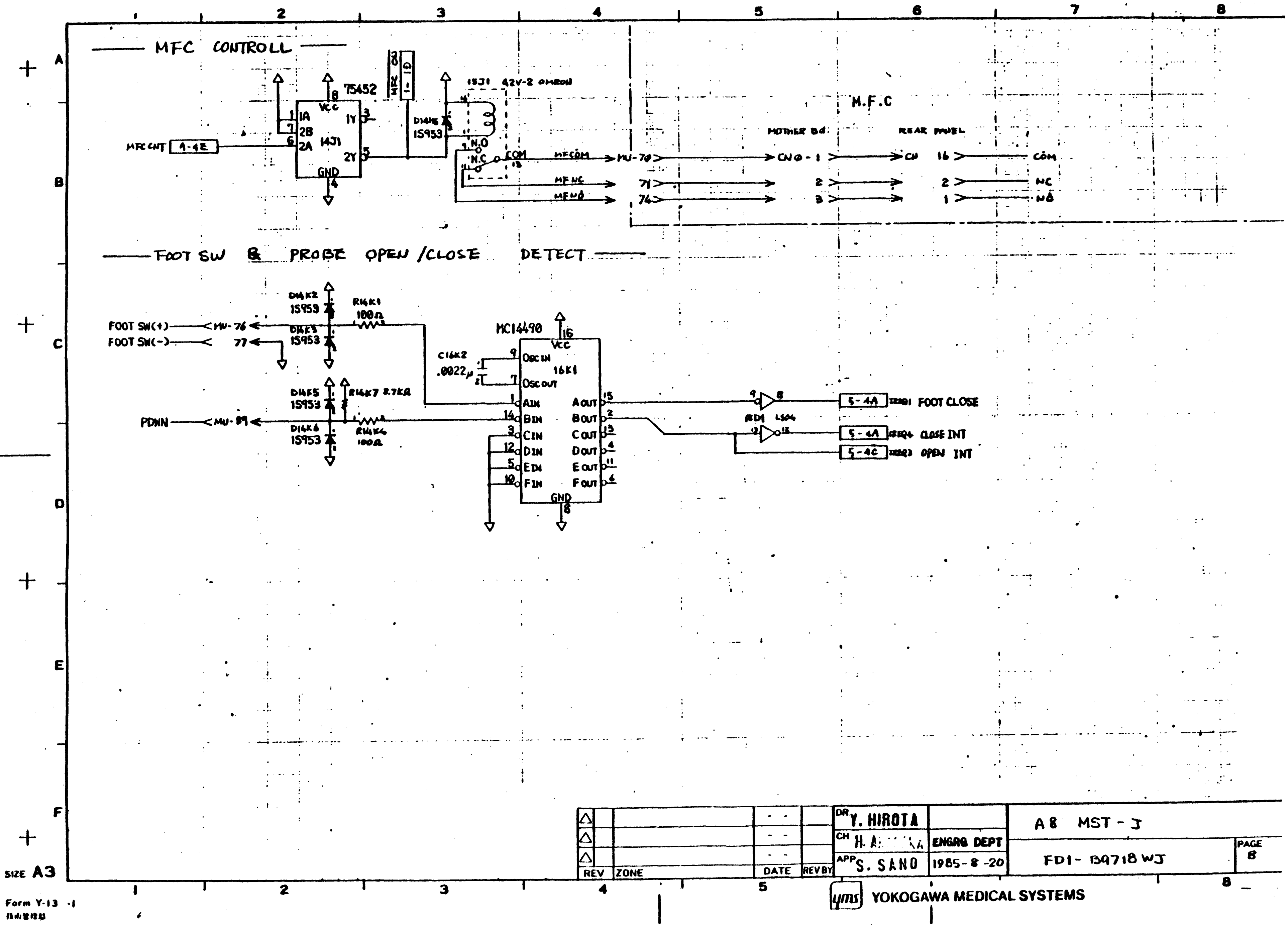
REV	ZONE	DATE	REV BY			
				DR H. AKASAKA		AB MST-J
				CH H. AKASAKA	ENGRG DEPT	
				APP S. SANO	1985-8-20	FD1-B9718WJ

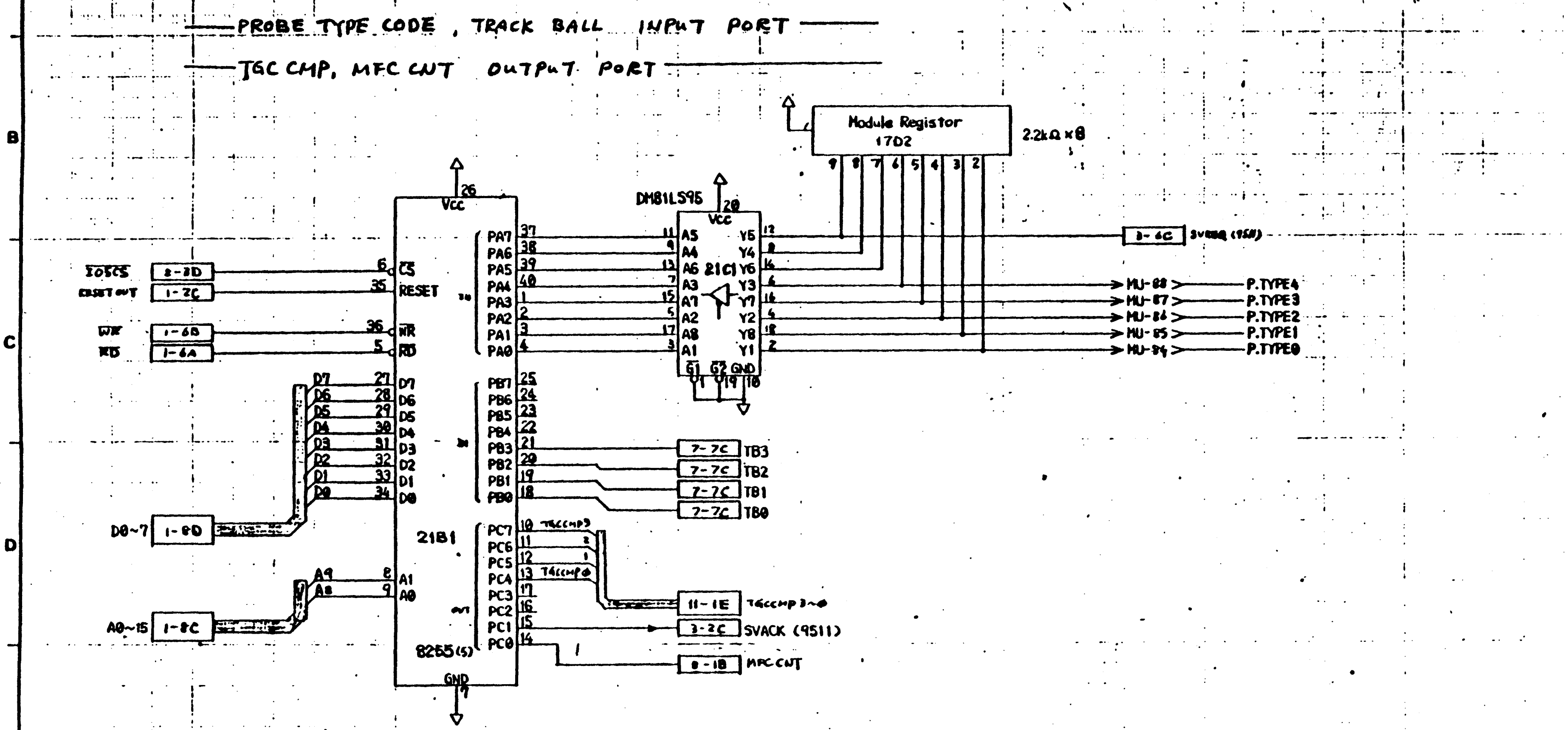
PAGE 7

SIZE A3

YOKOGAWA MEDICAL SYSTEMS

Form Y-13 -1


MFC CONTROLL
75452
MFC CNT 4-4E
D14K5 1S953
1SJ1 42V-2 OMRON
M.F.C
MOTHER BD
REAR PANEL
MFCOM
MFNC
MFNO
MU-70
CNO-1
CH 16
COM
NC
NO
FOOT SW & PROBE OPEN /CLOSE DETECT
FOOT SW(+)
FOOT SW(-)
MU-76
77
PDNN
MU-89
R14K1 100Ω
R14K7 2.7KΩ
R14K6 100Ω
C16K2 .0022μ
MC14490
16K1
FOOT CLOSE
CLOSE INT
OPEN INT
8D1 LS04
5-4A
5-4C
Y. HIROTA
ENGRG DEPT
S. SANO
1985-8-20
A8 MST-J
FDI-B9718WJ
PAGE 8
YOKOGAWA MEDICAL SYSTEMS
SIZE A3
Form Y-13 -1



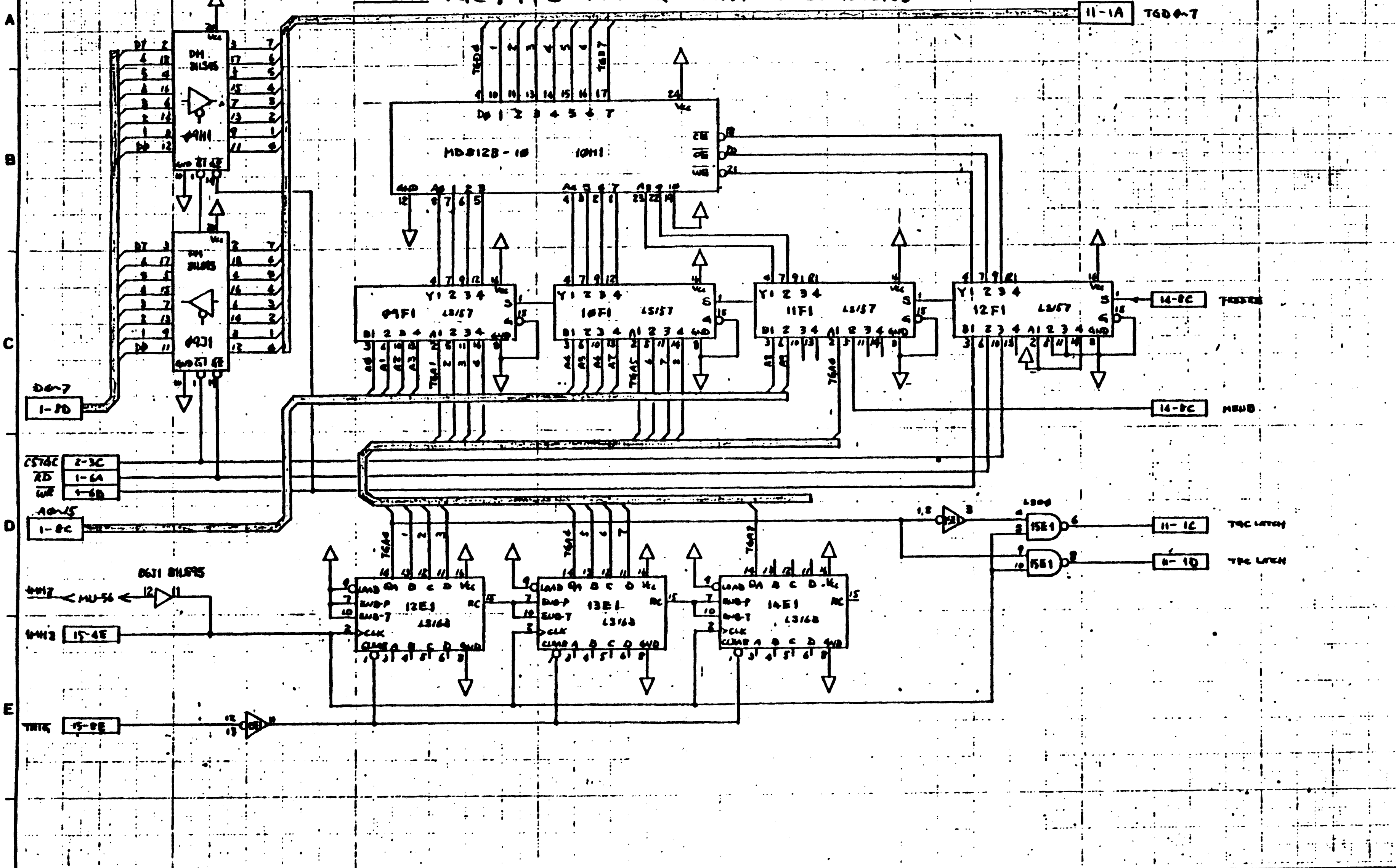
REV	ZONE	DATE	REV BY		
DR Y. HIROTA				A8 MST-J	
CH H. [illegible]	ENGRG DEPT				PAGE
APP S. SANO	1985-8-20			FDI-B9718WJ	9.

SIZE A3

yms YOKOGAWA MEDICAL SYSTEMS

Form Y-13 -1

TGC / TFC RAM & ADDRESS COUNTERS



REV	ZONE	DATE	REV BY		
		- -		DR. H. AKASAKA	
		- -		CH. H. AKASAKA	ENGRG DEPT
		- -		APP. S. SANO	1985-8-20

A8 MST-J

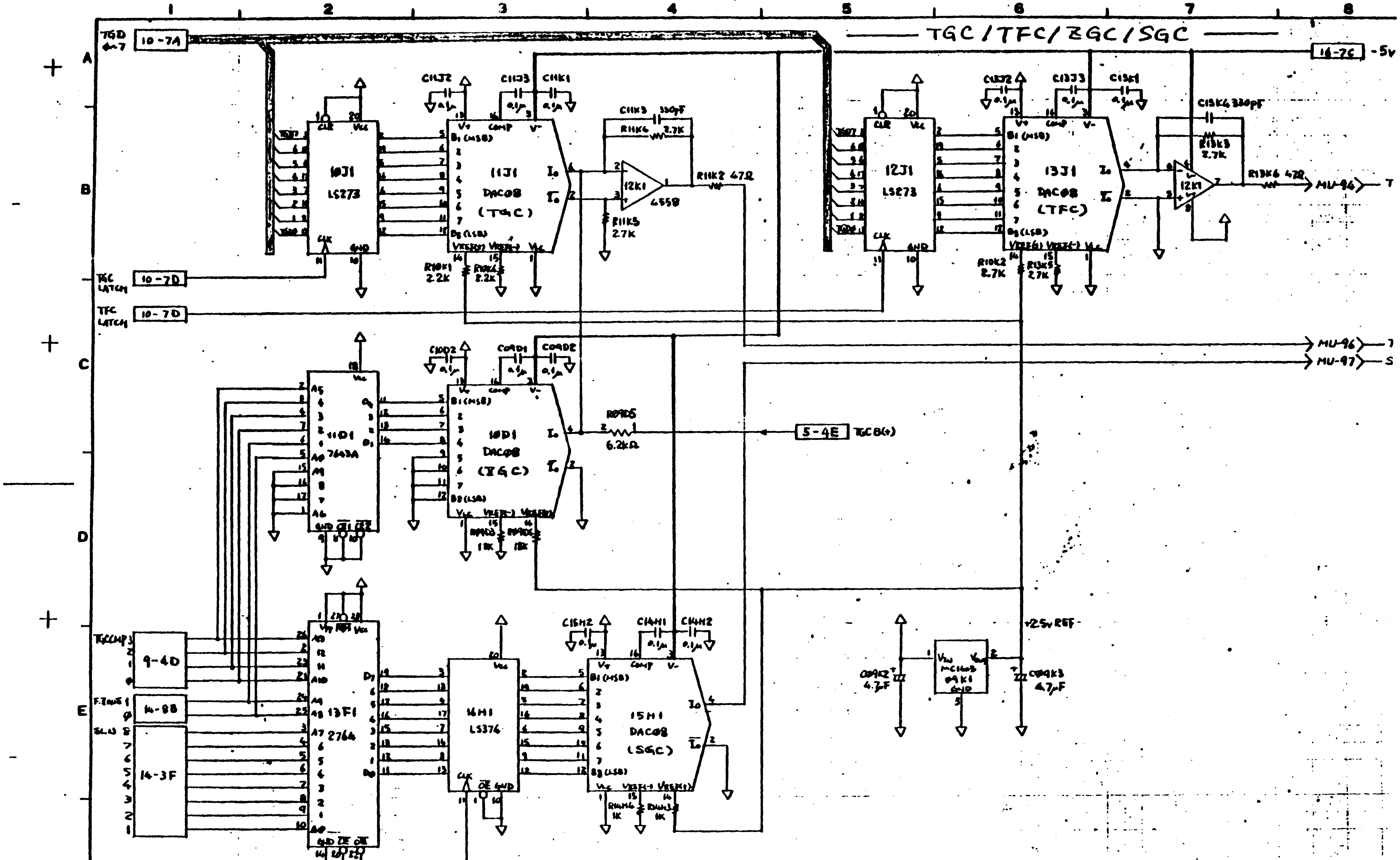
FD1-B9718WJ

PAGE 10

YOKOGAWA MEDICAL SYSTEMS

SIZE A3

Form Y-13 -1



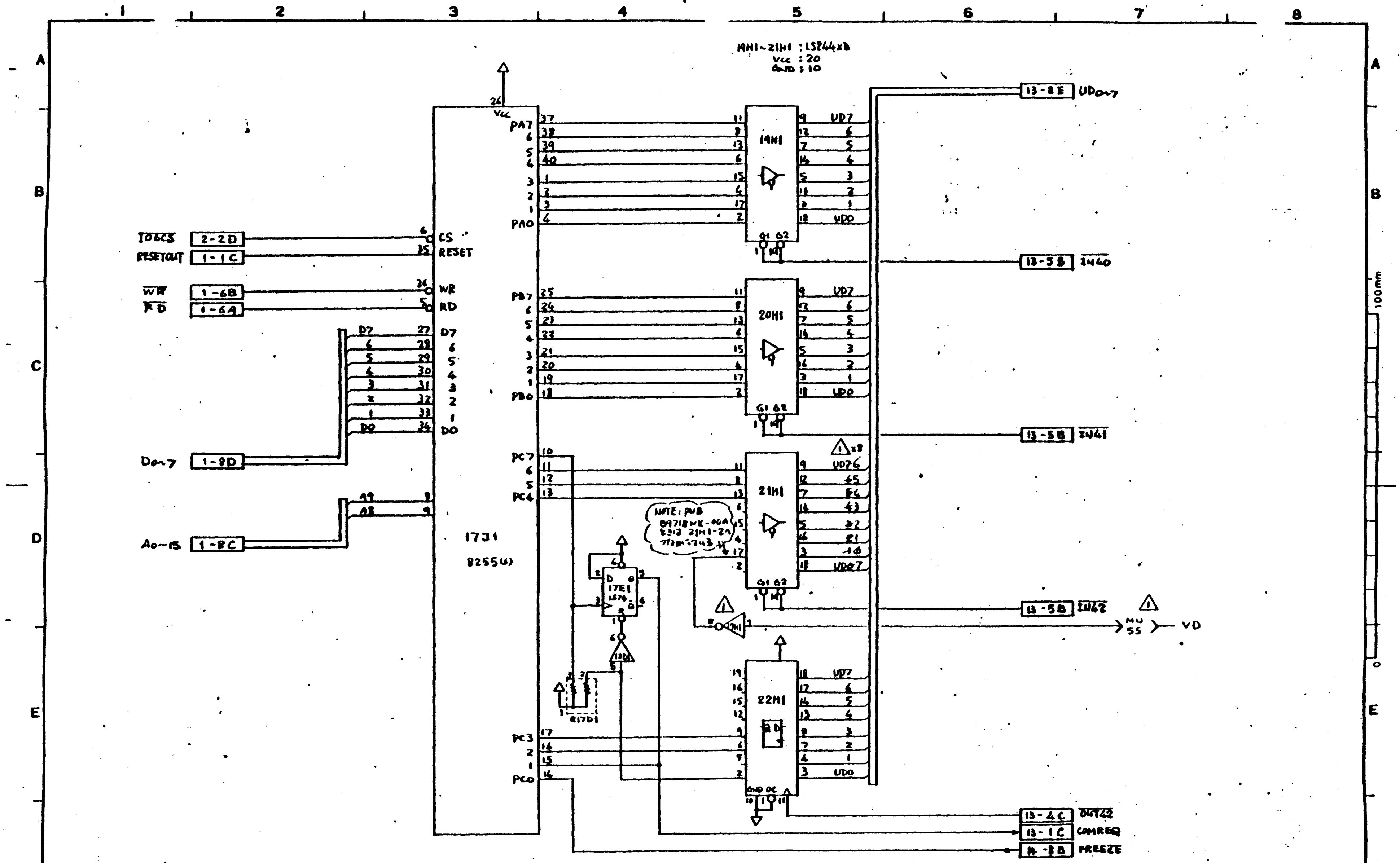
REV	ZONE	DATE	REV BY	DR H. AKASAKA		A8 MST-J
				CH H. AKASAKA	ENGRG DEPT	
				APP. S. SANO	1985-8-20	FD1-B9718WJ

PAGE 11

SIZE A3

Form Y-13 -1

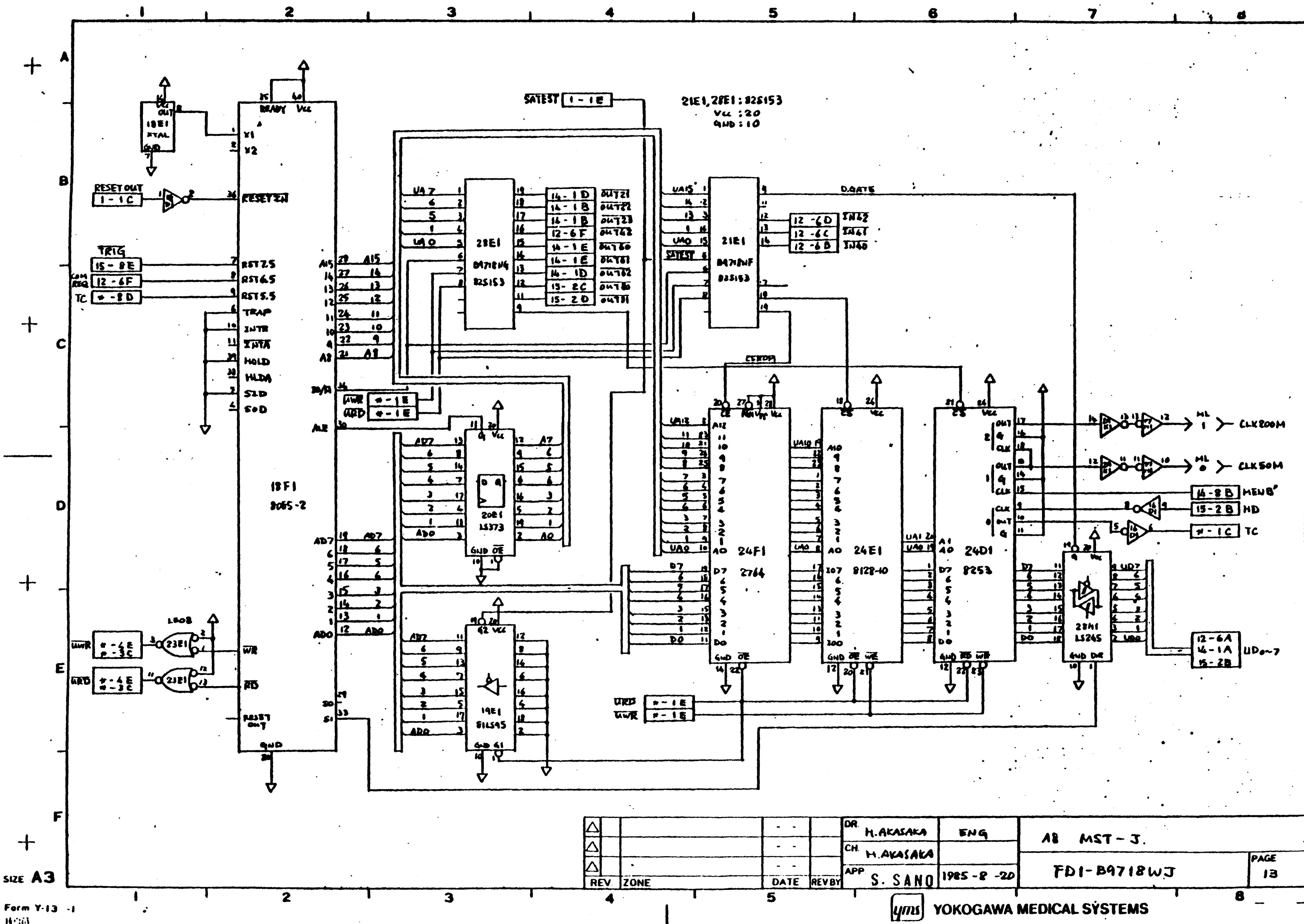
YOKOGAWA MEDICAL SYSTEMS

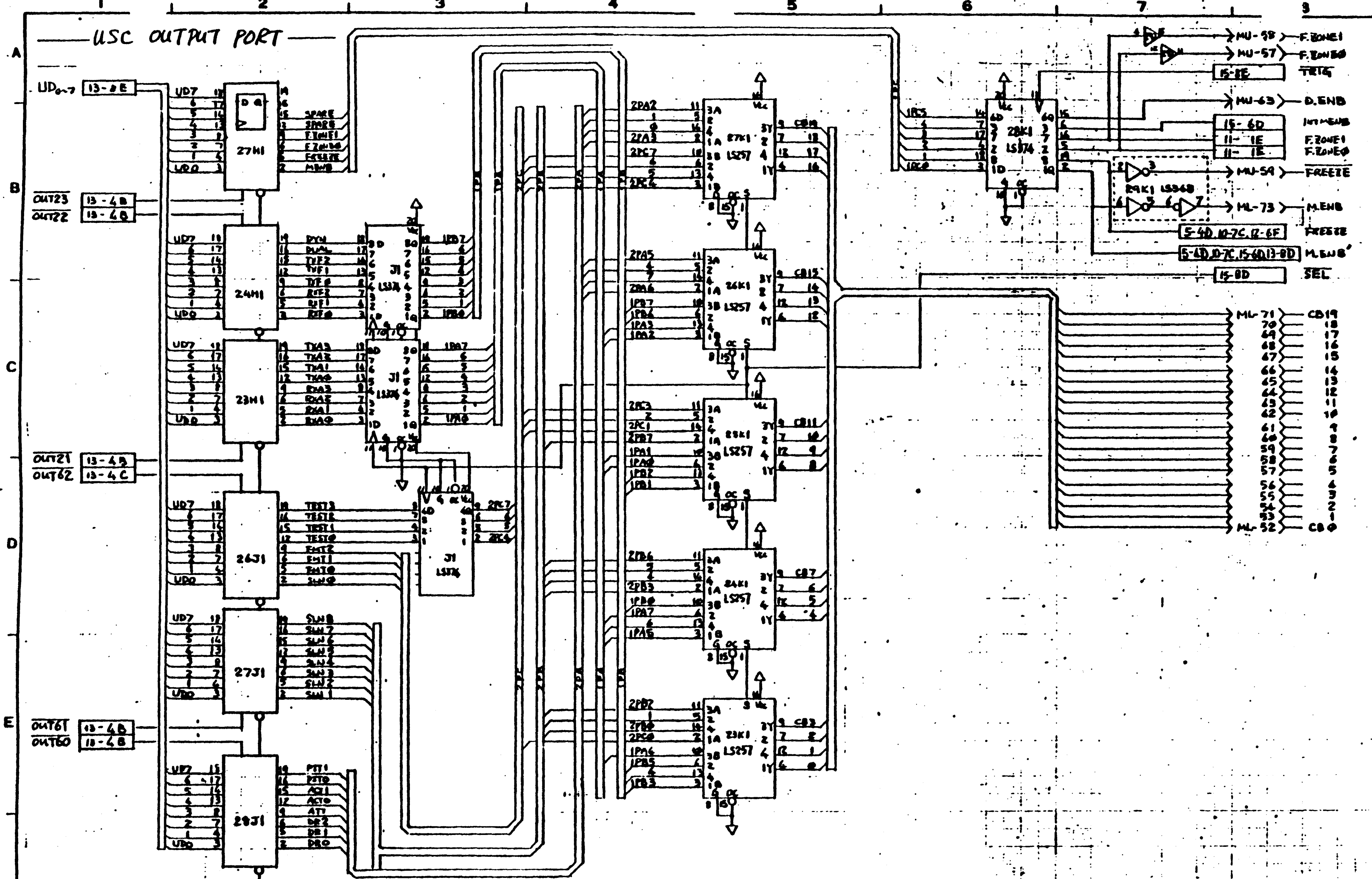


10	5D, 7D	WJ-01 XJ-01 YJ-00	85-10-7		DR. H. AKASAKA	ENG	A8 MST-I
					CH. H. AKASAKA		
REV	ZONE		DATE	REV BY	APP. S. SANO	1985-8-20	FDI-B9718WJ	PAGE 12

A3

YOKOGAWA MEDICAL SYSTEMS


18F1
8085-2
18E1
XTAL
RESET OUT
TRIG
COM REQ
TC
28E1
B9718NG
82S153
21E1
B9718NF
82S153
21E1, 28E1 : 82S153
Vcc : 20
GND : 10
SATEST
D.GATE
20E1
LS373
19E1
81LS95
24F1
2764
24E1
8128-10
24D1
8253
28H1
LS245
23E1
LS08
CLK200M
CLK50M
MENB'
HD
UD0~7
DR. H. AKASAKA
CH. H. AKASAKA
APP S. SANO
ENG
1985-8-20
A8 MST-J.
FD1-B9718WJ
PAGE 13
REV
ZONE
DATE
REVBY
SIZE A3
YOKOGAWA MEDICAL SYSTEMS
Form Y-13-1

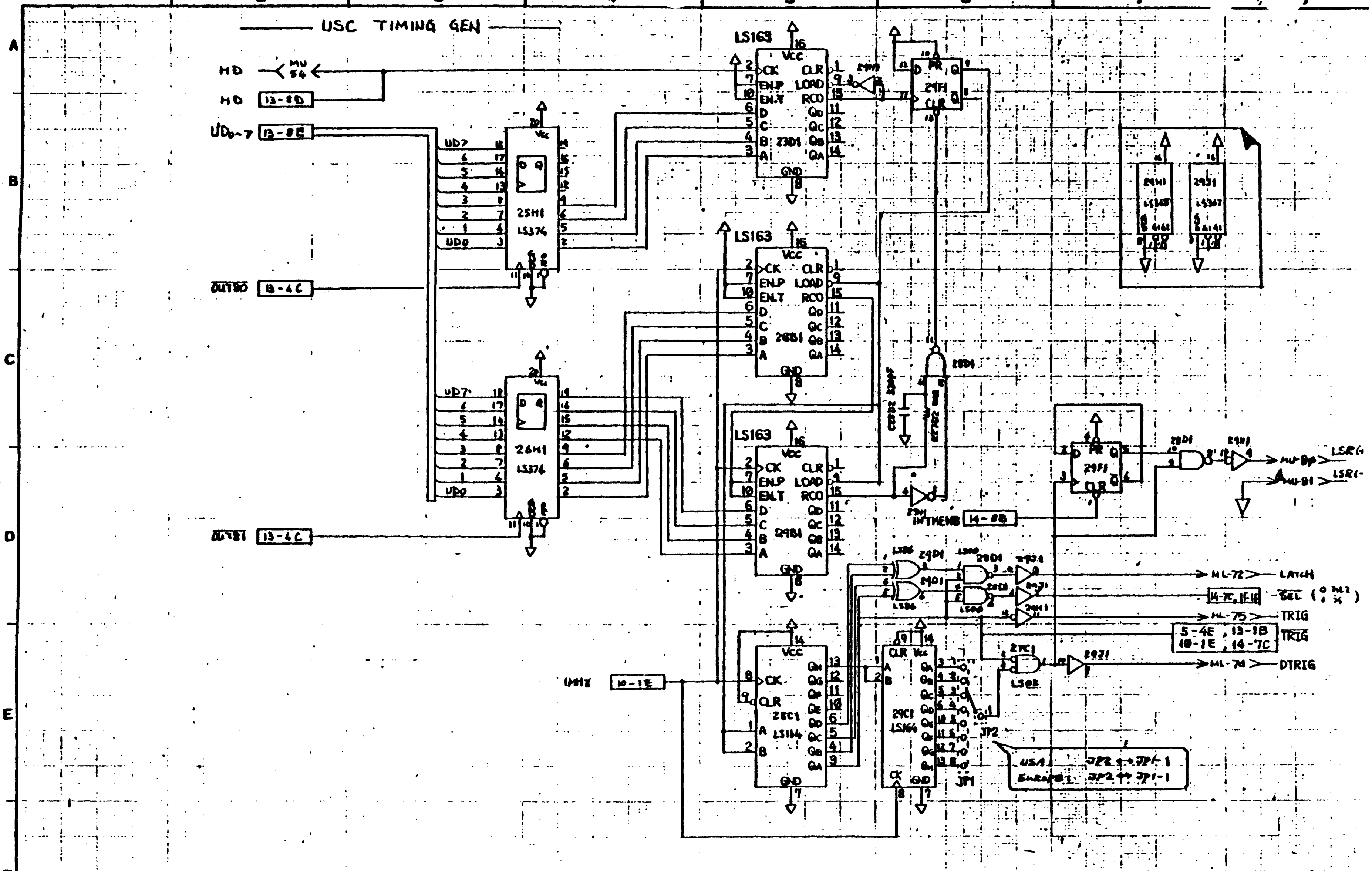


U23H1~U27H1, U26J1~U28J1 : 74LS374 ×6
Vcc:20 GND:10 OE: 1 TO GND

REV	ZONE	DATE	REV BY		
				DR H. AKASAKA	A8 MST-J
				CH H. AKASAKA ENGRG DEPT	FD1-B9718WJ
				APP S. SANO 1985-8-20	PAGE 14

YOKOGAWA MEDICAL SYSTEMS

A3



REV	ZONE	DATE	REV BY

DR. Y. HIROTA
CH. H. AKASAKA
APP. S. SAND
ENGRG DEPT 1985-8-20

A8 MST-J

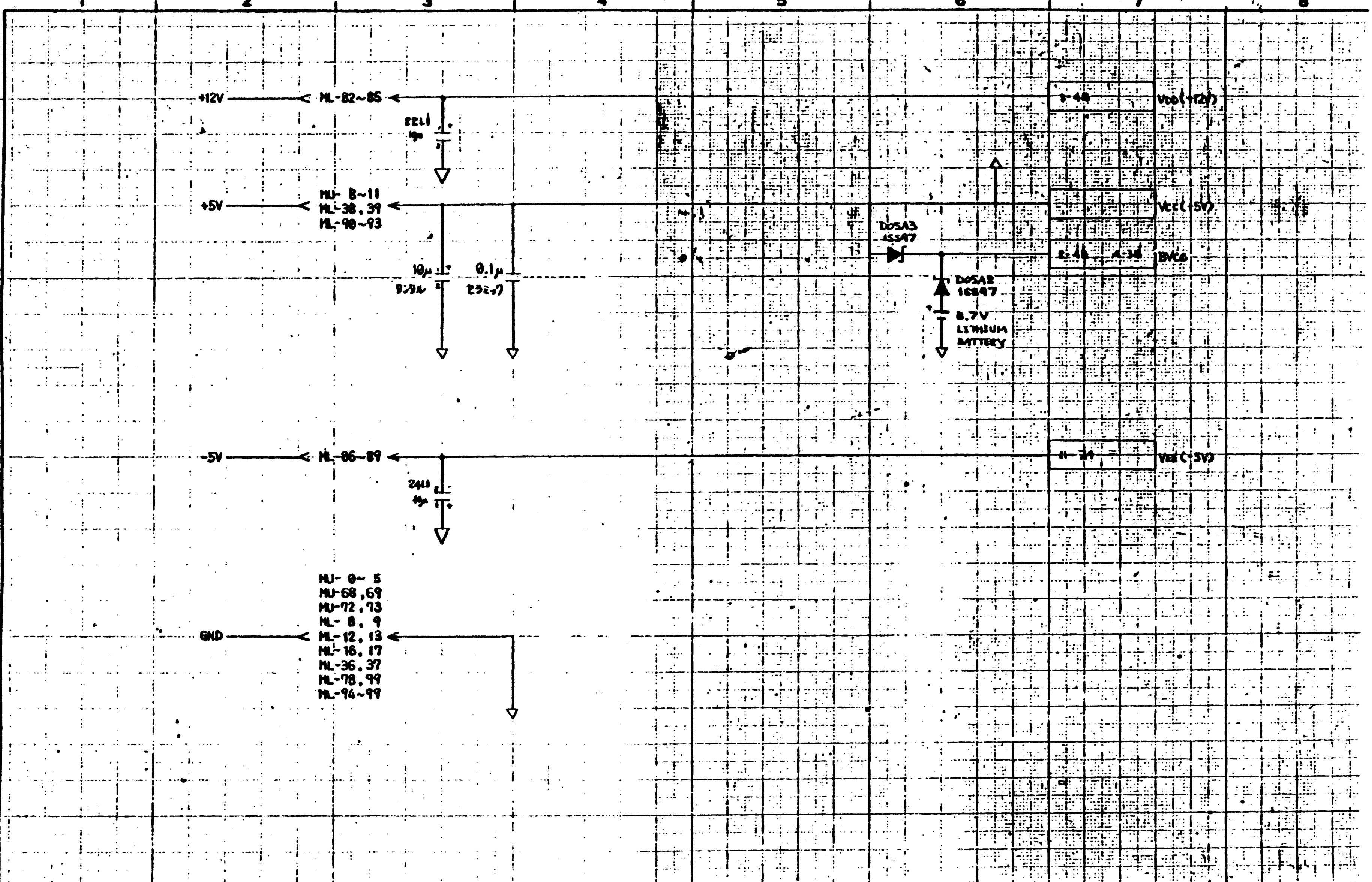
FDI-89718WJ

PAGE 15

SIZE A3

Form Y-13 -1

YOKOGAWA MEDICAL SYSTEMS



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△		- -	
△		- -	

DR. Y. HIROTA
CH. H. AKASAKA — ENGRG DEPT
APP. S. SANO — 1985-8-20

A8 MST-J

FDI- B9718WJ

PAGE 16

SIZE A3

Form Y-13(-1)

YOKOGAWA MEDICAL SYSTEMS

MU

Pin No.	SIGNAL NAME	Pin No.	SIGNAL NAME
0	GND	1	GND
2	GND	3	GND
4	GND	5	GND
6	INT	7	VCCØ
8	VCC1	9	VCC1
10	VCC1	11	VCC1
12		13	
14	DATA0	15	DATA1
16	DATA2	17	DATA3
18	DATA4	19	DATA5
20	DATA6	21	DATA7
22	ADD 0	23	ADD 1
24	ADD 2	25	ADD 3
26	ADD 4	27	ADD 5
28	ADD 6	29	ADD 7
30	ADD 8	31	ADD 9
32	ADD 10	33	ADD 11
34	ADD 12	35	ADD 13
36	ADD 14	37	ADD 15
38	IO/M	39	ALE
40	RD	41	WR
42	READY	43	CLKOUT
44	RESET OUT	45	S0
46	S1	47	HOLD
48	HLDA	49	TRS
50	TRAT	51	TRT
52	STOP	53	SP
54	HD	55	VD
56	1MHz	57	F.ZONE0
58	F.ZONE1	59	FREEZE
60		61	
62		63	D.ENB
64		65	
66		67	
68	GND	69	GND
70	MFCOM (CNØ-1)	71	MFNC (CNØ-2)
72	GND	73	GND
74	MFNO (CNØ-3)	75	MFC3 (CNØ-4)
76	FOOT+ (CNØ-5)	77	FOOT- (CNØ-6)
78	GND	79	GND
80	LSR+ (CNØ-7)	81	LSR- (CNØ-8)
82	SPAREØ (CNØ-9)	83	SPARE1 (CNØ-10)
84	P TYPE Ø (CN6-A2)	85	P TYPE 1 (CN6-B2)
86	P TYPE 2 (CN6-A3)	87	P TYPE 3 (CN6-B3)
88	P TYPE 4 ([illegible])	89	P DOWN ([illegible])
90		91	
92		93	
94	TFC+	95	TFC-
96	TGC+	97	TGC-
98	A OUT	99	B OUT

ML

Pin No.	SIGNAL NAME	Pin No.	SIGNAL NAME
0	CLK50M	1	CLK200M
2	OD0 (CN8-0)	3	OD1 (CN8-1)
4	OD2 (CN8-2)	5	OD3 (CN8-3)
6	OD4 (CN8-4)	7	OD5 (CN8-5)
8	GND (CN8-6)	9	GND (CN8-7)
10	OD6 (CN8-8)	11	OD7 (CN8-9)
12	E GND (CN8-10)	13	GND (CN8-11)
14	COM0 (CN8-12)	15	COM1 (CN8-13)
16	GND (CN8-14)	17	GND (CN8-15)
18	COM2 (CN8-16)	19	INREQ (CN8-17)
20	ID0 (CN8-18)	21	ID1 (CN8-19)
22	ID2 (CN8-20)	23	ID3 (CN8-21)
24	ID4 (CN8-22)	25	ID5 (CN8-23)
26	ID6 (CN8-24)	27	ID7 (CN8-25)
28	D.TYPE1 (CN8-26)	29	D.TYPE0 (CN8-27)
30	BUSY (CN8-28)	31	STROBE (CN8-29)
32	TBXD (CN8-30)	33	TBXU (CN8-31)
34	TBYD (CN8-32)	35	TBYU (CN8-33)
36	GND (CN8-34)	37	GND (CN8-35)
38	VCCØ (CN8-36)	39	VCCØ (CN8-37)
40	GND (CN8-38)	41	GND (CN8-39)
42	GND (CN8-40)	43	GND (CN8-41)
44	GND (CN8-42)	45	-5V (CN8-43)
46	JX (CN8-44)	47	JY (CN8-45)
48	GND (CN8-46)	49	GND (CN8-47)
50	GND (CN8-48)	51	GND (CN8-49)
52	CB 0	53	CB 1
54	CB 2	55	CB 3
56	CB 4	57	CB 5
58	CB 6	59	CB 7
60	CB 8	61	CB 9
62	CB10	63	CB11
64	CB12	65	CB13
66	CB14	67	CB15
68	CB16	69	CB17
70	CB18	71	CB19
72	CBLATCH	73	MENB
74	DTRG	75	TRIG
76	NC	77	NC
78	NC	79	NC
80	NC	81	NC
82	+12V	83	+12V
84	+12V	85	+12V
86	-5V	87	-5V
88	-5V	89	-5V
90	VCC1	91	VCC1
92	VCC1	93	VCC1
94	GND	95	GND
96	GND	97	GND
98	GND	99	GND

Pin No.	SIGNAL NAME	Pin No.	SIGNAL NAME

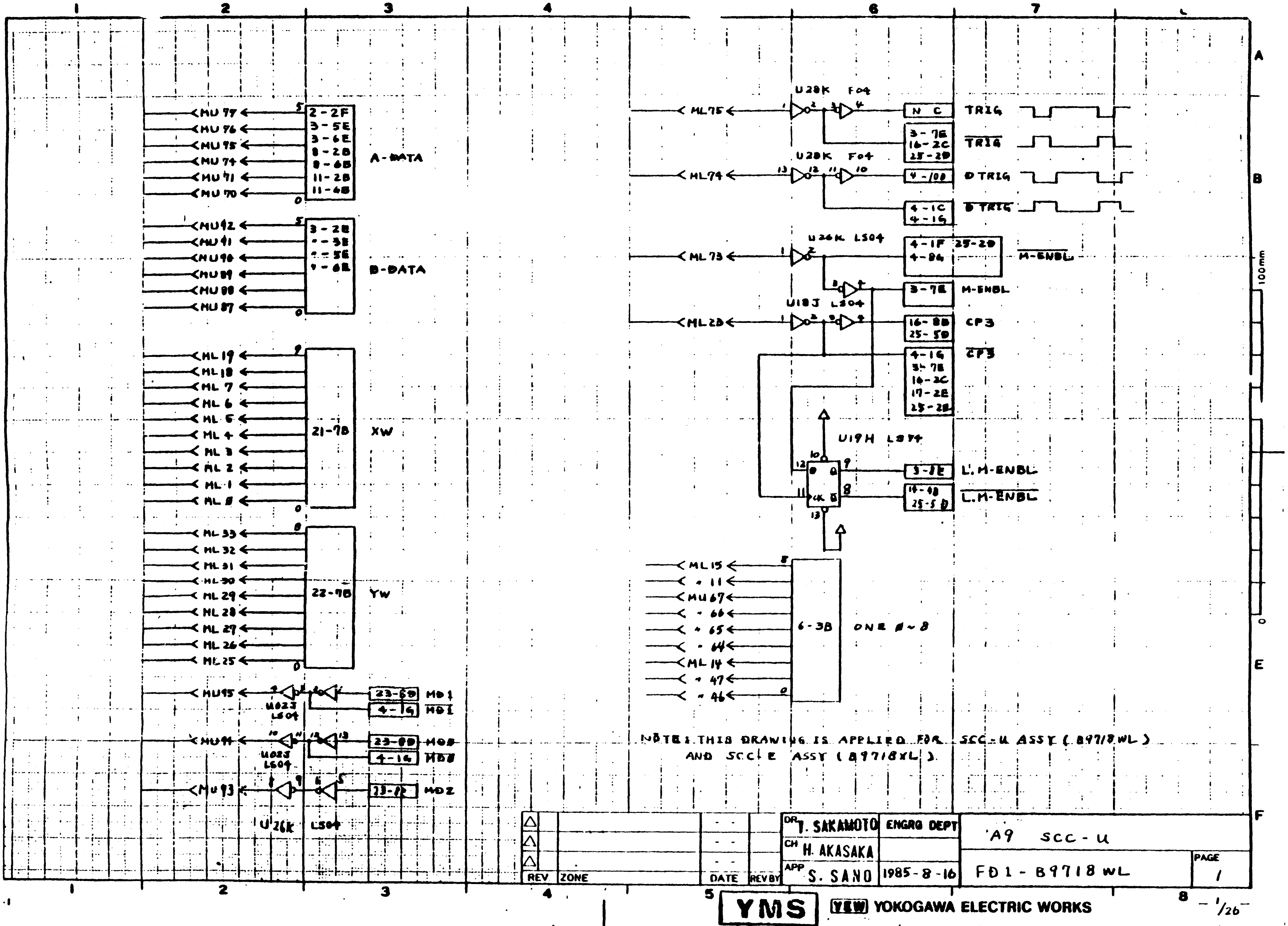
REV	ZONE		DATE	REV BY		
△			- -		DR. Y. HIROTA	
△			- -		CH H. AKASAKA	[illegible]
△			- -		APP S. SANO	1985-8-20

48 MST-J

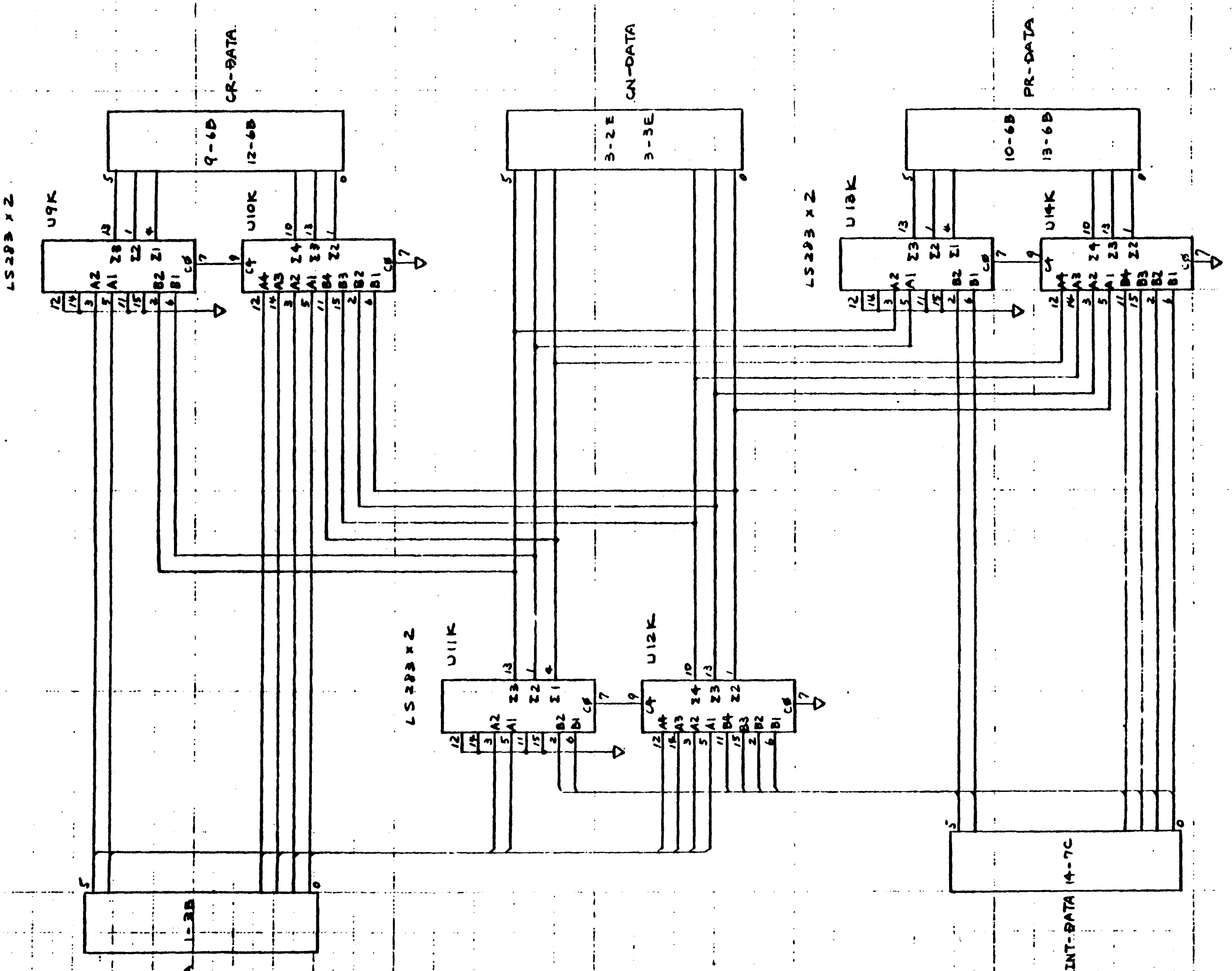
FDI-B9718WJ

PAGE 17

YOKOGAWA MEDICAL SYSTEMS



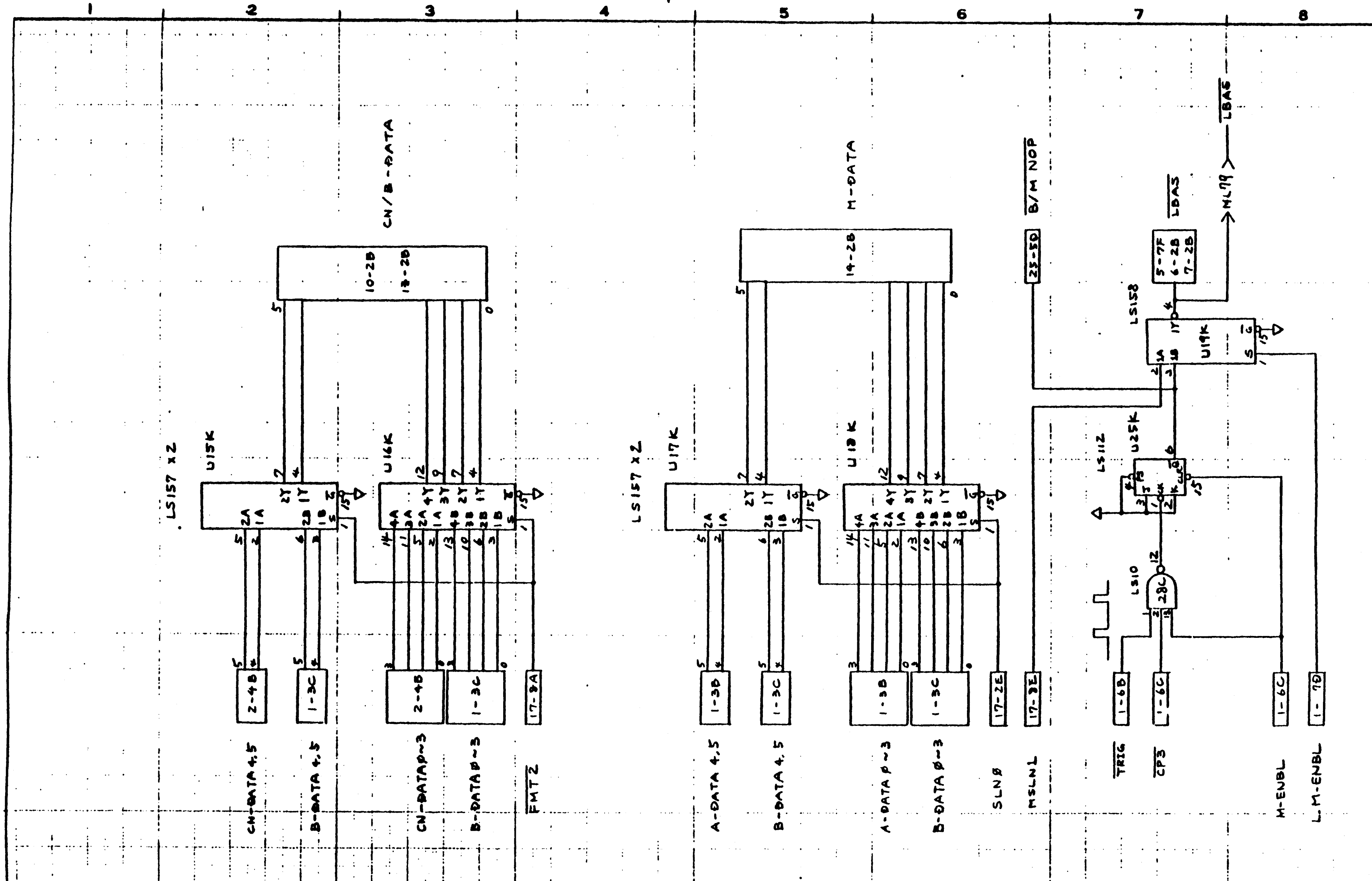
A-DATA
B-DATA
XW
YW
U28K F04
U26K LS04
U18J LS04
U19H LS74
U023 LS04
U26K LS04
TRIG
D TRIG
M-ENBL
CP3
L.M-ENBL
ONE 0~8
MD1
MD0
MD2
NOTE: THIS DRAWING IS APPLIED FOR SCC-U ASSY (B9718WL)
AND SCC-E ASSY (B9718XL).
DR T. SAKAMOTO
CH H. AKASAKA
APP S. SANO
ENGRG DEPT
1985-8-16
A9 SCC-U
FD1-B9718WL
PAGE 1
REV ZONE DATE REV BY
YMS
YEW YOKOGAWA ELECTRIC WORKS
1/26



REV	ZONE	DATE	REV BY			
		- -		DR T. SAKAMOTO	ENGRG DEPT	A9 SCC-u
		- -		CH H. AKASAKA		
		- -		APP S. SANO	1985-8-16	FD1-B9718 WL — PAGE 2

YMS

YEW YOKOGAWA ELECTRIC WORKS



REV.	ZONE	DATE	REV BY
△		- -	
△		- -	
△		- -	

DR. T. SAKAMOTO — ENGRG DEPT

CH. H. M.ISAKA

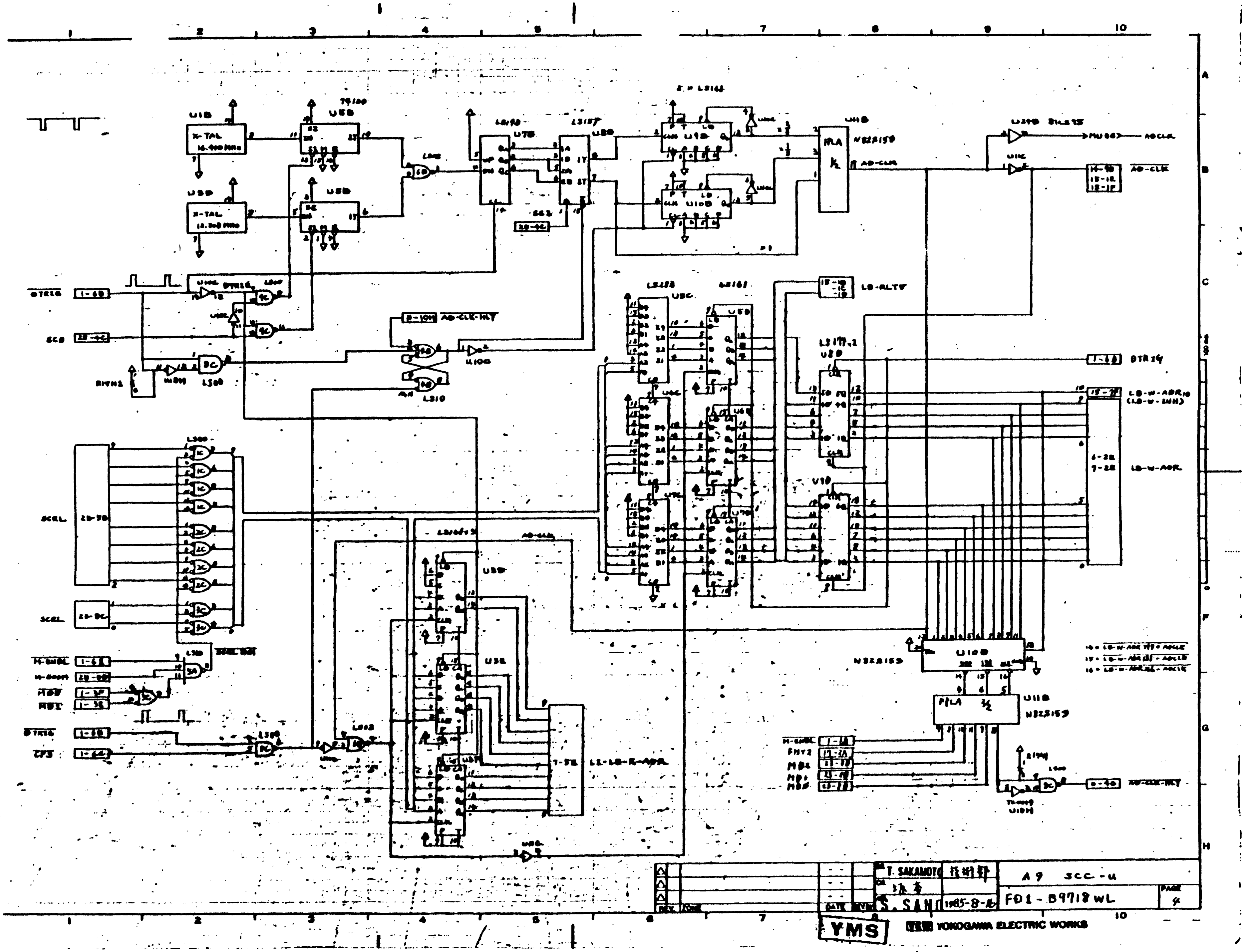
APP. S. SANO — 1985-8-16

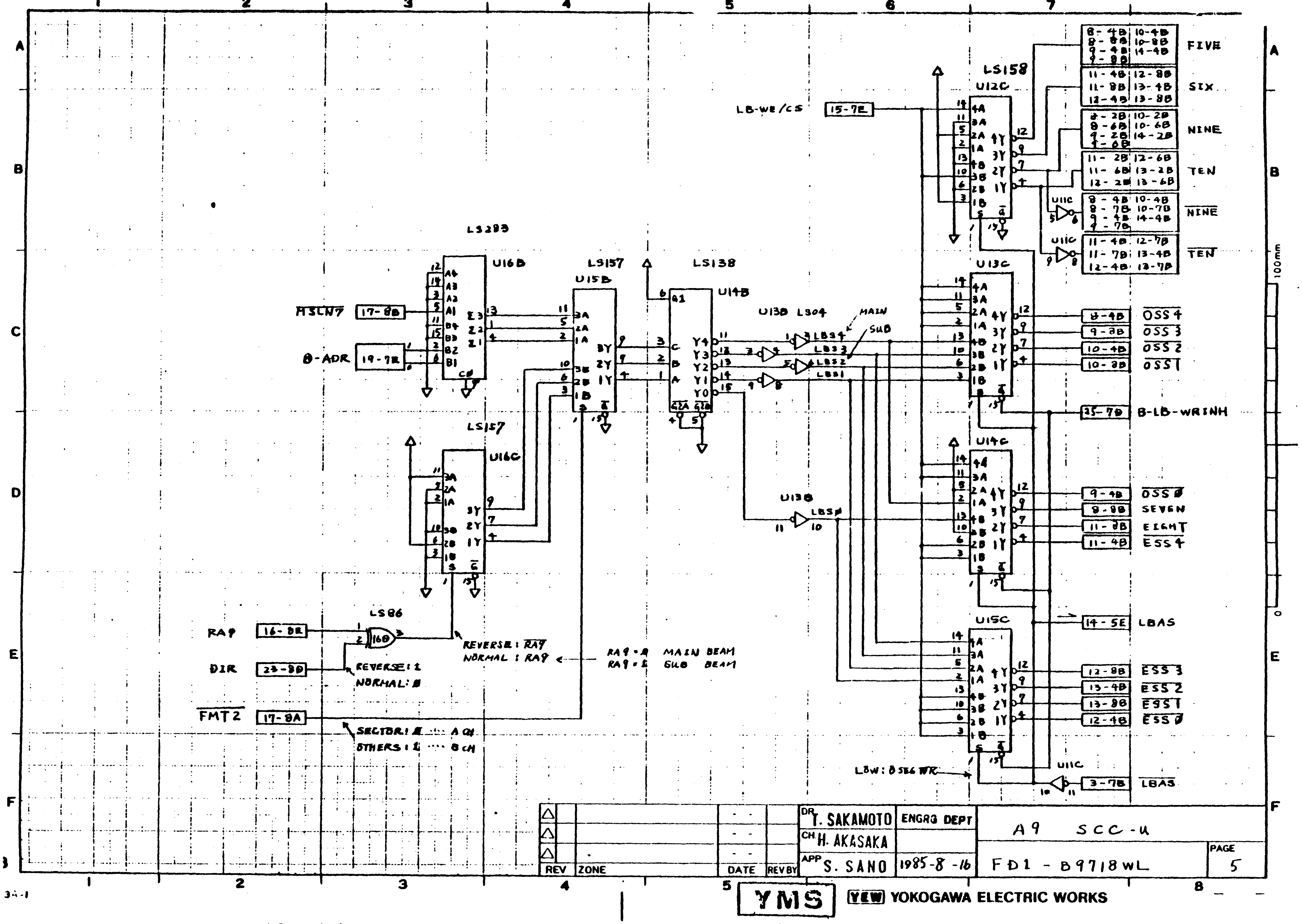
A9 SCC-U

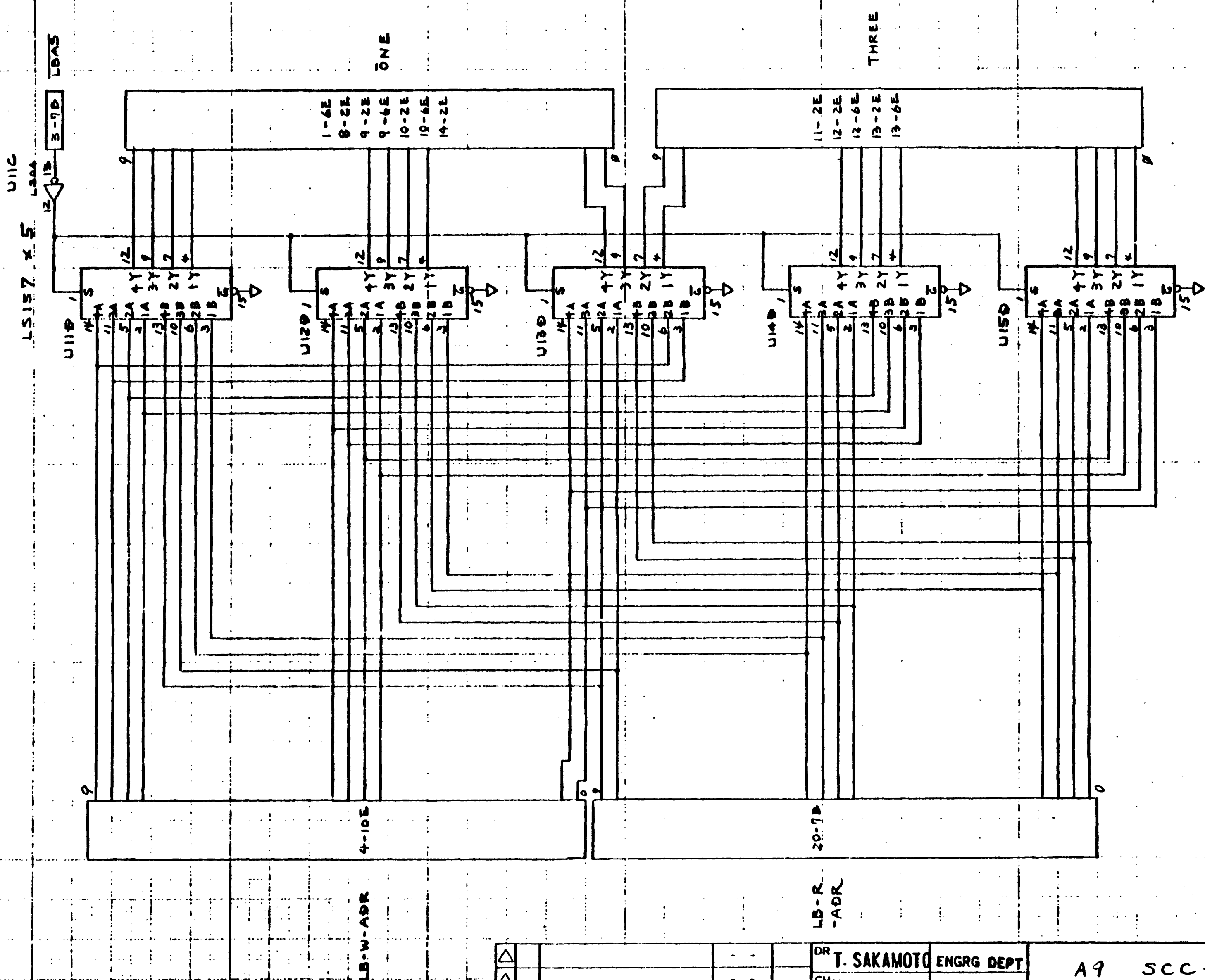
FD1-B9718WL

PAGE 3

YMS YEW YOKOGAWA ELECTRIC WORKS

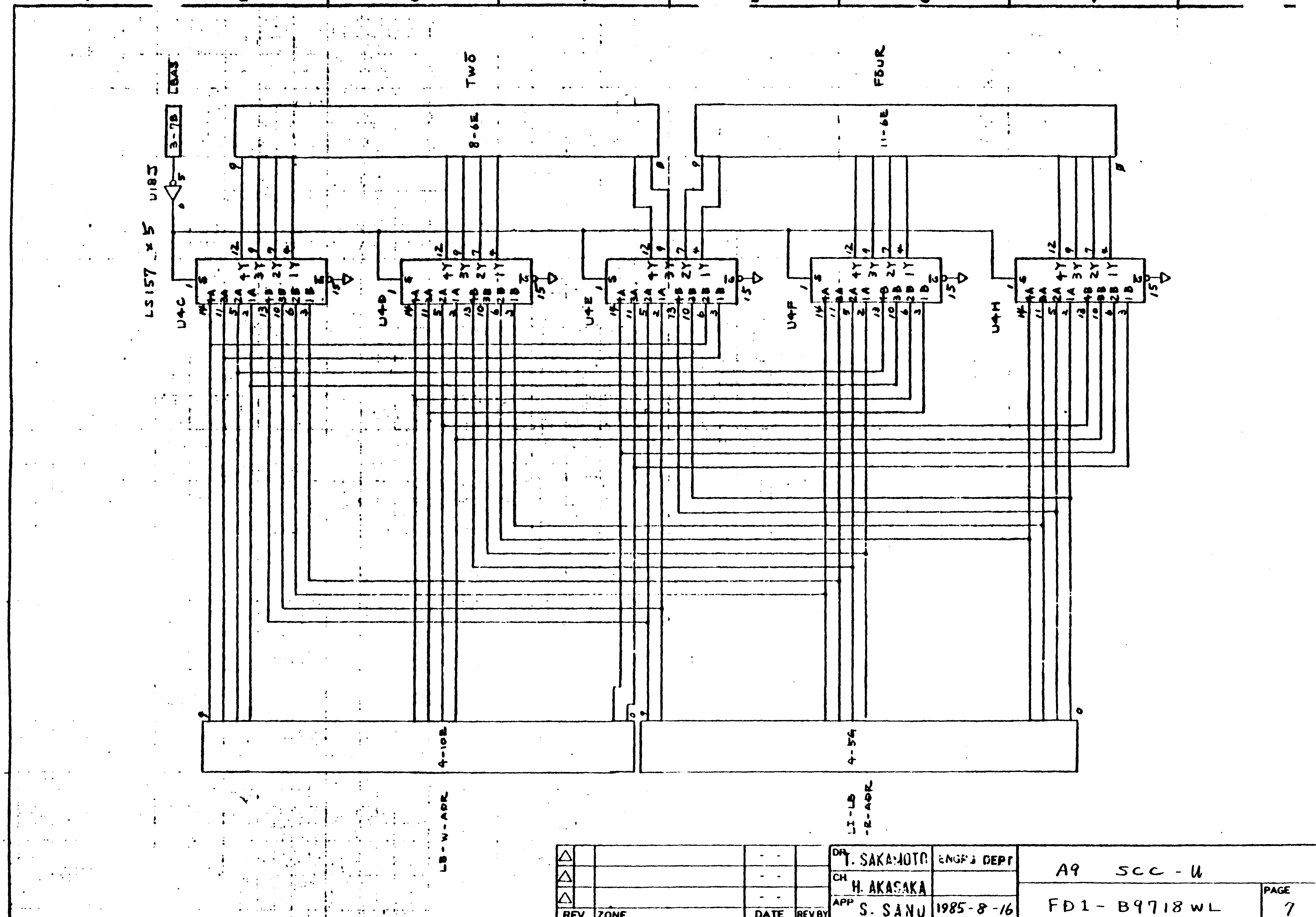

T. SAKAMOTO
S. SANO
1985-8-16
A9 SCC-U
FD1-B9718WL
PAGE 4
YMS
YOKOGAWA ELECTRIC WORKS


LS158
U12C
LB-WE/CS
15-7E
FIVE
SIX
NINE
TEN
NINE
TEN
U11C
U13C
OSS4
OSS3
OSS2
OSS1
B-LB-WRINH
35-7B
U14C
OSSØ
SEVEN
EIGHT
ESS4
U15C
LBAS
14-5E
ESS3
ESS2
ESS1
ESSØ
LBW: BSEG WR
LBAS
3-7B
LS283
U16B
MSLN7
17-8B
B-ADR
19-7E
LS157
U15B
LS138
U14B
U13B LS04
MAIN
SUB
LBS4
LBS3
LBS2
LBS1
U13B
LBSØ
LS157
U16C
LS86
RA9
16-8E
DIR
23-8D
FMT2
17-8A
REVERSE: RA9
NORMAL : RA9
RA9 = Ø MAIN BEAM
RA9 = 1 SUB BEAM
REVERSE: 1
NORMAL: Ø
SECTOR: Ø ··· A Q1
OTHERS: 1 ··· 8 CH
T. SAKAMOTO
H. AKASAKA
S. SANO
ENGRG DEPT
1985-8-16
A9 SCC-U
FD1 - B9718WL
PAGE
5
REV
ZONE
DATE
REVBY
YMS
YEW YOKOGAWA ELECTRIC WORKS



△		- -		DR T. SAKAMOTO	ENGRG DEPT	A9 SCC-u
△		- -		CH H. AKASAKA		
△		- -		APP S. SANO	1985-8-16	FD1-B9718WL — PAGE 6
REV	ZONE	DATE	REV BY			

YMS — YEW YOKOGAWA ELECTRIC WORKS



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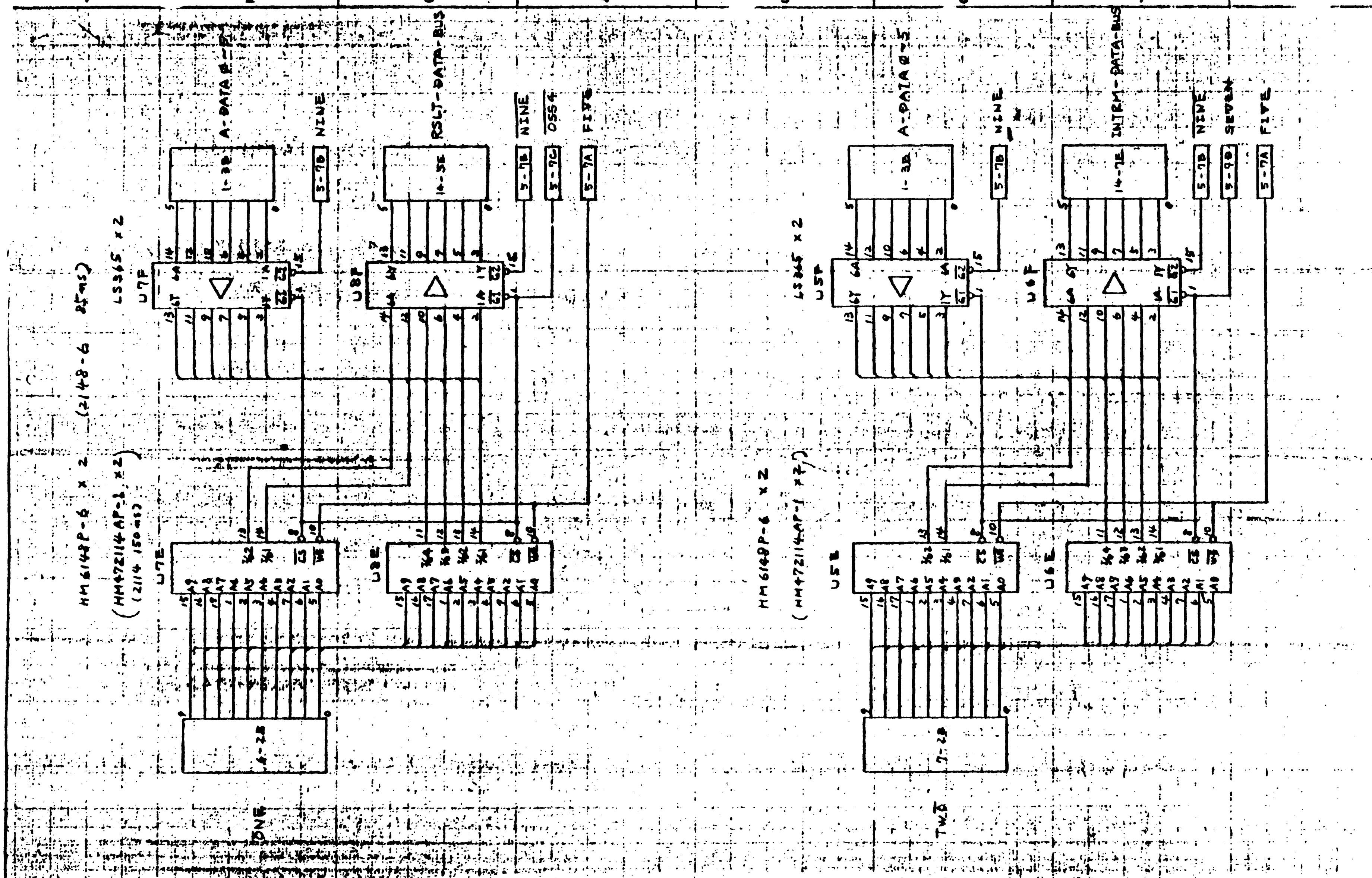
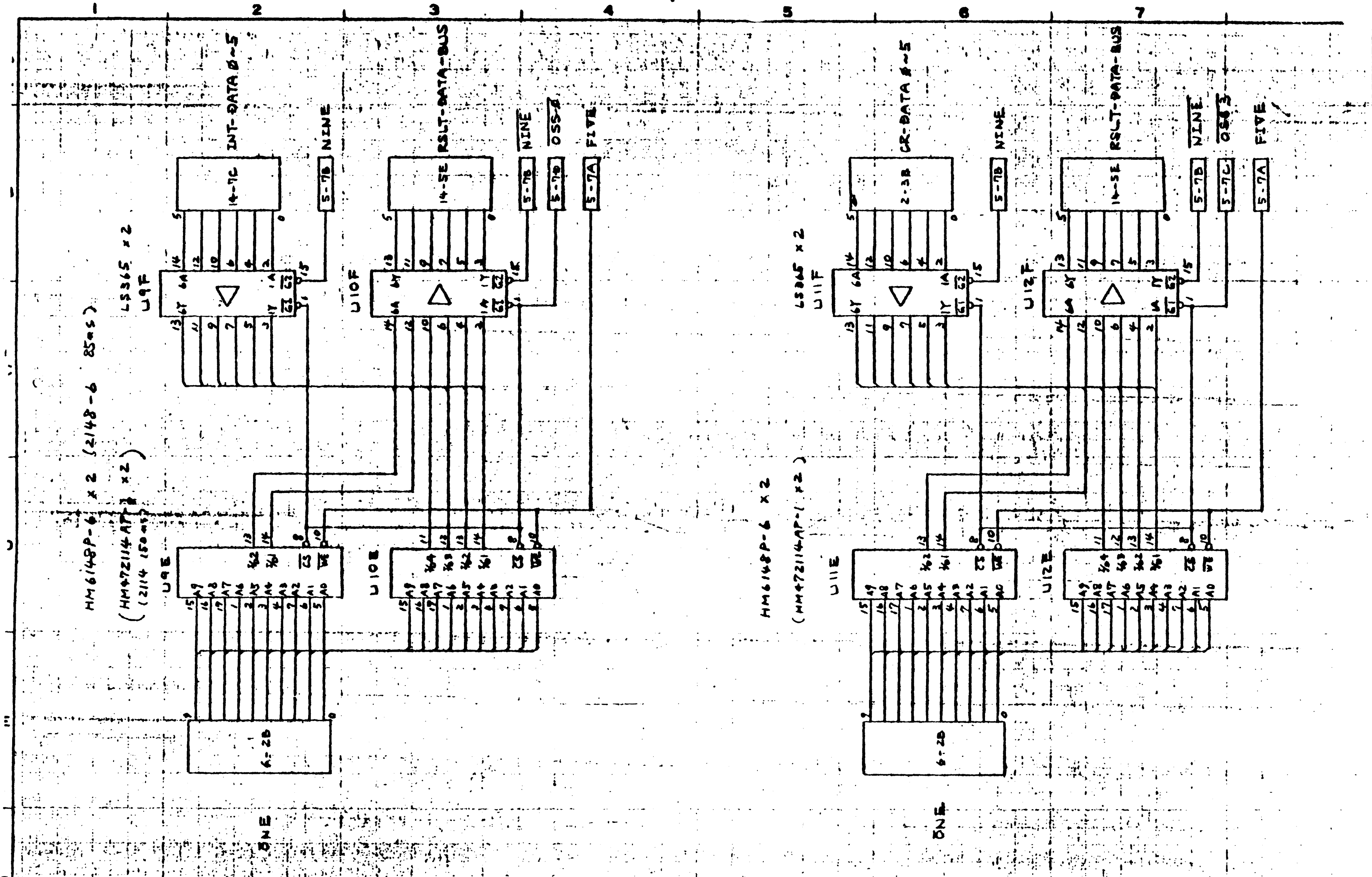
		- -		DR T. SAKAMOTO	ENG'G DEPT	A9 SCC-U	
		- -		CH H. AKASAKA		FD1-B9718WL	PAGE 7
		- -		APP S. SANU	1985-8-16		

YEW YOKOGAWA ELECTRIC WORKS



REV.	ZONE	DATE	REV BY				
				DR. T. SAKAMOTO	ENGRG DEPT	A9 SCC-u	
				CH. H. AKASAKA		FD1-B9718wL	PAGE 8
				APP. S. SANO	1985-8-16		

YMS **YEW** YOKOGAWA ELECTRIC WORKS



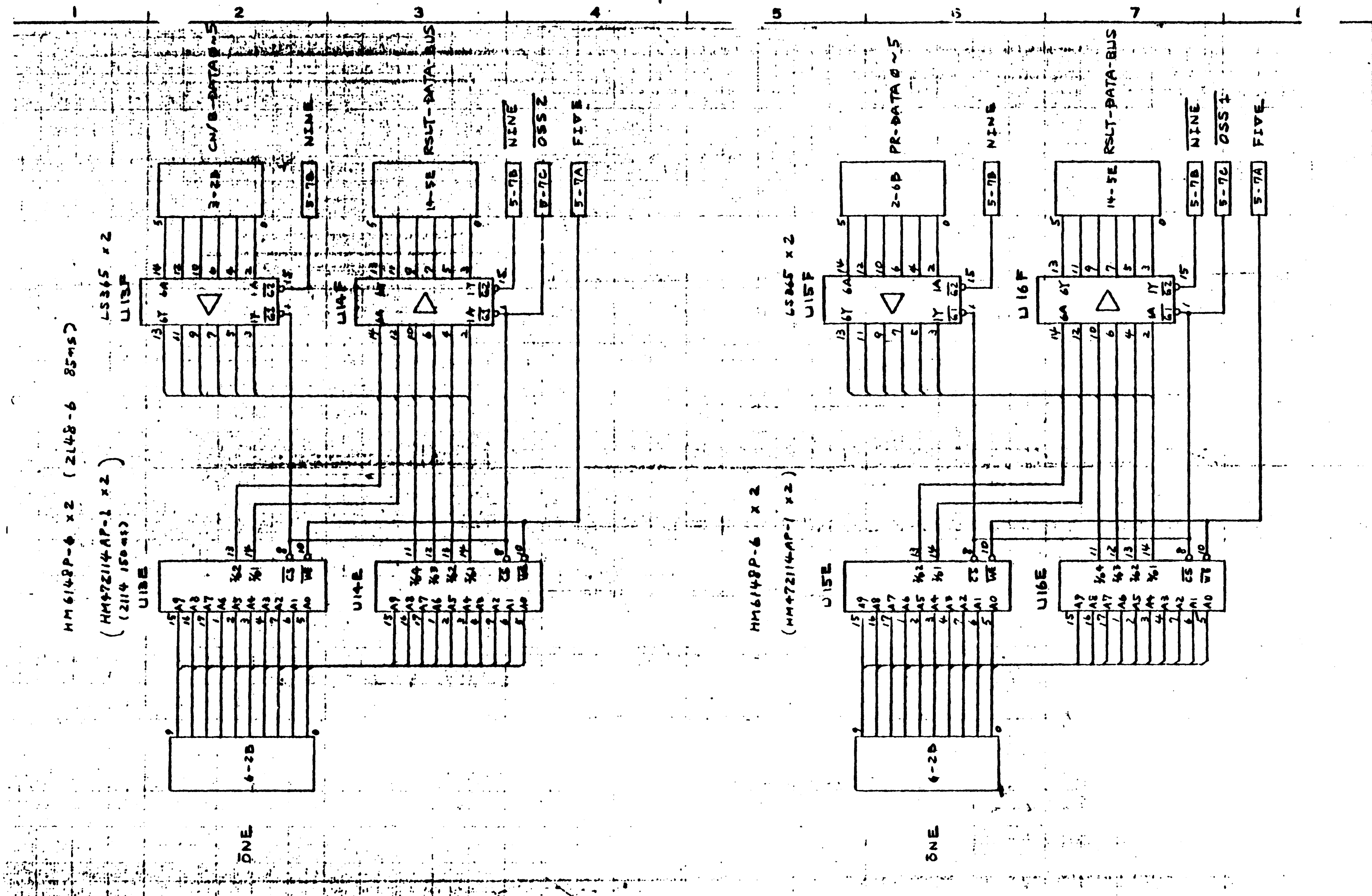
DR	F. SAKAMOTO	ENGRG. DEPT	A9 SCC-U
CK	H. AKASAKA		
APP	S. SANO	1985-8-16	ED1-B9718WL

REV. | ZONE | DATE | REV BY

PAGE 9

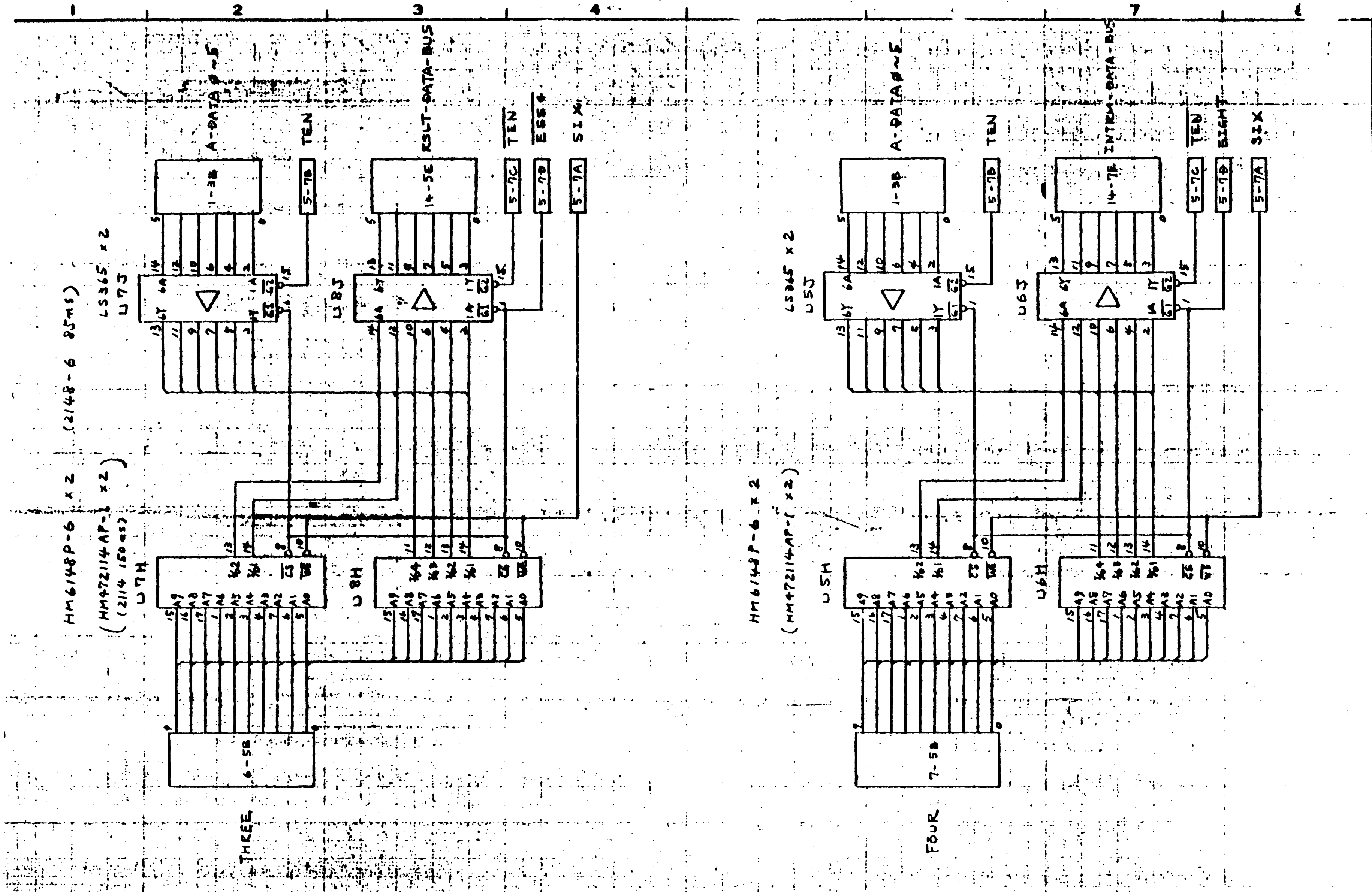
VMS

YEW YOKOGAWA ELECTRIC WORKS



REV.	ZONE	DATE	REV BY				
				DR. T. SAKAMOTO	ENGRG DEPT	A9 SCC-U	
				CH. H. AKASAKA			PAGE
				APP. S. SANO	1985-8-16	FD1-B9718WL	10

YEW YOKOGAWA ELECTRIC WORKS



DR T. SAKAMOTO	ENGRG DEPT	A9 SCC-U		
CH H. AKASAKA				
APP S. SANU	1985-8-16	FD1 - B9718 WL	PAGE	11

REV. | ZONE | DATE | REV BY

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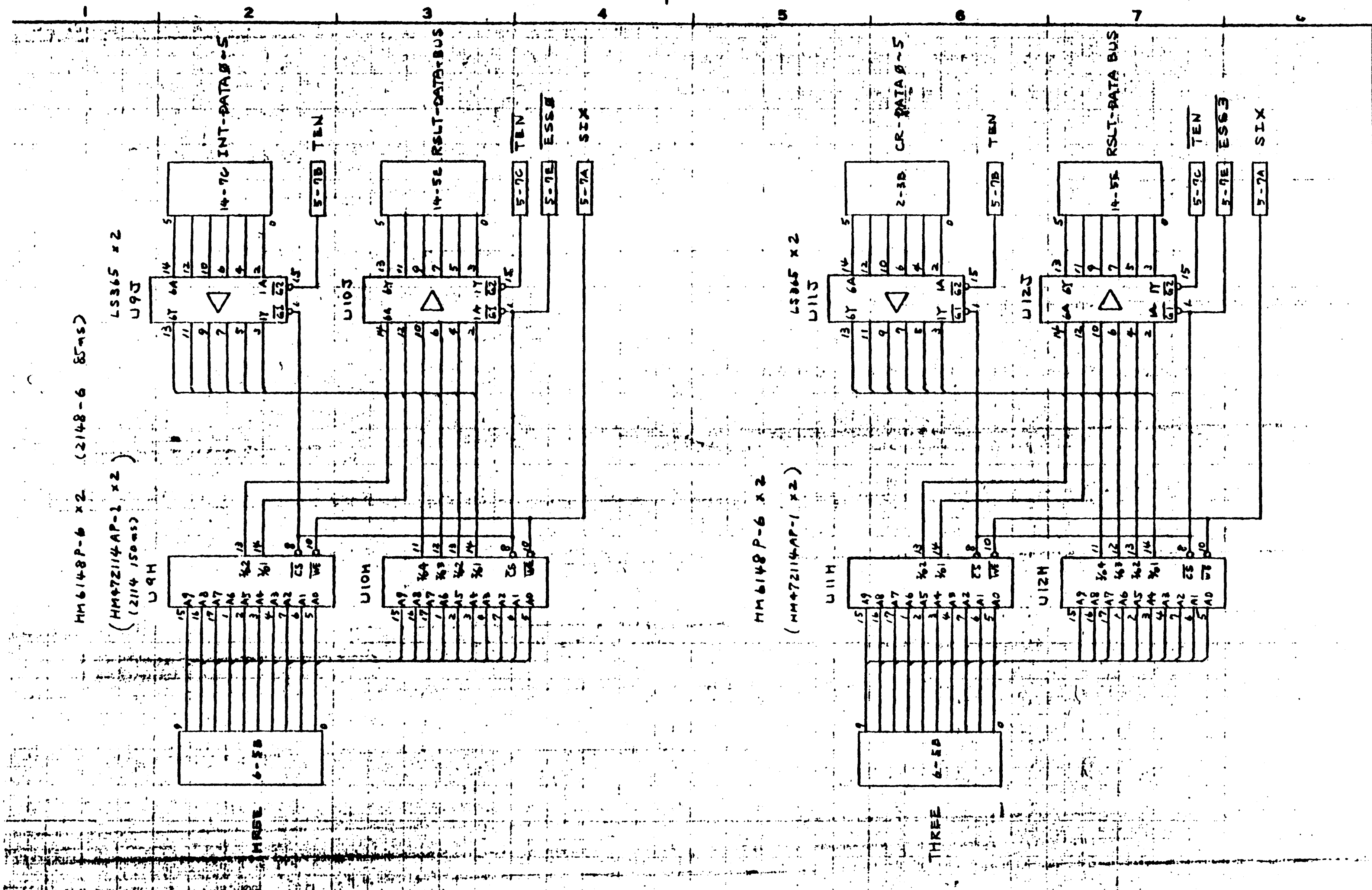
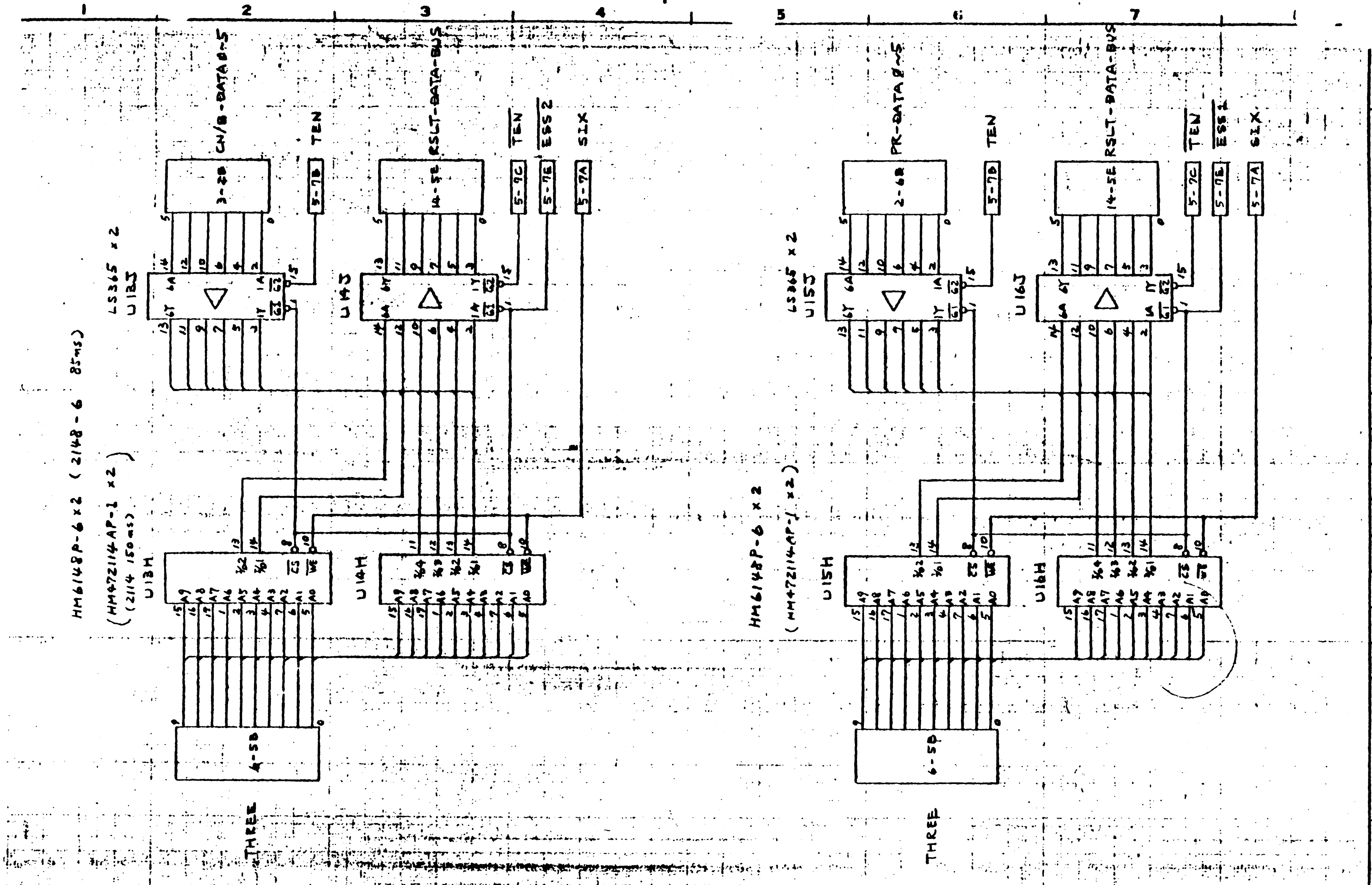


DR. T. SAKAMOTO	ENGRG DEPT	A9 SCC - u	
CH. H. AKASAKA			PAGE
APP. S. SANO	1985-8-16	FD1 - B9718WL	12

REV | ZONE | DATE | REV BY

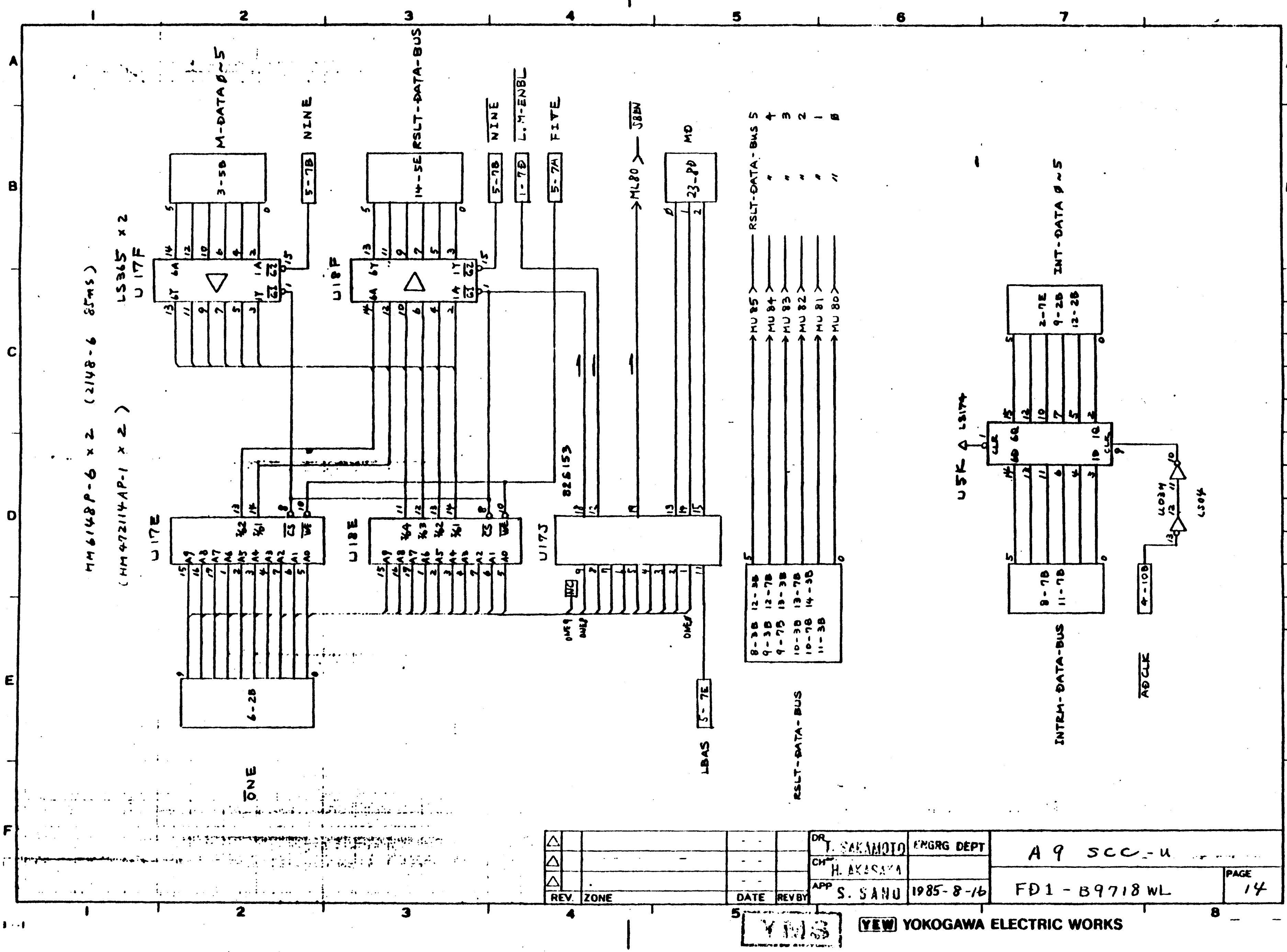
YMS

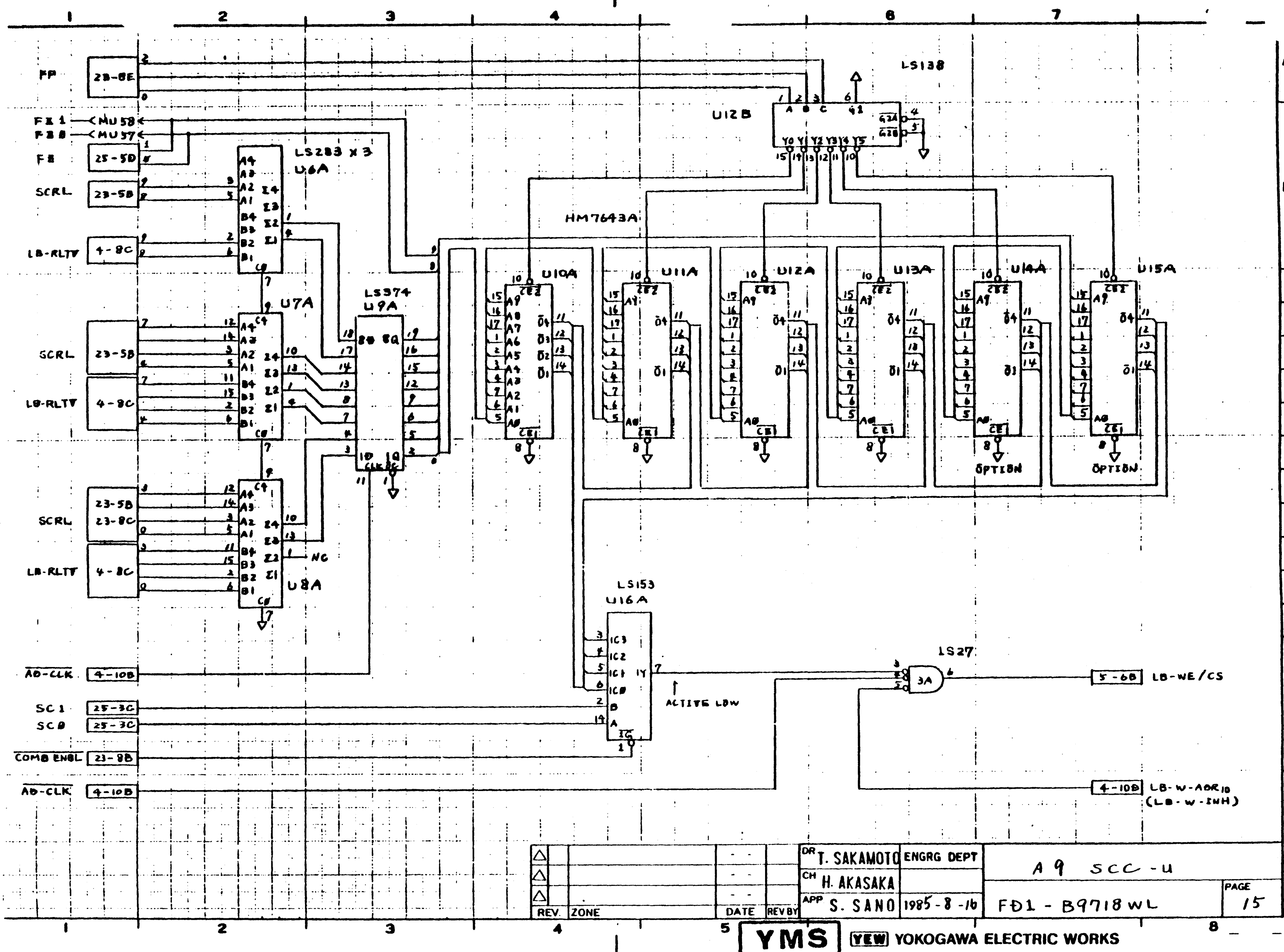
YEW YOKOGAWA ELECTRIC WORKS



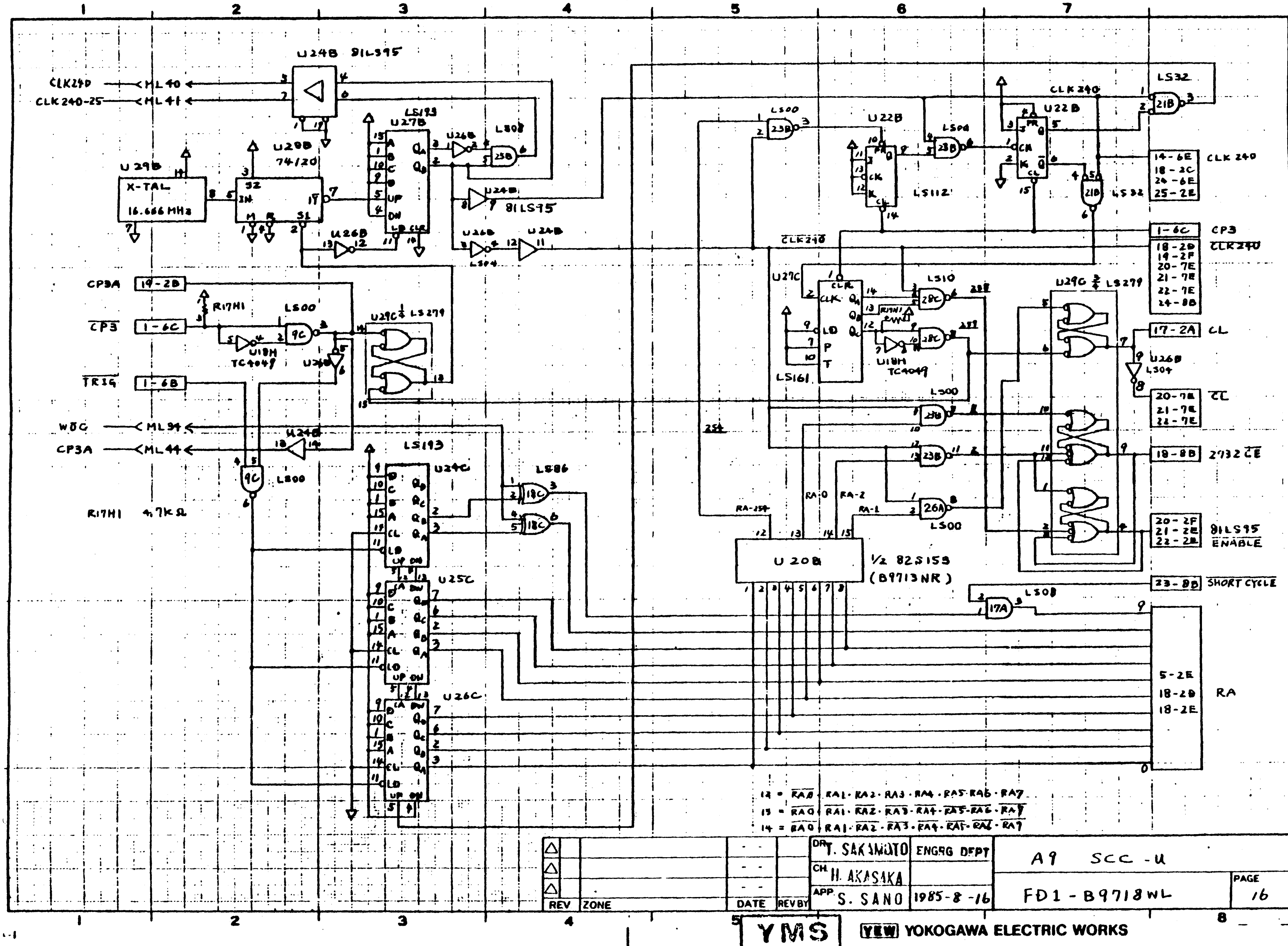
REV.	ZONE	DATE	REV BY	DR. T. SAKAMOTO	ENGRG DEPT	A9 SCC-u
				CH. H. AKASAKA		
				APP. S. SANO	1985-8-16	FD1-B9718WL — PAGE 13

YEW YOKOGAWA ELECTRIC WORKS

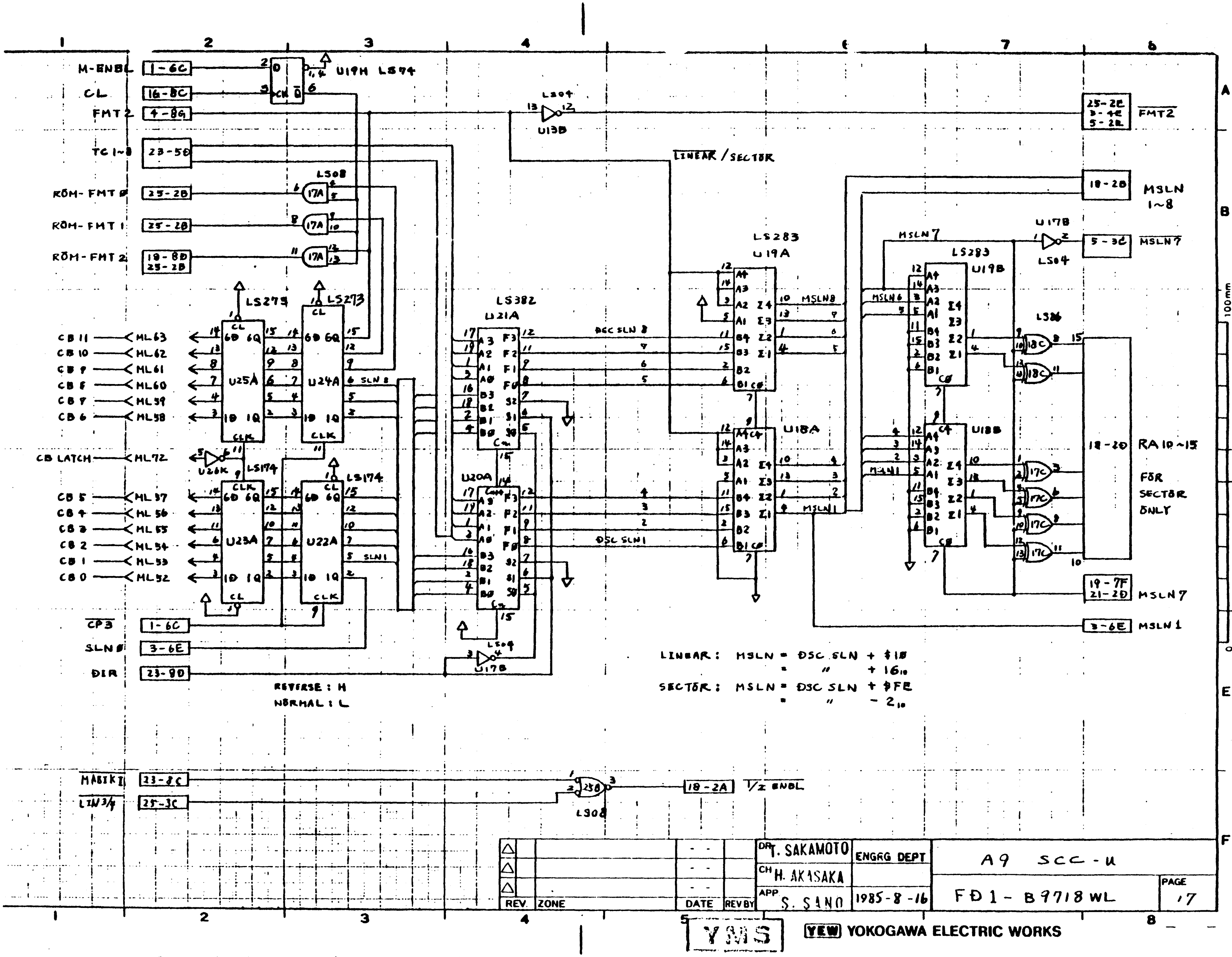

HM6148P-6 × 2 (2148-6 85ns)
(HM472114AP-1 × 2)
LS365 × 2
U17F
U18F
U17E
U18E
U17J
82S153
M-DATA 0~5
3-5B
NINE
5-7B
RSLT-DATA-BUS
14-5E
L.M-ENBL
1-7D
FITE
5-7A
ML80
SBEN
MD
23-8D
RSLT-DATA-BUS 5
MU 85
MU 84
MU 83
MU 82
MU 81
MU 80
8-3B 12-3B
9-3B 12-7B
9-7B 13-3B
10-3B 13-7B
10-7B 14-3B
11-3B
RSLT-DATA-BUS
6-2B
ONE
5-7E
LBAS
NC
INT-DATA 0~5
2-7E
9-2B
12-2B
8-7B
11-7B
INTRM-DATA-BUS
U5K
LS174
U03H
LS04
4-10B
ADCLK
DR T. SAKAMOTO
CH H. AKASAKA
APP S. SANO
ENGRG DEPT
1985-8-16
A9 SCC-U
FD1-B9718 WL
PAGE 14
REV. ZONE DATE REVBY
YEW YOKOGAWA ELECTRIC WORKS



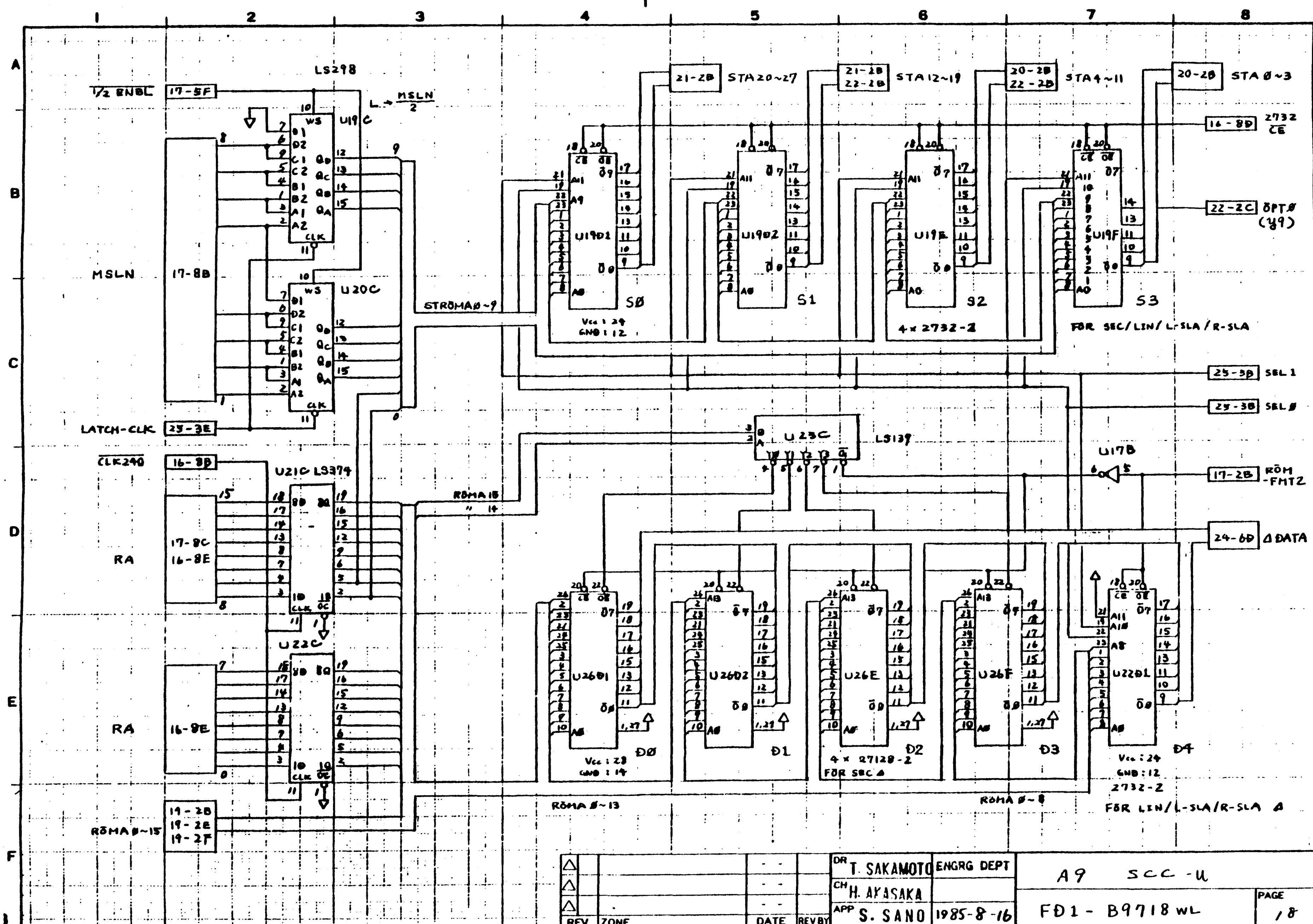
FP
23-8E
FX1
FXB
MU58
MU57
FX
25-5D
SCRL
23-5B
LB-RLTV
4-8C
23-8C
AD-CLK
4-10B
SC1
SC0
25-3C
COMB ENBL
23-9B
LS283 x 3
U6A
U7A
U8A
NC
LS374
U9A
LS138
U12B
HM7643A
U10A
U11A
U12A
U13A
U14A
U15A
OPTION
LS153
U16A
ACTIVE LOW
LS27
3A
5-6B
LB-WE/CS
LB-W-ADR10
(LB-W-INH)
T. SAKAMOTO
H. AKASAKA
S. SANO
ENGRG DEPT
1985-8-16
A9 SCC-U
FD1-B9718WL
PAGE
15
REV.
ZONE
DATE
REV BY
YMS
YEW YOKOGAWA ELECTRIC WORKS



U24B 81LS95
CLK240 ML40
CLK 240-25 ML41
U29B X-TAL 16.666 MHz
U29B 74120
LS193 U27B
U26B
LS08
U24B 81LS95
U26B LS04
CP3A 19-2B
CP3 1-6C
TRIG 1-6B
WDG ML34
CP3A ML44
R17H1
R17H1 4.7kΩ
LS00
U18H TC4049
U29C 1/4 LS279
U24B
LS193 U24C
U25C
U26C
LS86
LS00
U22B
LS04
LS112
CLK240
U29C
LS161
LS10
LS00
LS32
U22B
CLK 240
LS32
14-6E 18-2C 24-6E 25-2E CLK 240
1-6C CP3
18-2D 19-2F 20-7E 21-7E 22-7E 24-8B CLK240
U29C 3/4 LS279
17-2A CL
U26B LS04
20-7E 21-7E 22-7E CL
19-8B 2732 CE
20-2F 21-2E 22-2B 81LS95 ENABLE
23-8D SHORT CYCLE
U20B 1/2 82S155 (B9713NR)
RA-254 RA-0 RA-2 RA-1
LS08
5-2E 18-2D 18-2E RA
12 = RA0·RA1·RA2·RA3·RA4·RA5·RA6·RA7
13 = RA0·RA1·RA2·RA3·RA4·RA5·RA6·RA7
14 = RA0·RA1·RA2·RA3·RA4·RA5·RA6·RA7
DR T. SAKAMOTO
CH H. AKASAKA
APP S. SANO
ENGRG DEPT
1985-8-16
A9 SCC-U
FD1-B9718WL
PAGE 16
REV ZONE DATE REV BY
YMS
YEW YOKOGAWA ELECTRIC WORKS



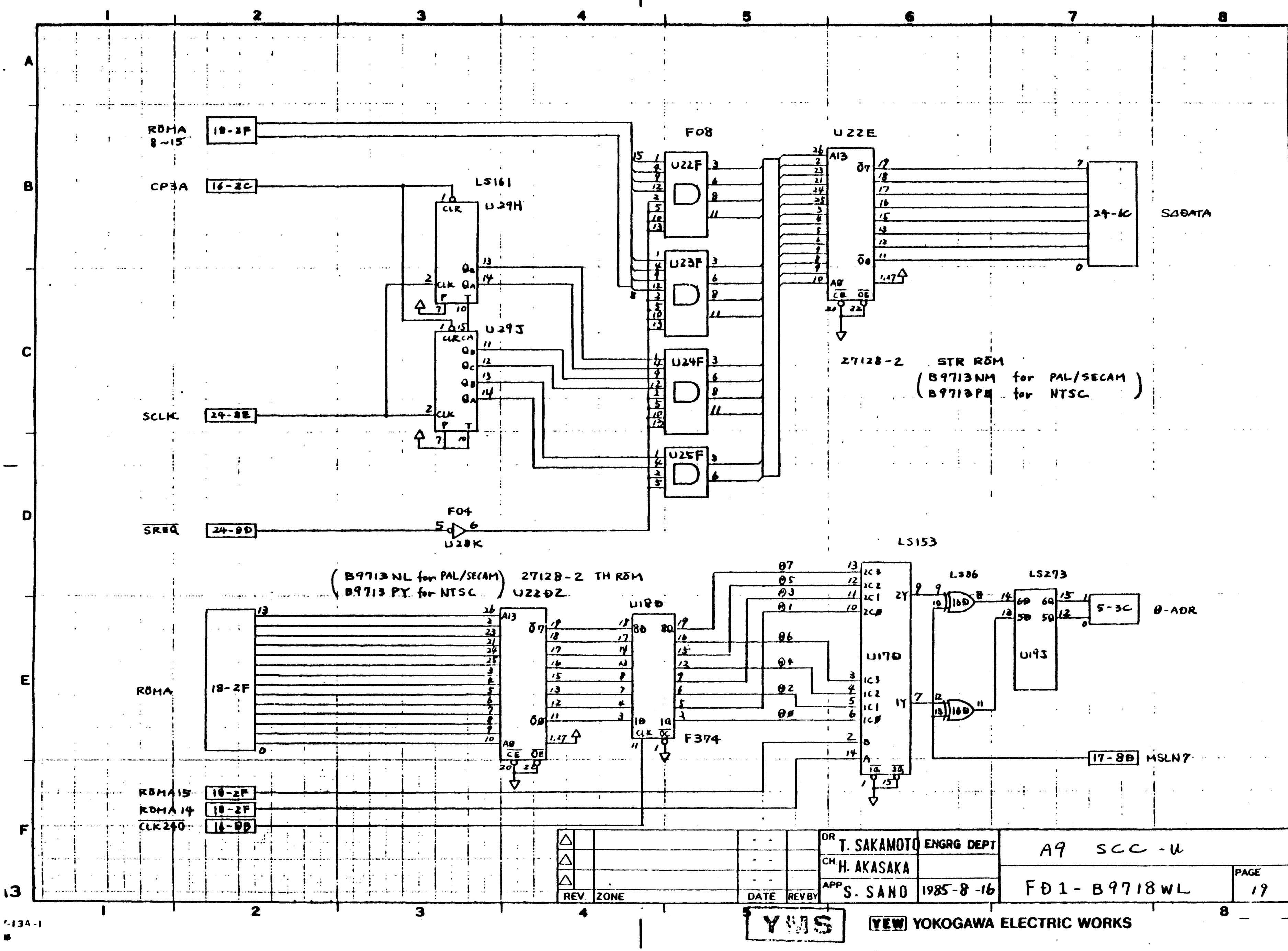
M-ENBL
CL
FMT2
TC1~8
RÖM-FMT0
RÖM-FMT1
RÖM-FMT2
CB11 ML63
CB10 ML62
CB9 ML61
CB8 ML60
CB7 ML59
CB6 ML58
CB LATCH ML72
CB5 ML57
CB4 ML56
CB3 ML55
CB2 ML54
CB1 ML53
CB0 ML52
CP3
SLN0
DIR
U19H LS74
LS04 U13B
LINEAR / SECTOR
LS08 17A
LS273 U24A
LS273 U25A
LS174 U22A
LS174 U23A
U26K
LS382 U21A
U20A
LS04 U17B
LS283 U19A
U18A
LS283 U19B
U18B
LS86 18C 17C
DSC SLN 8
DSC SLN 1
MSLN 8
MSLN 1
MSLN 7
MSLN 6
FMT2
MSLN 1~8
RA10~15
FOR SECTOR ONLY
LINEAR: MSLN = DSC SLN + $18
= " + 16₁₀
SECTOR: MSLN = DSC SLN + $FE
= " - 2₁₀
REVERSE: H
NORMAL: L
MABIKI
LIN3/4
LS08 23B
1/2 ENBL
DR T. SAKAMOTO
CH H. AKASAKA
APP S. SANO
ENGRG DEPT
1985-8-16
A9 SCC-U
FD1-B9718WL
PAGE 17
REV. ZONE DATE REVBY
YMS
YEW YOKOGAWA ELECTRIC WORKS

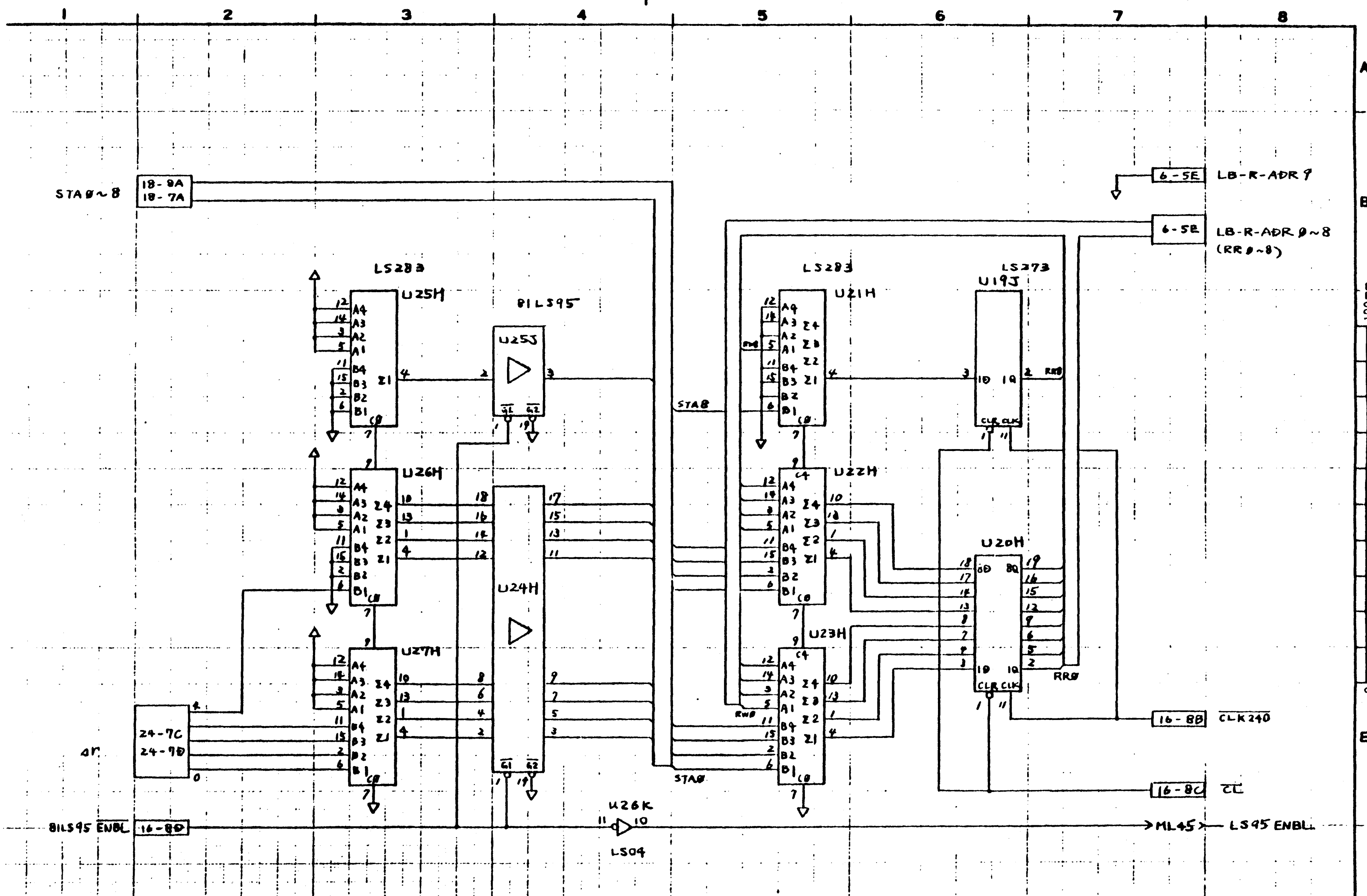


YMS

YEW YOKOGAWA ELECTRIC WORKS

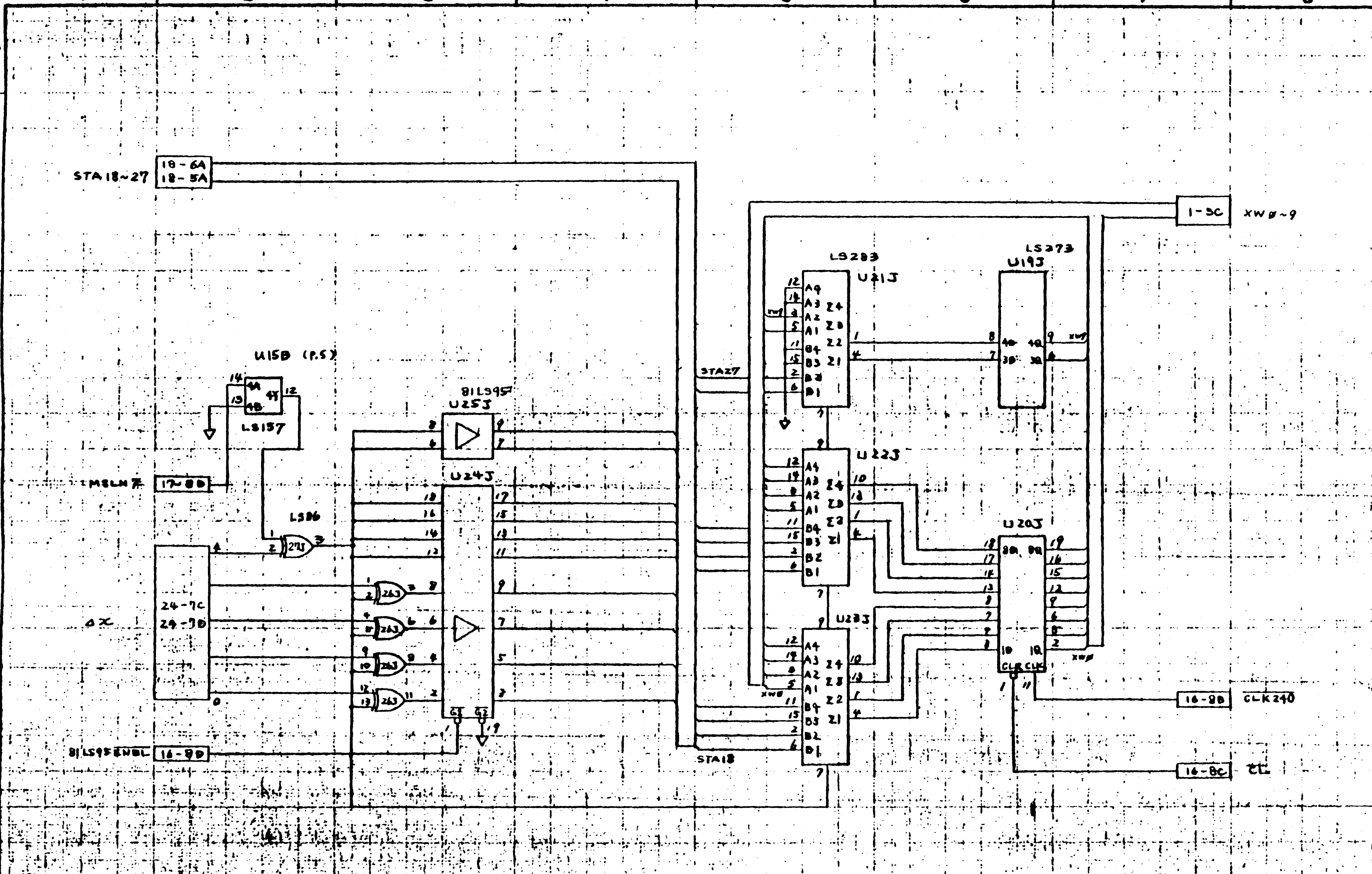
3A-1


ROMA 8~15
CP3A
SCLK
SREQ
ROMA
ROMA15
ROMA14
CLK240
LS161
U29H
U29J
F04
U28K
F08
U22F
U23F
U24F
U25F
U22E
24-6C
S0DATA
27128-2 STR ROM
(B9713NM for PAL/SECAM
B9713PE for NTSC)
(B9713NL for PAL/SECAM
B9713PY for NTSC)
27128-2 TH ROM
U22DZ
U18D
F374
LS153
U17D
LS86
LS273
U19J
5-3C
0-ADR
17-8B
MSLN7
T. SAKAMOTO
ENGRG DEPT
H. AKASAKA
S. SANO
1985-8-16
A9 SCC-U
FD1-B9718WL
PAGE 19
REV
ZONE
DATE
REV BY
YEW YOKOGAWA ELECTRIC WORKS



REV.	ZONE	DATE	REV BY	DR T. SAKAMOTO CH H. AKASAKA APP S. SANO	ENGRG DEPT 1985-8-16	A9 SCC-U FD1-B9718WL
						PAGE 20

YMS YEW YOKOGAWA ELECTRIC WORKS



REV	ZONE	DATE	REV BY		
		- -		DR T. SAKAMOTO	ENGRG DEPT
		- -		CH H. AKASAKA	
		- -		APP S. SANO	1985-8-16

A9 SCC-U

FD1- B9718WL

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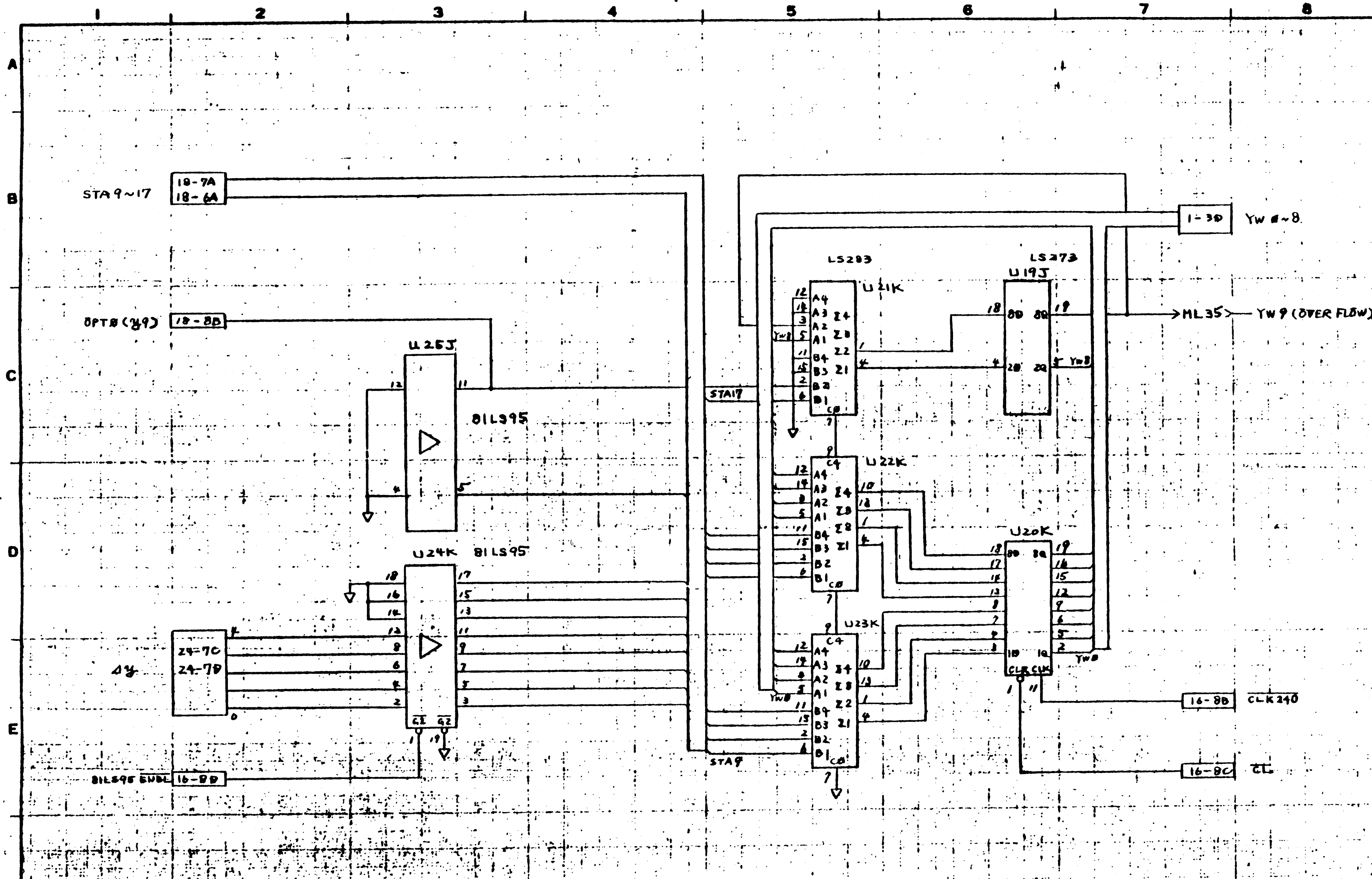
YEW YOKOGAWA ELECTRIC WORKS



REV.	ZONE	DATE	REV BY
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△		- -	
△	.	- -	

DR T. SAKAMOTO | ENGRG DEPT
CH H. AKASAKA
APP S. SANO | 1985-8-16

A9 SCC-U

FD1-B9718WL

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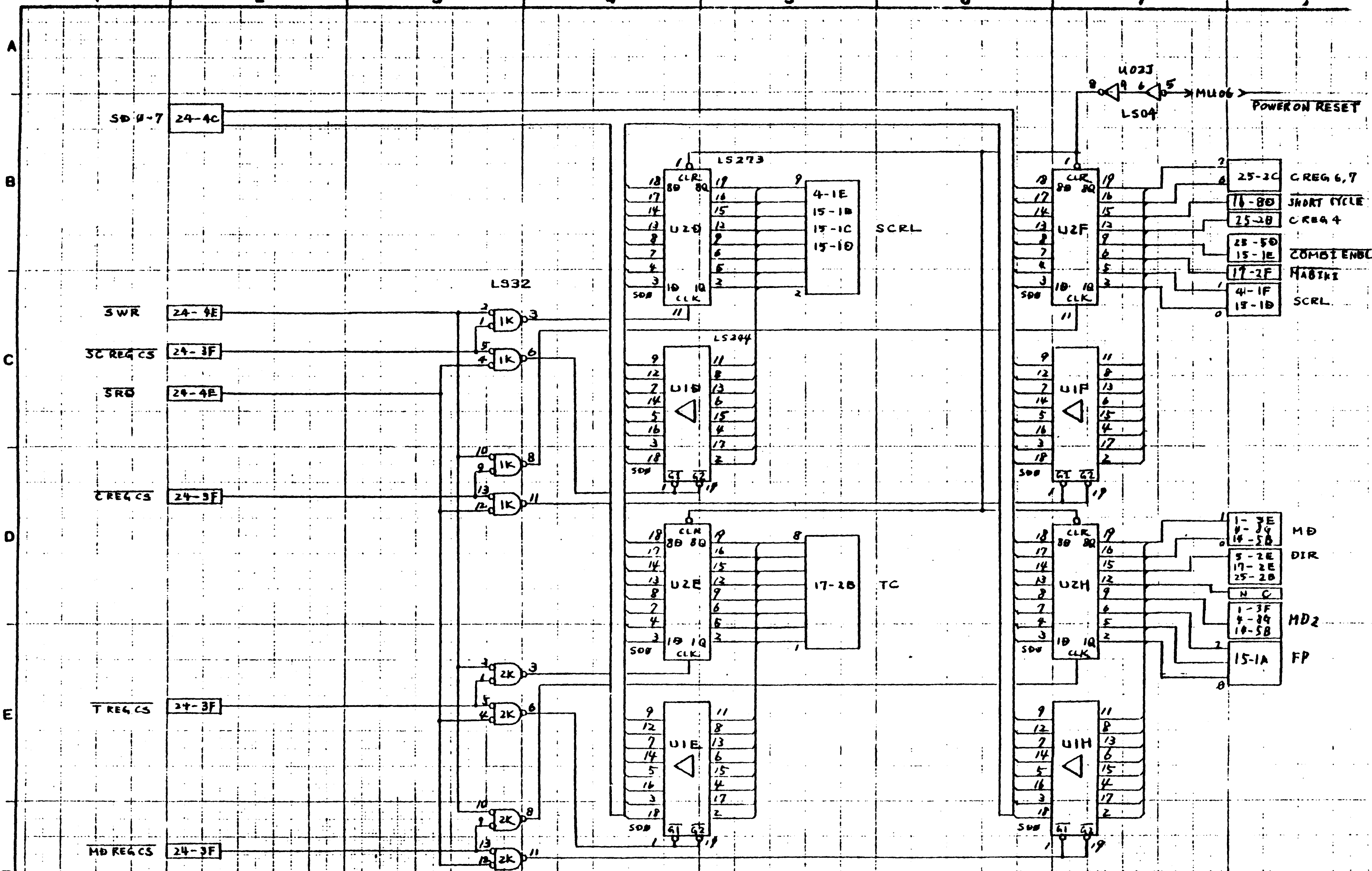
YMS

YEW YOKOGAWA ELECTRIC WORKS

13A-1



REV.	ZONE	DATE	REV BY
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△		- -	
△		- -	

DR T. SAKAMOTO
CH H. AKASAKA
APR S. SANO

ENGRG DEPT
1985-8-16

A9 SCC-U

FD1-B9718WL

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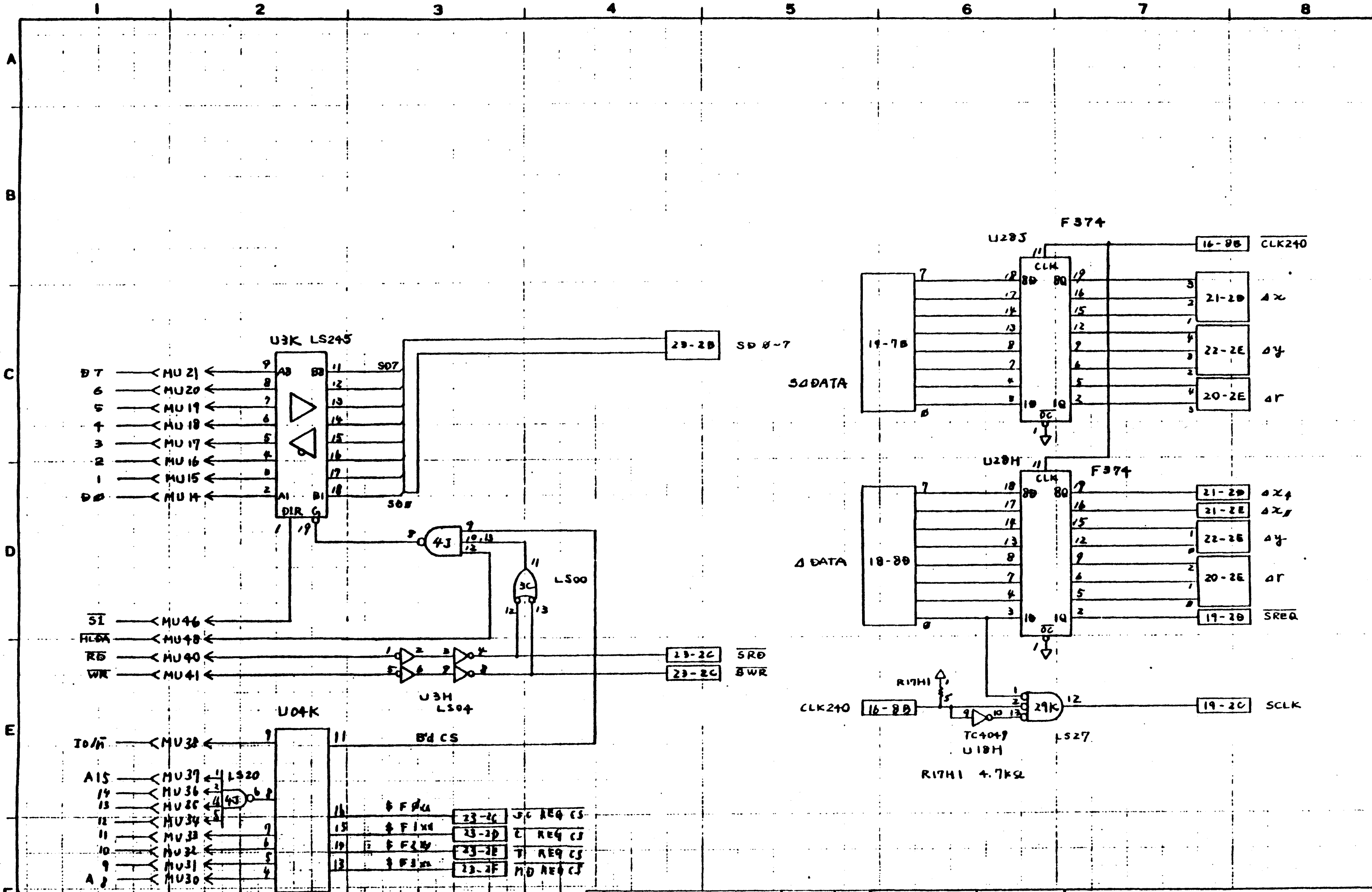
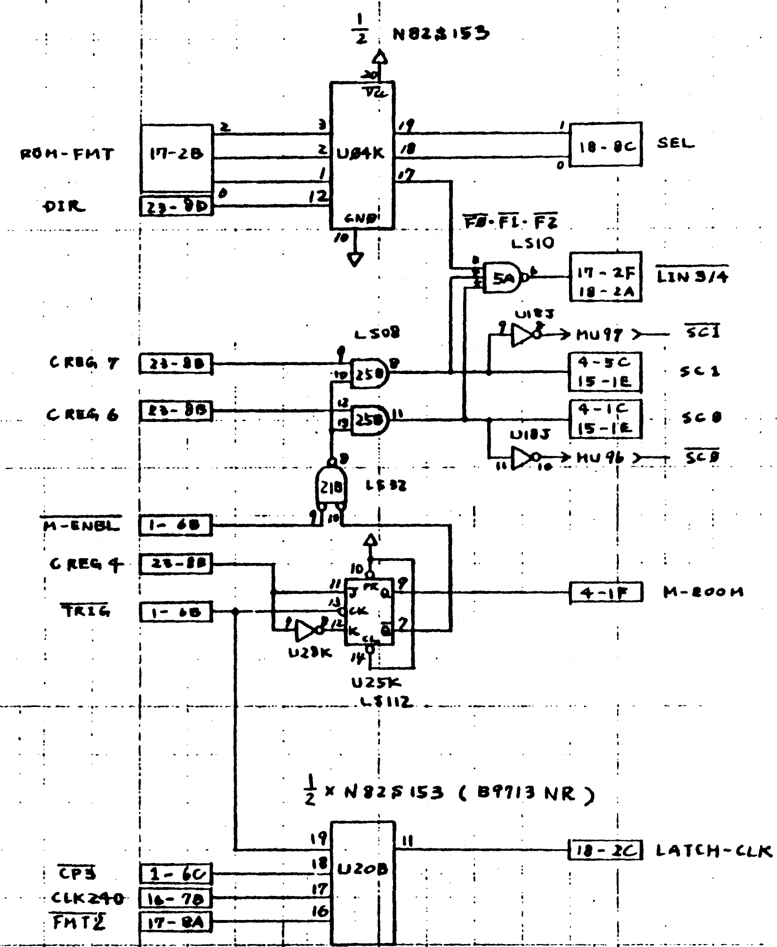
YEW YOKOGAWA ELECTRIC WORKS



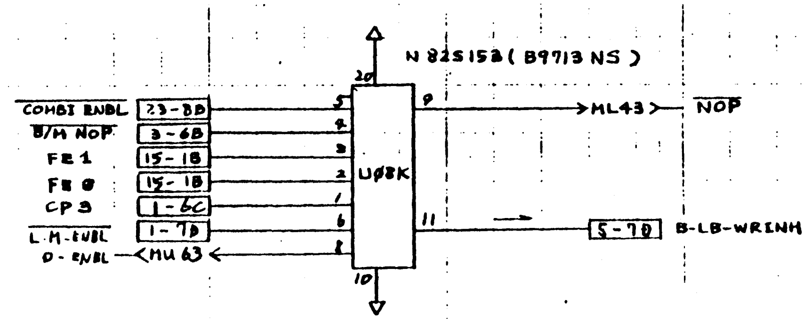
DR T. SAKAMOTO	ENG'G DEPT	A9 SCC-u		
CH H. AKASAKA				
APP S. SANO	1985-8-16	FD1-B9718WL	PAGE	24

YMS YEW YOKOGAWA ELECTRIC WORKS



U04K TRUTH TABLE

DIR	FORMAT 2	FORMAT 1	FORMAT 0	SEL 1	SEL 0	
X	0	0	0	0	0	LINEAR
0	0	1	0	0	1	LEFT SLANT
0	0	1	1	1	0	RIGHT SLANT
X	1	X	X	1	1	SECTOR
1	0	1	0	1	0	RIGHT SLANT
1	0	1	1	0	1	LEFT SLANT



DR	T. SAKAMOTO	ENGRG DEPT	A 9 SCC-U
CH	H. AKASAKA		
APP	S. SANO	1985-8-16	FD1 - B9718 WL

REV | ZONE | DATE | REV BY

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A3

Y-13A-1

YMS

YEW YOKOGAWA ELECTRIC WORKS

MU

Pin No.	SIGNAL NAME	Pin No.	SIGNAL NAME
0	GND	1	GND
2	GND	3	GND
4	GND	5	GND
6	INZ	7	
8	+5V D	9	+5V D
10	+5V D	11	+5V D
12		13	
14	DATA0	15	DATA1
16	DATA2	17	DATA3
18	DATA4	19	DATA5
20	DATA6	21	DATA7
22	ADD 0	23	ADD 1
24	ADD 2	25	ADD 3
26	ADD 4	27	ADD 5
28	ADD 6	29	ADD 7
30	ADD 8	31	ADD 9
32	ADD 10	33	ADD 11
34	ADD 12	35	ADD 13
36	ADD 14	37	ADD 15
38	IO/M	39	ALE
40	RD	41	WR
42	READY	43	CLKOUT
44	RESETOUT	45	S0
46	S1	47	HOLD
48	HLDA	49	TR3
50	TR4	51	TR7
52	SP0	53	SP1
54	HD	55	VD
56	1M CLK	57	F.ZONE0
58	F.ZONE1	59	FREEZE
60		61	
62		63	D-ENBL
64	ONE 3	65	ONE 4
66	" 5	67	" 6
68	GND	69	GND
70	A-DATA0	71	A-DATA1
72	GND	73	GND
74	A-DATA2	75	A-DATA3
76	A-DATA4	77	A-DATA5
78	GND	79	GND
80	RSLT-DATA0	81	RSLT-DATA1
82	RSLT-DATA2	83	RSLT-DATA3
84	RSLT-DATA4	85	RSLT-DATA5
86	AD CLK	87	B-DATA0
88	B-DATA1	89	B-DATA2
90	B-DATA3	91	B-DATA4
92	B-DATA5	93	MD2
94	MD0	95	MD1
96	SC0	97	SC1
98	A.OUT	99	B.OUT

ML

Pin No.	SIGNAL NAME	Pin No.	SIGNAL NAME
0	XW0	1	XW1
2	XW2	3	XW3
4	XW4	5	XW5
6	XW6	7	XW7
8	GND	9	GND
10		11	ONE 7
12	GND	13	GND
14	ONE 2	15	ONE 8
16	GND	17	GND
18	XW8	19	XW9
20	FI	21	CP1
22	H.RST	23	CP3
24	C.BL	25	
26		27	
28	YW0	29	YW1
30	YW2	31	YW3
32	YW4	33	YW5
34	W0C	35	YW9
36	GND	37	GND
38	+5V	39	+5V
40	CLK240-25	41	CLK240-25
42	GRAY SCALE 7	43	NOP
44	CP3A	45	LS95 ENBL
46	ONE 8	47	ONE 1
48	NC	49	NC
50	NC	51	NC
52	CB 0	53	CB 1
54	CB 2	55	CB 3
56	CB 4	57	CB 5
58	CB 6	59	CB 7
60	CB 8	61	CB 9
62	CB10	63	CB11
64	CB12	65	CB13
66	CB14	67	CB15
68	CB16	69	CB17
70	CB18	71	CB19
72	CB LATCH	73	MENB
74	DTRG	75	TRIG
76	NC	77	NC
78	T.CLP	79	LBAS
80	SBBN	81	NC
82	+12V	83	+12V
84	+12V	85	+12V
86	-5V	87	-5V
88	-5V	89	-5V
90	+5V A	91	+5V A
92	+5V A	93	+5V A
94	GND	95	GND
96	GND	97	GND
98	GND	99	GND

Pin No.	SIGNAL NAME	Pin No.	SIGNAL NAME

REV.	ZONE	DATE	REV BY

DR. Y. HIROTA
CH. T. SAKAMOTO
APP. S. SANO
ENG.
1985-8-16

A9 SCC-u

FDI-B9718WL

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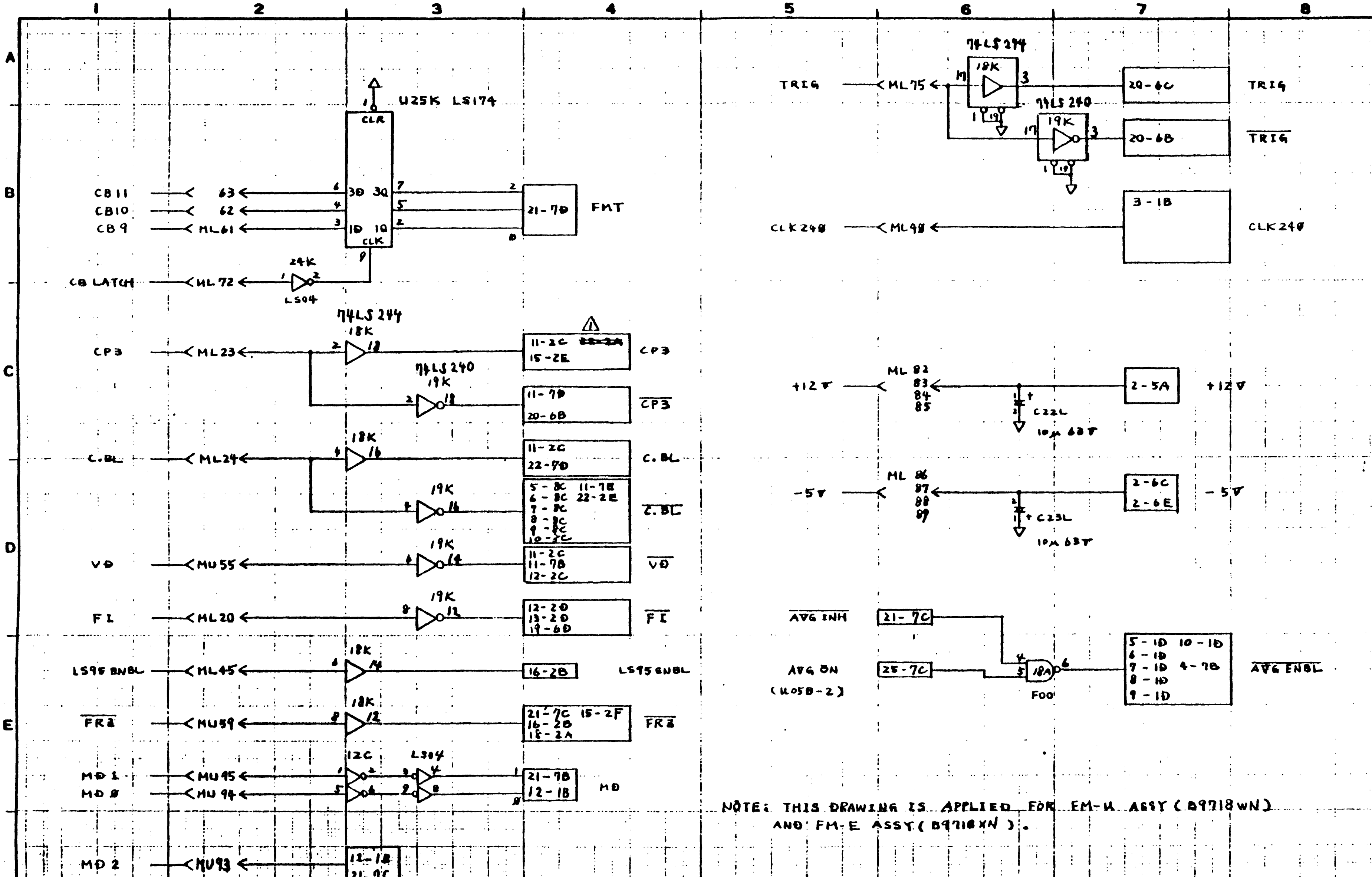
YMS

YEW YOKOGAWA ELECTRIC WORKS

A3 HIROTA Form Y-13-1



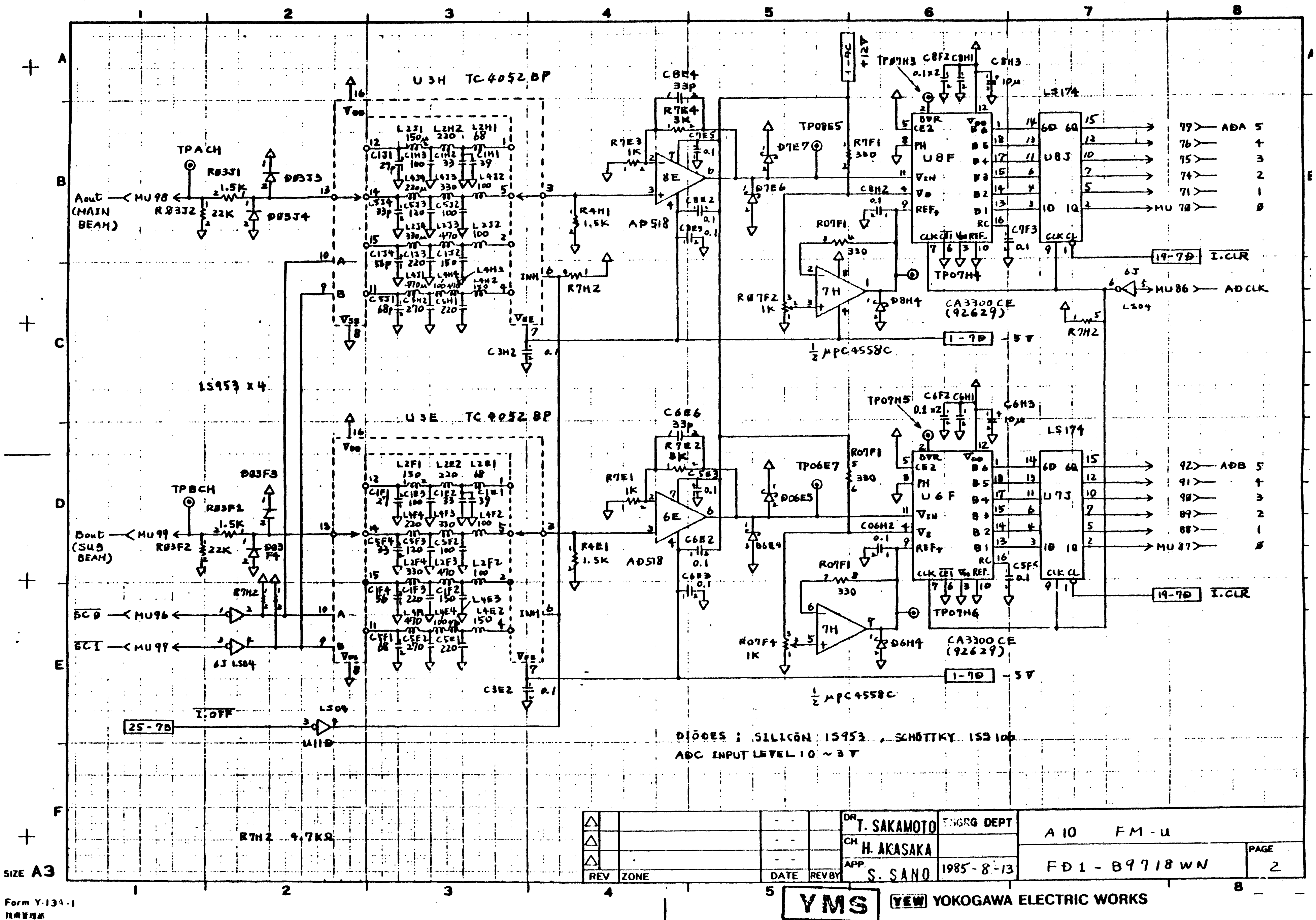
NOTE: THIS DRAWING IS APPLIED FOR FM-U ASSY (B9718WN) AND FM-E ASSY (B9718XN).

REV	ZONE		DATE	REV BY			
1	4C	誤記訂正	85-9-24	塚本	DR. T. SAKAMOTO	ENGRG DEPT	A10 FM-U
					CH. H. AKASAKA		
					APP. S. SANO	1985-8-13	FD1-B9718WN

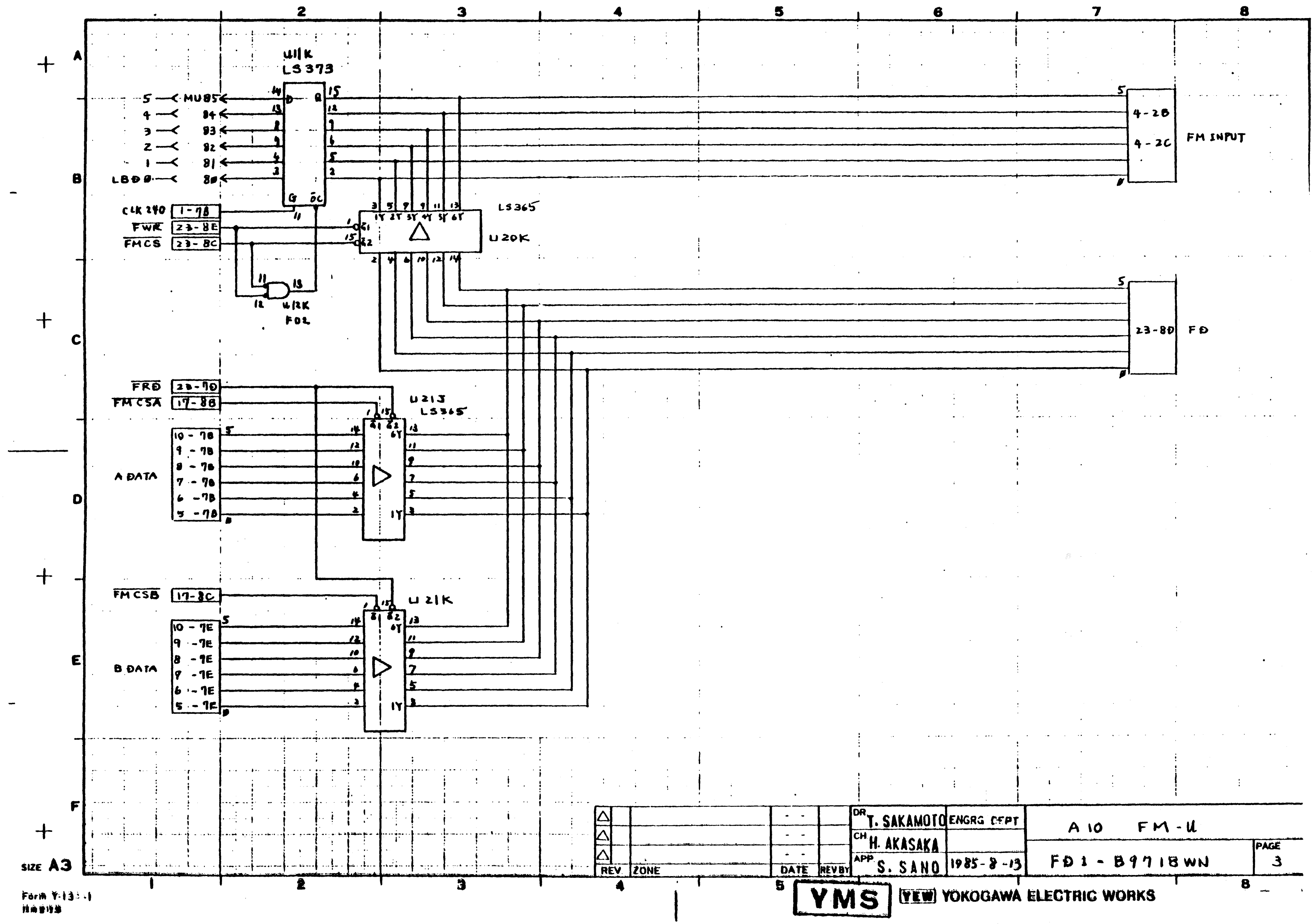
PAGE 1

YMS YEW YOKOGAWA ELECTRIC WORKS

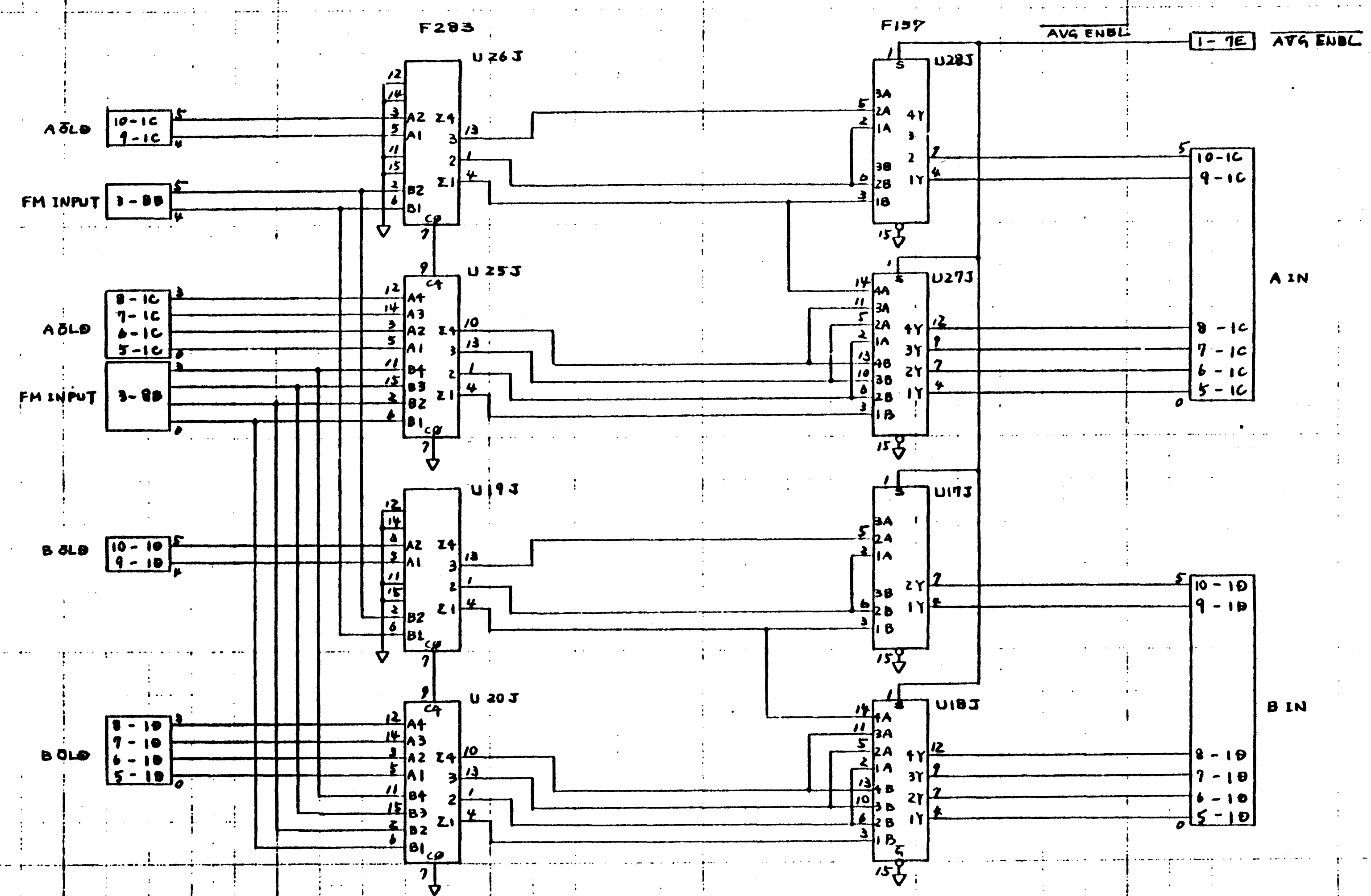
A3



U3H TC4052BP
U3E TC4052BP
Aout (MAIN BEAM)
Bout (SUB BEAM)
MU98
MU99
MU96
MU97
TPACH
TPBCH
1S953 x 4
AD518
1/2 μPC4558C
CA3300CE (92629)
U8F
U6F
LS174
U8J
U7J
ADA
ADB
ADCLK
MU86
MU87
MU70
I.CLR
I.OFF
19-7D
1-7D
25-7B
+12V
-5V
DIODES ; SILICON 1S953 , SCHOTTKY 1SS106
ADC INPUT LEVEL 1.0 ~ 3V
R7H2 4.7KΩ
SIZE A3
DR T. SAKAMOTO
CH H. AKASAKA
APP. S. SANO
ENGRG DEPT
1985-8-13
A10 FM-U
FD1-B9718WN
PAGE 2
REV ZONE DATE REVBY
VMS
YEW YOKOGAWA ELECTRIC WORKS
Form Y-134-1



U11K
LS373
U20K
LS365
U12K
F02
U21J
LS365
U21K
MUB5
B4
B3
B2
B1
B0
LBD0
CLK 240
1-7B
FWR
23-8E
FMCS
23-8C
FRD
23-9D
FMCSA
17-8B
A DATA
FMCSB
17-8C
B DATA
4-2B
4-2C
FM INPUT
23-8D
FD
T. SAKAMOTO
ENGRG DEPT
H. AKASAKA
S. SANO
1985-8-13
A10 FM-U
FD1-B9718WN
PAGE 3
REV
ZONE
DATE
REV BY
YMS
YEW YOKOGAWA ELECTRIC WORKS
SIZE A3
Form Y-13-1



DR. T. SAKAMOTO	ENGRG DEPT	A10 FM-II		
CH. H. AKASAKA				
APP. S. SANO	1985-8-13	FD1-B9718WN	PAGE	4

REV	ZONE	DATE	REV BY
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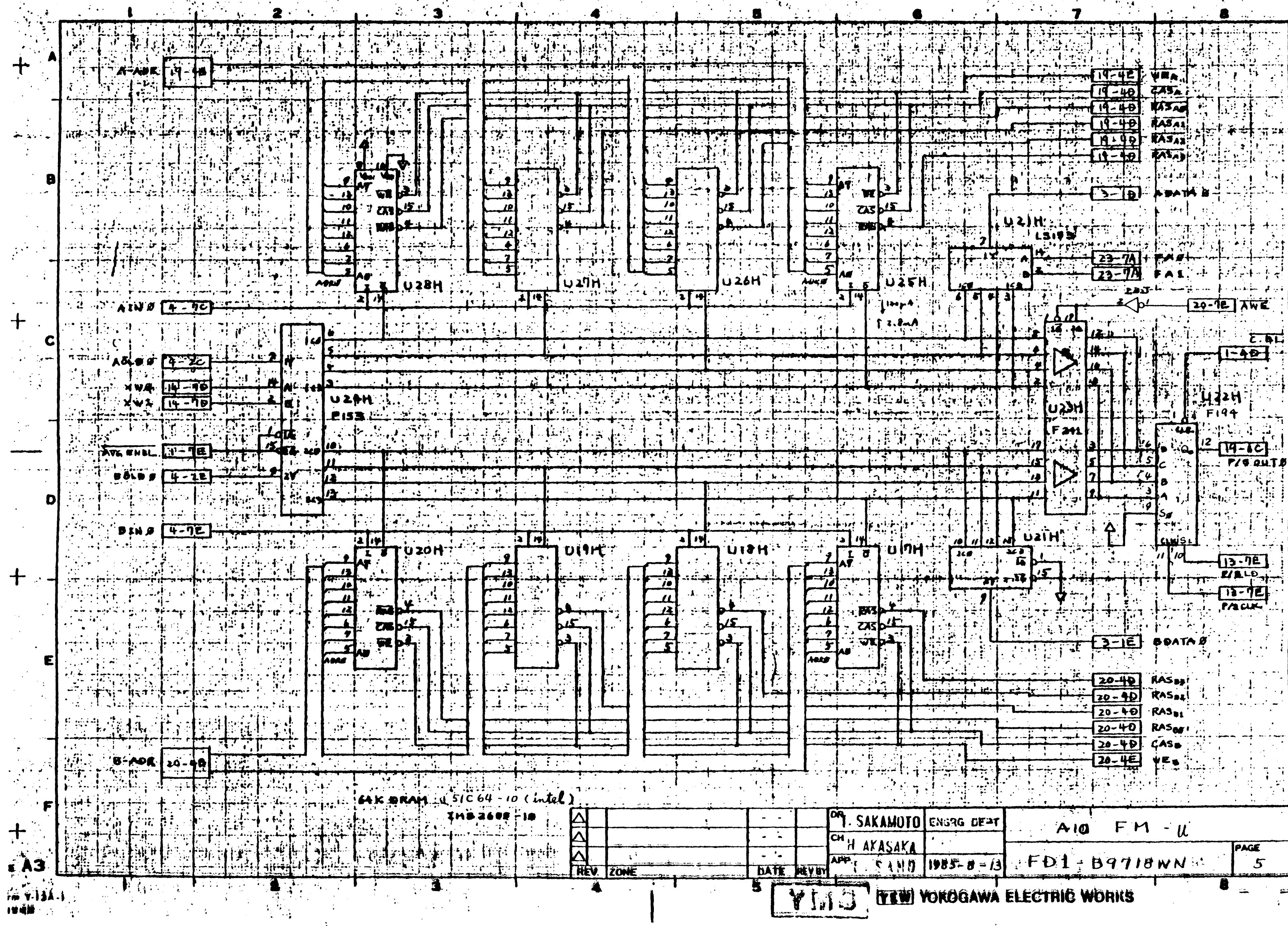
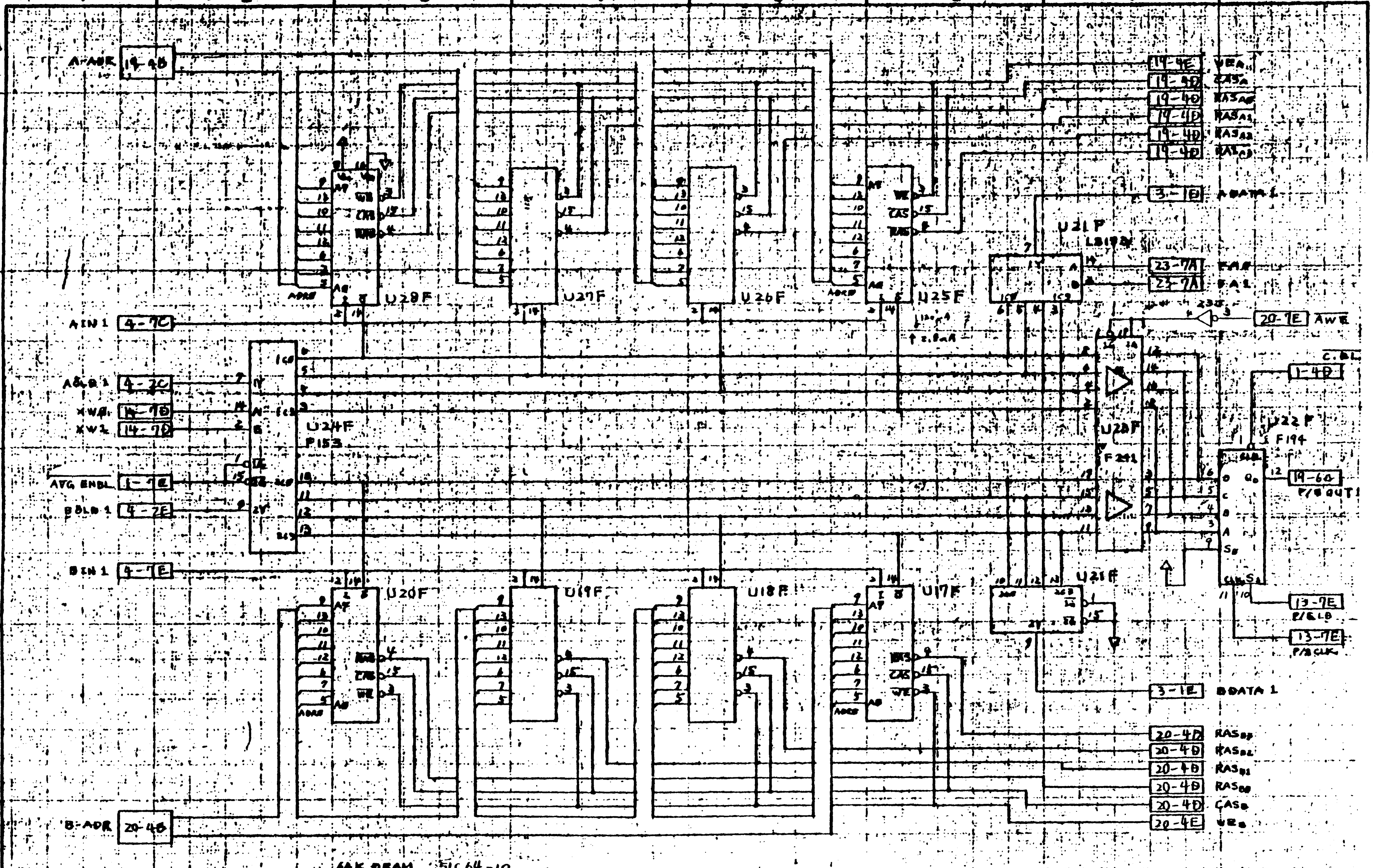
△		- -	
△		- -	

SIZE A3

Form Y-133-1
技術管理部

YMS YEW YOKOGAWA ELECTRIC WORKS


A-ADR
AIN Ø
ADLD Ø
XWA
XW2
AVG ENBL
BDLD Ø
BIN Ø
B-ADR
U28H
U27H
U26H
U25H
U24H
F153
U23H
F241
U22H
F194
U21H
LS153
U20H
U19H
U18H
U17H
WE A
CAS A
RAS A0
RAS A1
RAS A2
RAS A3
ADATA Ø
FA Ø
FA 1
AWE
C.BL
P/S OUT Ø
P/BLD
P/SCLK
BDATA Ø
RAS B3
RAS B2
RAS B1
RAS B0
CAS B
WE B
64K DRAM 51C64-10 (intel)
TMS 2600-10
T. SAKAMOTO
H AKASAKA
ENGRG DEPT
1985-8-13
A10 FM-II
FD1-B9718WN
PAGE 5
YOKOGAWA ELECTRIC WORKS



REV.	ZONE	DATE	REV BY

DR T. SAKAMOTO — ENGR. DEPT
CH H. AKASAKA
APP S. SANO — 1985-8-13

A10 FM-u

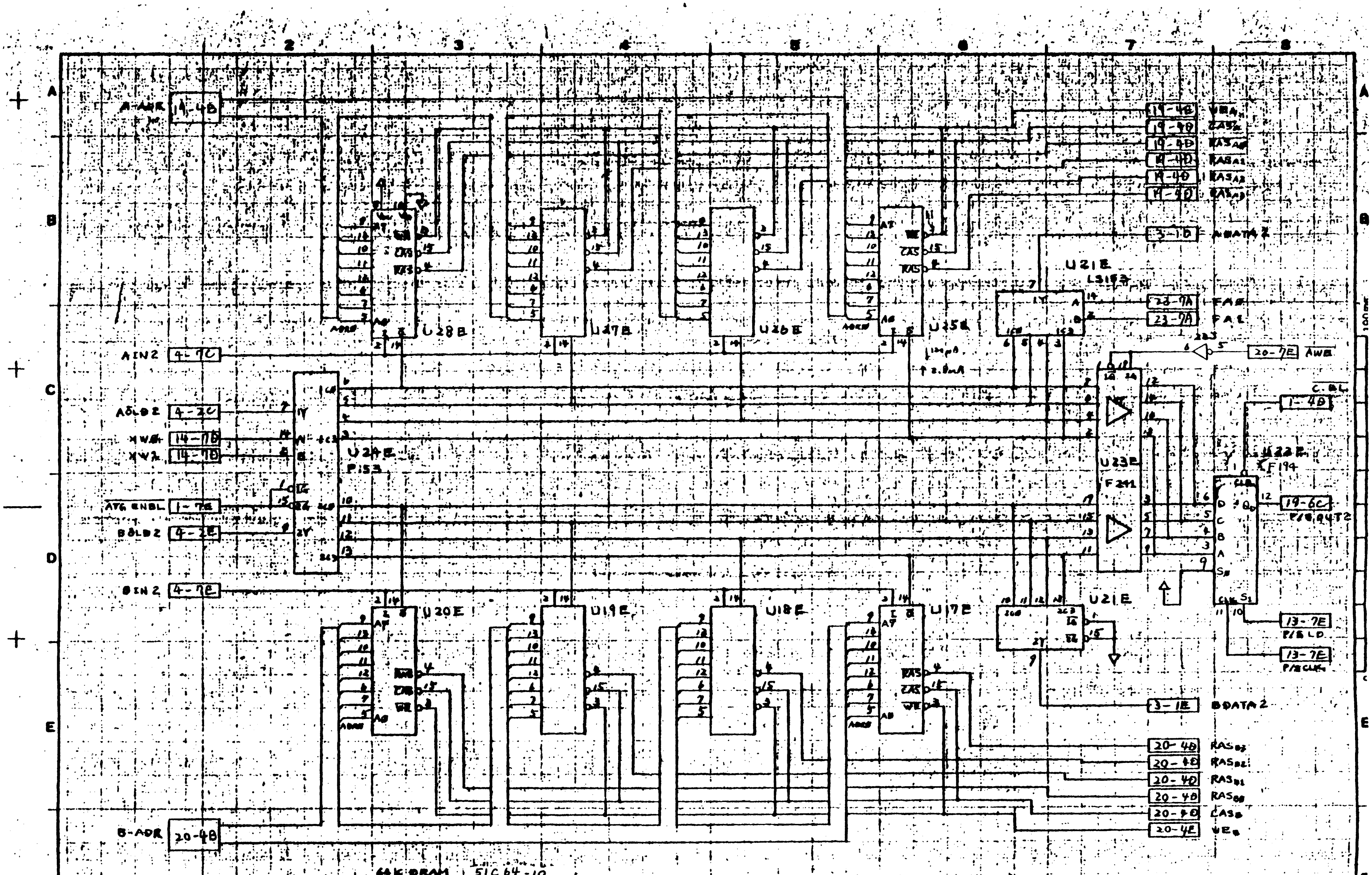
FD1-B9718WN

PAGE 6

SIZE A3

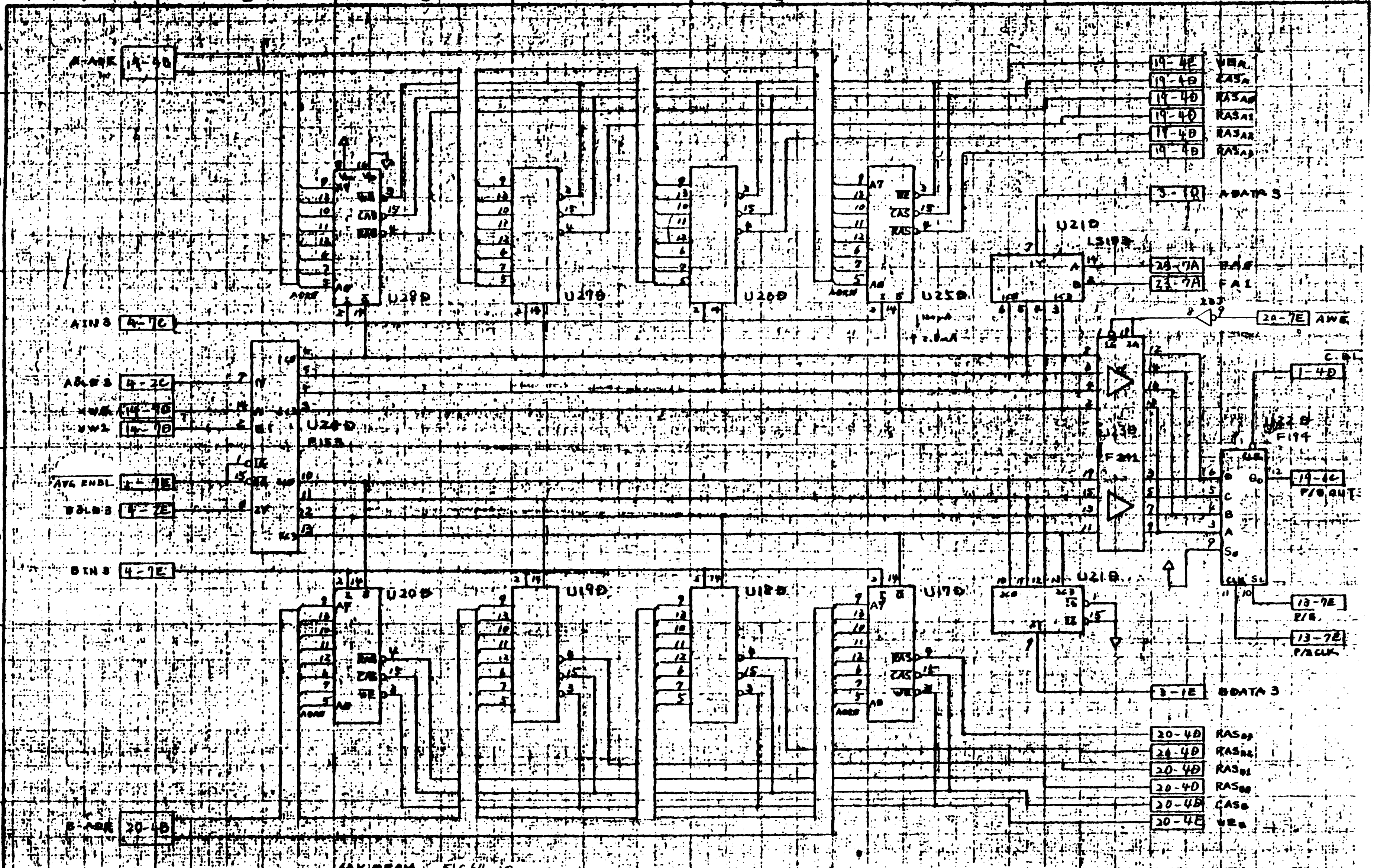
YEW YOKOGAWA ELECTRIC WORKS

Form Y-13A-1



DR T. SAKAMOTO	ENGRG DEPT	A10 FM - U	
CH H AKASAKA			
APP S. SANO	1985-8-13	FD1 - B9718WN	PAGE 7

YEW YOKOGAWA ELECTRIC WORKS

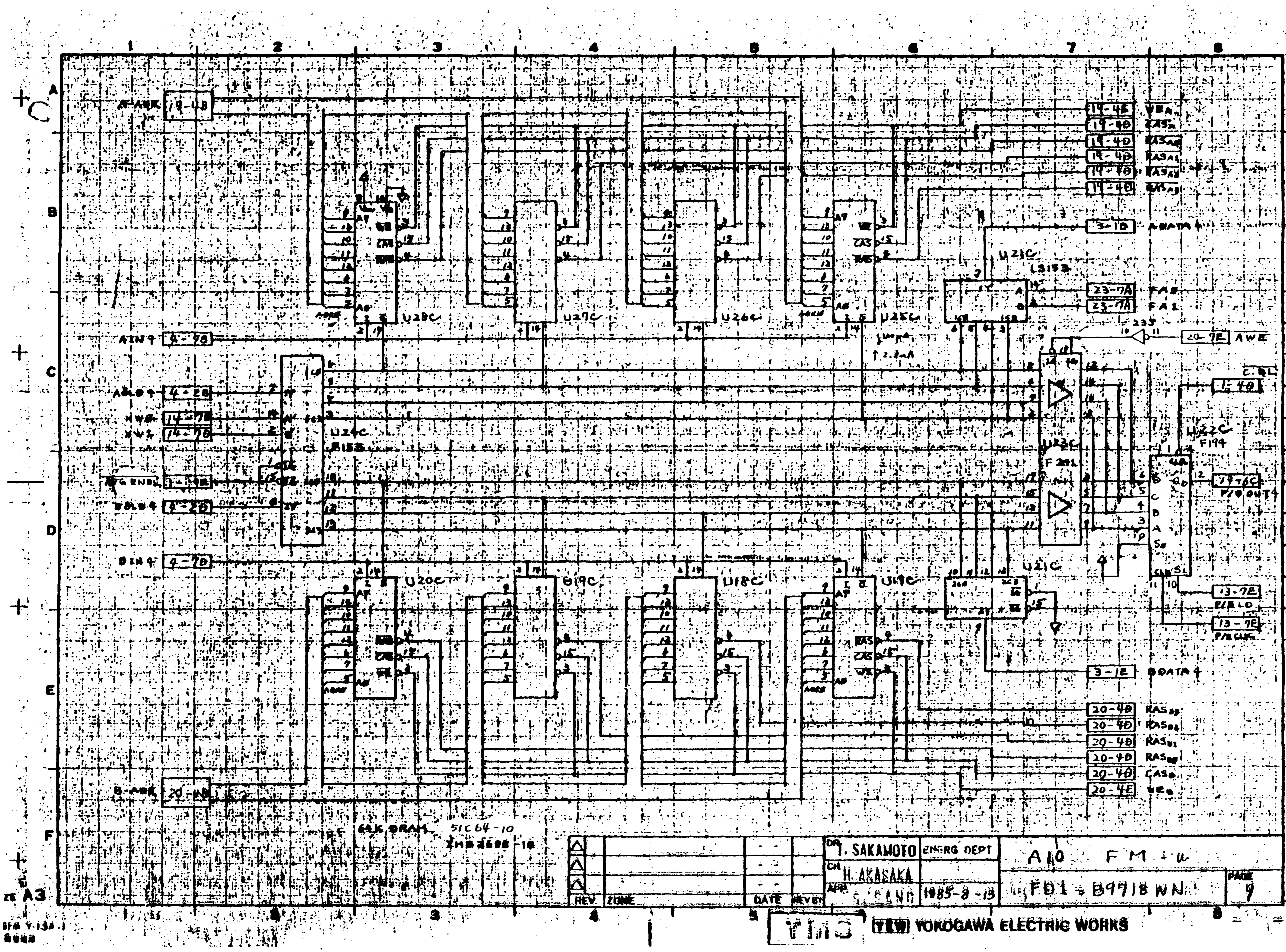


DR	T. SAKAMOTO	ENGRG DEP.	A10 FM-U
CH	H. AKASAKA		
APP	C. SANO	1985-8-13	FD1-B9718WN

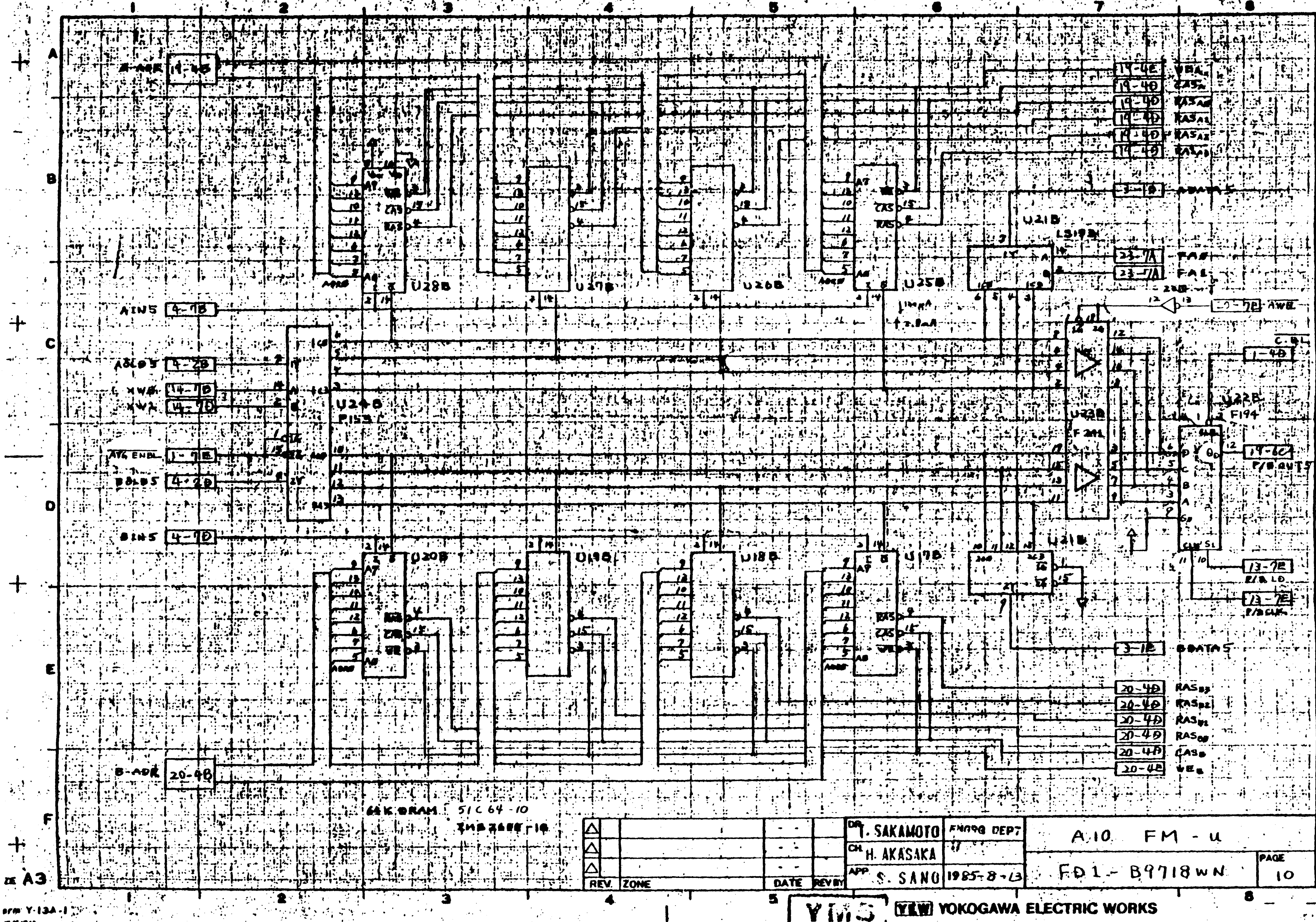
PAGE 8

SIZE A3

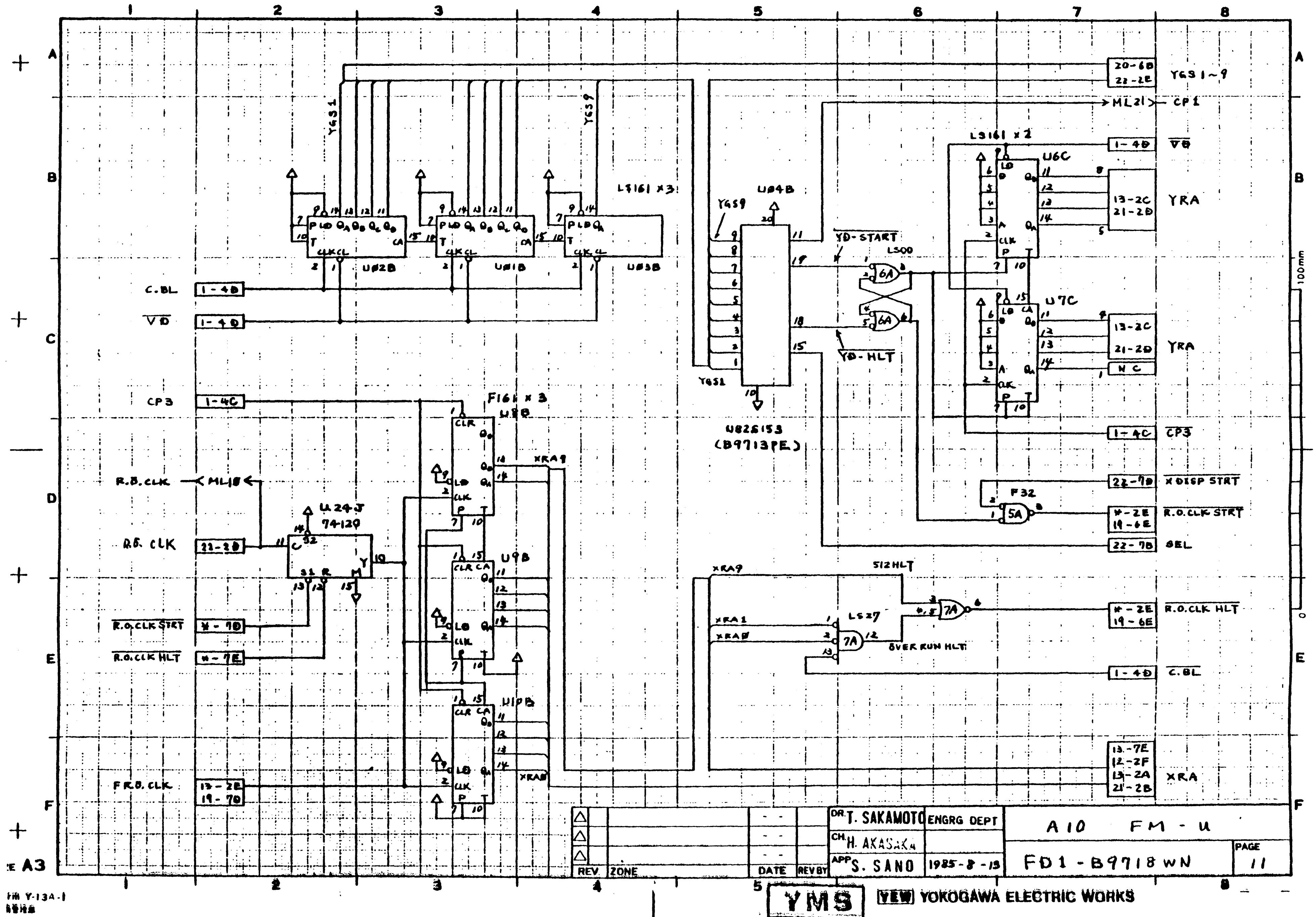
YEW YOKOGAWA ELECTRIC WORKS



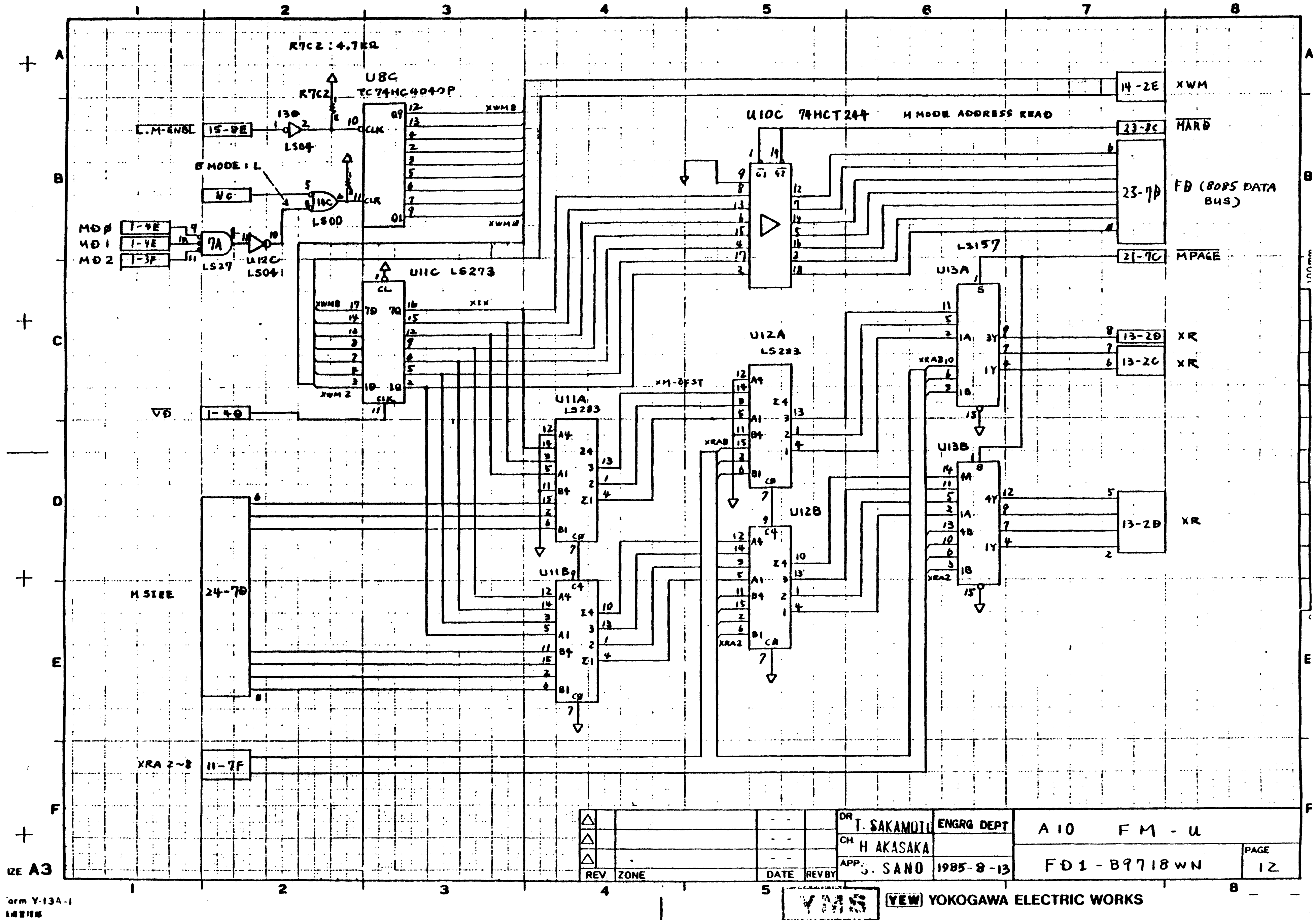
U28C
U27C
U26C
U25C
U24C
U21C
LS153
U23C
F241
U22C
F194
U20C
U19C
U18C
U17C
64K DRAM
51C64-10
T. SAKAMOTO
ENGRG DEPT
H. AKASAKA
1985-8-13
A10 FM-u
FD1 - B9718WN
PAGE
9
YEW YOKOGAWA ELECTRIC WORKS

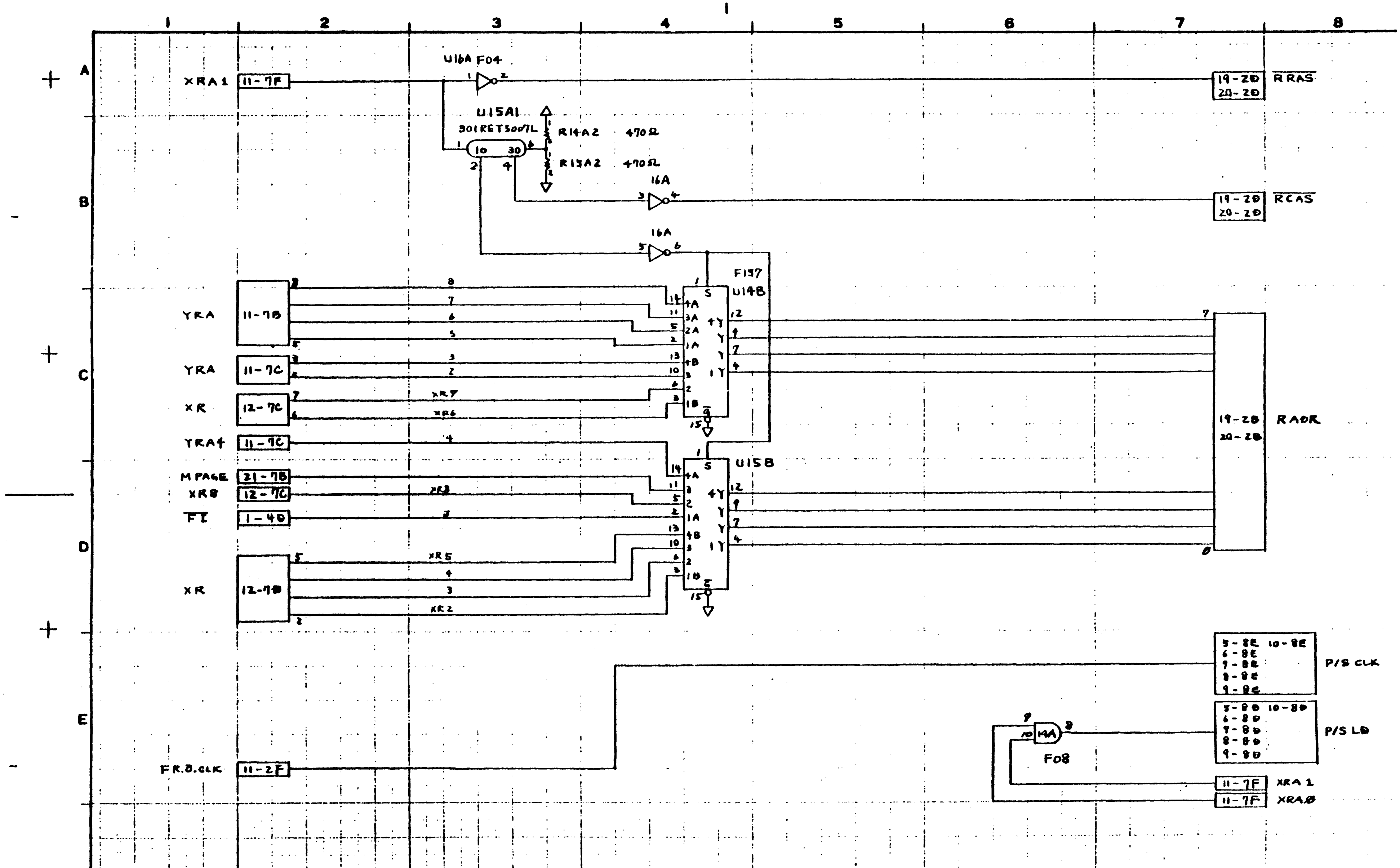


U28B
U27B
U26B
U25B
U24B
F153
U23B
F241
U22B
F194
U21B
LS193
U20B
U19B
U18B
U17B
64K DRAM 51C64-10
T. SAKAMOTO
H. AKASAKA
S. SANO
1985-8-13
A10 FM-u
FD1-B9718WN
PAGE 10
YOKOGAWA ELECTRIC WORKS



YGS 1~9
ML21 CP1
VD
YRA
LS161 x 2
U6C
U7C
LS161 x 3
U02B
U01B
U03B
U04B
U026153 (B9713PE)
YGS9
YGS1
YD-START
YD-HLT
LS00
6A
C.BL
CP3
X DISP STRT
R.O.CLK STRT
SEL
F32
5A
F161 x 3
U8B
U9B
U10B
XRA9
XRA1
XRA0
512HLT
LS27
7A
OVER RUN HLT
R.O.CLK HLT
XRA
R.B.CLK
ML18
R.B. CLK
U24J
74120
F.R.B.CLK
13-2C
21-2D
NC
T. SAKAMOTO
ENGRG DEPT
H. AKASAKA
S. SANO
1985-8-15
A10 FM-U
FD1-B9718WN
PAGE 11
REV
ZONE
DATE
REV BY
YMS
YEW YOKOGAWA ELECTRIC WORKS
A3


R7C2 : 4.7KΩ
U8C
TC74HC4040P
L.M-ENBL
15-8E
LS04
B MODE : L
NC
LS00
MDØ
MD1
MD2
1-4E
1-4E
1-3F
LS27
U12C
LS041
U11C LS273
XWM8
XWM2
XIX
VD
1-4Ø
U10C 74HCT244
M MODE ADDRESS READ
14-2E
XWM
23-8C
HARD
23-7D
FD (8085 DATA BUS)
21-7C
MPAGE
LS157
U13A
U13B
13-2D
13-2C
13-2B
XR
U12A
LS283
U12B
U11A
LS283
U11B
XM-OFST
XRAB
XRA2
M SIZE
24-7D
XRA 2~8
11-7F
REV.
ZONE
DATE
REV BY
DR T. SAKAMOTO
CH H. AKASAKA
APP. J. SANO
ENGRG DEPT
1985-8-13
A10 FM-U
FD1-B9718WN
PAGE 12
YEW YOKOGAWA ELECTRIC WORKS
SIZE A3
Form Y-13A-1



DR. T. SAKAMOTO	ENGRG DEPT	A10 FM - U		
CH. H. AKASAKA				
APP. S. SANO	1985-8-13	FD1 - B9718 WN	PAGE 13	

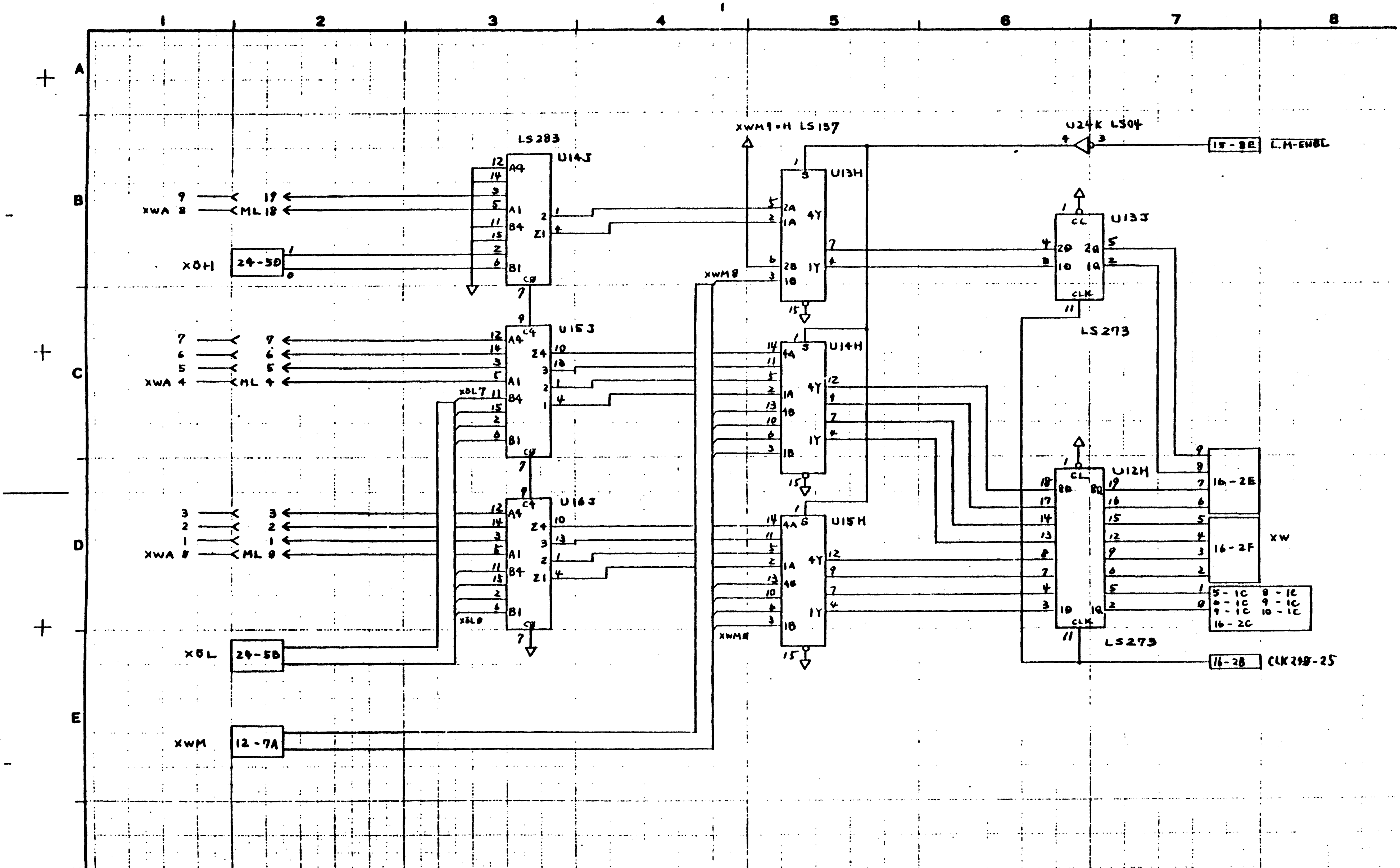
REV | ZONE | DATE | REV BY

SIZE A3

Form Y-131-1

VMS

YEW YOKOGAWA ELECTRIC WORKS



REV	ZONE	DATE	REV BY
△		- -	
△		- -	
△		- -	

DR T. SAKAMOTO — ENGRG DEPT
CH H. AKASAKA
APP S. SANO — 1985-8-13

A10 FM - U

FD1 - B9718 WN

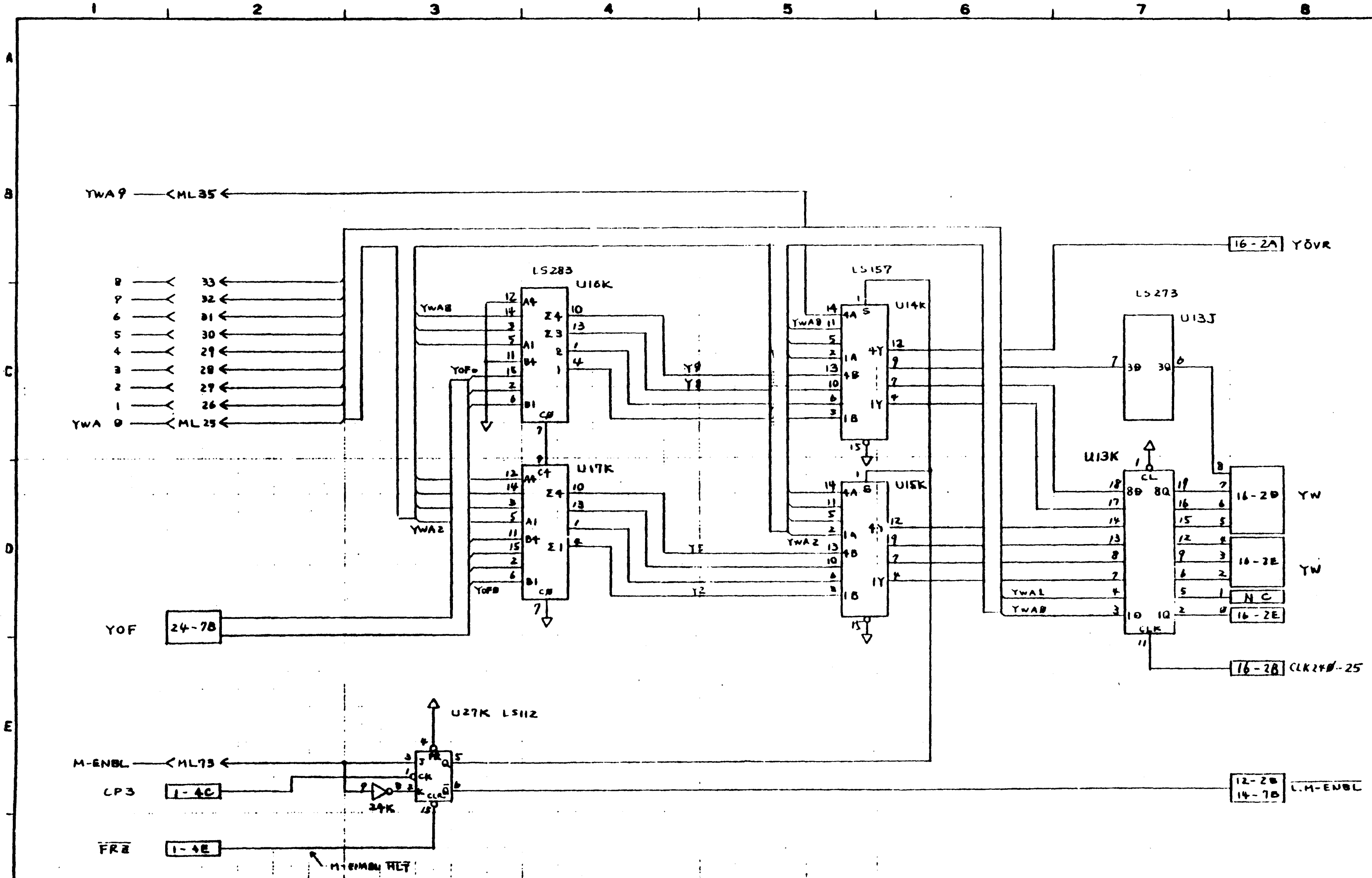
PAGE 14

SIZE A3

Form Y-13A-1

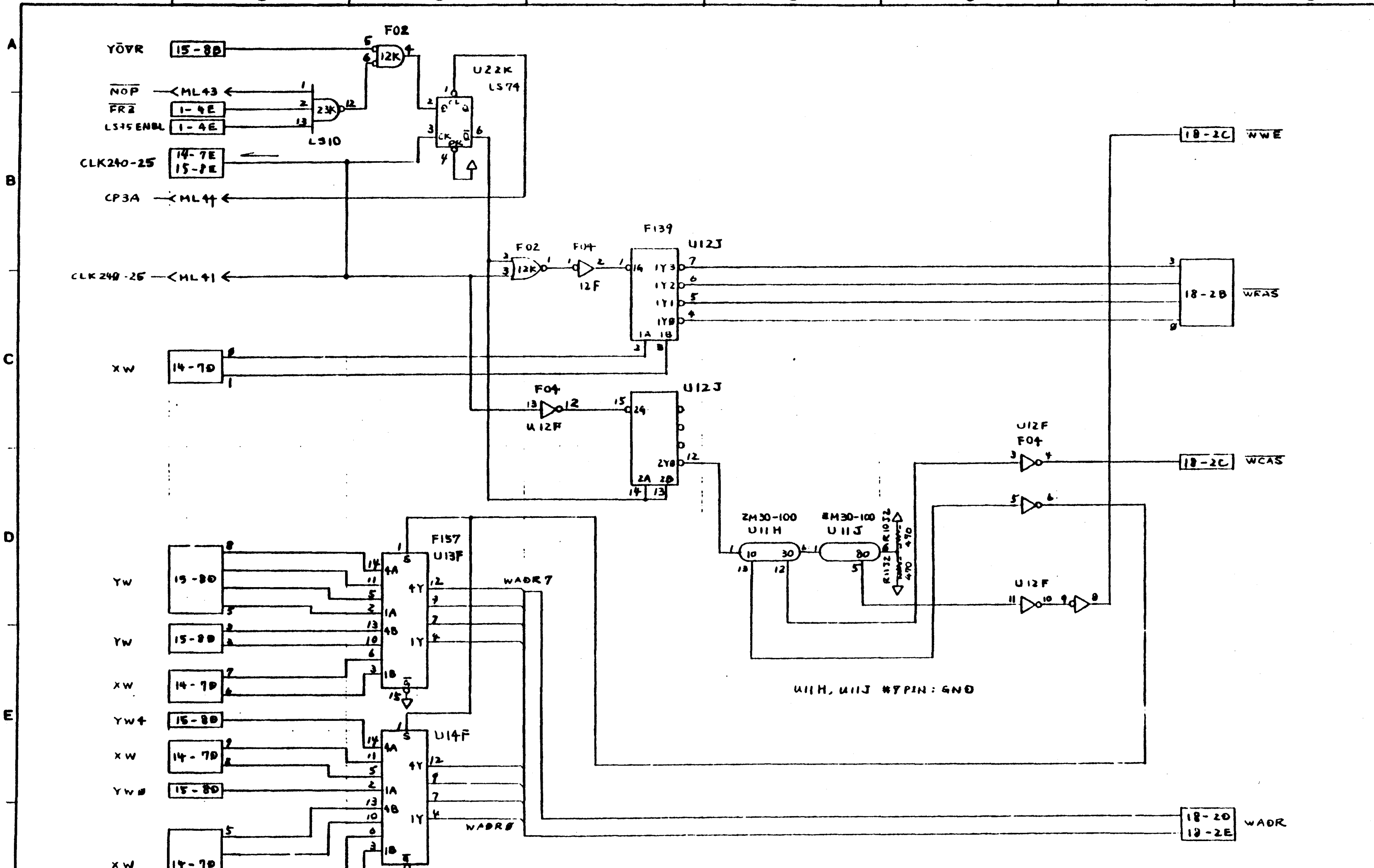
YMS

YEW YOKOGAWA ELECTRIC WORKS



REV.	ZONE	DATE	REV BY		
DR T. SAKAMOTO	ENG'RG DEP'	A10 FM-U	
CH H. A. [illegible]			
APP S. SANO	1985-8-13	FD1-B9718WN	PAGE 15

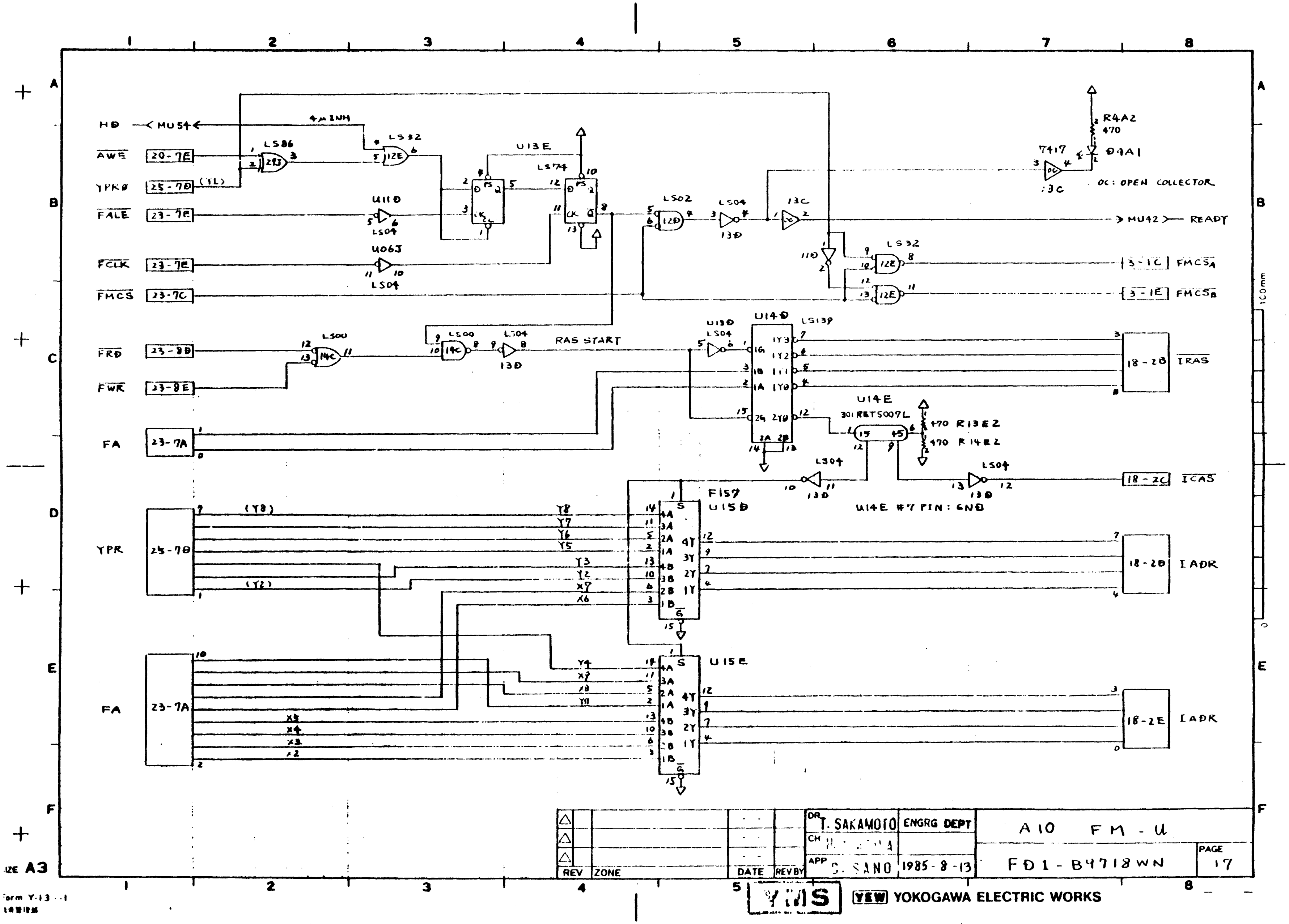
YMS YEW YOKOGAWA ELECTRIC WORKS

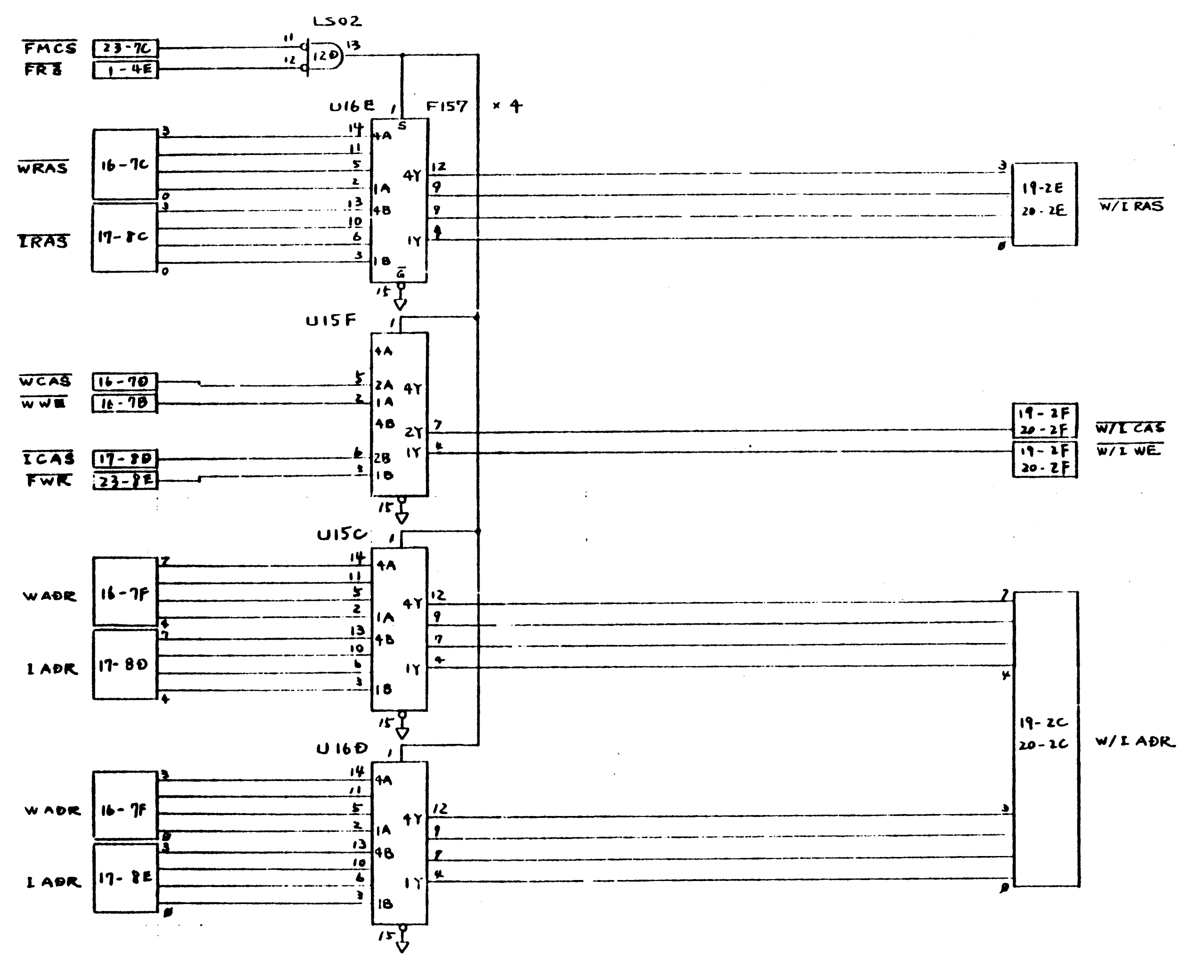


REV.	ZONE	DATE	REV BY	DR T. SAKAMOTO	ENGRG DEPT	A10 FM - U	
				CH			
				APP S.	1985-8-13	FD1 - B7718WN	PAGE 16

YEW YOKOGAWA ELECTRIC WORKS

A3
Form Y-13


HD
MU54
AWE
20-7E
YPK0
25-7D
FALE
23-7E
FCLK
23-7E
FMCS
23-7C
FRD
23-8D
FWR
23-8E
FA
23-7A
YPR
25-7D
FA
23-7A
LS86
LS32
U13E
LS74
U11D
LS04
U06J
LS00
RAS START
LS02
13D
LS32
U14D
LS139
U14E
301RETS007L
470 R13E2
470 R14E2
U14E #7 PIN: GND
F157
U15D
U15E
7417
R4A2
470
D4A1
OC: OPEN COLLECTOR
MU42
READY
3-1C
FMCSA
3-1E
FMCSB
18-2B
IRAS
18-2C
ICAS
18-2D
IADR
18-2E
IADR
T. SAKAMOTO
ENGRG DEPT
S. SANO
1985-8-13
REV
ZONE
DATE
REVBY
A10 FM-U
FD1-B4718WN
PAGE
17
YOKOGAWA ELECTRIC WORKS
SIZE A3

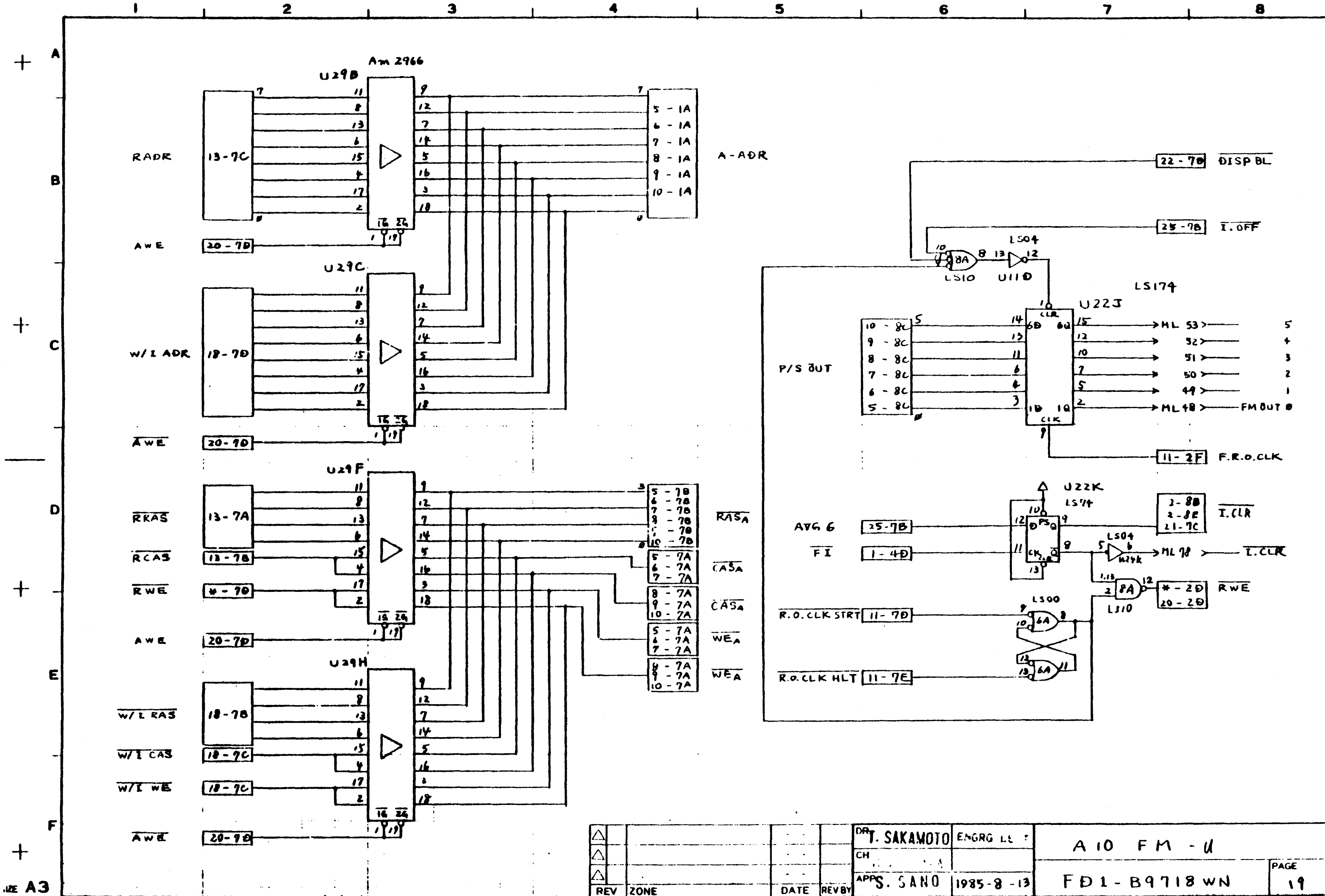


DR T. SAKAMOTO	ENGRG DEPT	A10 FM - u		
CH H. AKASAKA				
APP S. SANO	1985-8-13	FD1 - B9718WN	PAGE	18

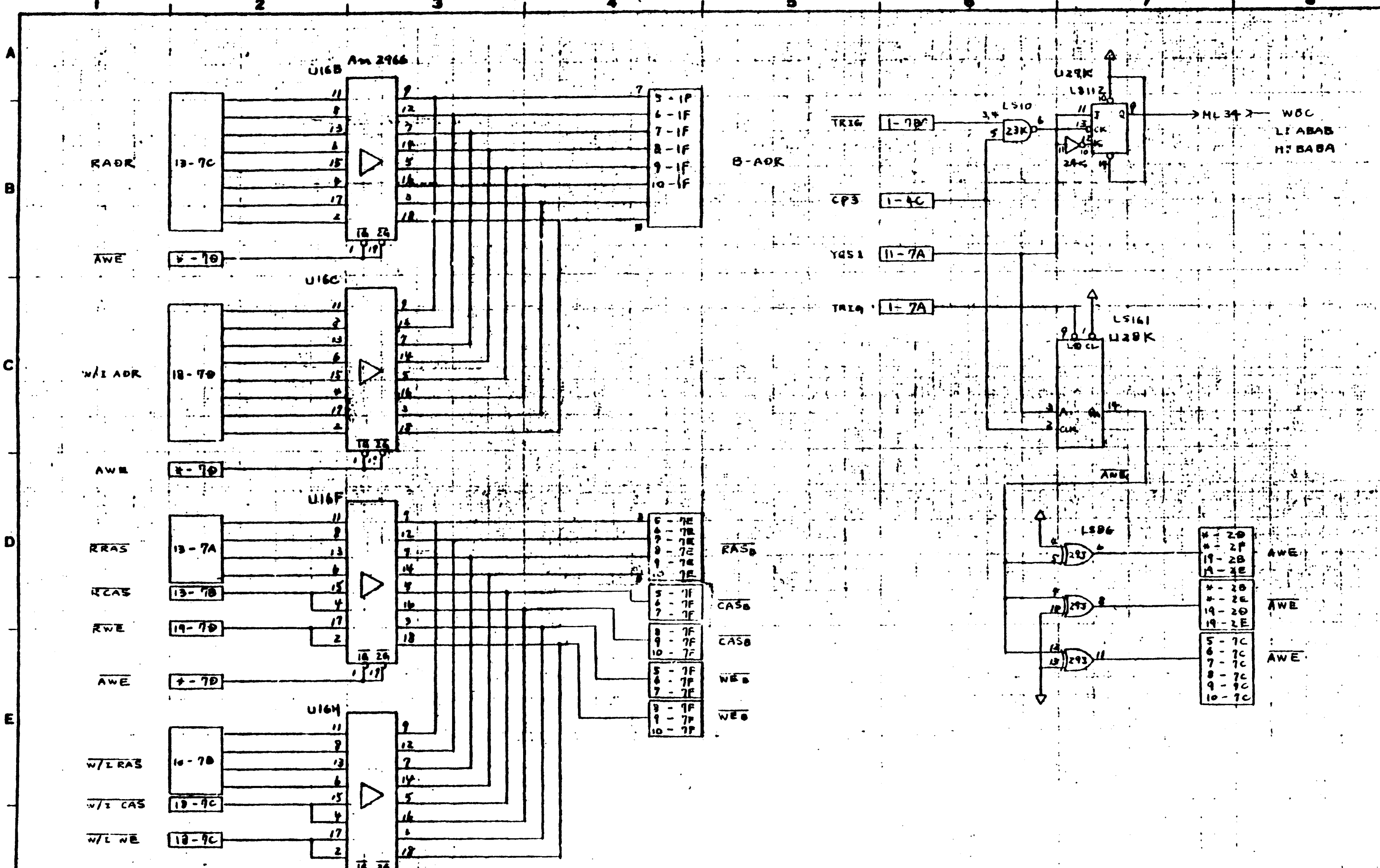
YMS YEW YOKOGAWA ELECTRIC WORKS

SIZE A3

Form Y-13-1

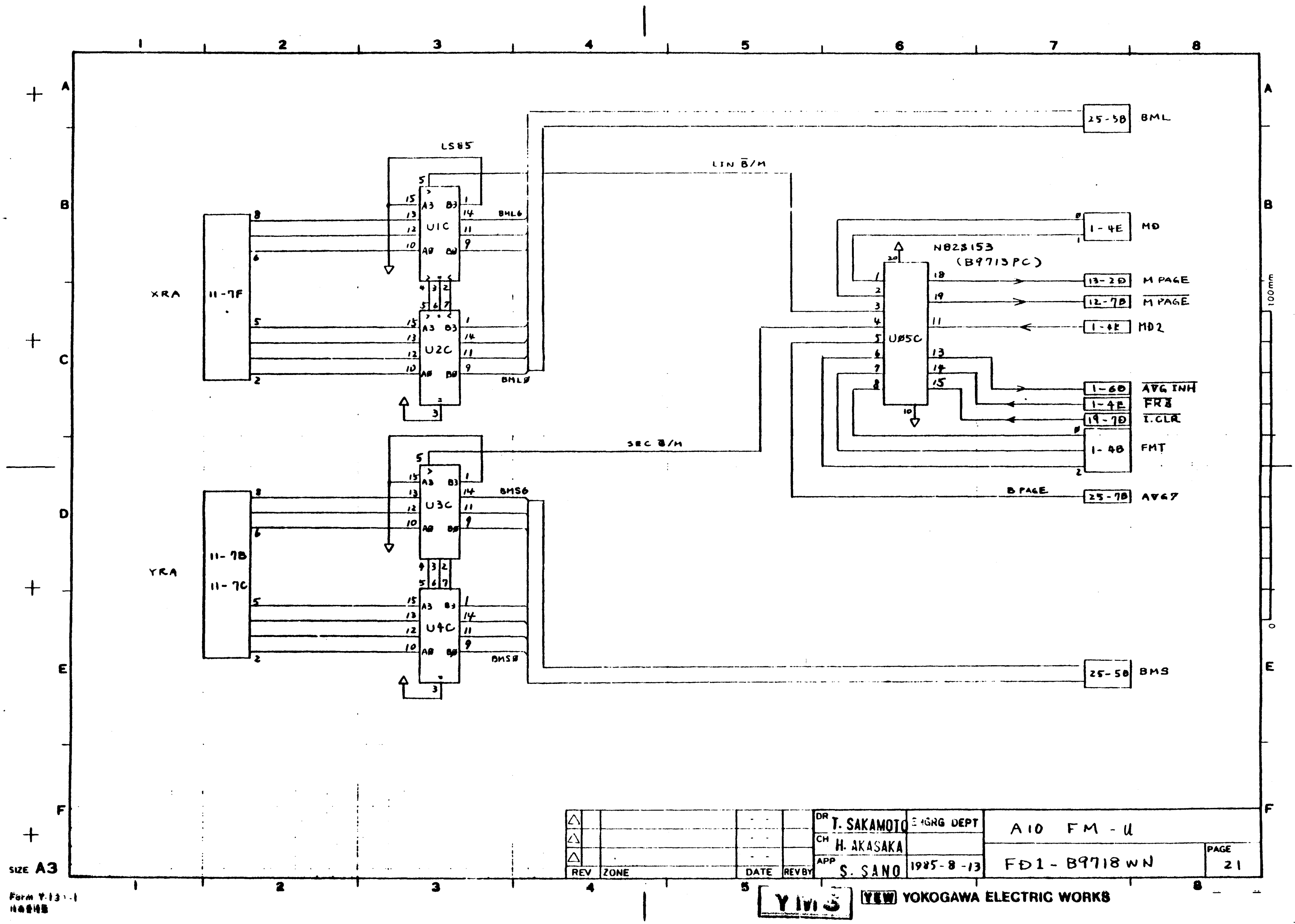


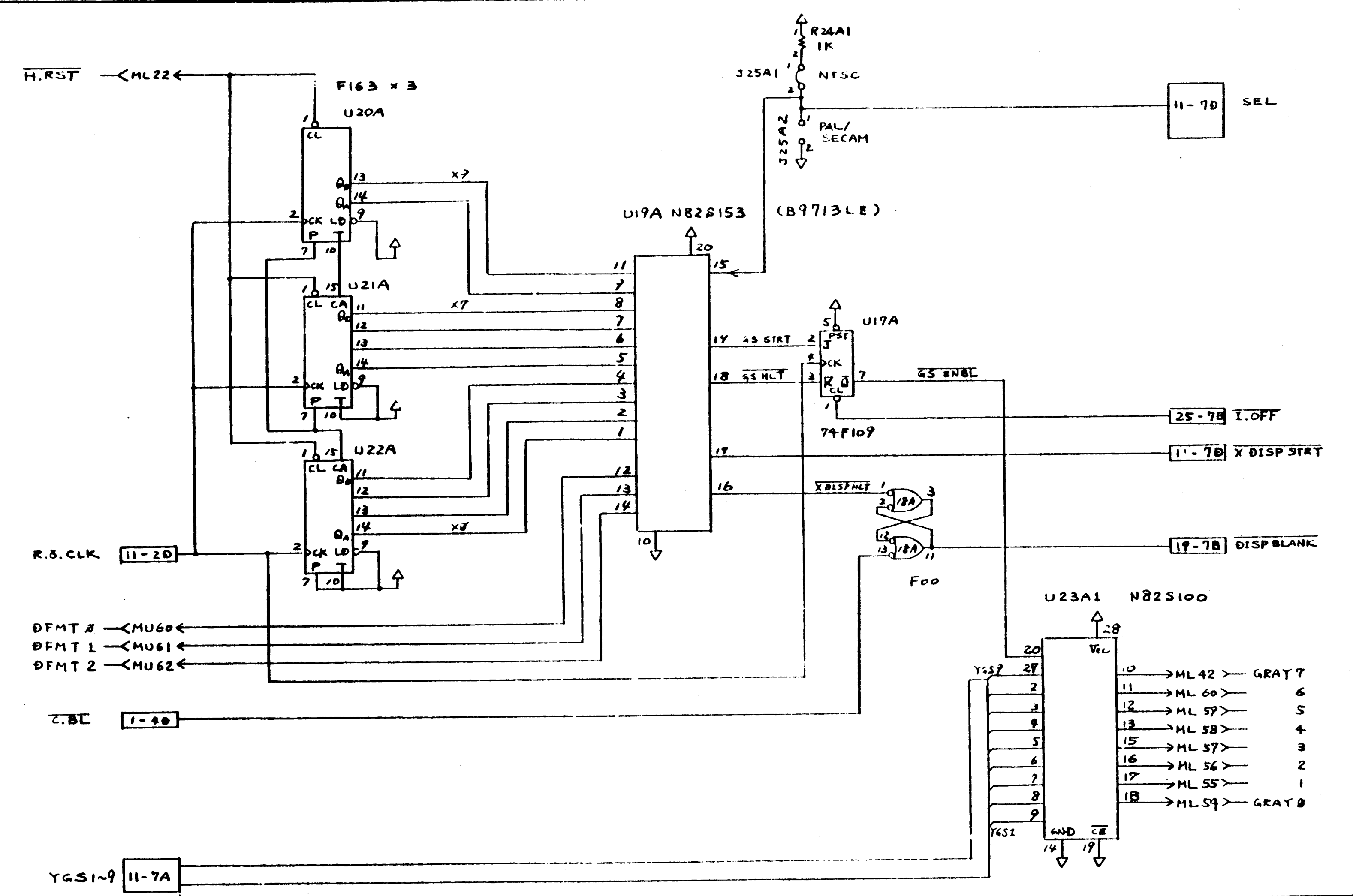
YEW YOKOGAWA ELECTRIC WORKS



			DR. T. SAKAMOTO	ENGRG DEPT	A10 FM - U		
			CH H. [illegible]		FD1 - B9718 WN		PAGE 20
REV	ZONE	DATE	REV BY	APP S [illegible]	1985-8-13		

YEW YOKOGAWA ELECTRIC WORKS


LS85
U1C
U2C
U3C
U4C
U05C
N82S153
(B9713PC)
XRA
YRA
11-7F
11-7B
11-7C
BML6
BML0
BMS6
BMS0
LIN B/M
SEC B/M
B PAGE
25-5B BML
1-4E MD
13-2D M PAGE
12-7B M PAGE
1-4E MD2
1-6D AVG INH
1-4E FR8
19-7D I.CLR
1-4B FMT
25-7B AV67
25-5B BMS
DR T. SAKAMOTO
CH H. AKASAKA
APP S. SANO
ENGRG DEPT
1985-8-13
A10 FM-U
FD1-B9718WN
PAGE 21
REV ZONE DATE REVBY
SIZE A3
YEW YOKOGAWA ELECTRIC WORKS



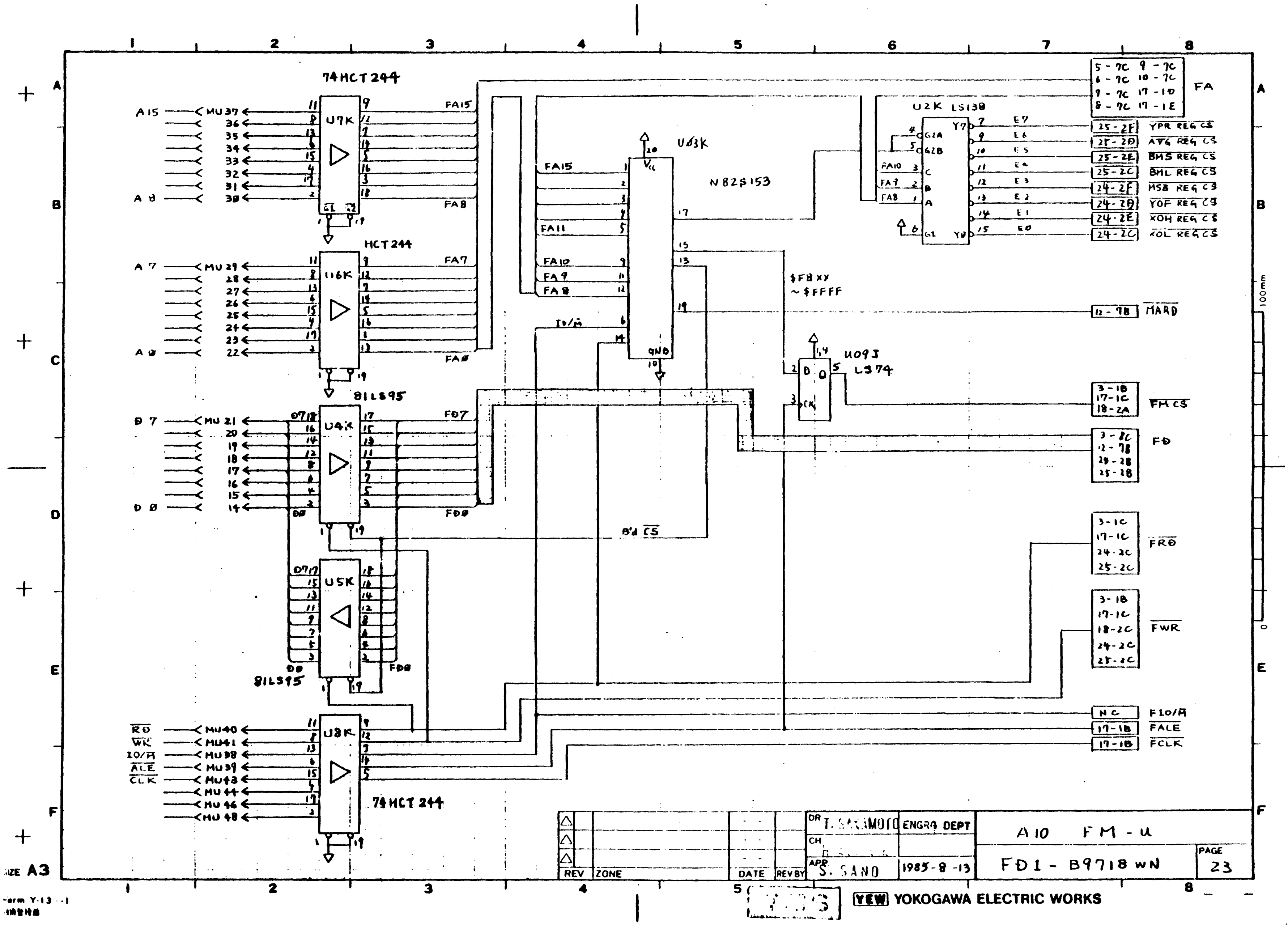
REV	ZONE	DATE	REV BY			
				DR T. SAKAMOTO	ENGRG DEPT	A10 FM-U
				CH H. AKASAKA		
				APP S. SANO	1985-8-13	FD1- B9718WN

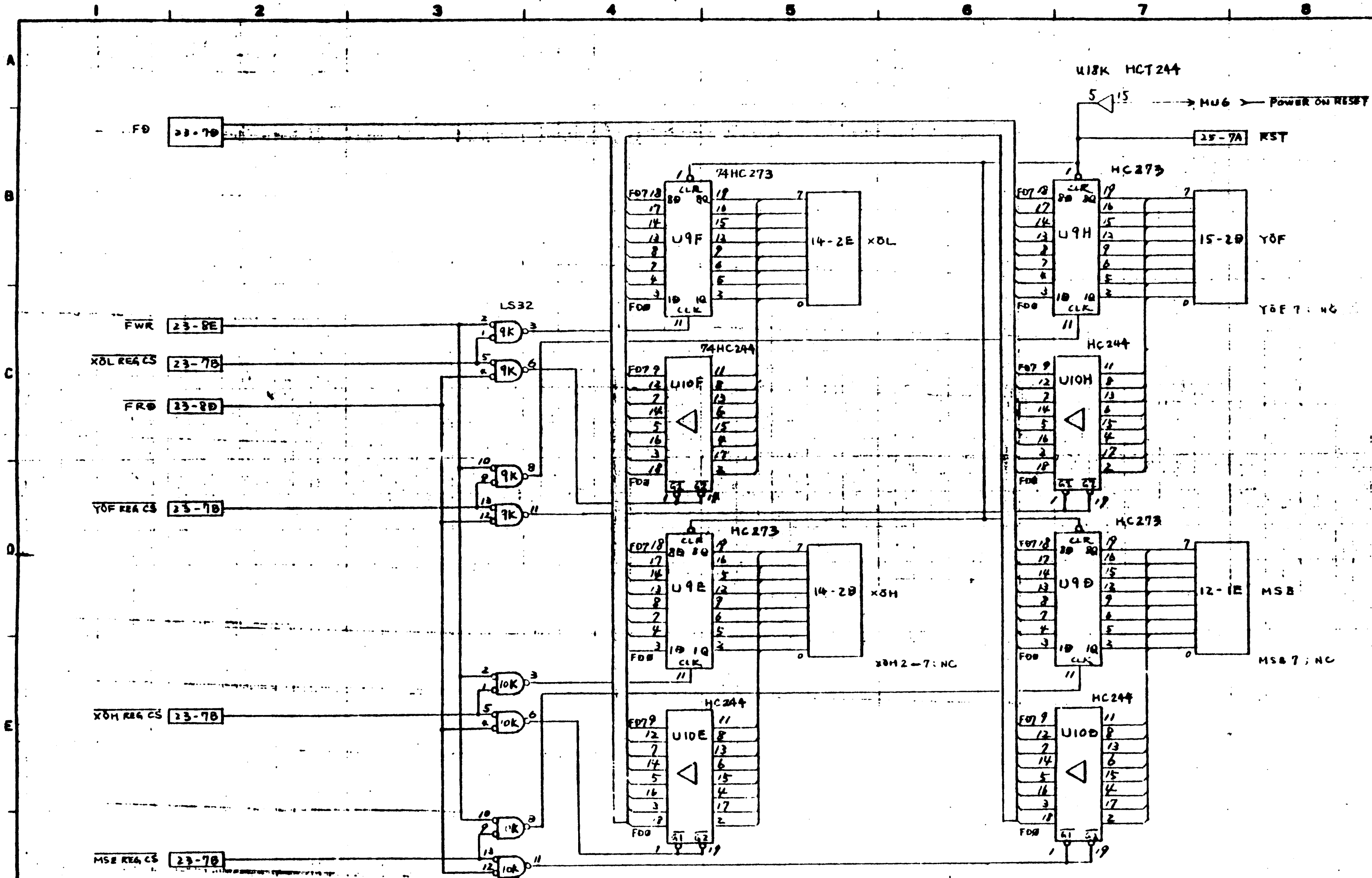
PAGE 22

YOKOGAWA MEDICAL SYSTEMS

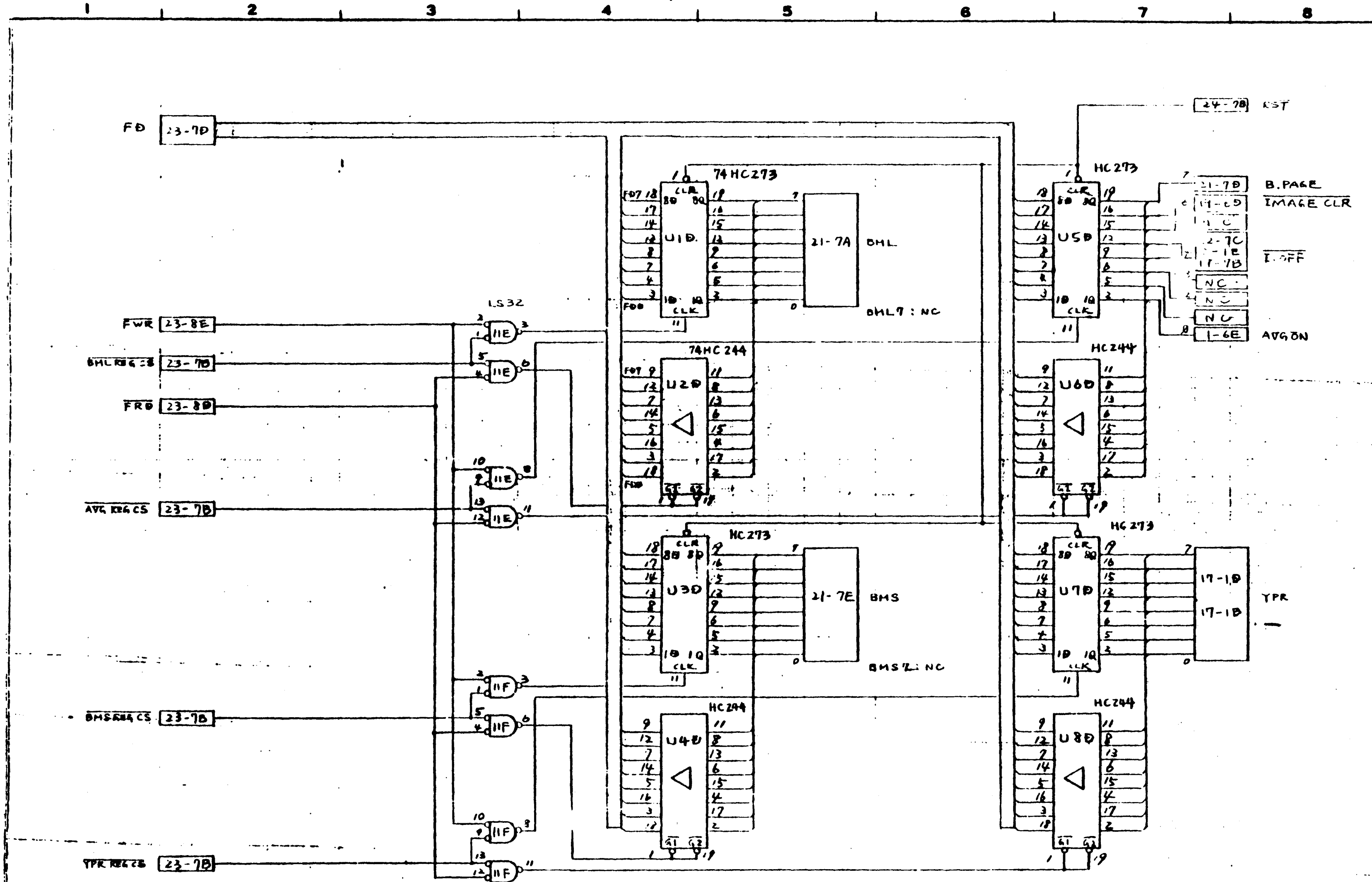
SIZE A3

Form Y-13-1


74HCT244
U7K
HCT244
U6K
81LS95
U4K
U5K
81LS95
U8K
74HCT244
U03K
N82S153
U2K LS138
U09J
LS74
$F8XX
~$FFFF
B'd CS
FA
YPR REG CS
ATG REG CS
BMS REG CS
BML REG CS
MSB REG CS
YOF REG CS
XOH REG CS
XOL REG CS
MARD
FM CS
FD
FRD
FWR
F10/M
FALE
FCLK
A15
A8
A7
A0
D7
D0
RD
WR
IO/M
ALE
CLK
DR T. SAKAMOTO
ENGRG DEPT
APR S. SANO
1985-8-13
A10 FM-u
FD1-B9718WN
PAGE 23
YEW YOKOGAWA ELECTRIC WORKS
SIZE A3



DR T. SAKAMOTO | ENG'G DEPT
CH H. [illegible]SAKA
APP S. [illegible] | 1985-8-13
A10 FM-U
FD1-B9718WN
PAGE 24
REV. | ZONE | DATE | REV BY
YEW YOKOGAWA ELECTRIC WORKS



REV	ZONE	DATE	REV BY

DR T. SAKAMOTO
CH
APP 1985-8-13

A I O FM - U

FD1- B9718WN

PAGE 25

YEW YOKOGAWA ELECTRIC WORKS

MU

Pin No.	SIGNAL NAME	Pin No.	SIGNAL NAME
0	GND	1	GND
2	GND	3	GND
4	GND	5	GND
6	INT	7	NC
8	+5V D	9	+5V D
10	+5V D	11	+5V D
12		13	
14	DATA0	15	DATA1
16	DATA2	17	DATA3
18	DATA4	19	DATA5
20	DATA6	21	DATA7
22	ADD 0	23	ADD 1
24	ADD 2	25	ADD 3
26	ADD 4	27	ADD 5
28	ADD 6	29	ADD 7
30	ADD 8	31	ADD 9
32	ADD 10	33	ADD 11
34	ADD 12	35	ADD 13
36	ADD 14	37	ADD 15
38	IO/M	39	ALE
40	RD	41	WR
42	READY	43	CLKOUT
44	RESETOUT	45	S0
46	S1	47	HOLD
48	HLDA	49	TR3
50	TR4	51	[illegible]
52	SP0	53	SP1
54	HD	55	VD
56	1MCLK	57	F.ZONE0
58	F.ZONE1	59	FREEZE
60		61	
62		63	DENBL
64	ONE 3	65	ONE 4
66	ONE 5	67	ONE 6
68	GND	69	GND
70	A-DATA0	71	A-DATA1
72	GND	73	GND
74	A-DATA2	75	A-DATA3
76	A-DATA4	77	A-DATA5
78	GND	79	GND
80	RSLT DATA 0	81	RSLT DATA 1
82	" 2	83	" 3
84	" 4	85	" 5
86	ADCLK	87	B-DATA0
88	B-DATA1	89	B-DATA2
90	B-DATA3	91	B-DATA4
92	B-DATA5	93	HD2
94	MD0	95	MD1
96	SC0	97	SC1
98	AOUT	99	BOUT

ML

Pin No.	SIGNAL NAME	Pin No.	SIGNAL NAME
0	XW0	1	XW1
2	XW2	3	XW3
4	XW4	5	XW5
6	XW6	7	XW7
8	GND	9	GND
10	R.O.CLK	11	ONE 7
12	GND	13	GND
14	ONE 2	15	ONE 8
16	GND	17	GND
18	XW8	19	XW9
20	F1	21	CP1
22	H.RST	23	CP3
24	C.BL	25	
26		27	
28	YW0	29	YW1
30	YW2	31	YW3
32	YW4	33	YW5
34	WOC	35	YW7
36	GND	37	GND
38	+5V	39	+5V
40	CLK240-25	41	CLK240-25
42	GRAY SCALE 7	43	NOP
44	CP3A	45	LS95 ENBL
46	ONE 0	47	ONE 1
48	FM DATA 0	49	FM DATA 1
50	FM DATA 2	51	FM DATA 3
52	FM DATA 4	53	FM DATA 5
54	GRAY SCALE 0	55	GRAY SCALE 1
56	GRAY SCALE 2	57	GRAY SCALE 3
58	GRAY SCALE 4	59	GRAY SCALE 5
60	GRAY SCALE 6	61	CB 9
62	CB10	63	CB11
64	NC	65	NC
66	NC	67	NC
68	NC	69	NC
70	NC	71	NC
72	CB LATCH	73	MENB
74	DTRG	75	TRIG
76	NC	77	NC
78	I.CLR	79	LBAS
80	SBEN	81	NC
82	+12V	83	+12V
84	+12V	85	+12V
86	-5V	87	-5V
88	-5V	89	-5V
90	+5V A	91	+5V A
92	+5V A	93	+5V A
94	GND	95	GND
96	GND	97	GND
98	GND	99	GND

Pin No.	SIGNAL NAME	Pin No.	SIGNAL NAME

REV	ZONE	DATE	REV BY	DR Y. HIROTA		A10 FM-II	
				CH.	ENG.	FD1 - 39718 WN	PAGE 26
				APP. [illegible] 10	1985-8-13		

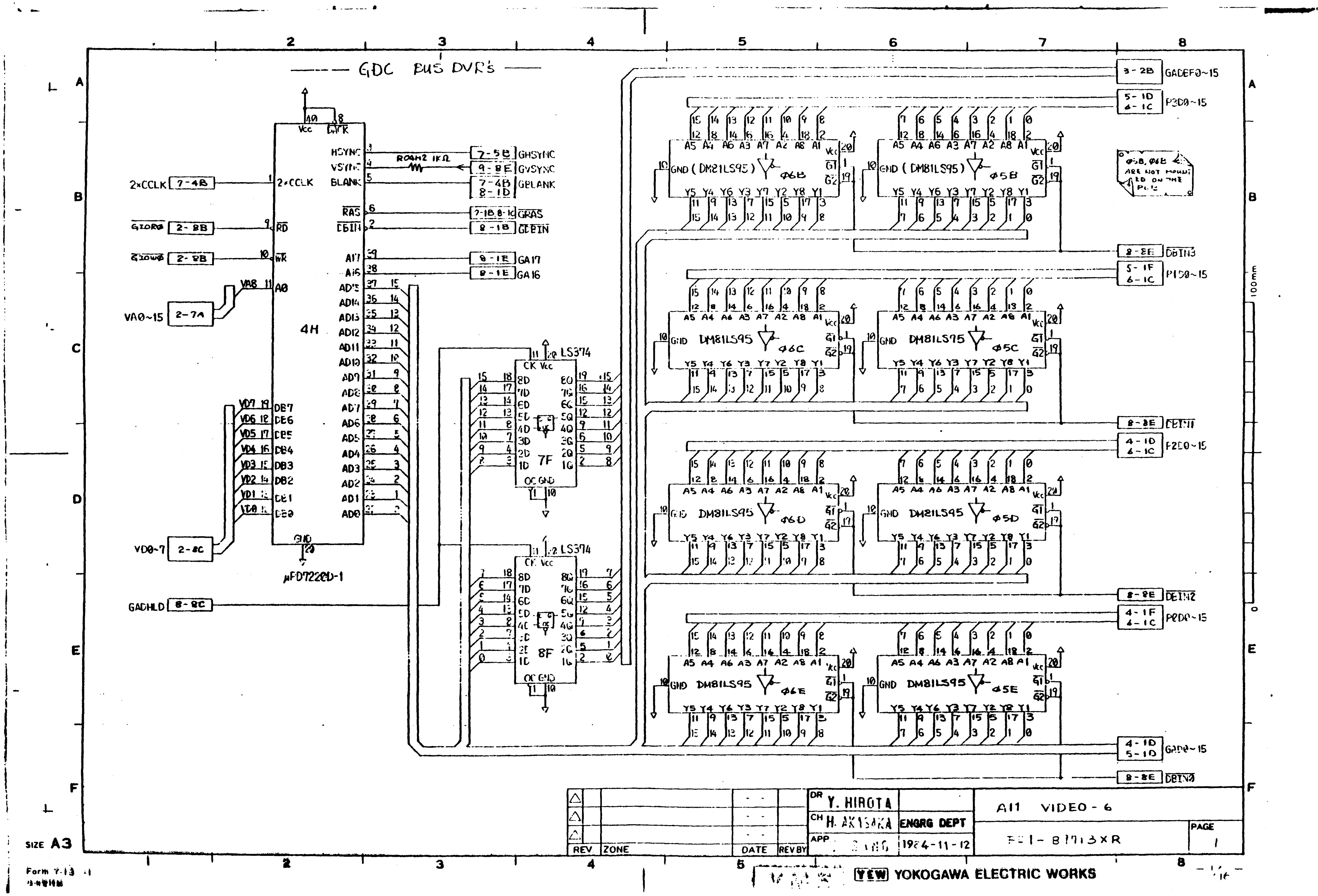
SIZE A3

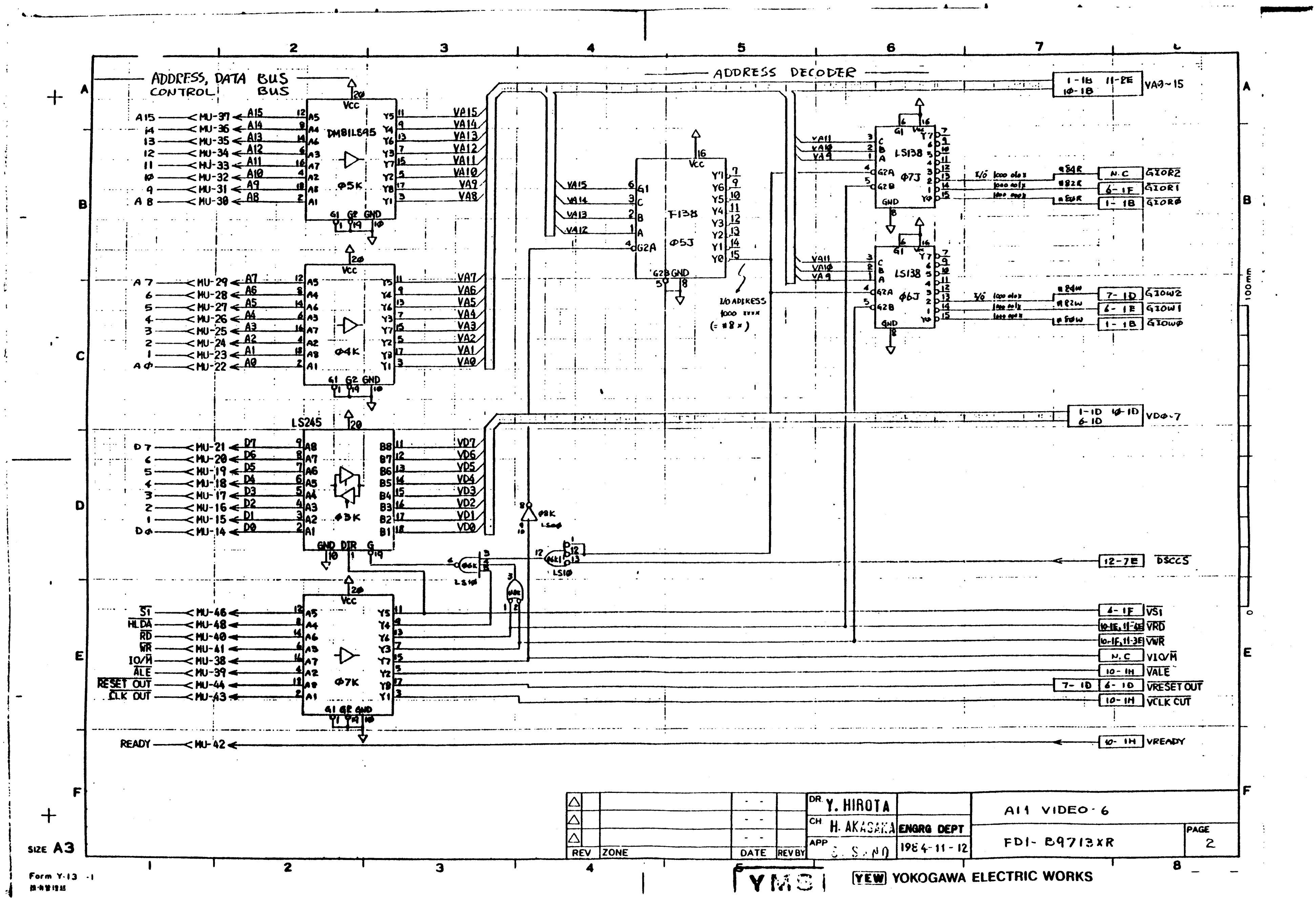
Y. HIROTA

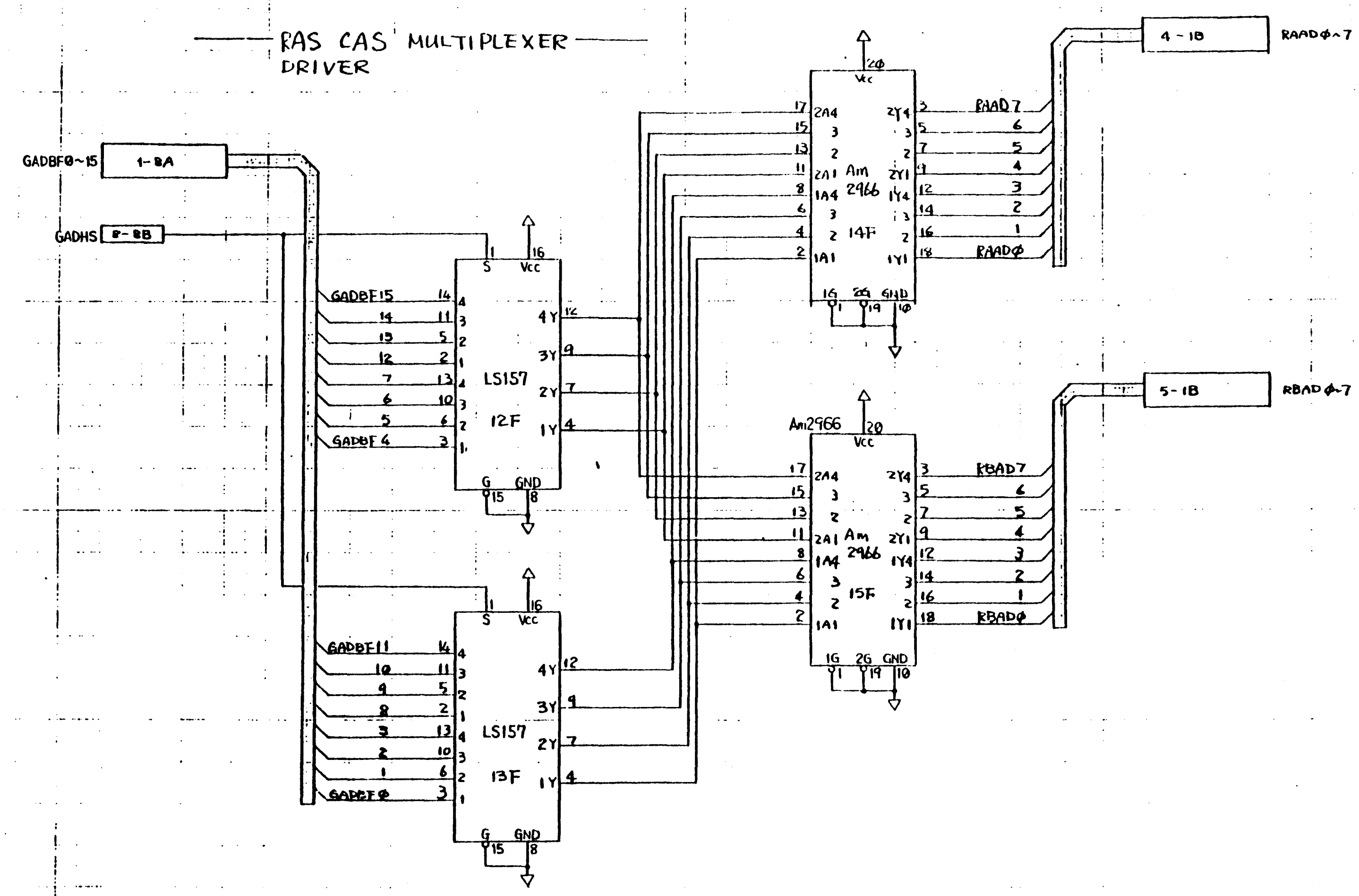
Form Y-13-1

YMS

YEW YOKOGAWA ELECTRIC WORKS


GDC BUS DVR'S
μPD7220D-1
4H
LS374
7F
8F
DM81LS95
2×CCLK
VA0~15
VD0~7
GADHLD
GHSYNC
GVSYNC
GBLANK
GRAS
GDBIN
GA17
GA16
GADEF0~15
P3D0~15
P1D0~15
P2D0~15
P0D0~15
GAD0~15
DBIN3
DBIN1
DBIN2
DBIN0
Y. HIROTA
H. AKISAKA
ENGRG DEPT
1984-11-12
A11 VIDEO - 6
PAGE 1
YOKOGAWA ELECTRIC WORKS
SIZE A3


ADDRESS, DATA BUS
CONTROL BUS
ADDRESS DECODER
DM81LS95
LS245
LS138
F138
I/O ADDRESS
VA0~15
VD0-7
DSCCS
VS1
VRD
VWR
VIO/M
VALE
VRESET OUT
VCLK OUT
VREADY
READY
DR Y. HIROTA
CH H. AKASAKA
ENGRG DEPT
1984-11-12
A11 VIDEO-6
FDI-B9713XR
PAGE 2
REV
ZONE
DATE
REV BY
SIZE A3
Form Y-13-1
YEW YOKOGAWA ELECTRIC WORKS



REV	ZONE	DATE	REV BY
		- -	
		- -	
		- -	

DR Y. HIROTA
CH H. AKASAKA
APP S. SANO
ENGRG DEPT 1984-11-12

A11 VIDEO-6

FDI-B9713XR

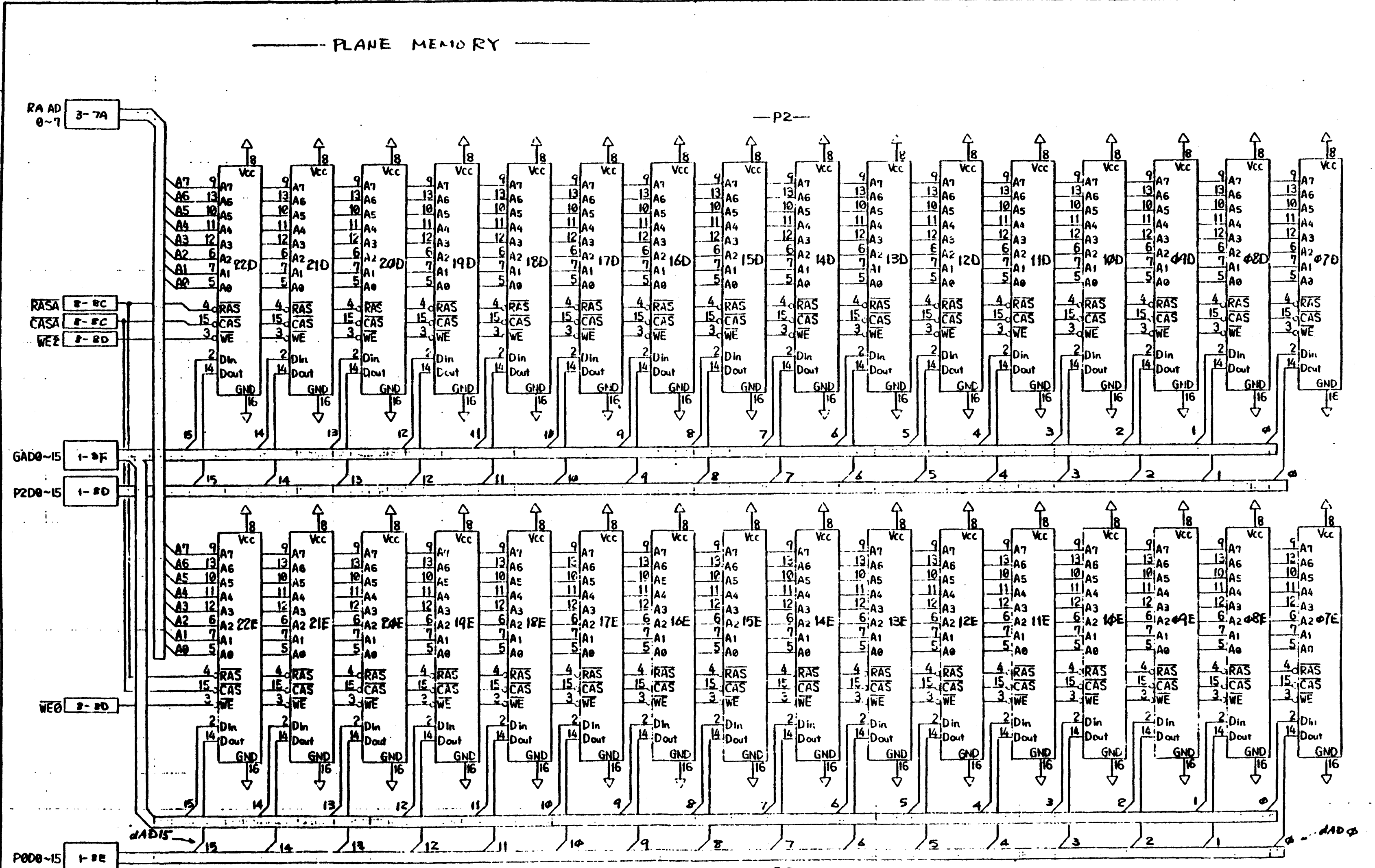
PAGE 3

SIZE A3

Form Y-13 -1

YMS

YEW YOKOGAWA ELECTRIC WORKS



μPD4164C-3 × 32
64K D-RAM
μPD4164C-3(NEC) OR EQUIV.
150nS ACCESS TIME
Vcc: 8pin GND: 16pin

REV	ZONE	DATE	REVBY

DR Y. HIROTA
CH H. AKASAKA — ENGRG DEPT
APP S. SENO — 1984-11-12

A11 VIDEO-6

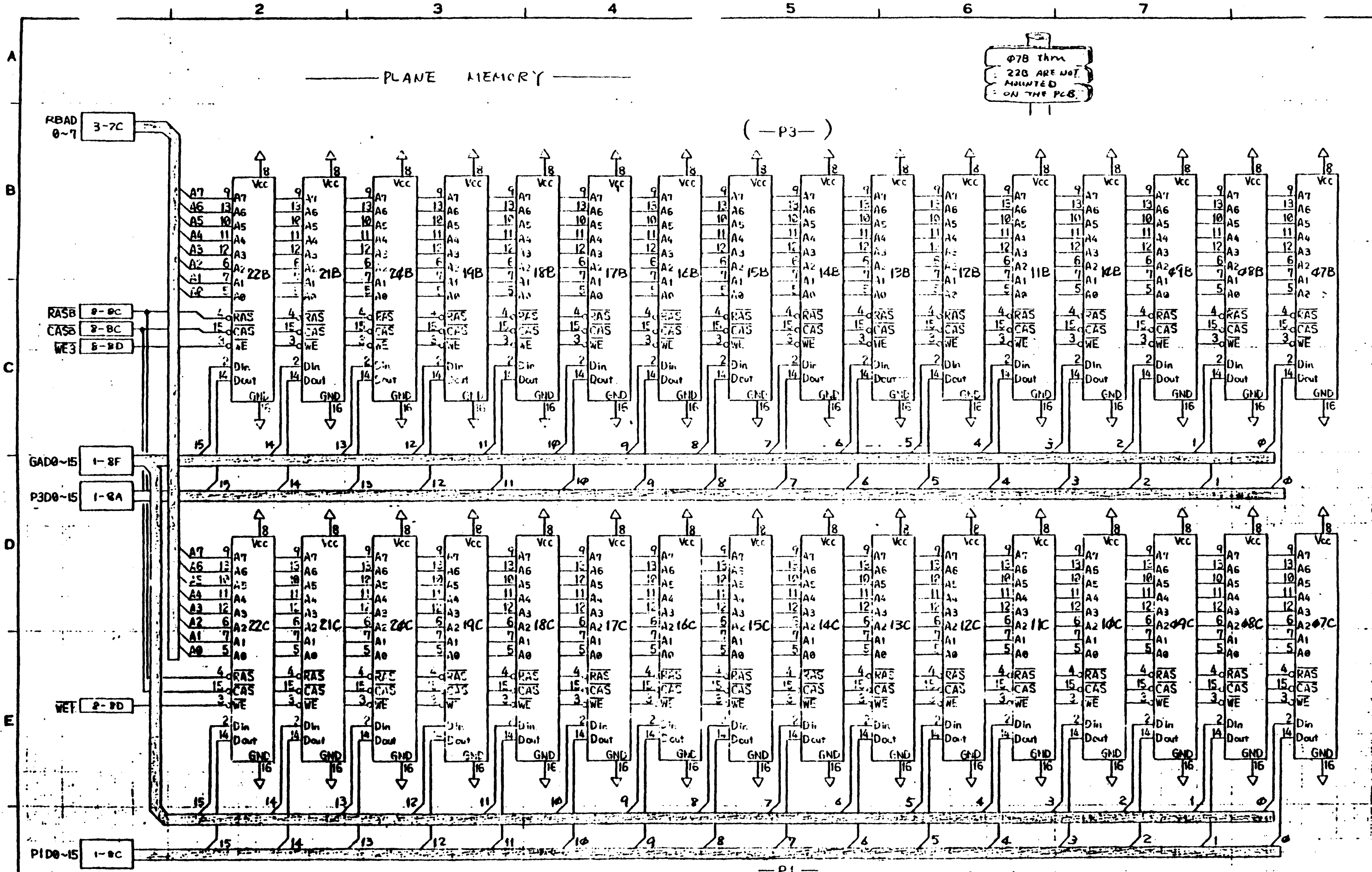
FD1-B9713XR

PAGE 4

SIZE A3

Form Y-13-1

YMS (YEW) YOKOGAWA ELECTRIC WORKS



μPD4164C-3 × 32
64K D-RAM
μPD4164C-3(NEC) OR EQUIV.
150nS ACCESS TIME
Vcc: 8pin GND: 16pin

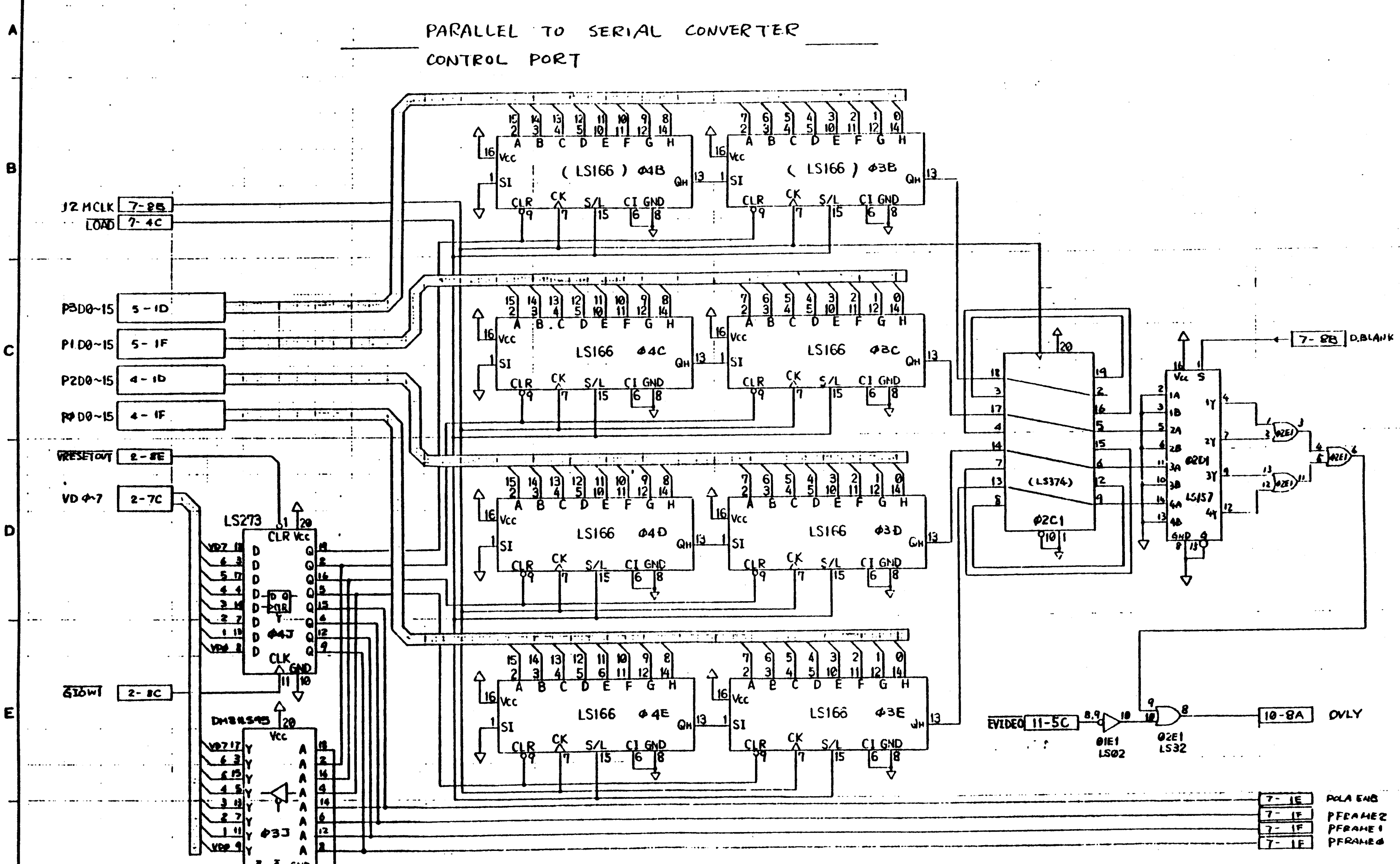
REV	ZONE	DATE	REV BY

DR Y. HIROTA
CH H. AKASAKA
APP
1984-11-12

A11 VIDEO-6
FDI-B9713XR
PAGE 5

SIZE A3
Form Y-13-1

YMS
YEW YOKOGAWA ELECTRIC WORKS



REV	ZONE	DATE	REV BY		
				DR	Y. HIROTA
				CH	H. AKASAKA
				APP	S. S...

ENGRG DEPT 1984-11-12

A11 VIDEO-6

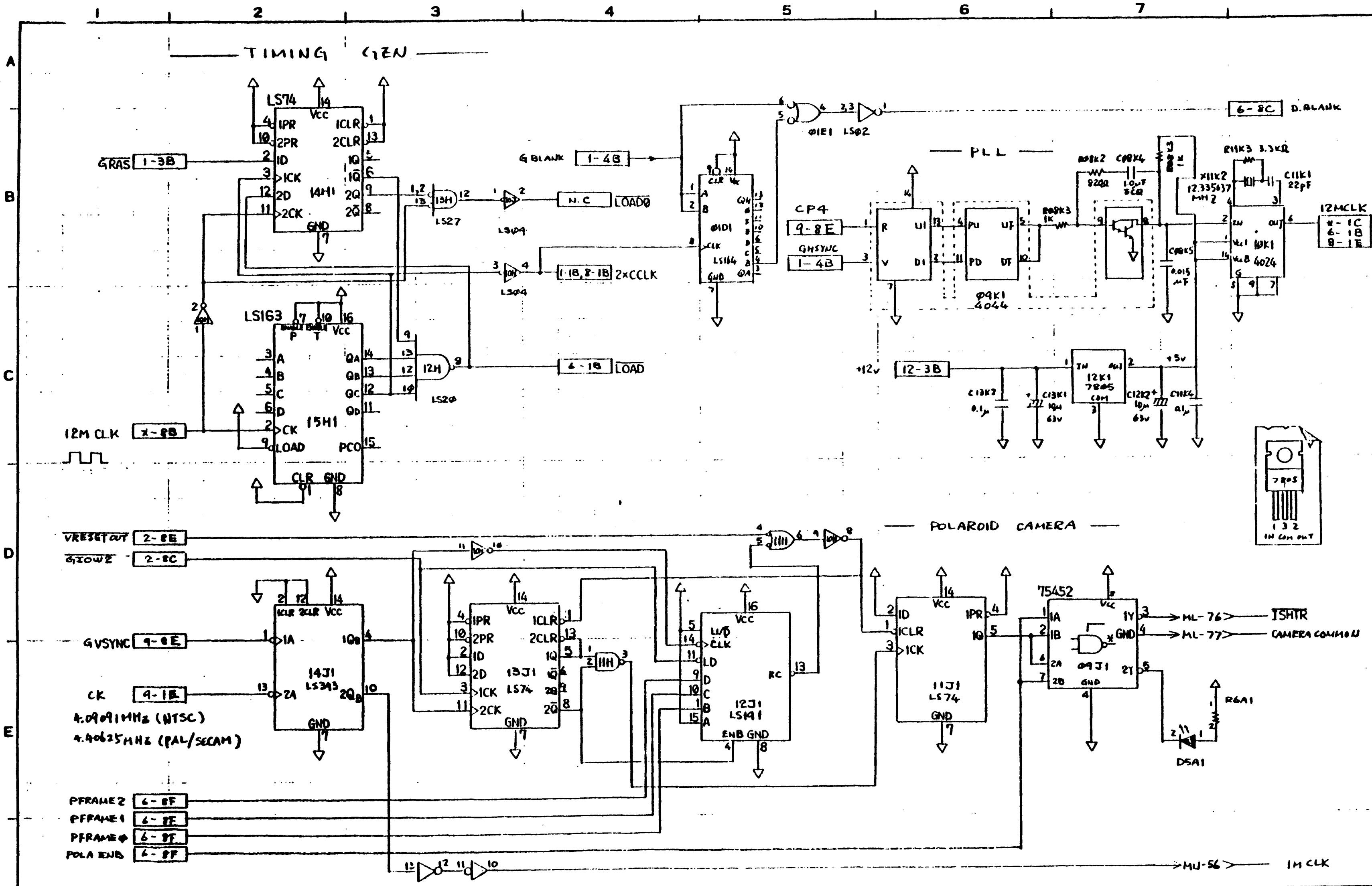
FD1-134713XR

PAGE 6

YEW YOKOGAWA ELECTRIC WORKS

SIZE A3

Form Y-13-1



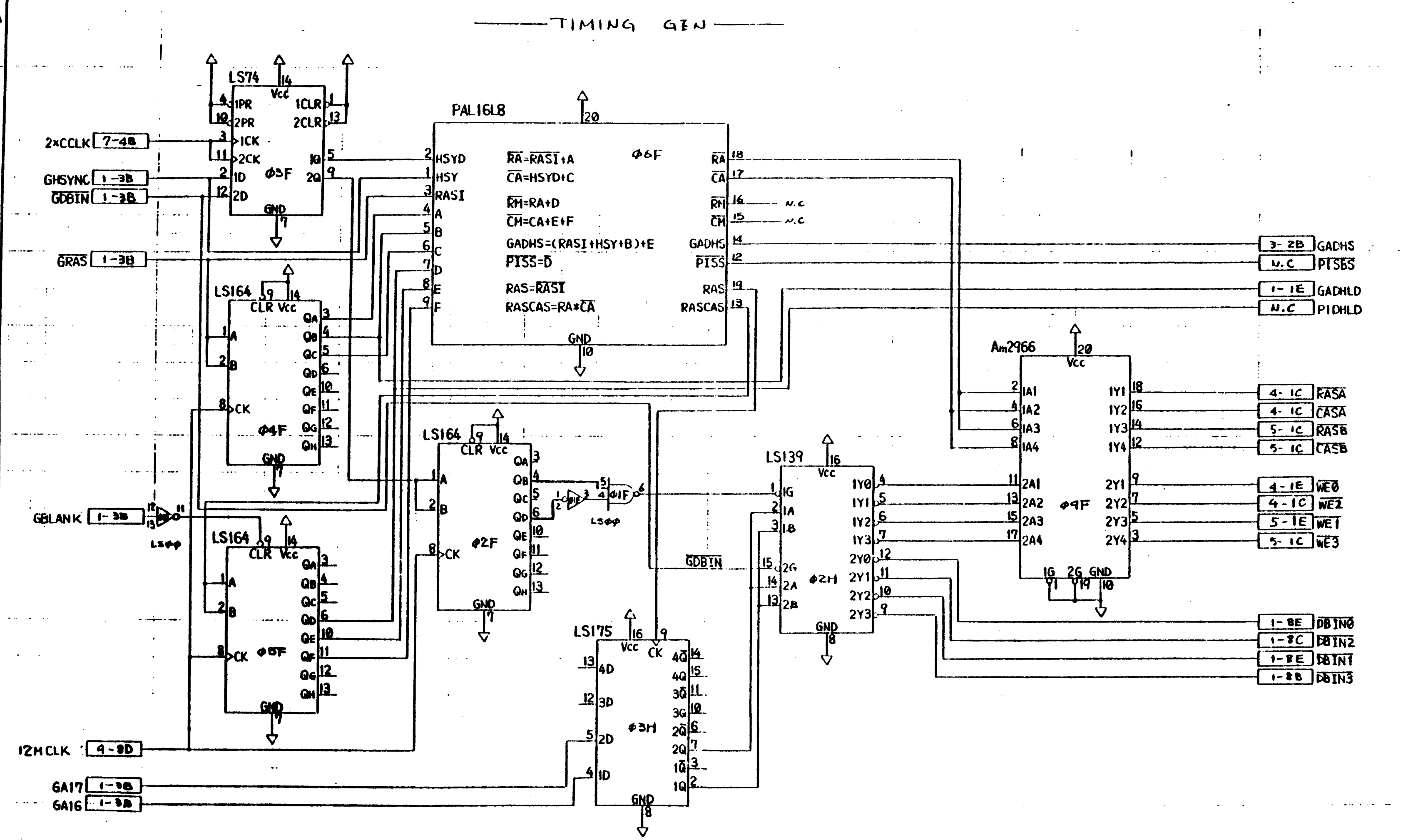
REV	ZONE	DATE	REV BY	DR Y. HIROTA		A11 VIDEO-6	
				CH H. AKASAKA	ENGRG DEPT		
				APP S. S...O	1984-11-12	FD1-B9713XR	PAGE 7

SIZE A3

Form Y-13-1

YMS (YEW) YOKOGAWA ELECTRIC WORKS

TIMING GEN



DR Y. HIROTA	ENGRG DEPT	A11 VIDEO-6
CH H. AKASAKA		
APP S. SANO	1984-11-12	FDI-B9713XR

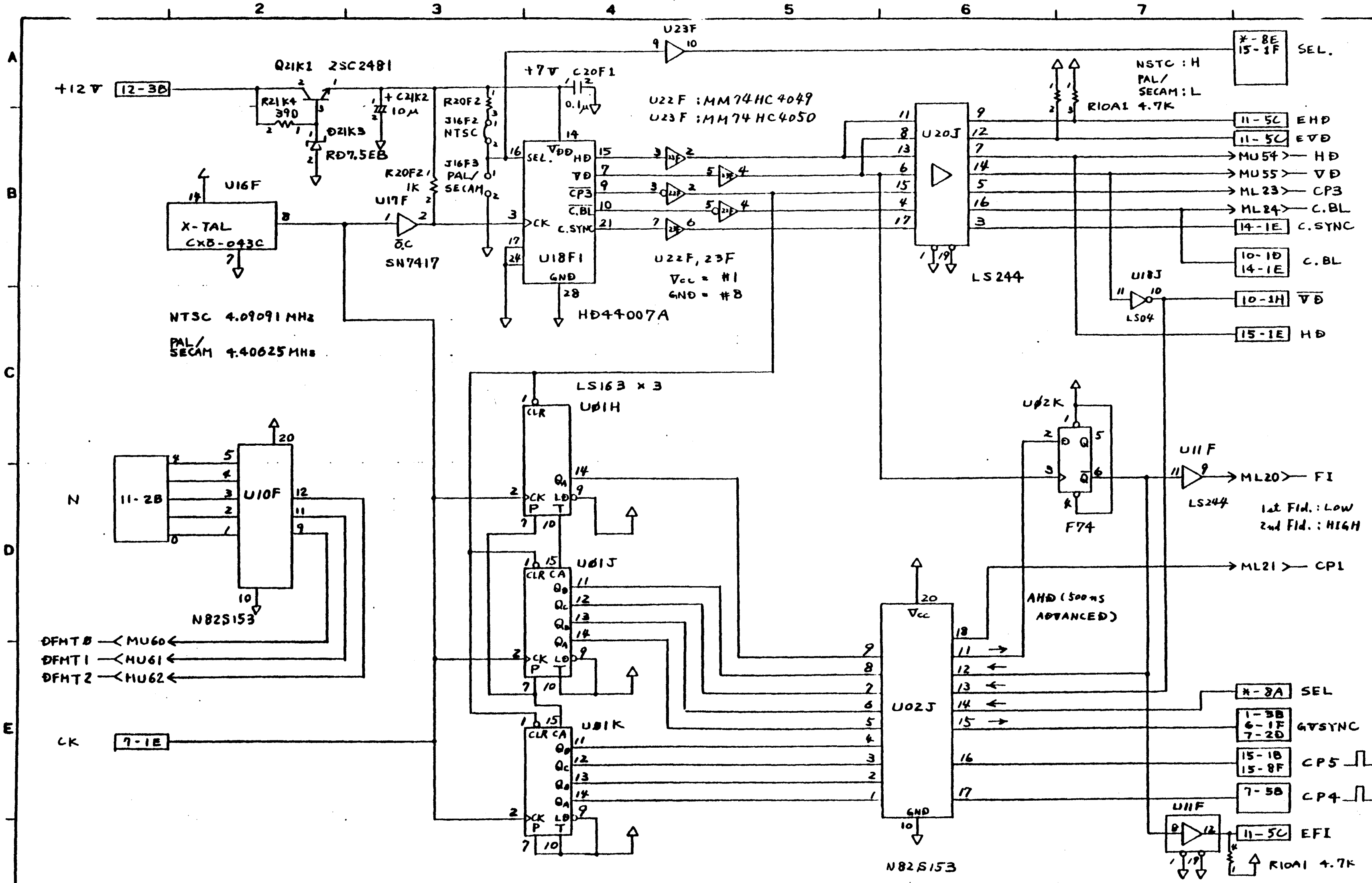
PAGE 2

SIZE A3

Form Y-13 -1

YMS

YEW YOKOGAWA ELECTRIC WORKS



T. SAKAMOTO ENGRG DEPT
ENGRG DEPT
1984-11-12

A11 VD0-6

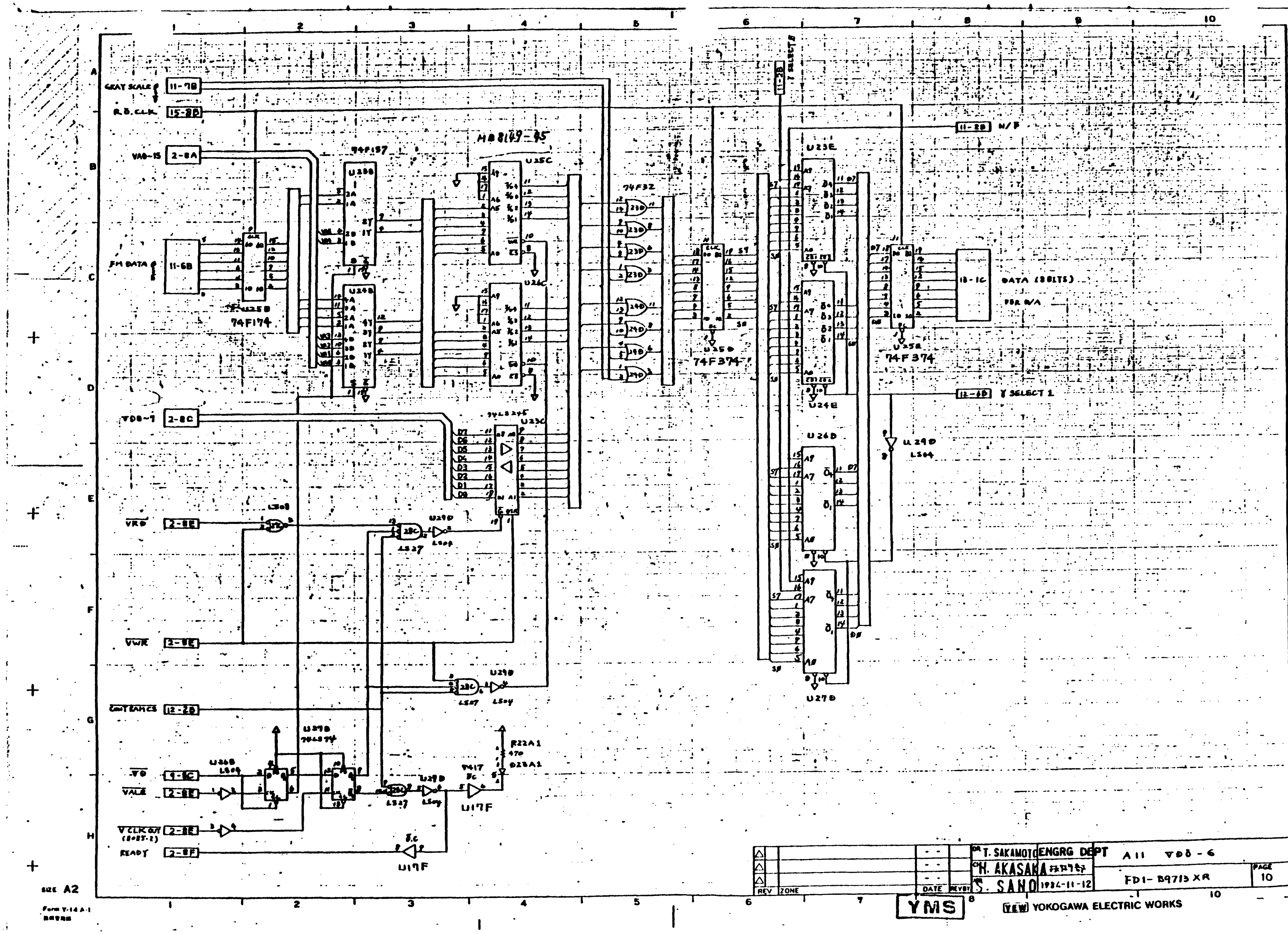
FD1-B9713XR

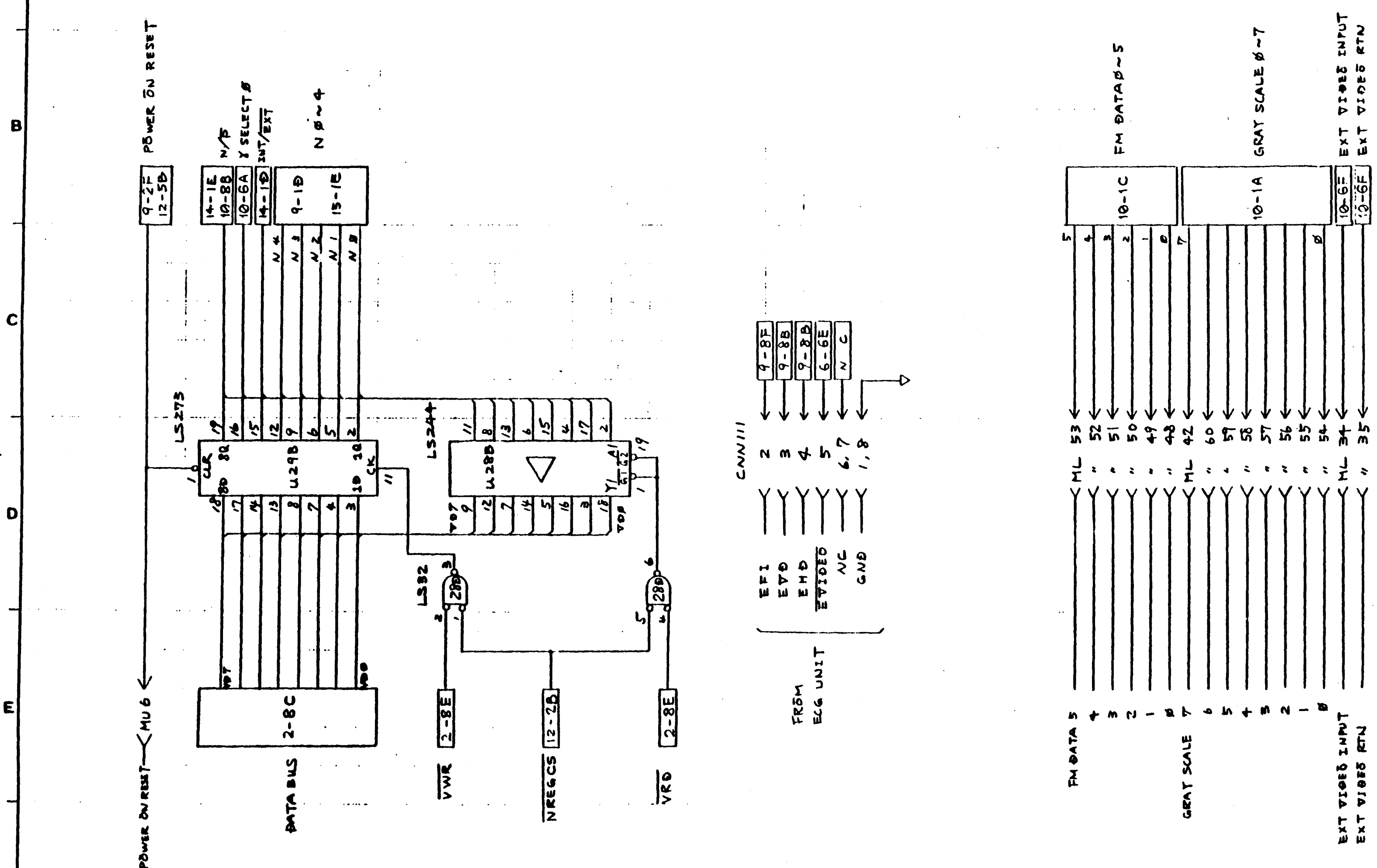
PAGE 9

SIZE A3

YOKOGAWA MEDICAL SYSTEMS

Form Y-13


GRAY SCALE
11-7B
R.D.CLK
15-2B
VA0-15
2-8A
FM DATA
11-6B
74F174
74F157
U29B
HB8149-15
U25C
U26C
74F32
74LS245
U23C
VD0-7
2-8C
VRD
2-8E
VWR
U29D
LS27
LS04
CNT EANCS
12-2D
VD
1-5C
VALE
2-8E
V CLK OUT
READY
2-8F
U17F
U27B
74LS74
R22A1
470
D23A1
74F374
U25D
U23E
U24E
U26D
U27D
U25E
11-2B
N/F
X SELECT B
11-2B
DATA (8BITS)
FOR D/A
13-1C
12-6D
Y SELECT 1
DR T. SAKAMOTO
ENGRG DEPT
CH H. AKASAKA
S. SANO
1984-11-12
A11 VDO-6
FD1-B9713XR
PAGE 10
YMS
YEW YOKOGAWA ELECTRIC WORKS
SIZE A2

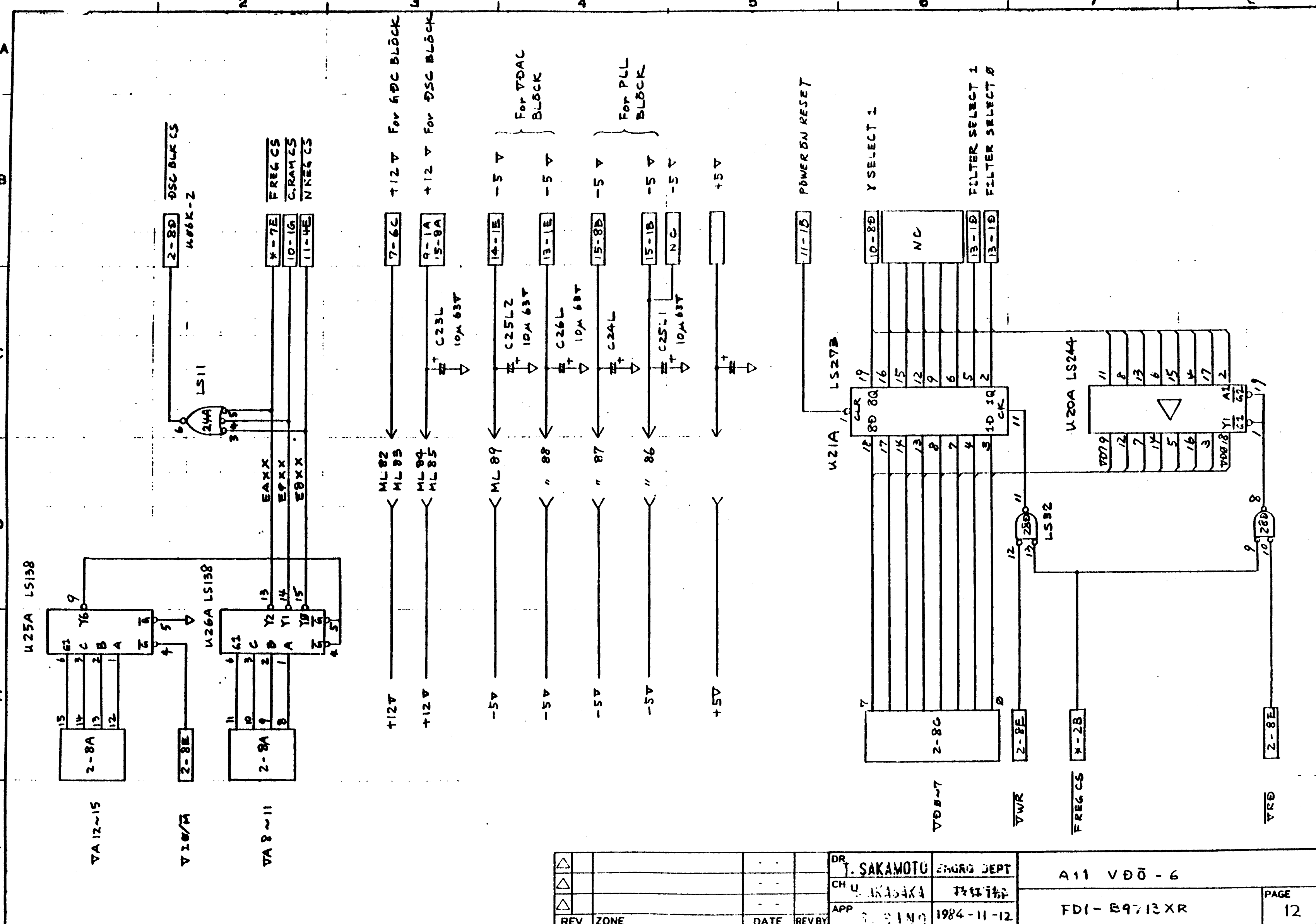


REV	ZONE	DATE	REV BY			
		DR	T. SAKAMOTO		A11 VDŌ-6	
		CH.	H. AKASAKA		FD1- B9713XR	PAGE 11
		APP	S. SANO	1984-11-12		

YEW YOKOGAWA ELECTRIC WORKS

SIZE A3

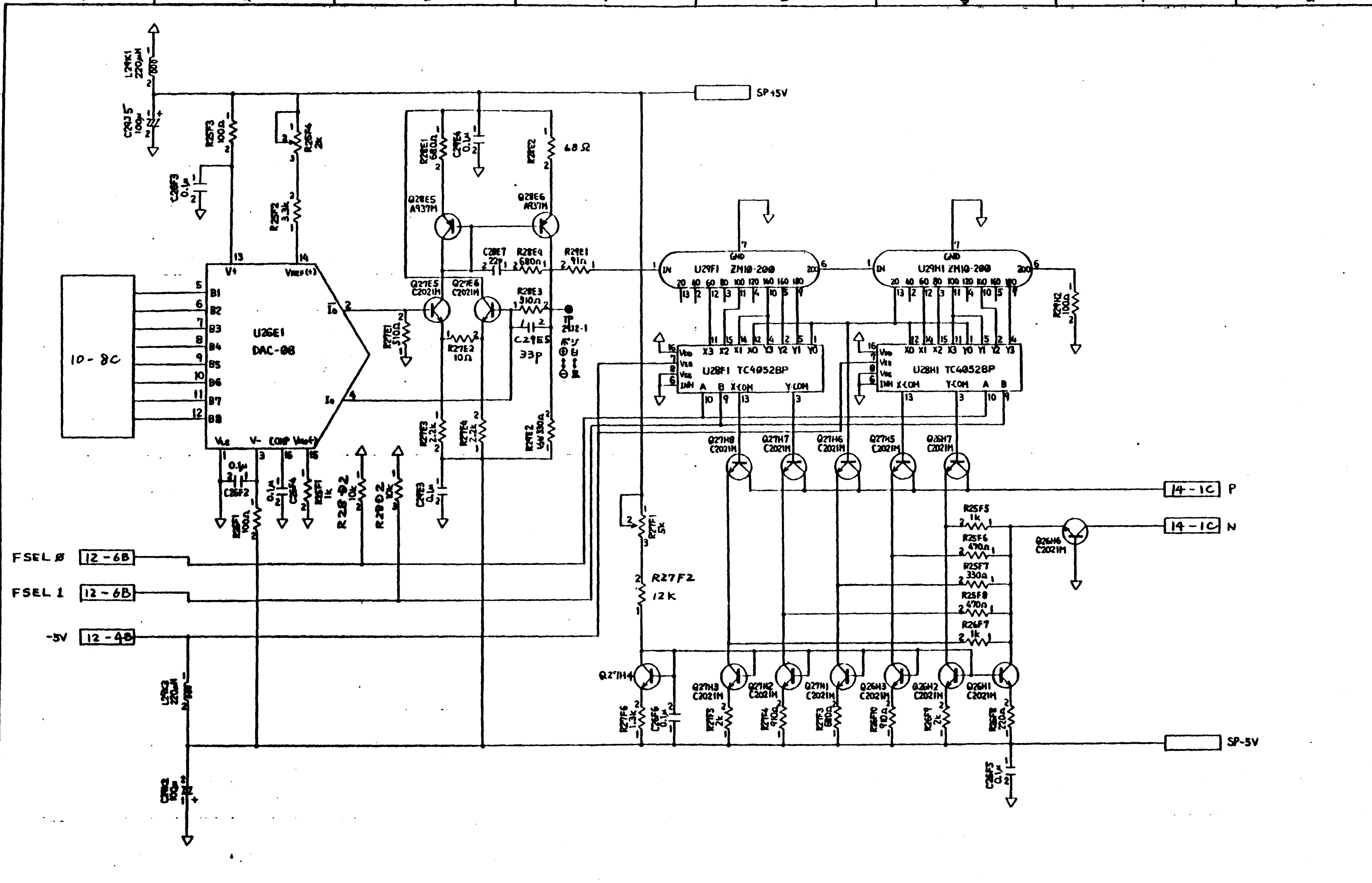
Form Y-13 -1



SIZE A3

YEW YOKOGAWA ELECTRIC WORKS

Form Y-13

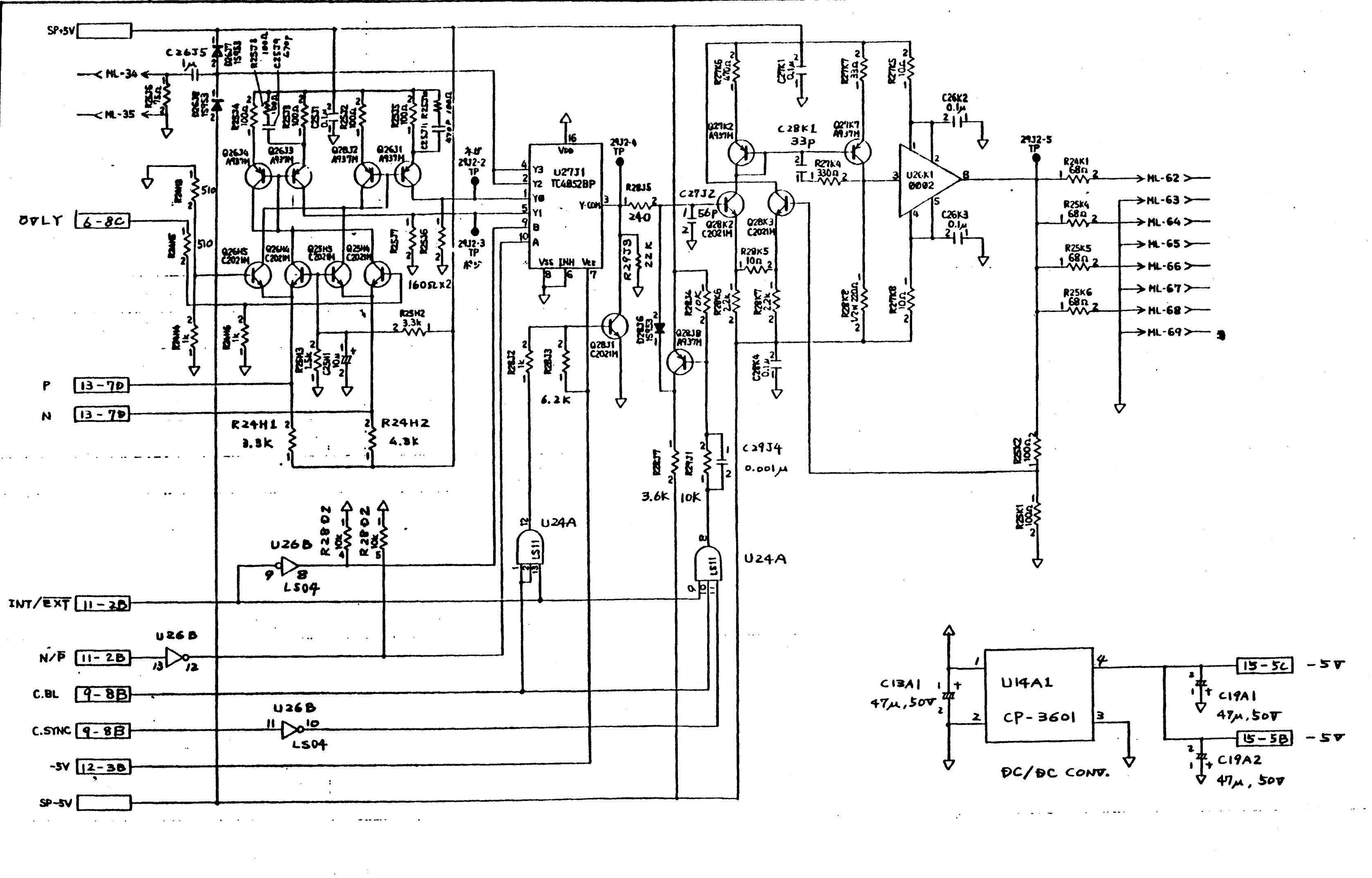


REV	ZONE	DATE	REV BY	DR Y. HIROTA	ENGRG DEPT	A11 VDO-6
				CH H. AKASAKA		FD1-B9713XR
				APP S. SANO	1984-11-12	PAGE 13

yms YOKOGAWA MEDICAL SYSTEMS

SIZE A3

Form Y13-1



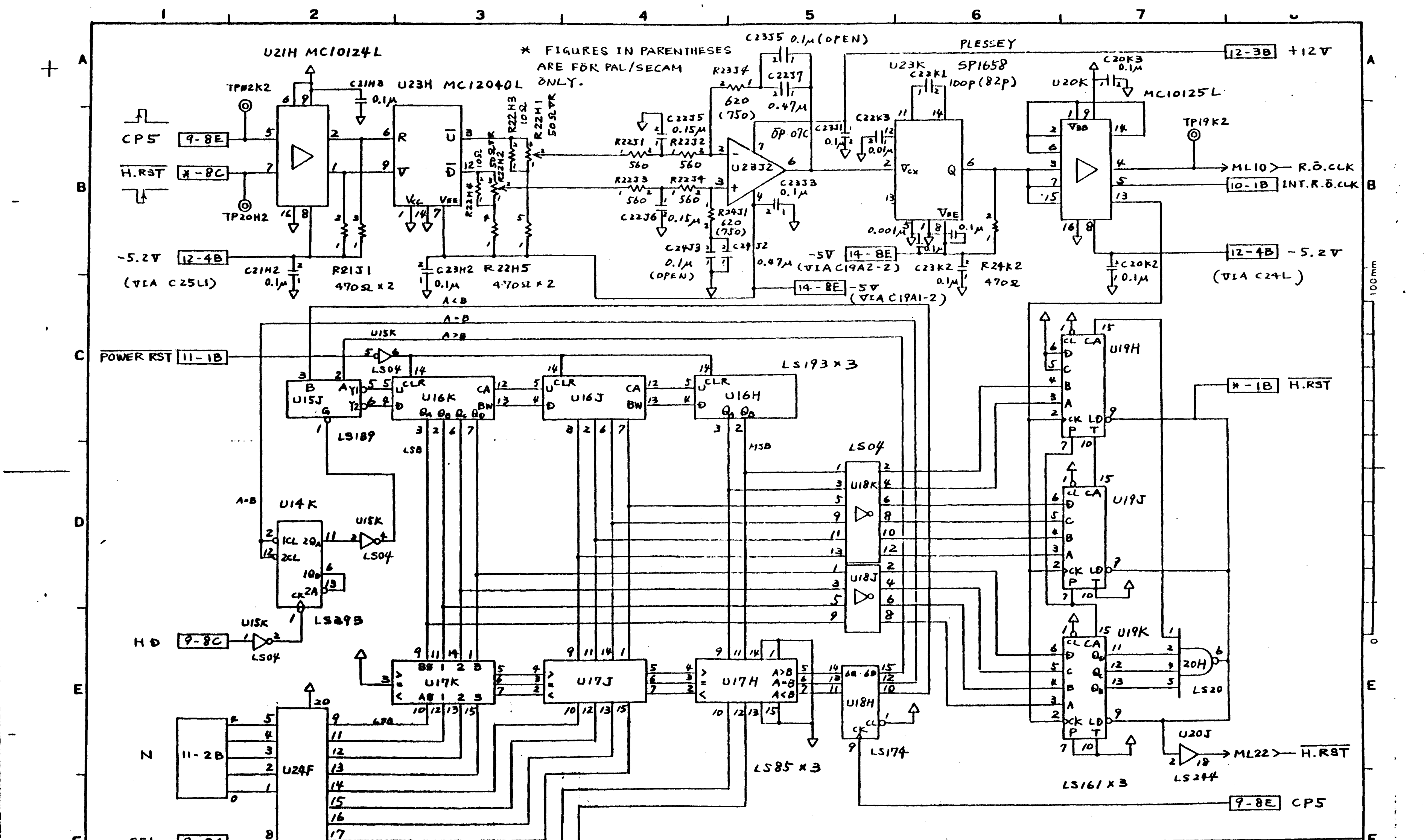
REV	ZONE	DATE	REV BY			
				DR Y. HIROTA	ENGRG DEPT	A11 VDO-6
				CH H. AKASAKA	技術3部	
				APP S. SANO	1984-11-12	FD1-B9713XR

PAGE 1+

SIZE A3

Form Y-13

YOKOGAWA MEDICAL SYSTEMS



DR T. SAKAMOTO | ENGRG DEPT | A11 VDŌ-6

CH

APP | 1984-11-12 | FD1-B1713XR | PAGE 15

REV | ZONE | DATE | REV BY

SIZE A3

Form Y-13

YOKOGAWA MEDICAL SYSTEMS

MU

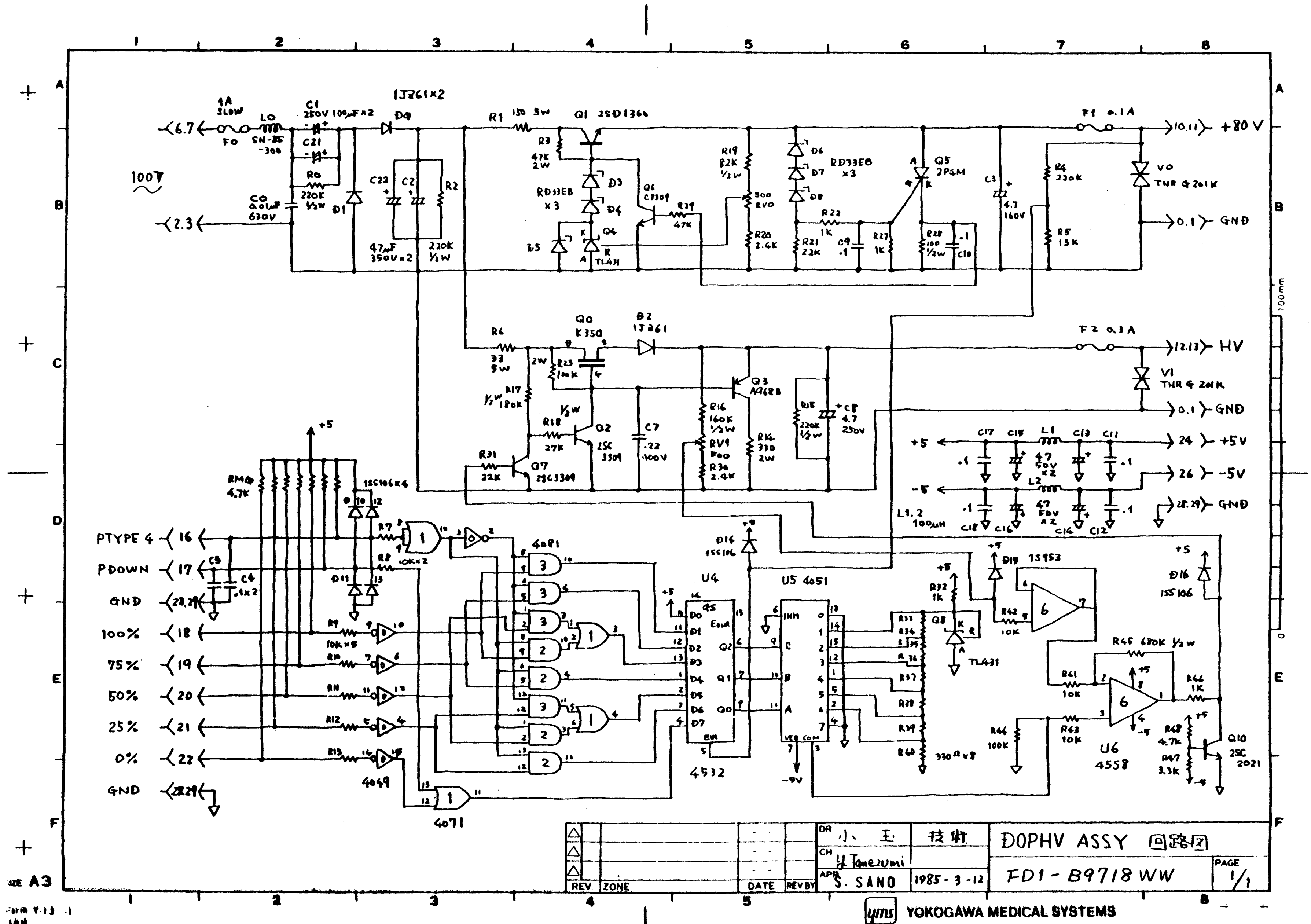
Pin No.	SIGNAL NAME	Pin No.	SIGNAL NAME
0	GND	1	GND
2	GND	3	GND
4	GND	5	GND
6	INZ	7	NC
8	+5V D	9	+5V D
10	+5V D	11	+5V D
12		13	
14	DATA0	15	DATA1
16	DATA2	17	DATA3
18	DATA4	19	DATA5
20	DATA6	21	DATA7
22	ADD 0	23	ADD 1
24	ADD 2	25	ADD 3
26	ADD 4	27	ADD 5
28	ADD 6	29	ADD 7
30	ADD 8	31	ADD 9
32	ADD 10	33	ADD 11
34	ADD 12	35	ADD 13
36	ADD 14	37	ADD 15
38	IO/M	39	ALE
40	RD	41	WR
42	READY	43	CLKOUT
44	RESETOUT	45	S0
46	S1	47	HOLD
48	HLDA	49	TR3
50	TR4	51	TR7
52	SP0	53	SP1
54	HD	55	VD
56	1M CLK	57	F.ZONE0
58	F.ZONE1	59	FREEZE
60		61	
62		63	
64		65	
66		67	
68	GND	69	GND
70	A-DATA0	71	A-DATA1
72	GND	73	GND
74	A-DATA2	75	
76		77	A-DATA5
78	GND	79	GND
80	LB-DATA0	81	LB-DATA1
82	LB-DATA2	83	LB-DATA3
84	LB-DATA4	85	LB-DATA5
86	ADCLK	87	B-DATA0
88	B-DATA1	89	B-DATA2
90	B-DATA3	91	B-DATA4
92	B-DATA5	93	LB-FLT
94	MD0	95	MD1
96	SC0	97	SC1
98		99	

ML

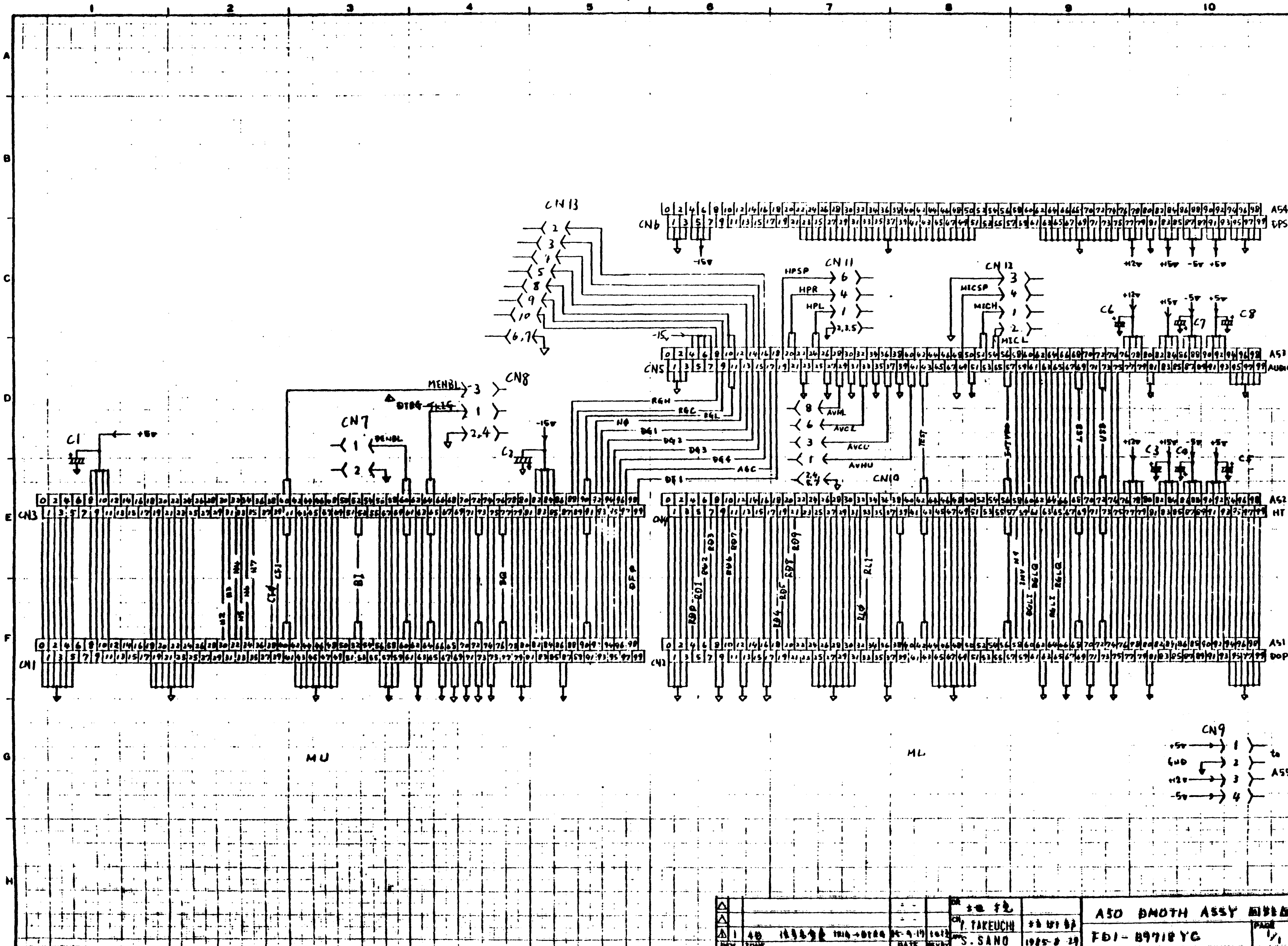
Pin No.	SIGNAL NAME	Pin No.	SIGNAL NAME
0	XW0	1	XW1
2	XW2	3	XW3
4	XW4	5	XW5
6	XW6	7	XW7
8	GND	9	GND
10	R.O.CLK	11	
12	GND	13	GND
14		15	
16	GND	17	GND
18	XW8	19	XW9
20	F1	21	CP1
22	H.RST	23	CP3
24	C.BL	25	
26		27	
28	YW0	29	YW1
30	YW2	31	YW3
32	YW4	33	YW5
34	EXT VDO OUT	35	EXT VDO RTN
36	GND	37	GND
38	+5V	39	+5V
40	CLK240-25	41	CLK240-25
42	GRAY SCALE 7	43	NCP
44	CP3A	45	LS95 ENBL
46		47	
48	FM DATA 0	49	FM DATA 1
50	FM DATA 2	51	FM DATA 3
52	FM DATA 4	53	FM DATA 5
54	GRAY SCALE 0	55	GRAY SCALE 1
56	GRAY SCALE 2	57	GRAY SCALE 3
58	GRAY SCALE 4	59	GRAY SCALE 5
60	GRAY SCALE 6	61	NC
62	12" MON OUT	63	12" MON RTN
64	8" MON OUT	65	8" MON RTN
66	VIDEO OUT 1	67	VIDEO RTN 1
68	VIDEO OUT 2	69	VIDEO RTN 2
70		71	
72	CB LATCH	73	MENB
74	DTRG	75	TRIG
76	ISHTR	77	CAMERA COM.
78	NC	79	NC
80	NC	81	NC
82	+12V	83	+12V
84	+12V	85	+12V
86	-5V	87	-5V
88	-5V	89	-5V
90	+5V A	91	+5V A
92	+5V A	93	+5V A
94	GND	95	GND
96	GND	97	GND
98	GND	99	GND

Pin No.	SIGNAL NAME	Pin No.	SIGNAL NAME

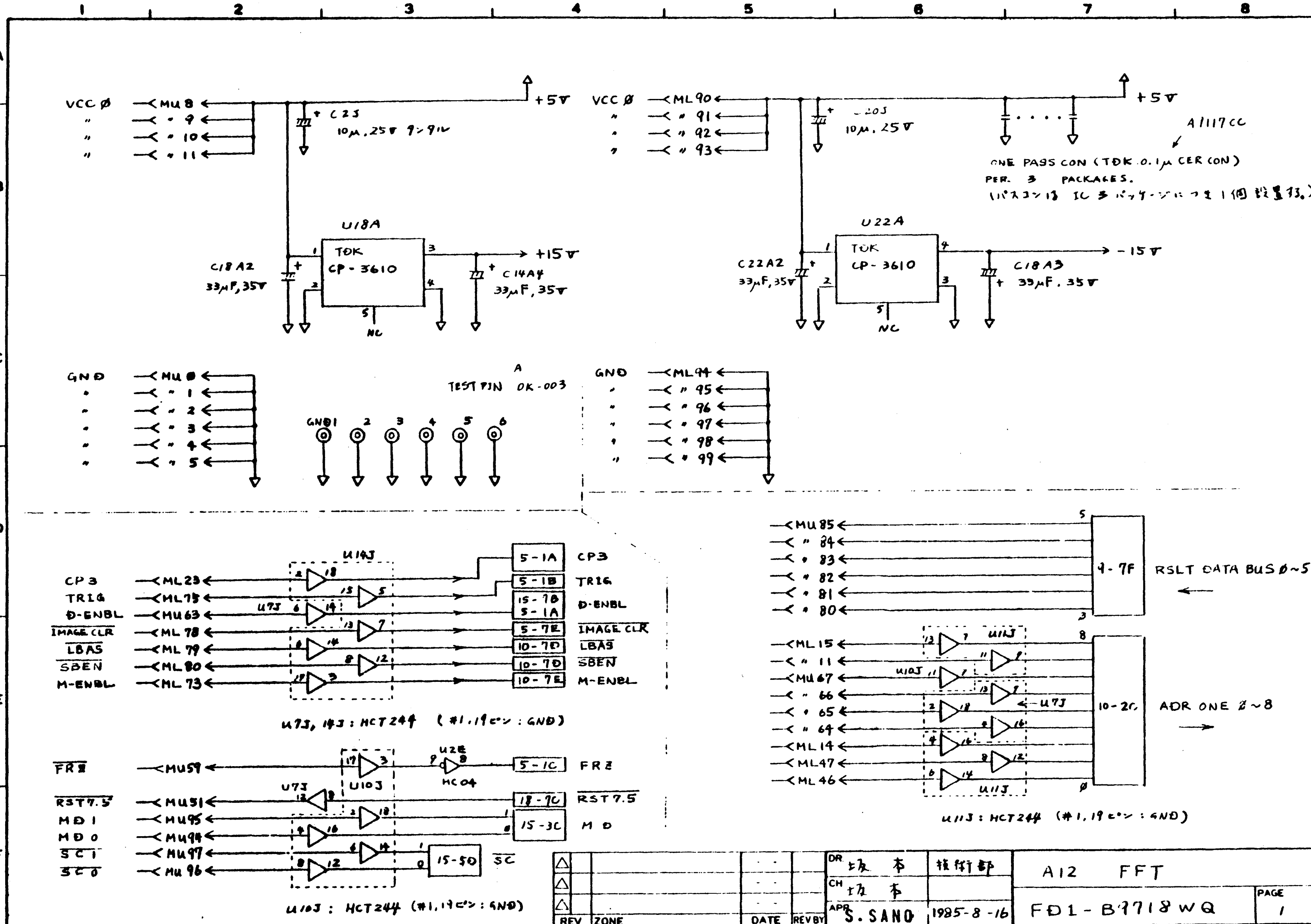
DR Y. HIROTA		A11 · VDO-6	
CH SAK MOTO	ENG.		
APP		EDI-B971	



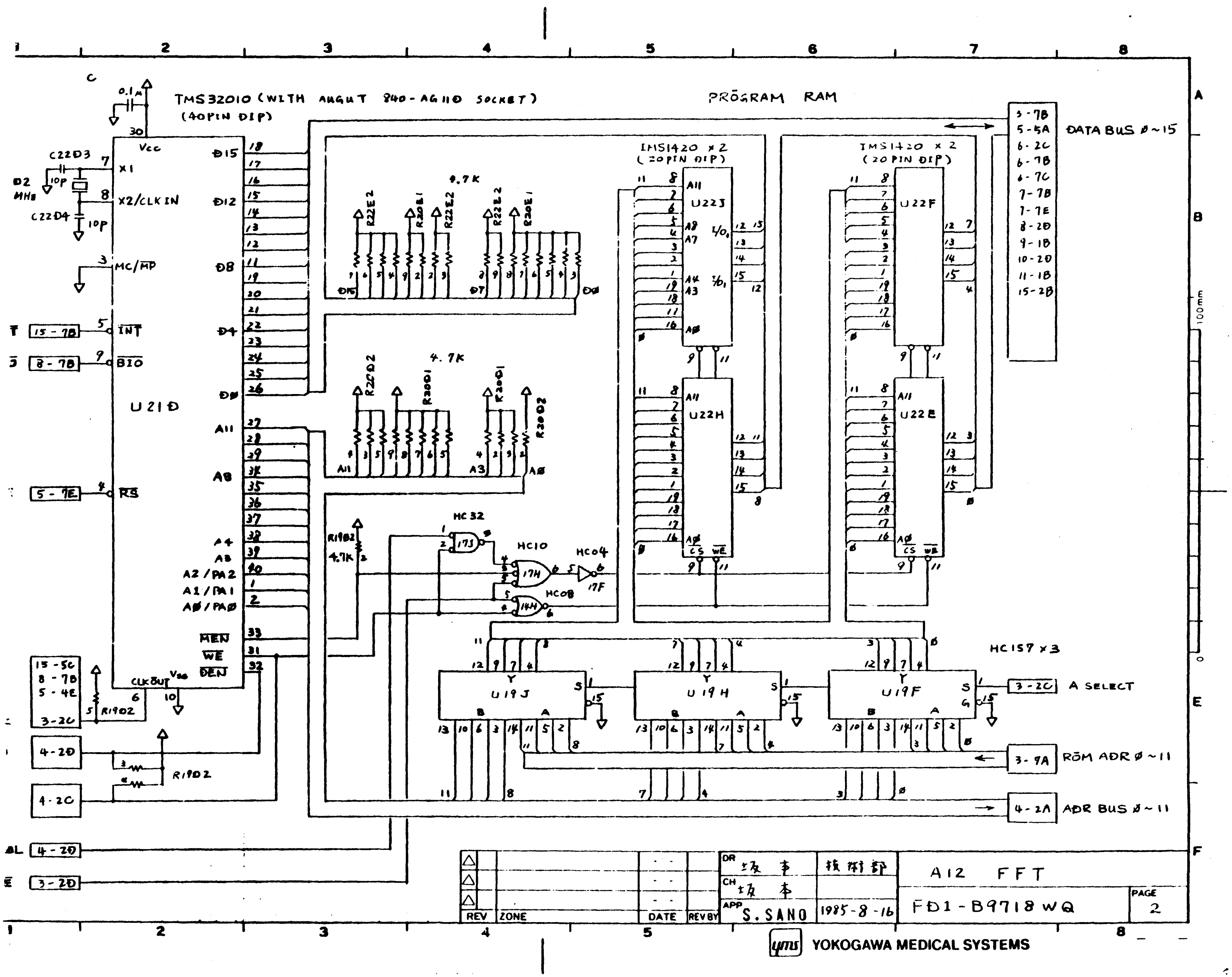
+80V
GND
HV
+5V
-5V
PTYPE 4
PDOWN
GND
100%
75%
50%
25%
0%
100V
U4 4532
U5 4051
U6 4558
4081
4071
4049
DOPHV ASSY 回路図
FD1-B9718WW
PAGE 1/1
1985-3-12
S. SANO
YOKOGAWA MEDICAL SYSTEMS
A3

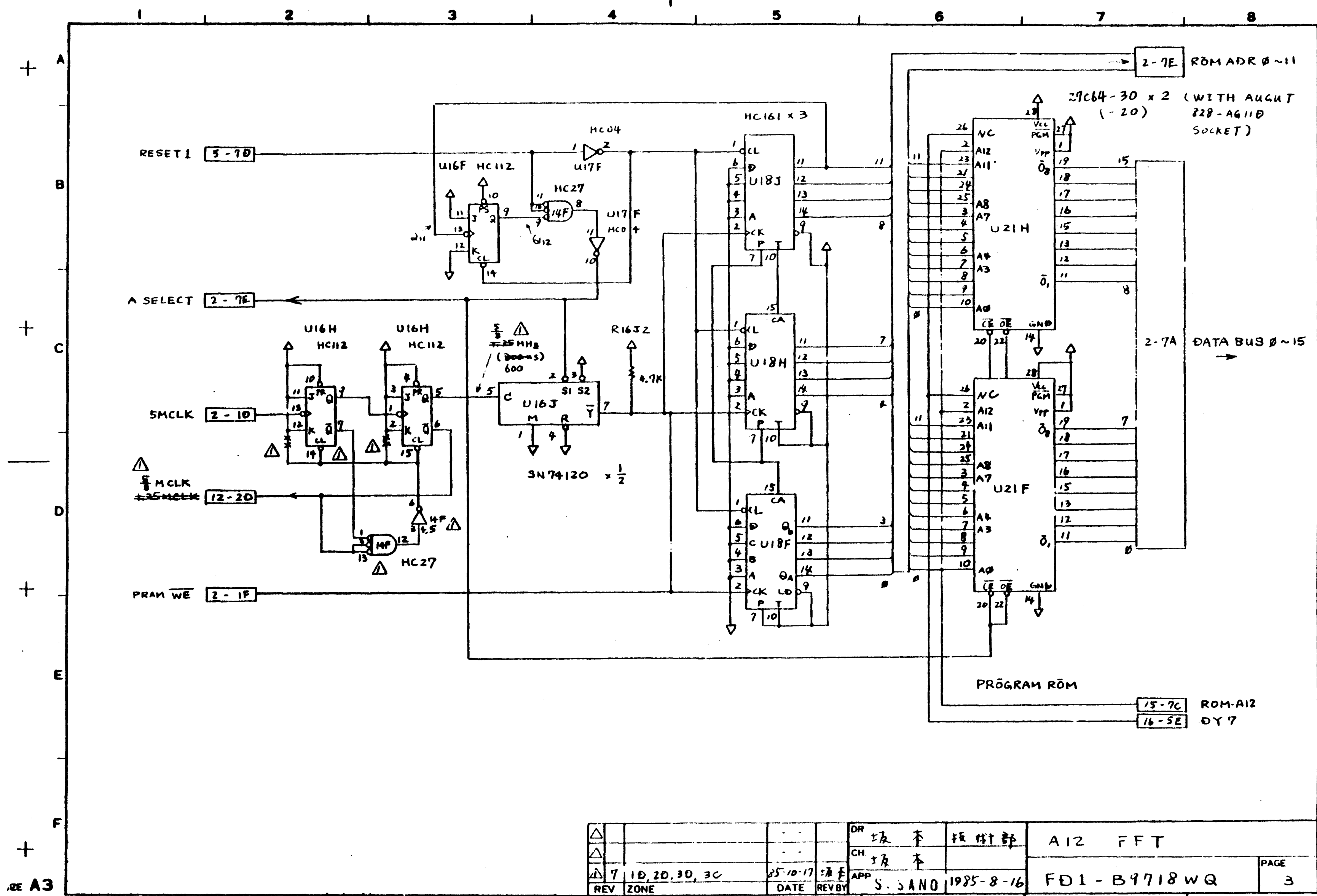


CN13
CN6
A54
DPS
CN11
CN12
CN5
A53
AUDIO
CN8
CN7
CN10
C1
C2
C3
C6
C7
C8
CN3
CN1
CN4
CN2
A52
HT
A51
DOP
MU
ML
CN9
to
A55
A50 BMOTH ASSY
FDI-B9718YG
T. TAKEUCHI
S. SANO
1985-8-29
YOKOGAWA MEDICAL SYSTEMS



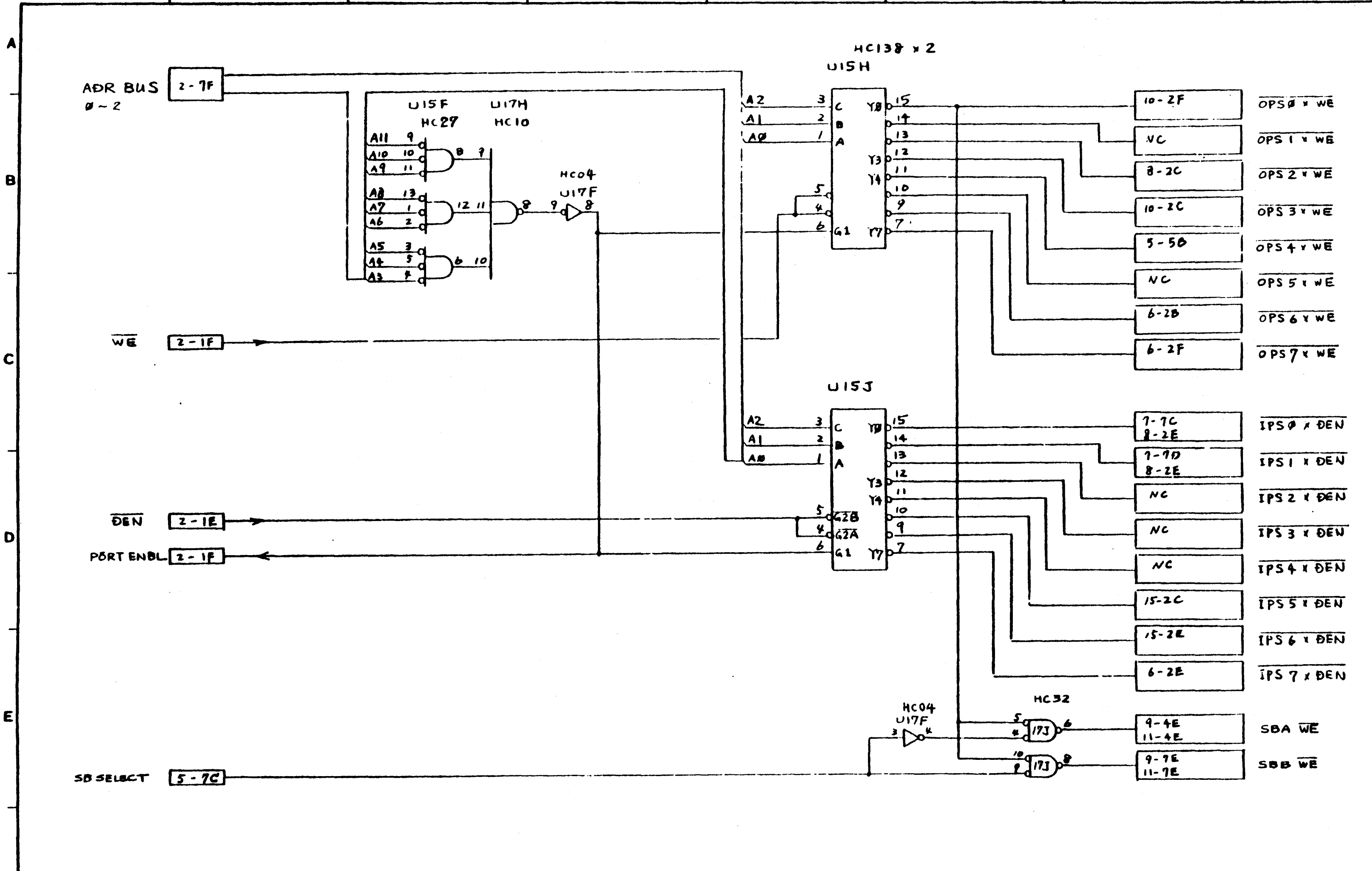
YOKOGAWA MEDICAL SYSTEMS


TMS32010 (WITH AUGUT 840-AG110 SOCKET)
(40PIN DIP)
PROGRAM RAM
DATA BUS Ø~15
TMS1420 x 2
(20PIN DIP)
U21D
U22J
U22H
U22F
U22E
U19J
U19H
U19F
HC157 x3
A SELECT
ROM ADR Ø~11
ADR BUS Ø~11
HC32
HC10
HC04
HC08
4.7K
C22D3
C22D4
10P
0.1μ
Vcc
X1
X2/CLKIN
MC/MP
INT
BIO
RS
CLKOUT
Vss
D15
D12
D8
D4
DØ
A11
A8
A4
A3
A2/PA2
A1/PA1
AØ/PAØ
MEN
WE
DEN
R19D2
R19B2
15-7B
8-7B
5-7E
15-5C
8-7B
5-4E
3-2C
4-2D
4-2C
4-2D
3-2D
3-2C
3-7A
4-2A
3-7B
5-5A
6-2C
6-7B
6-7C
7-7B
7-7E
8-2D
9-1B
10-2D
11-1B
15-2B
REV
ZONE
DATE
REV BY
DR
CH
APP
S. SANO
技術部
1985-8-16
A12 FFT
FD1-B9718WQ
PAGE
2
YOKOGAWA MEDICAL SYSTEMS



YOKOGAWA MEDICAL SYSTEMS

Form Y-13-1



REV	ZONE	DATE	REV BY			
				DR 功本	技術部	A12 FFT
				CH 功本		
				APP S. SANO	1985-8-16	FD1 - B9718WQ

PAGE 4

YMS YOKOGAWA MEDICAL SYSTEMS

SIZE A3

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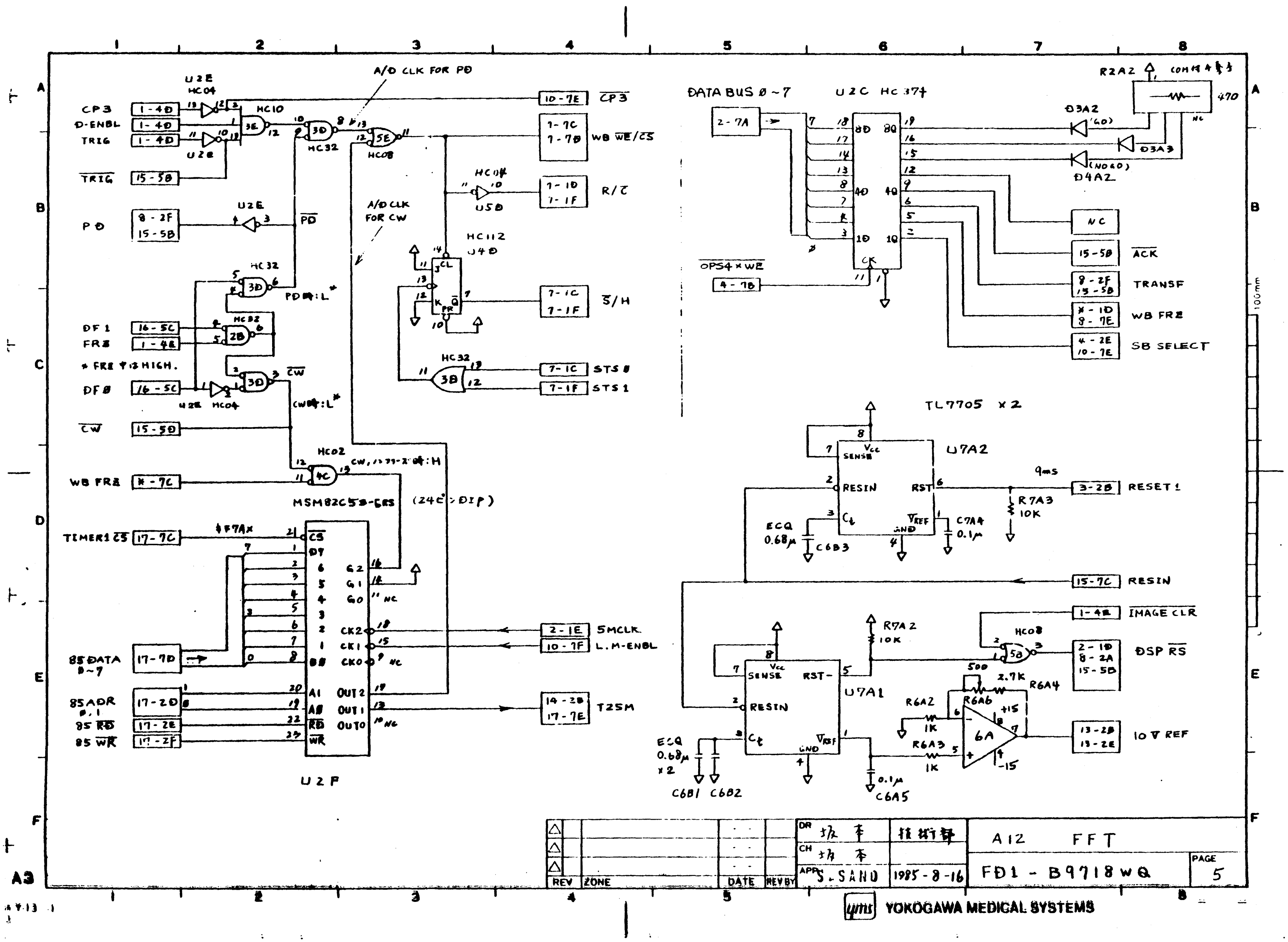
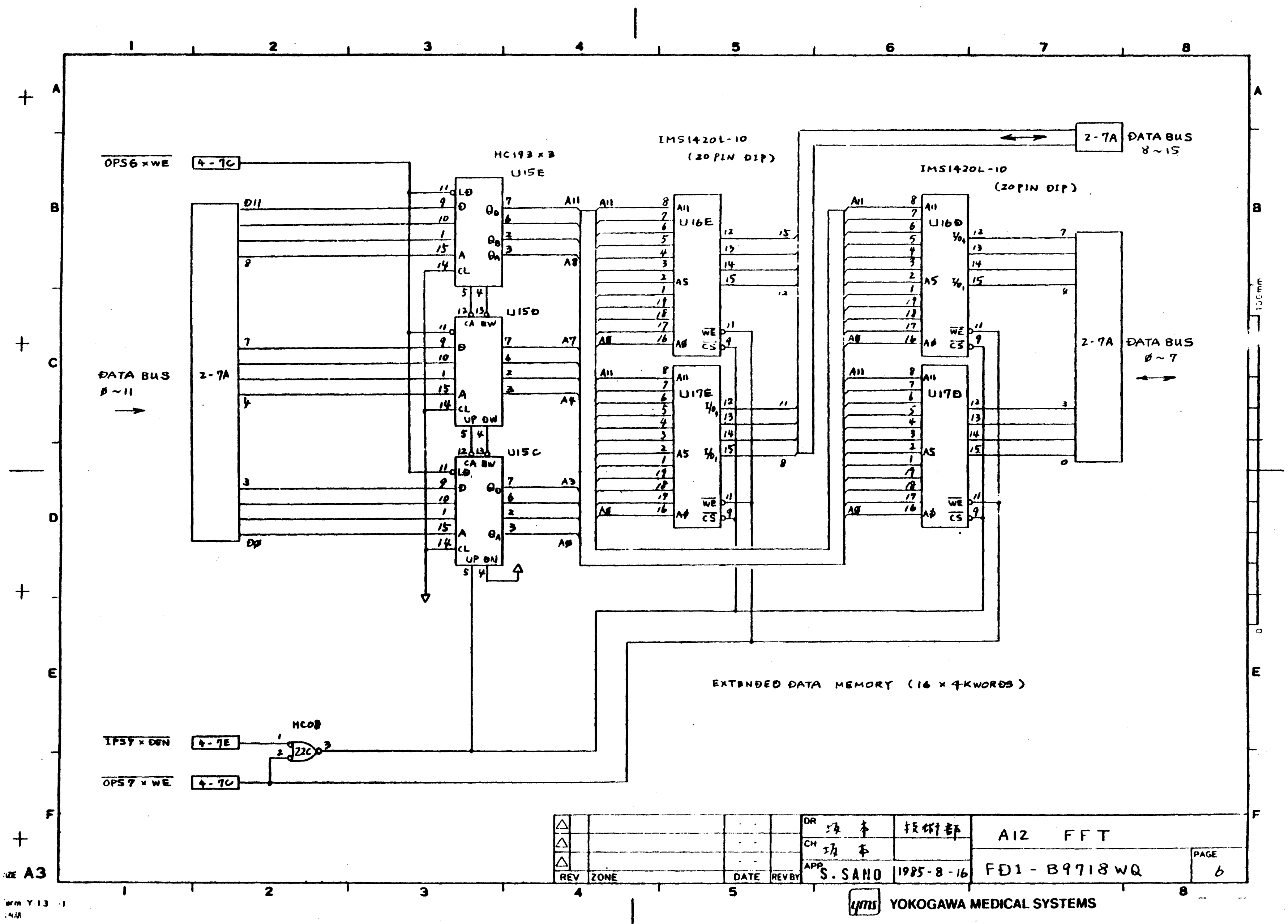
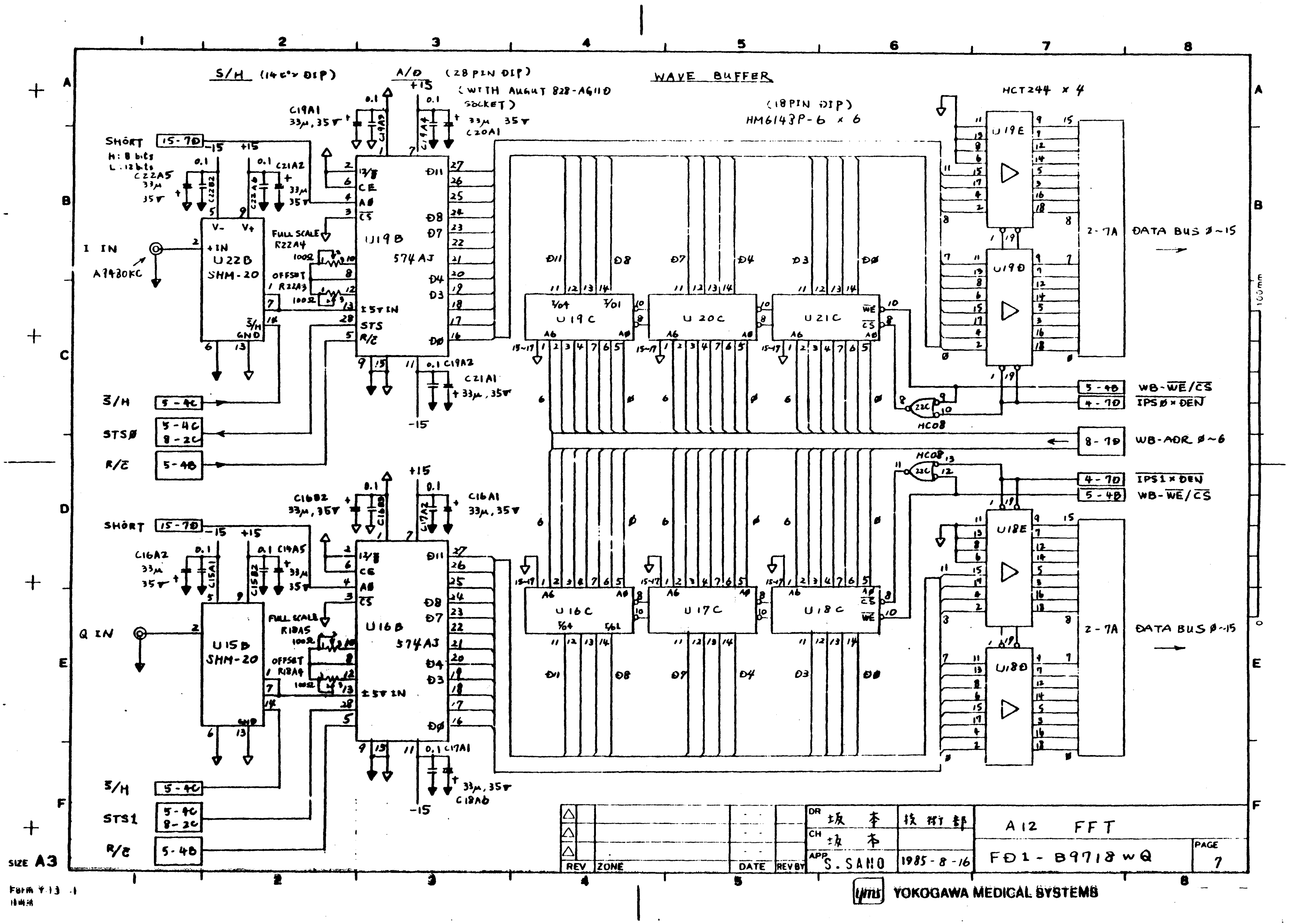
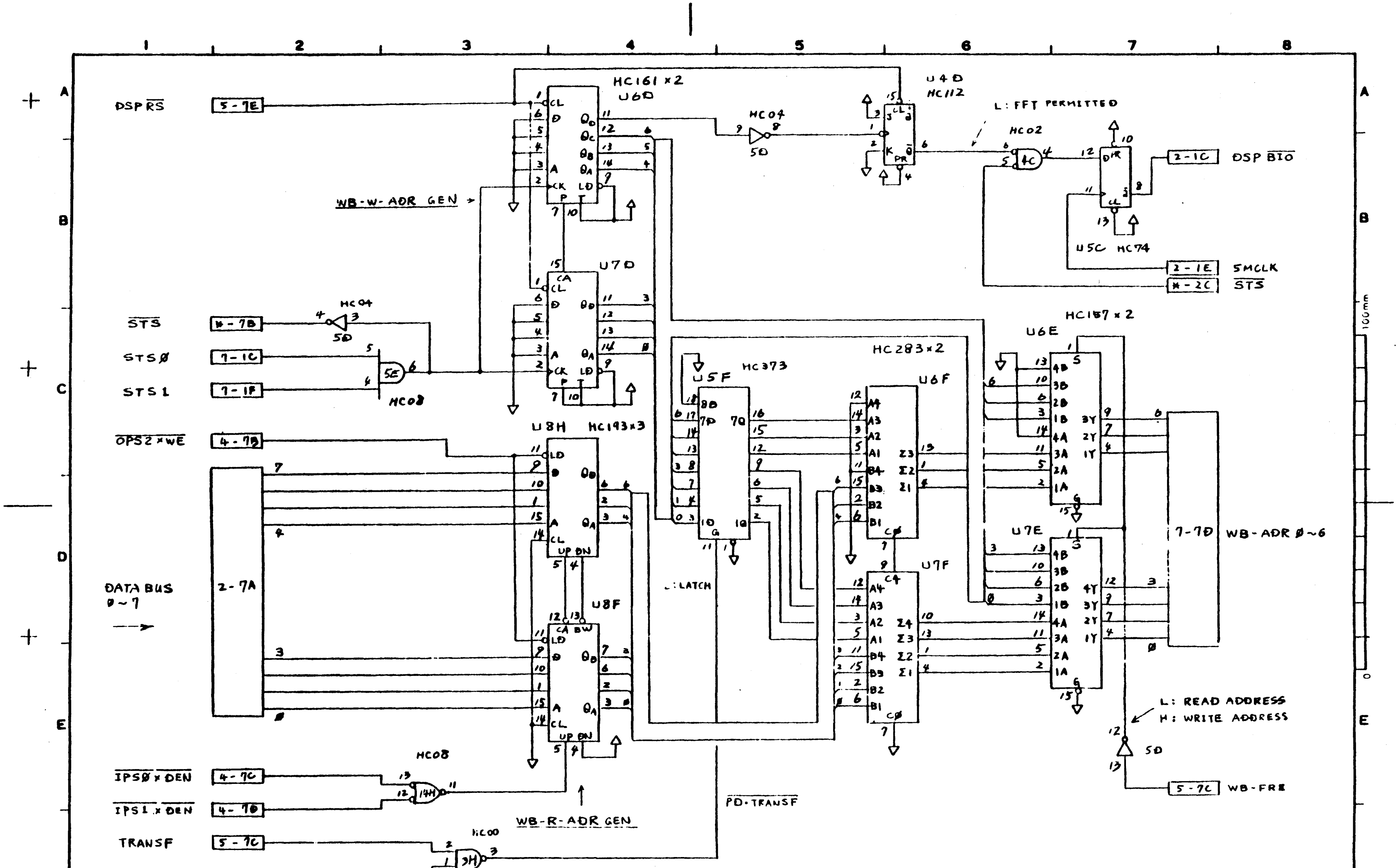

A12 FFT
FD1 - B9718WQ
PAGE 5
1985-8-16
S. SANO
YOKOGAWA MEDICAL SYSTEMS
U2C HC374
DATA BUS 0~7
TL7705 x2
U7A2
U7A1
MSM82C53-5RS
U2F
CP3
D-ENBL
TRIG
PD
DF1
DF0
CW
WB FRZ
TIMER1 CS
85DATA
85ADR
RESET1
RESIN
IMAGE CLR
DSP RS
10V REF
ACK
TRANSF
SB SELECT
S/H
STS0
STS1
5MCLK
L.M-ENBL
T25M
A/D CLK FOR PD
A/D CLK FOR CW

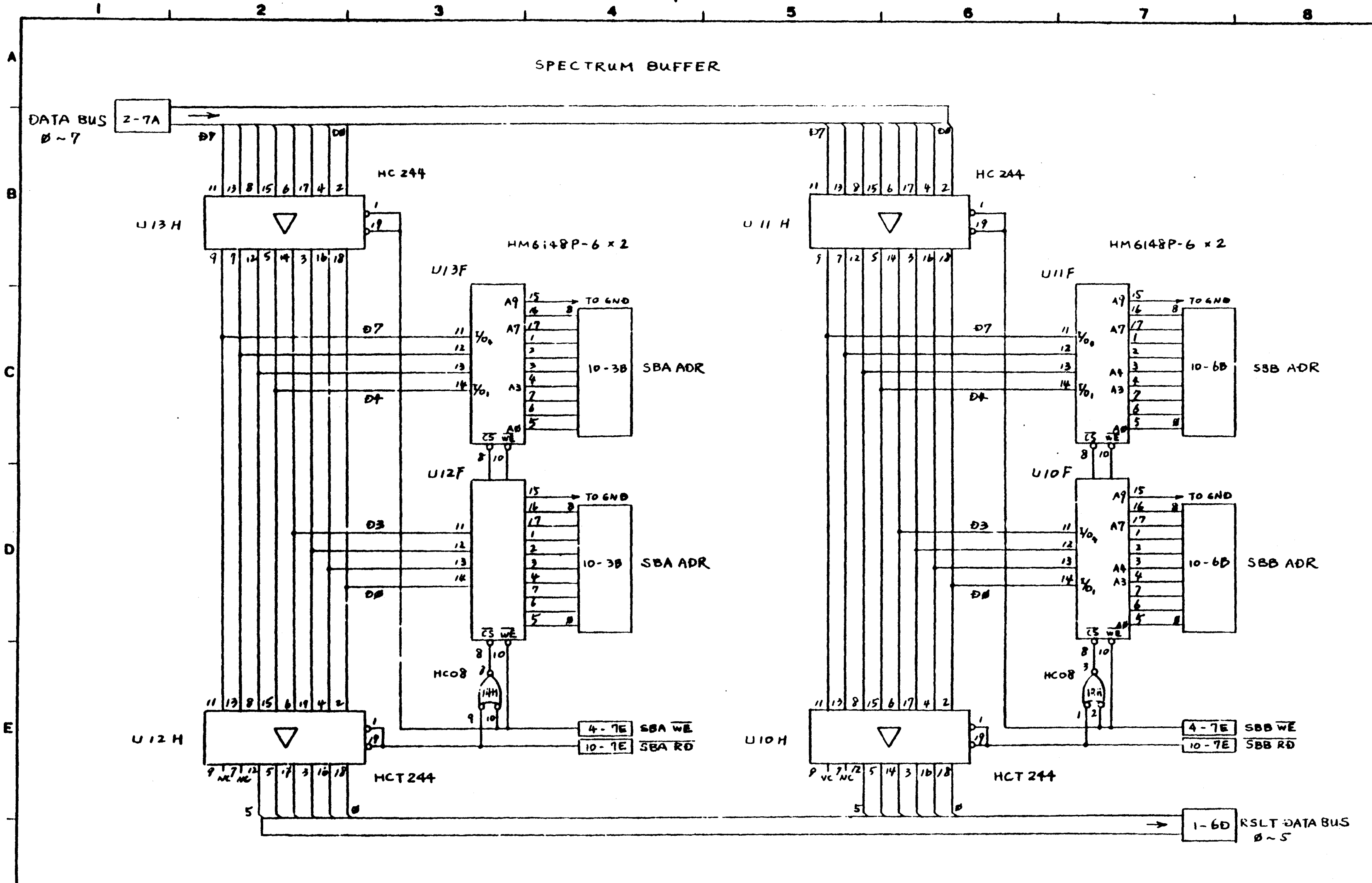

OPS6 x WE
4-7C
HC193 x 3
U15E
U15D
U15C
DATA BUS
∅ ~ 11
2-7A
IMS1420L-10
(20 PIN DIP)
U16E
U17E
U16D
U17D
2-7A
DATA BUS
8 ~ 15
DATA BUS
∅ ~ 7
EXTENDED DATA MEMORY (16 x 4K WORDS)
HC08
IPS7 x DEN
4-7E
OPS7 x WE
A12 FFT
FD1 - B9718 WQ
PAGE 6
S. SANO
1985-8-16
YOKOGAWA MEDICAL SYSTEMS
A3


S/H (14ピン DIP)
A/D (28 PIN DIP) (WITH AUGAT 828-AG11D SOCKET)
WAVE BUFFER
(18 PIN DIP) HM6143P-6 x 6
HCT244 x 4
SHORT
H: 8 bits
L: 12 bits
I IN
A7480KC
U22B
SHM-20
U19B
574AJ
FULL SCALE R22A4
OFFSET R22A3
U19C
U20C
U21C
U19E
U19D
2-7A
DATA BUS Ø~15
S/H
STSØ
R/C
WB-WE/CS
IPSØ x DEN
WB-ADR Ø~6
IPS1 x DEN
HC08
Q IN
U15B
SHM-20
U16B
574AJ
FULL SCALE R18A5
OFFSET R18A4
U16C
U17C
U18C
U18E
U18D
STS1
C19A1 33μ, 35V
C20A1
C21A1
C21A2
C22A5
C16B2
C16A1
C16A2
C14A5
C17A1
C18A6
+15
-15
5-4C
8-2C
5-4B
15-7D
4-7D
8-7D
A12 FFT
FD1-B9718WQ
PAGE 7
1985-8-16
S. SANO
坂本
技術部
DR
CH
APP
REV
ZONE
DATE
REV BY
SIZE A3
YOKOGAWA MEDICAL SYSTEMS



REV	ZONE	DATE	REV BY		
DR	坂本	技術部	A12 FFT		
CH	坂本		FD1-B9718WQ	PAGE	8
APP	S. SAHO	1985-8-16			

YOKOGAWA MEDICAL SYSTEMS



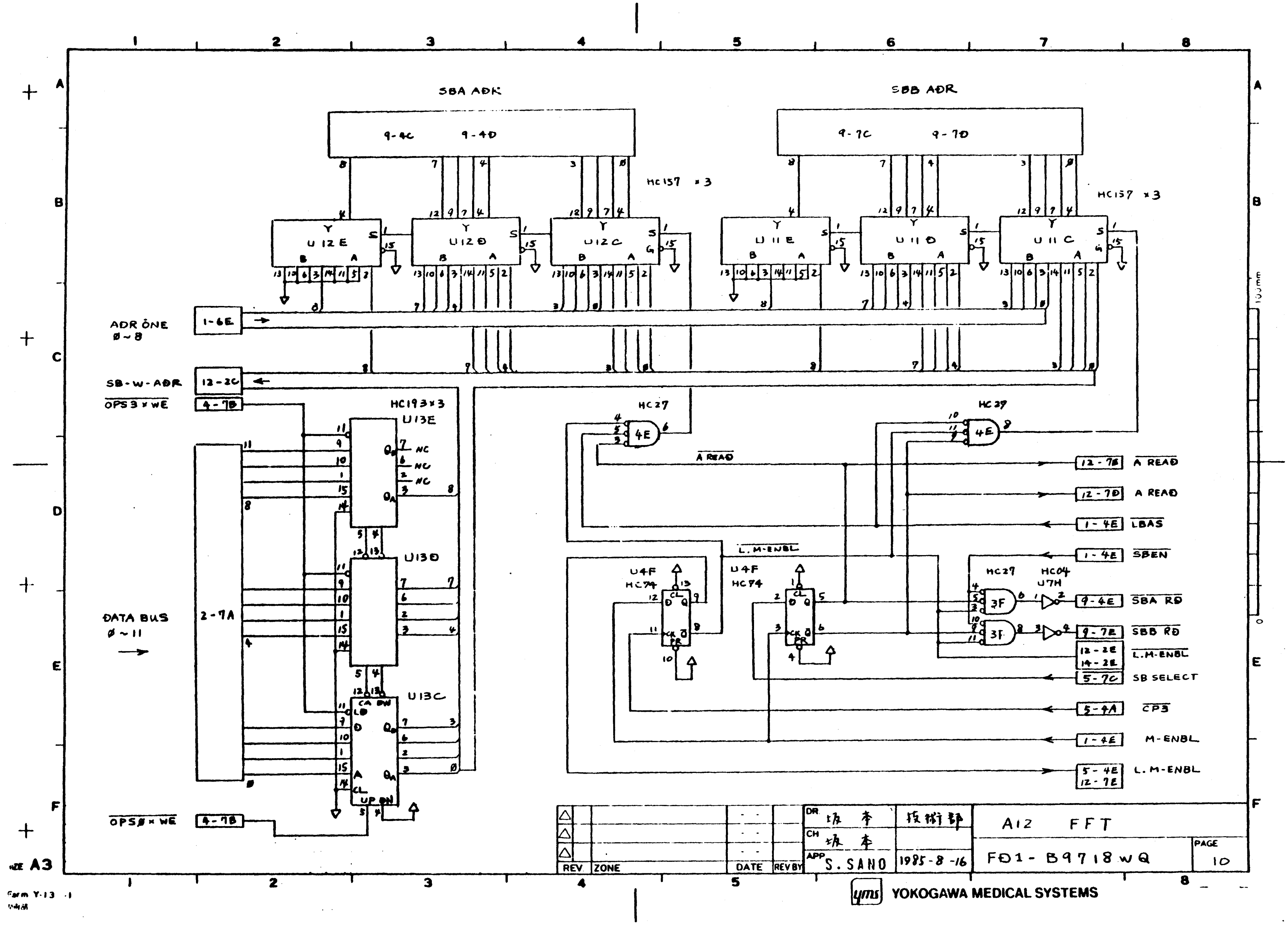
DR	坂本	技術部	A12 FFT
CH	坂本		
APP	S. SANO	1985-8-16	FD1-B9718WQ

PAGE 7

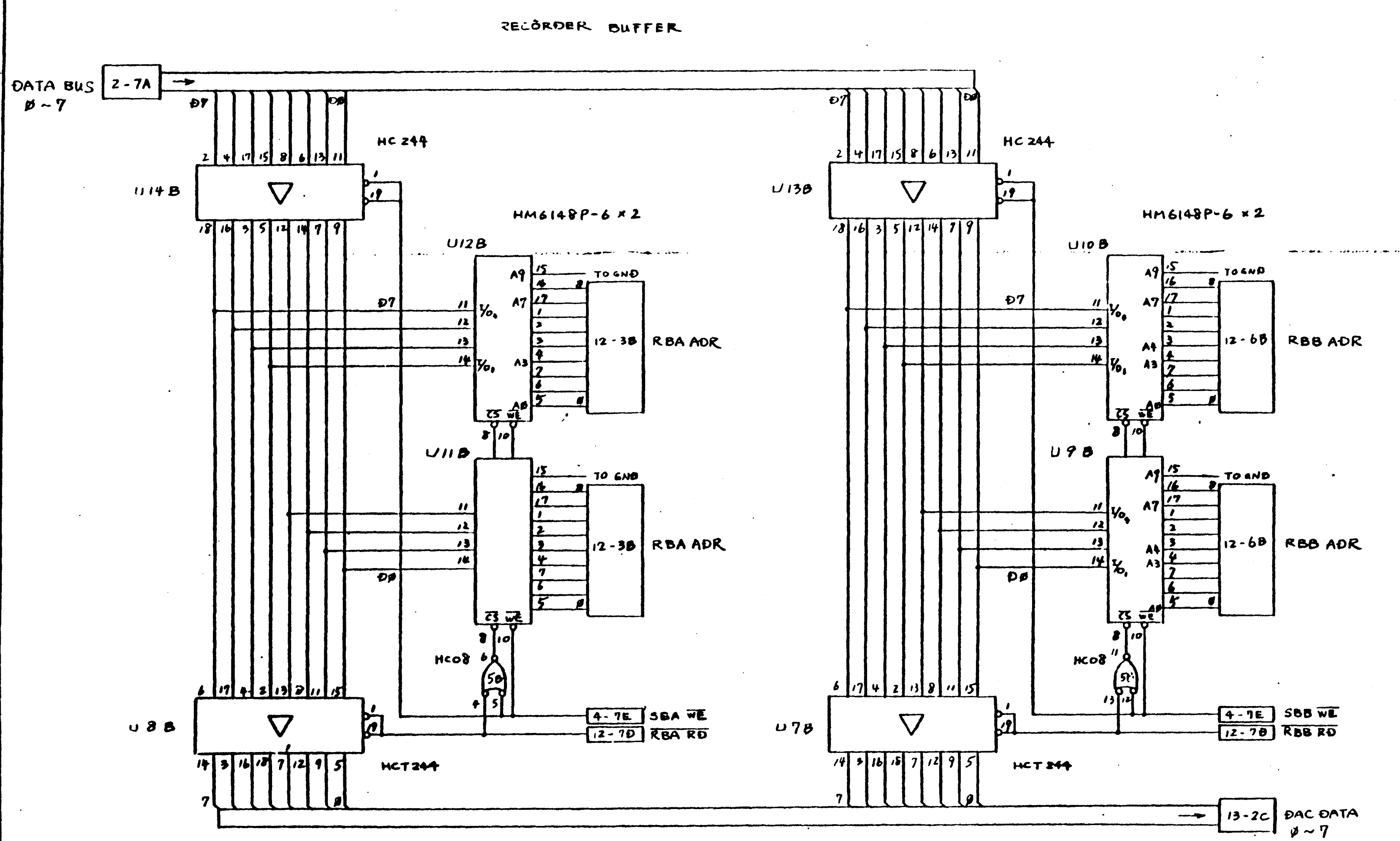
SIZE A3

Form Y-13-1 H4A

YOKOGAWA MEDICAL SYSTEMS



SBA ADR
9-4C 9-4D
SBB ADR
9-7C 9-7D
HC157 ×3
U12E
U12D
U12C
U11E
U11D
U11C
ADR ONE Ø~8
1-6E
SB-W-ADR
12-2C
OPS3 × WE
4-7B
HC193×3
U13E
U13D
U13C
DATA BUS Ø~11
2-7A
OPSØ × WE
4-7B
HC27
4E
A READ
U4F HC74
L.M-ENBL
HC04 U7H
3F
12-7E A READ
12-7D A READ
1-4E LBAS
1-4E SBEN
9-4E SBA RD
9-7E SBB RD
12-2E 14-2E L.M-ENBL
5-7C SB SELECT
5-4A CP3
1-4E M-ENBL
5-4E 12-7E L.M-ENBL
REV ZONE DATE REV BY
DR 坂本
CH 坂本
APP S. SANO
技術部
1985-8-16
A12 FFT
FD1-B9718WQ
PAGE 10
YOKOGAWA MEDICAL SYSTEMS
A3



REV.	ZONE	DATE	REV BY				
DR	坂本	技術部	A12 FFT				
CH	坂本						
APP	S. SANO	1985-8-16	FD1-B9718 WQ	PAGE 11			

A3

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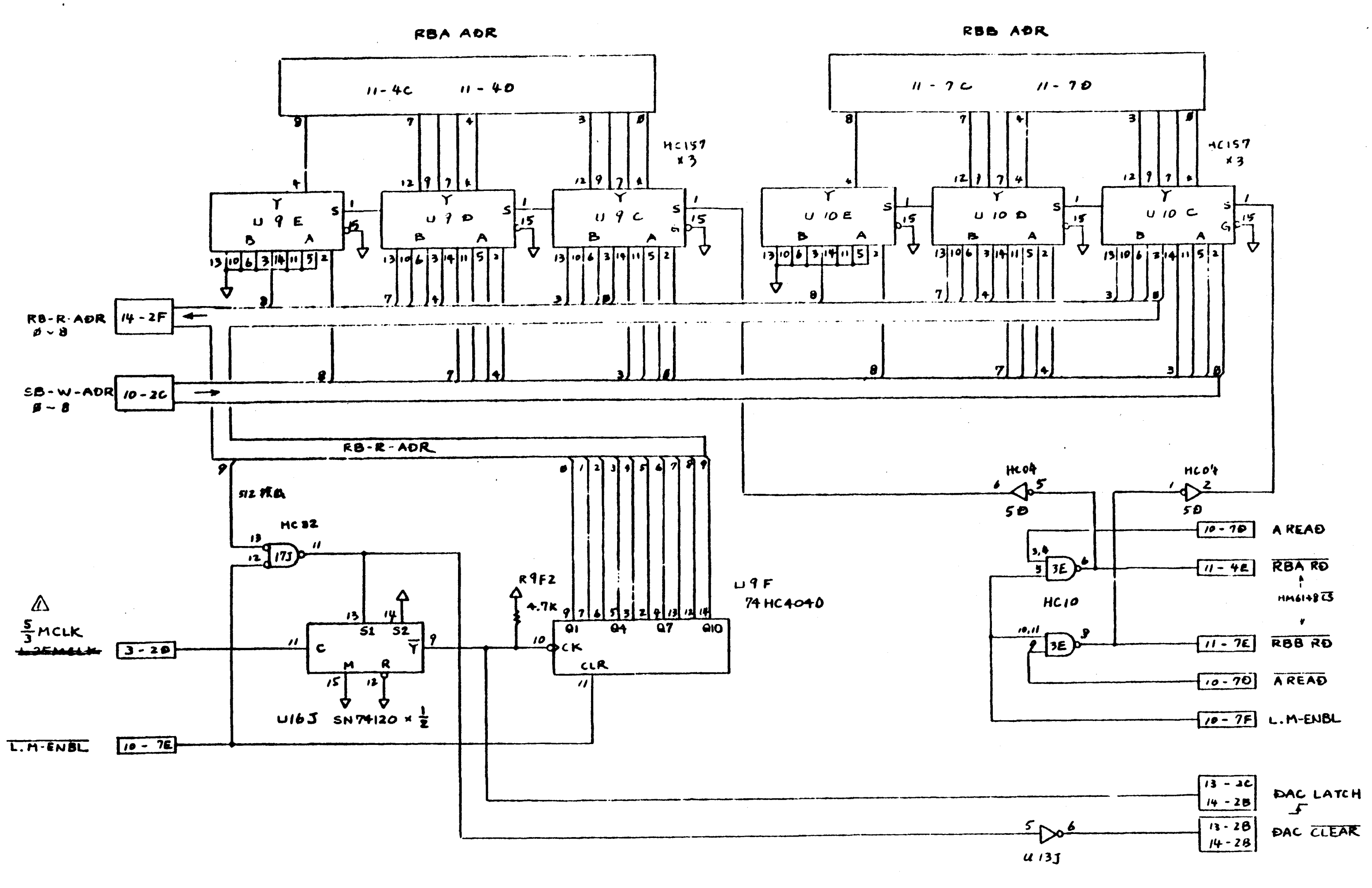
YOKOGAWA MEDICAL SYSTEMS



REV	ZONE	DATE	REV BY			
1	10	85-10-17	坂本	DR 坂本	技術部	A12 FFT
				CH 坂本		
				APP S. SANO	1985-8-16	FD1 - B9718WQ

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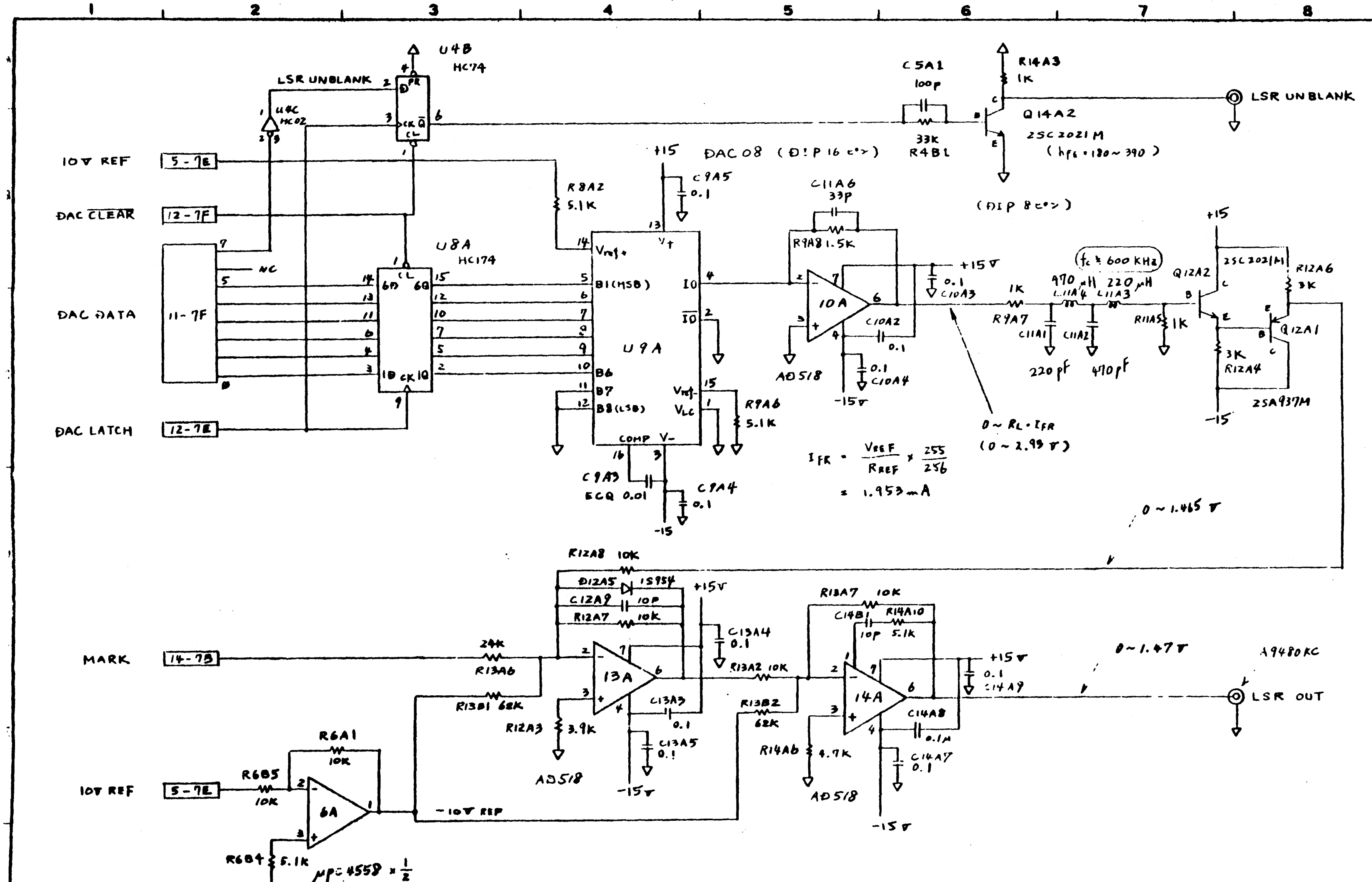
SIZE A3

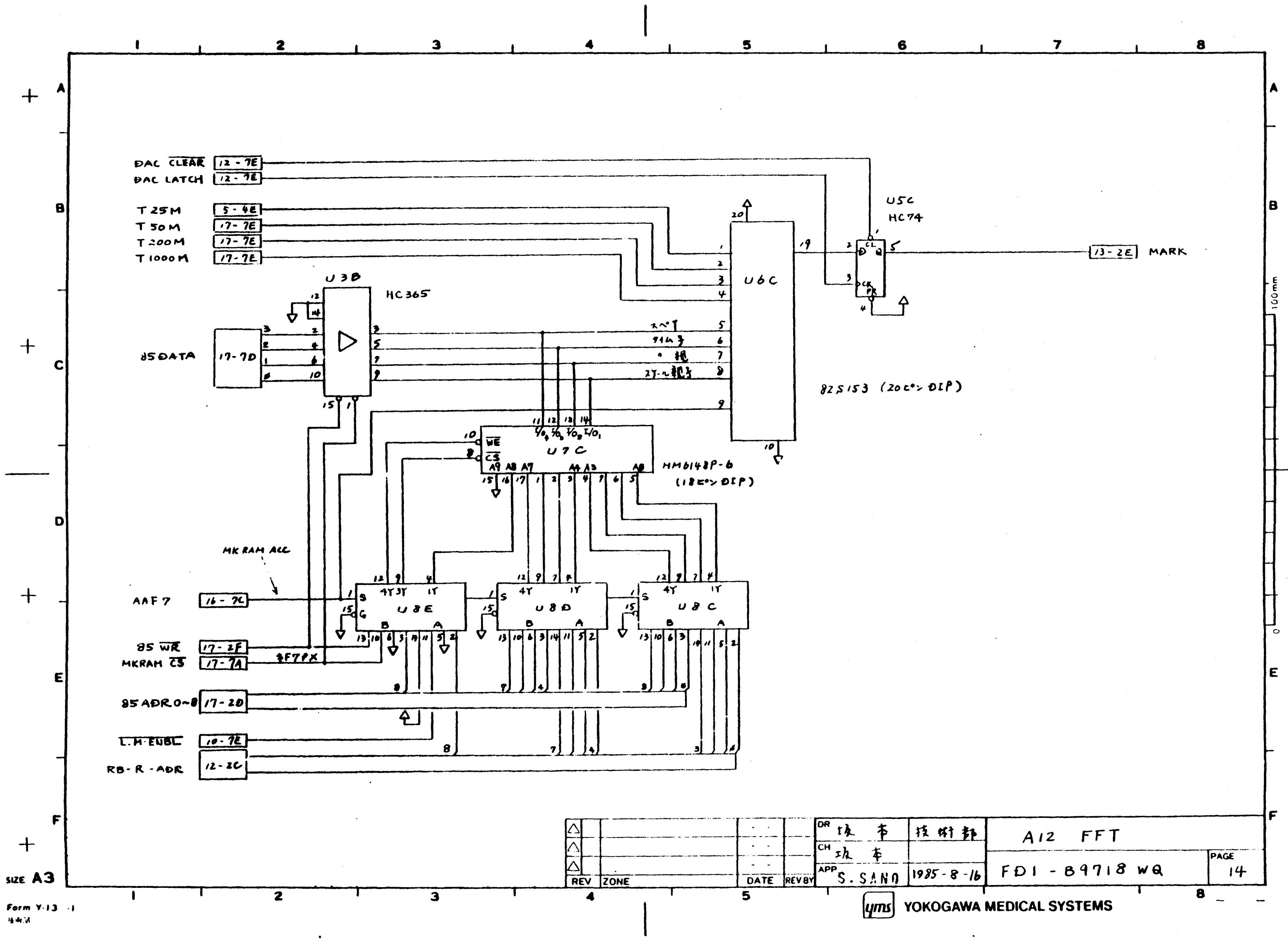
Form Y-13-1

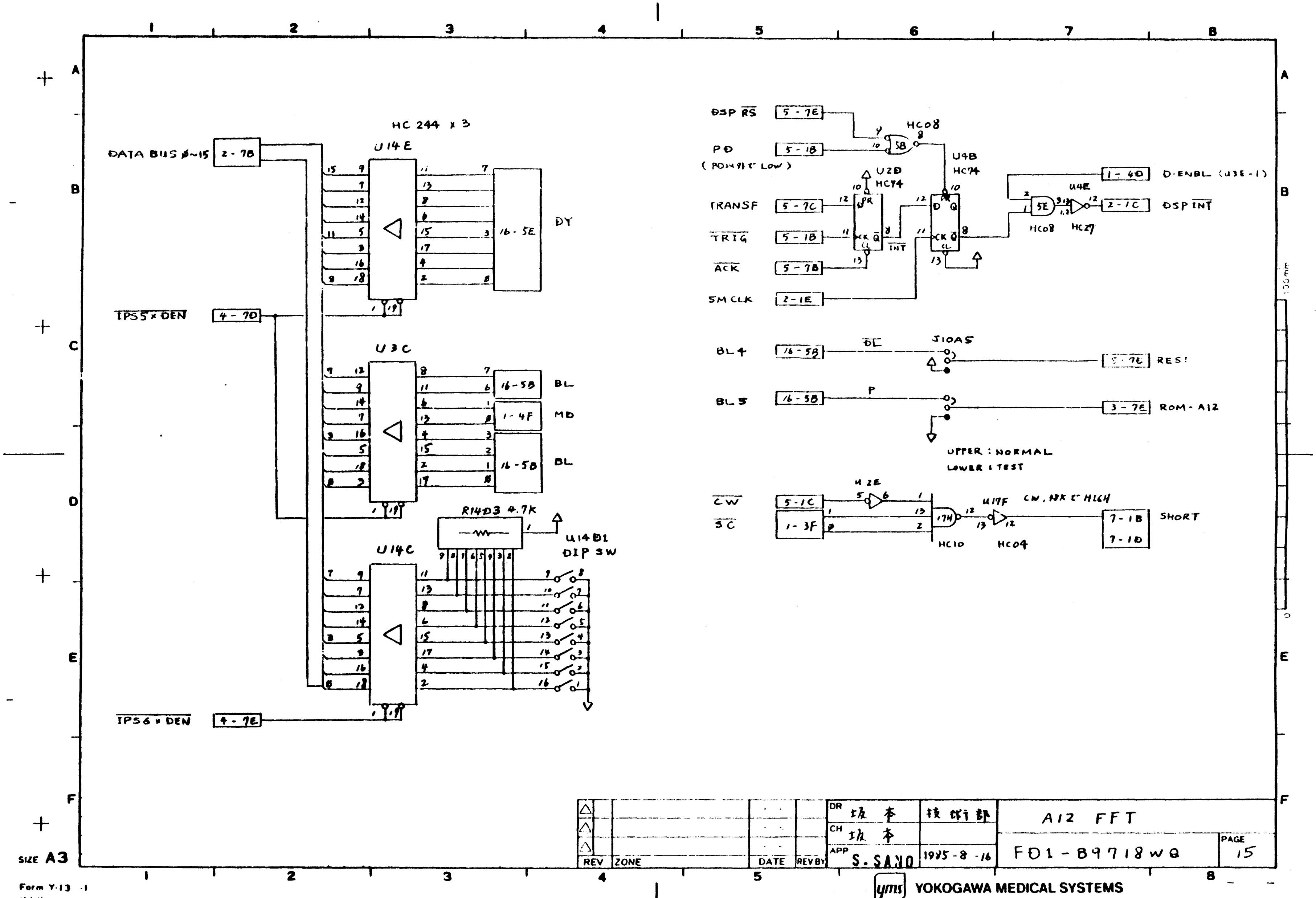
YOKOGAWA MEDICAL SYSTEMS



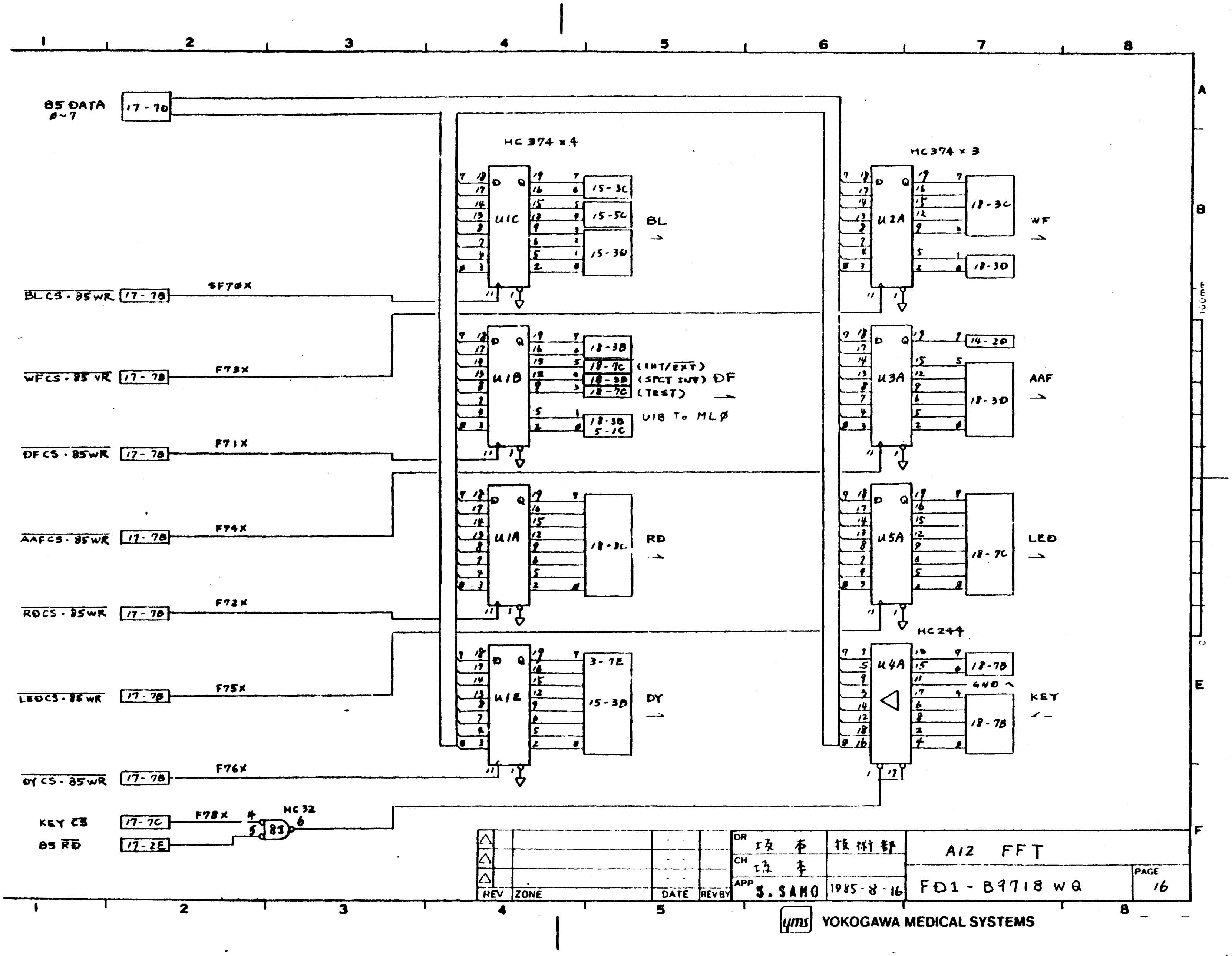
REV	ZONE	DATE	REVBY	DR 功本 / CH 功本 / APP S. SANO	技術部 / 1985-8-16	A12 FFT / FD1 - B9718WQ	PAGE 13

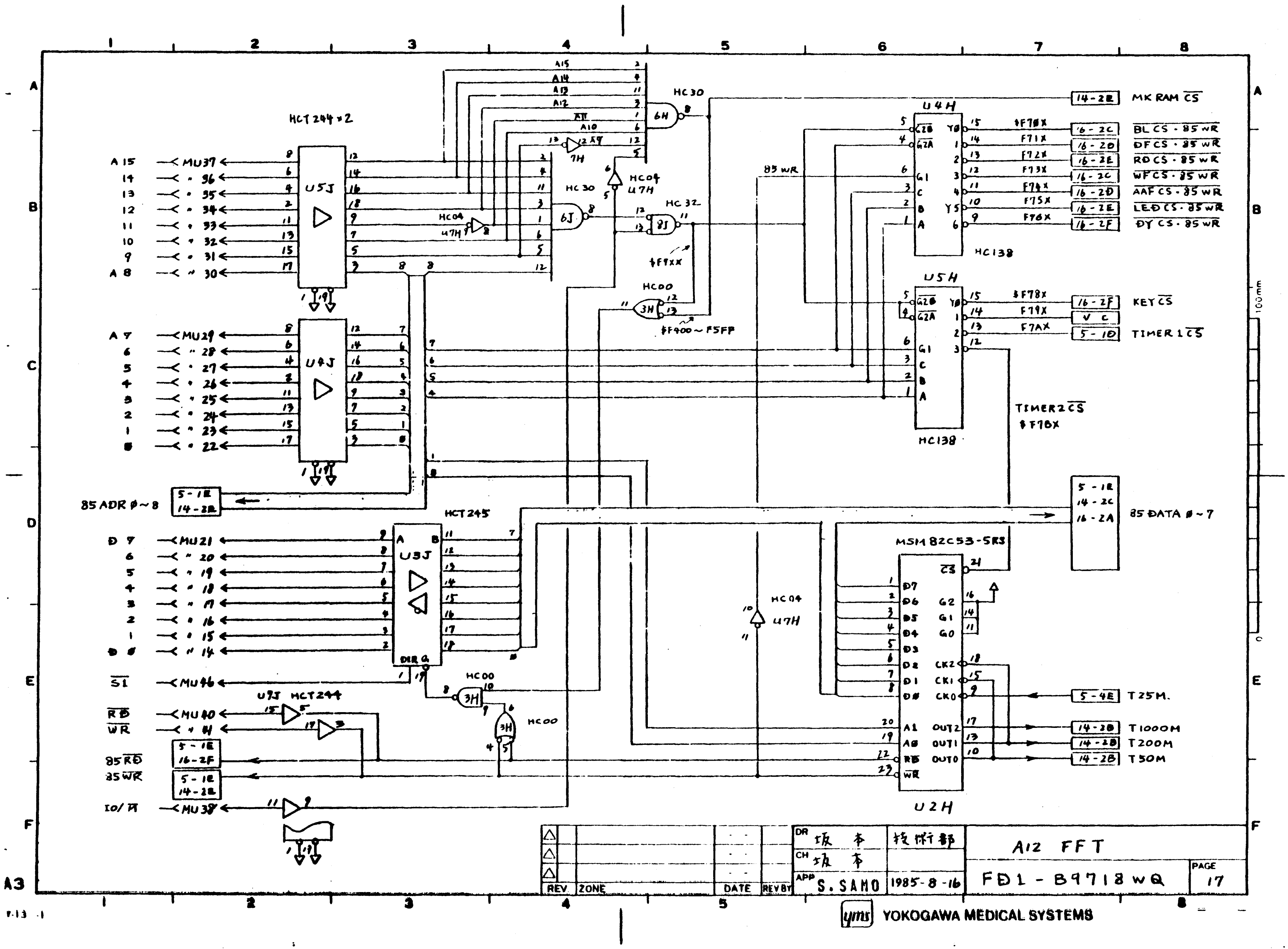
YOKOGAWA MEDICAL SYSTEMS

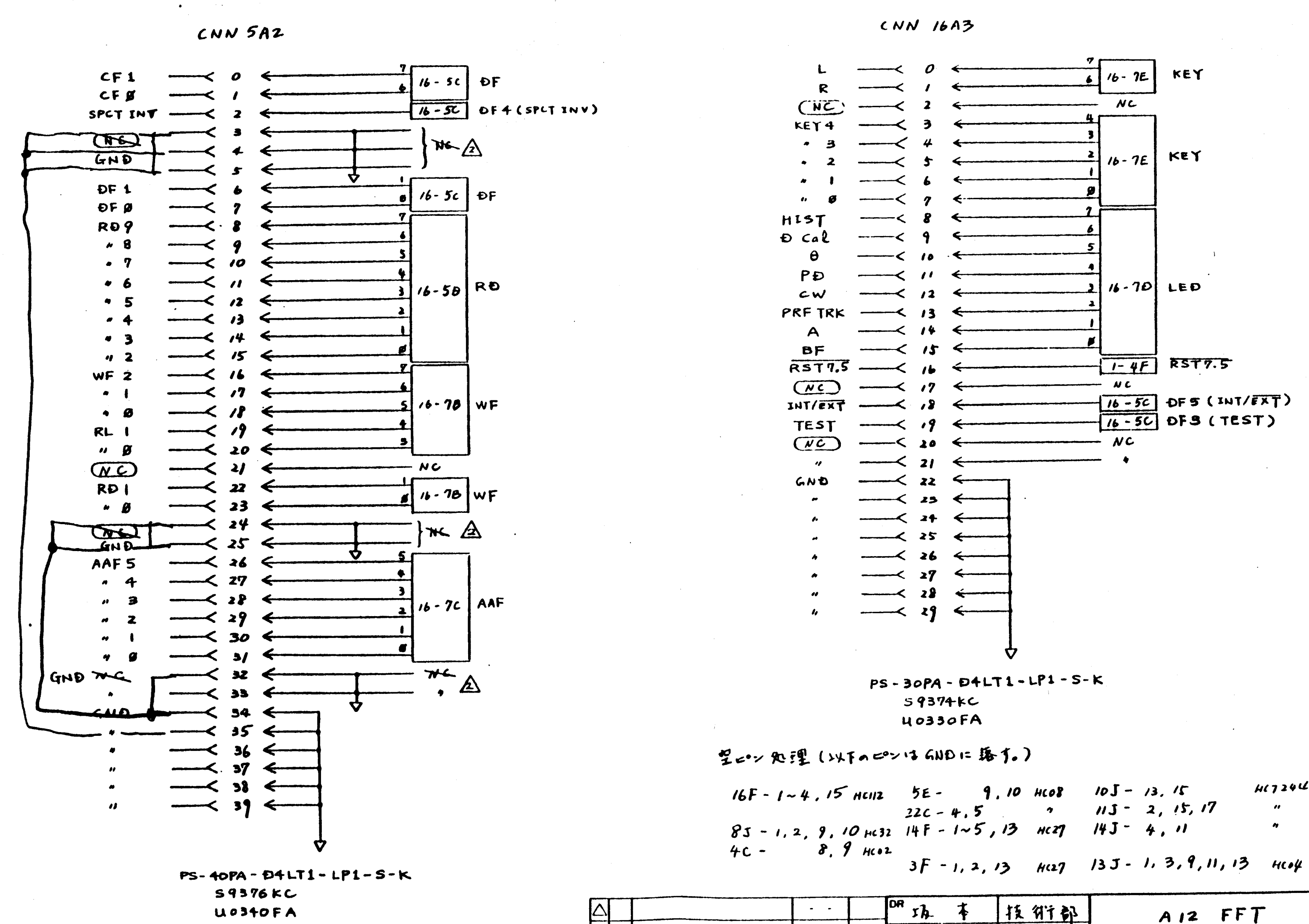

DAC CLEAR
DAC LATCH
T 25M
T 50M
T 200M
T 1000M
85DATA
U3B
HC365
U6C
82S153 (20ピン DIP)
U5C
HC74
MARK
U7C
HM6148P-6 (18ピン DIP)
MK RAM ACC
AAF 7
85 WR
MKRAM CS
85ADR0~8
L.H.ENBL
RB-R-ADR
U8E
U8D
U8C
A12 FFT
FD1-B9718 WQ
PAGE 14
S. SANO
1985-8-16
技術部
SIZE A3
YOKOGAWA MEDICAL SYSTEMS



YOKOGAWA MEDICAL SYSTEMS


85 DATA
Ø~7
BLCS·85WR
WFCS·85WR
DFCS·85WR
AAFCS·85WR
RDCS·85WR
LEDCS·85WR
DYCS·85WR
KEY CS
85 RD
$F7ØX
F73X
F71X
F74X
F72X
F75X
F76X
F78X
HC32
HC 374 x 4
HC374 x 3
HC244
U1C
U1B
U1A
U1E
U2A
U3A
U5A
U4A
BL
DF
(INT/EXT)
(SPCT INV)
(TEST)
U1B To MLØ
RD
DY
WF
AAF
LED
KEY
GND
A12 FFT
FD1 - B9718 WQ
PAGE 16
S. SANO
1985-8-16
技術部
REV
ZONE
DATE
REVBY
DR
CH
APP
YOKOGAWA MEDICAL SYSTEMS


HCT 244 ×2
U5J
U4J
HCT 245
U3J
HC30
HC32
HC04
47H
HC00
3H
6H
6J
8J
7H
U4H
U5H
HC138
MSM 82C53-5RS
U2H
A 15
A 8
A 7
MU37
MU30
MU29
MU22
85 ADR ∅~8
D 7
MU21
MU14
$\overline{S1}$
MU46
$\overline{RD}$
$\overline{WR}$
MU40
MU41
U9J HCT244
85$\overline{RD}$
85$\overline{WR}$
IO/M
MU38
85 WR
$F400~F5FF
$F7XX
MK RAM $\overline{CS}$
BL CS · 85 WR
DF CS · 85 WR
RO CS · 85 WR
WF CS · 85 WR
AAF CS · 85 WR
LED CS · 85 WR
DY CS · 85 WR
KEY $\overline{CS}$
TIMER 1 $\overline{CS}$
TIMER 2 $\overline{CS}$
$F7BX
85 DATA ∅~7
T25M.
T1000M
T200M
T50M
REV
ZONE
DATE
REV BY
DR 坂本
CH 坂本
技術部
APP S. SAMO
1985-8-16
A12 FFT
FD1-B9718WQ
PAGE 17
A3
YOKOGAWA MEDICAL SYSTEMS



空ピン処理（以下のピンはGNDに落す。）

16F - 1~4, 15 HC112　5E - 9, 10 HC08　10J - 13, 15 HC7244
22C - 4, 5 "　11J - 2, 15, 17 "
8J - 1, 2, 9, 10 HC32　14F - 1~5, 13 HC27　14J - 4, 11 "
4C - 8, 9 HC02
3F - 1, 2, 13 HC27　13J - 1, 3, 9, 11, 13 HC04

REV	ZONE		DATE	REV BY
△			- -	
△			- -	
△3	3B, 3D, 2E	GND 追加	85-11-15	西村

DR 坂本　技術部
CH 坂本
APP S. SANO　1985-8-16

A12 FFT

FD1-B9718WQ

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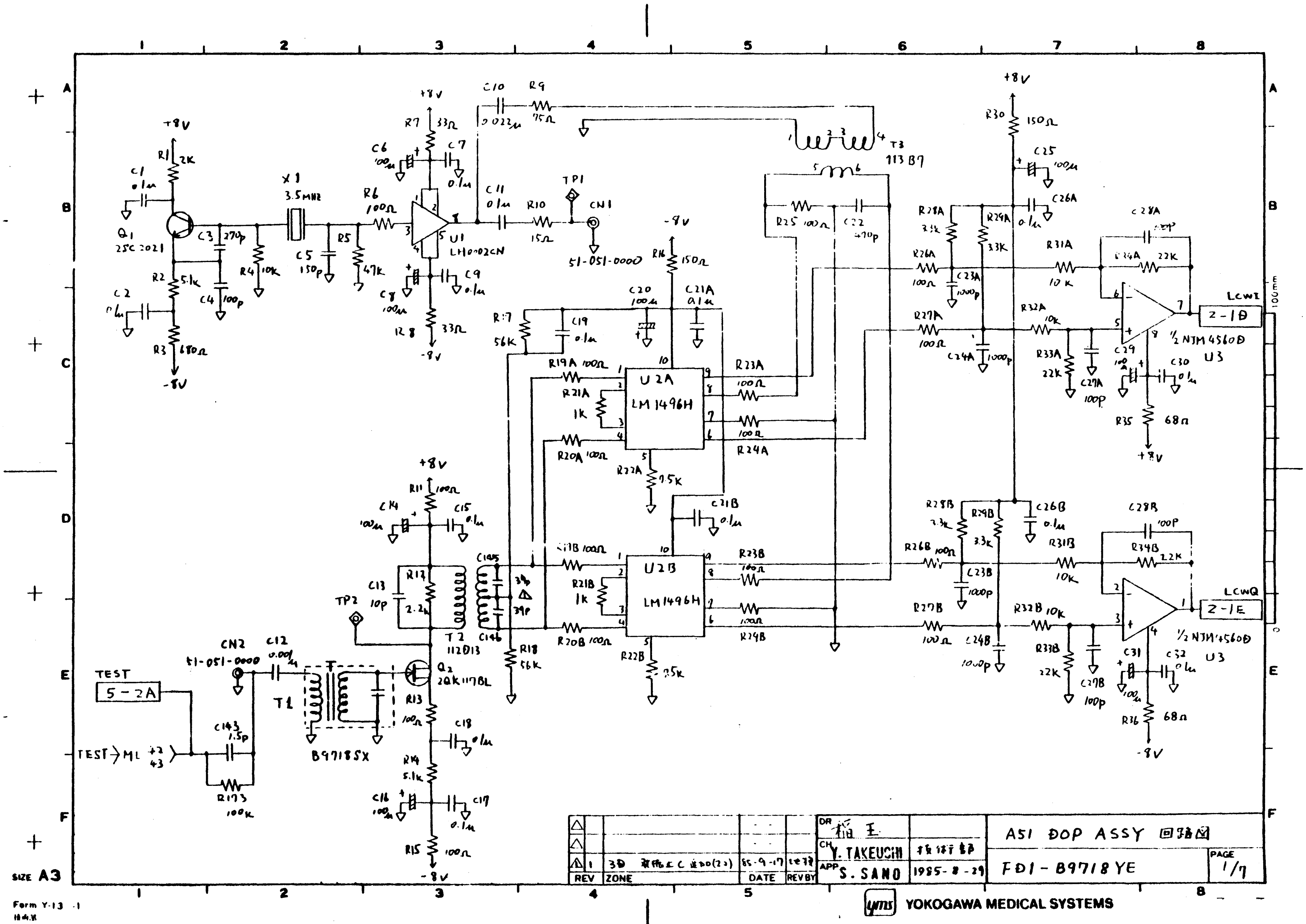
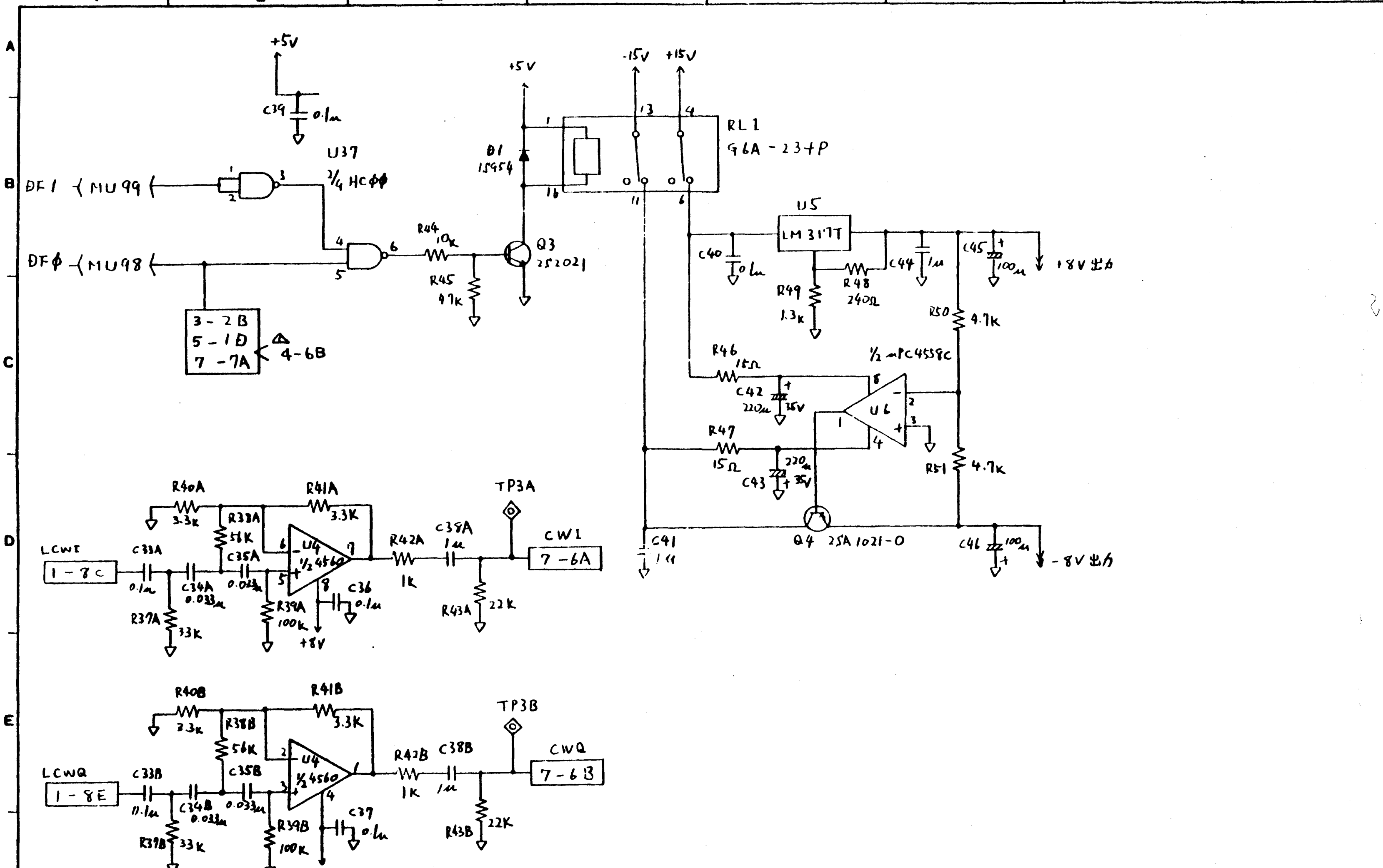
YMS YOKOGAWA MEDICAL SYSTEMS

SIZE A3

Form Y-13-1


ASI DOP ASSY 回路図
FDI-B9718YE
PAGE 1/7
DR
CH Y. TAKEUCHI
APP S. SANO
1985-8-29
REV ZONE DATE REVBY
1 3D 85-9-17
YOKOGAWA MEDICAL SYSTEMS
SIZE A3
Form Y-13-1
TEST 5-2A
TEST ML
LCWI 2-1D
LCWQ 2-1E
U2A LM1496H
U2B LM1496H
U1 LH0002CN
1/2 NJM4560D U3
Q1 2SC2021
Q2 2SK117BL
X1 3.5MHz
T1 B9718SX
T2 112D13
T3 113B7
CN1 51-051-0000
CN2 51-051-0000
TP1
TP2
+8V
-8V

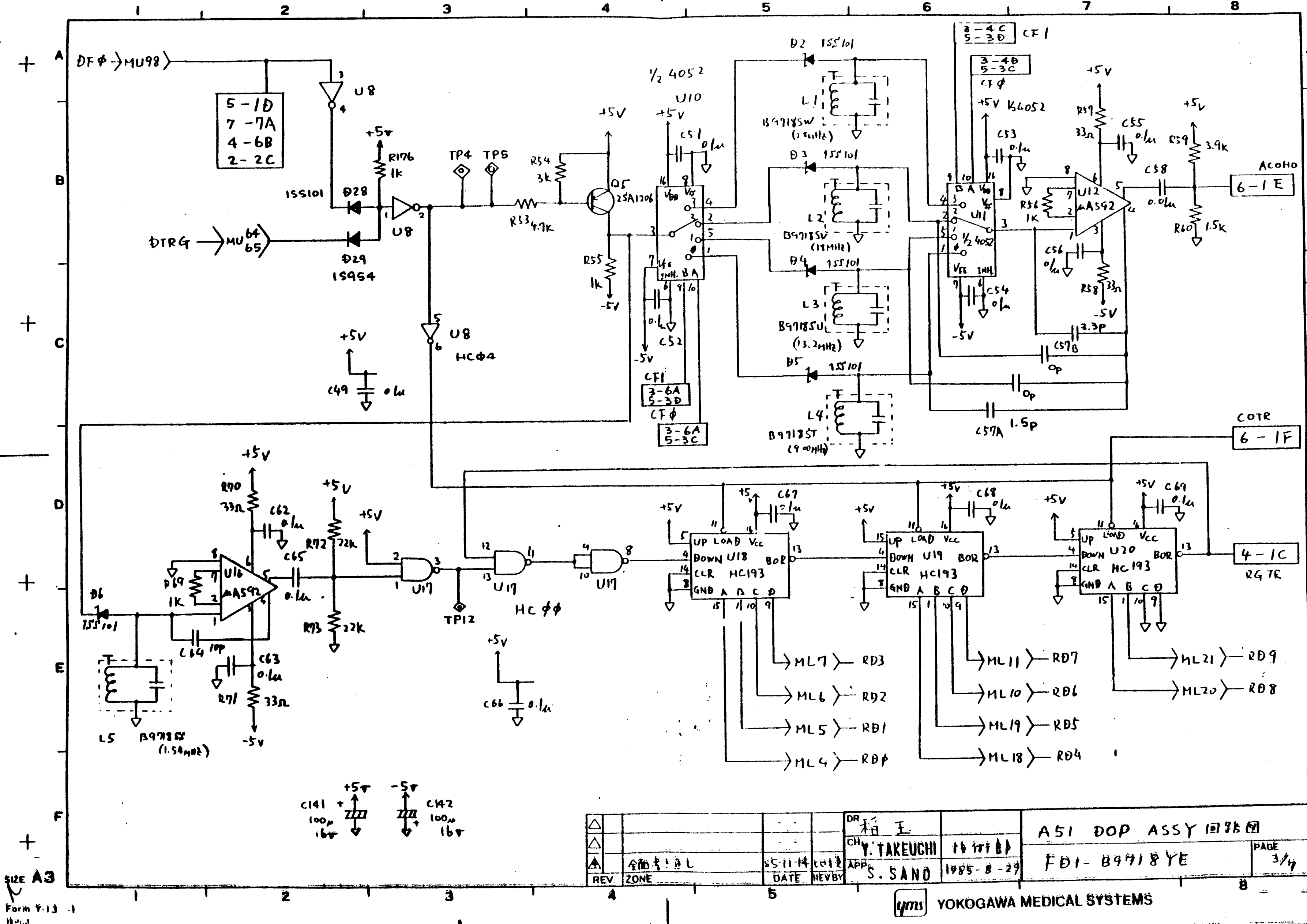


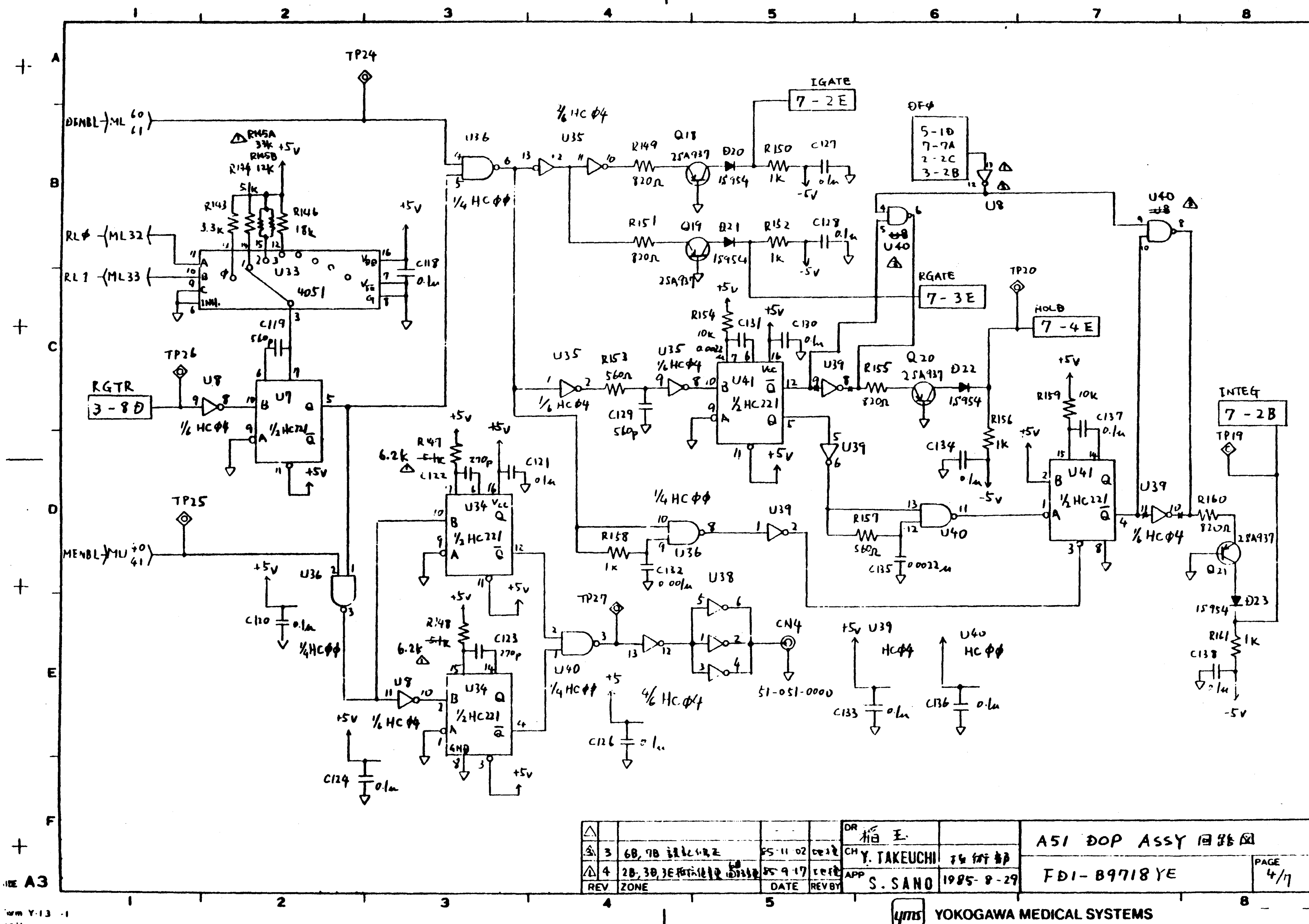
REV	ZONE		DATE	REVBY			
1	2C	DF0 行き追加	85.9.17		DR 稲王		A51 DOP ASSY 回路図
					CH Y. TAKEUCHI	林	FDI-B9718YE
					APP S. SANO	1985-8-29	PAGE 2/7

YOKOGAWA MEDICAL SYSTEMS

SIZE A3

Form Y-13-1


DFΦ → MU98
5-1D
7-7A
4-6B
2-2C
DTRG → MU64 65
U8
D28 1SS101
D29 1S954
R176 1k
TP4 TP5
R54 3k
R53 4.7k
Q5 2SA1206
R55 1k
1/2 4052
U10
C51 0.1μ
C52
CF1 3-6A 5-3D
CFΦ 3-6A 5-3C
D2 1SS101
D3 1SS101
D4 1SS101
D5 1SS101
L1 B9718SW
L2 B9718SV (19MHz)
L3 B9718SU (13.2MHz)
L4 B9718ST (9.0MHz)
3-4C 5-3D CF1
3-4D 5-3C CFΦ
U11 1/2 4052
C53 0.1μ
C54 0.1μ
U12 μA592
R57 33Ω
R56 1K
C55 0.1μ
C56 0.1μ
R58 33Ω
C57B 3.3p
C57A 1.5p
C58 0.01μ
R59 3.9k
R60 1.5k
ACOHO 6-1E
COTR 6-1F
U8 HCΦ4
C49 0.1μ
R70 33Ω
C62 0.1μ
R69 1K
U16 μA592
C64 10P
C63 0.1μ
R71 33Ω
C65 0.1μ
R72 22k
R73 22k
D6 1SS101
L5 B9718SS (1.54MHz)
U17
TP12
HC ΦΦ
C66 0.1μ
U18 HC193
U19 HC193
U20 HC193
C67 0.1μ
C68 0.1μ
C69 0.1μ
4-1C RG TR
ML7 RD3
ML6 RD2
ML5 RD1
ML4 RDΦ
ML11 RD7
ML10 RD6
ML19 RD5
ML18 RD4
ML21 RD9
ML20 RD8
C141 100μ 16V
C142 100μ 16V
REV ZONE DATE REVBY
全面書き直し 85-11-14
DR 稲王
CH Y. TAKEUCHI
APP S. SANO
1985-8-29
A51 DOP ASSY 回路図
FD1-B9718YE
PAGE 3/4
yms YOKOGAWA MEDICAL SYSTEMS
SIZE A3


TP24
DENBL ML 60 61
RL0 ML32
RL1 ML33
U33 4051
R143 3.3k
R134 12k
R145A 3.4k
R145B
R146 18k
5.1k
+5V
C118 0.1u
C119 560p
TP26
RGTR
3-8D
U8 1/6 HC04
U7 1/2 HC221
TP25
MENBL MU 40 41
U36 1/4 HC00
C120 0.1u
C124 0.1u
U35 1/6 HC04
R149 820Ω
Q18 2SA937
D20 1S954
R150 1k
C127 0.1u
-5V
IGATE
7-2E
R151 820Ω
Q19 2SA937
D21 1S954
R152 1k
C128 0.1u
R153 560Ω
C129 560p
R154 10k
C131 0.0022u
C130 0.1u
U41 1/2 HC221
U39
R155 820Ω
Q20 2SA937
D22 1S954
RGATE
7-3E
DF4
5-1D
7-7A
2-2C
3-2B
U40
TP20
HOLD
7-4E
R156 1k
C134 0.1u
R159 10k
C137 0.1u
R160 820Ω
Q21 2SA937
D23 1S954
R161 1k
C138 0.1u
INTEG
7-2B
TP19
R147 6.2k
C122
C121 0.1u
270p
U34 1/2 HC221
R148 6.2k
C123 270p
R158 1k
C132 0.001u
R157 560Ω
C135 0.0022u
U40 1/4 HC00
TP27
U38 4/6 HC04
CN4
51-051-0000
C126 0.1u
+5V U39 HC04
U40 HC00
C133 0.1u
C136 0.1u
REV
ZONE
DATE
REV BY
3 6B, 7B
4 2B, 3B, 3E
85-11-02
85-9-17
DR
CH Y. TAKEUCHI
APP S. SANO
1985-8-29
A51 DOP ASSY 回路図
FDI-B9718YE
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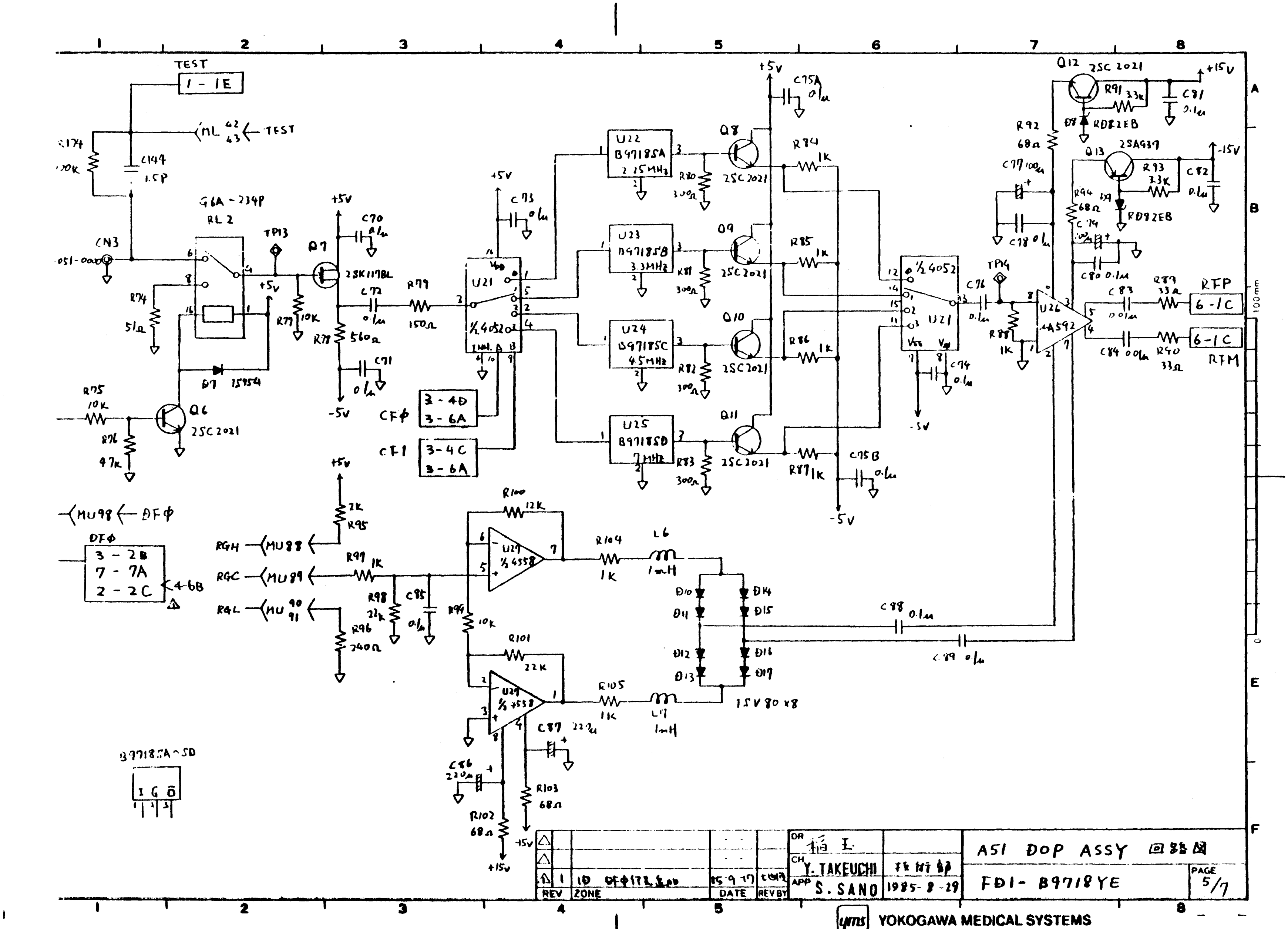
YOKOGAWA MEDICAL SYSTEMS


TEST
1 - 1E
ML 42 43
TEST
C144 1.5P
CN3
G6A-234P
RL2
TP13
Q7 2SK117BL
C70
C72
C71
R79 150Ω
R78 560Ω
R77 10K
R74 51Ω
R75 10K
R76 4.7K
Q6 2SC2021
D7 1S954
U21 ½4052
3-4D
3-6A
CFΦ
3-4C
3-6A
CF1
U22 B97185A 2.25MHz
U23 B97185B 3.3MHz
U24 B97185C 4.5MHz
U25 B97185D 7MHz
Q8 2SC2021
Q9 2SC2021
Q10 2SC2021
Q11 2SC2021
R80 300Ω
R81 300Ω
R82 300Ω
R83 300Ω
R84 1K
R85 1K
R86 1K
R87 1K
C75A
C75B
C76
C74
TP14
R88 1K
U26 μA592
Q12 2SC2021
Q13 2SA937
R91 33k
R92 68Ω
R93 33K
R94 68Ω
RD82EB
C77 100μ
C78
C79
C80
C81
C82
C83
C84
R89 33Ω
R90 33Ω
RFP
6-1C
6-1C
RFM
MU98
DFΦ
3 - 2B
7 - 7A
2 - 2C
4-6B
RGH
MU88
RGC
MU89
RGL
MU 90 91
R95 2K
R97 1K
R98 22K
R96 240Ω
C85
R99 10K
R100 12K
R101 22K
U27 ½4558
R104 1K
R105 1K
L6 1mH
L7 1mH
D10 D11 D12 D13
D14 D15 D16 D17
1SV80 x8
C88 0.1μ
C89 0.1μ
C86 220μ
C87 22.0μ
R102 68Ω
R103 68Ω
+15V
-15V
+5V
-5V
B97185A~SD
I G O
REV
ZONE
DATE
REVBY
1
1D
DFΦ17R
85.9.17
DR
CH Y. TAKEUCHI
APP S. SANO
1985-8-29
A51 DOP ASSY
FDI- B9718YE
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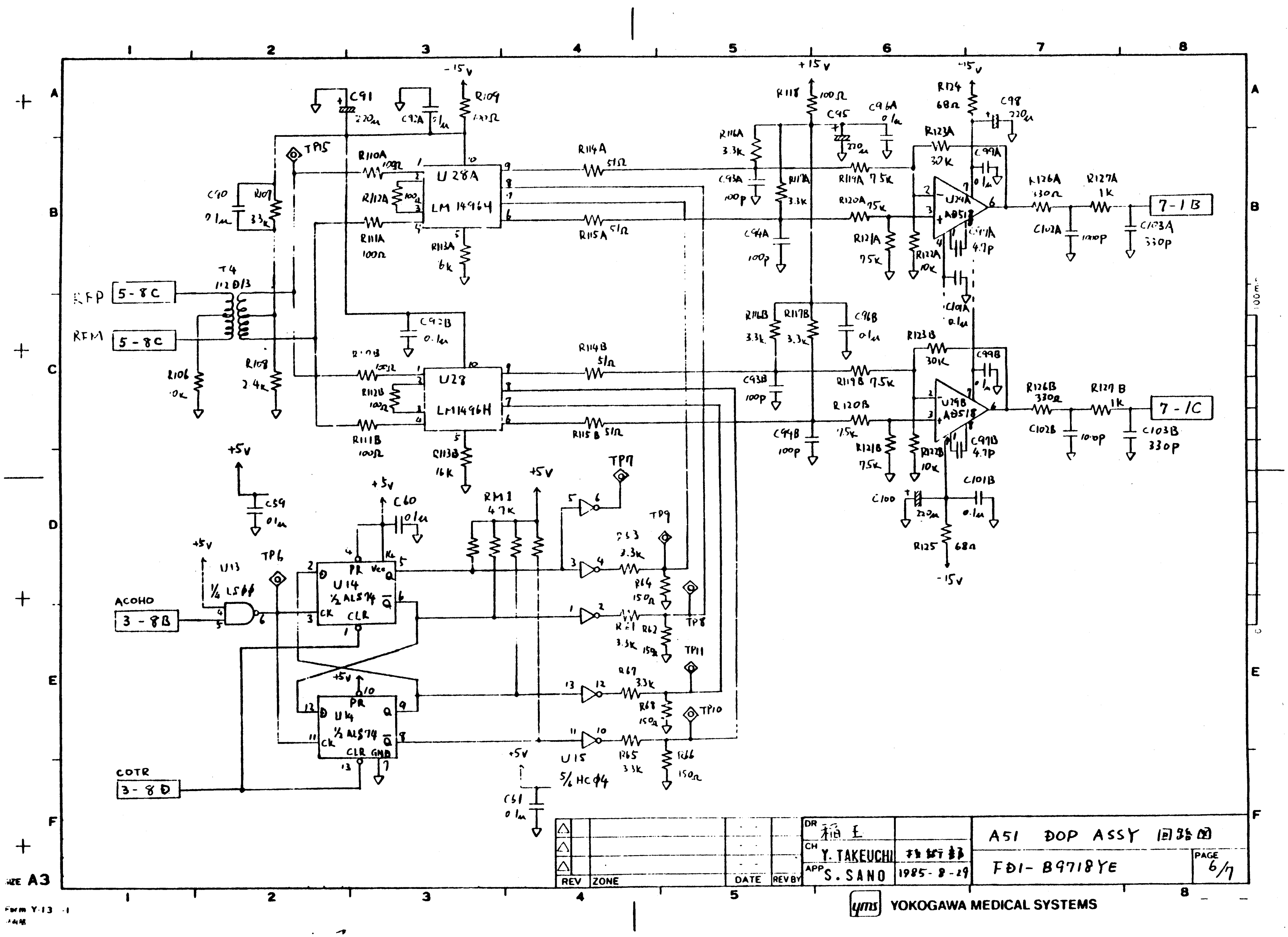
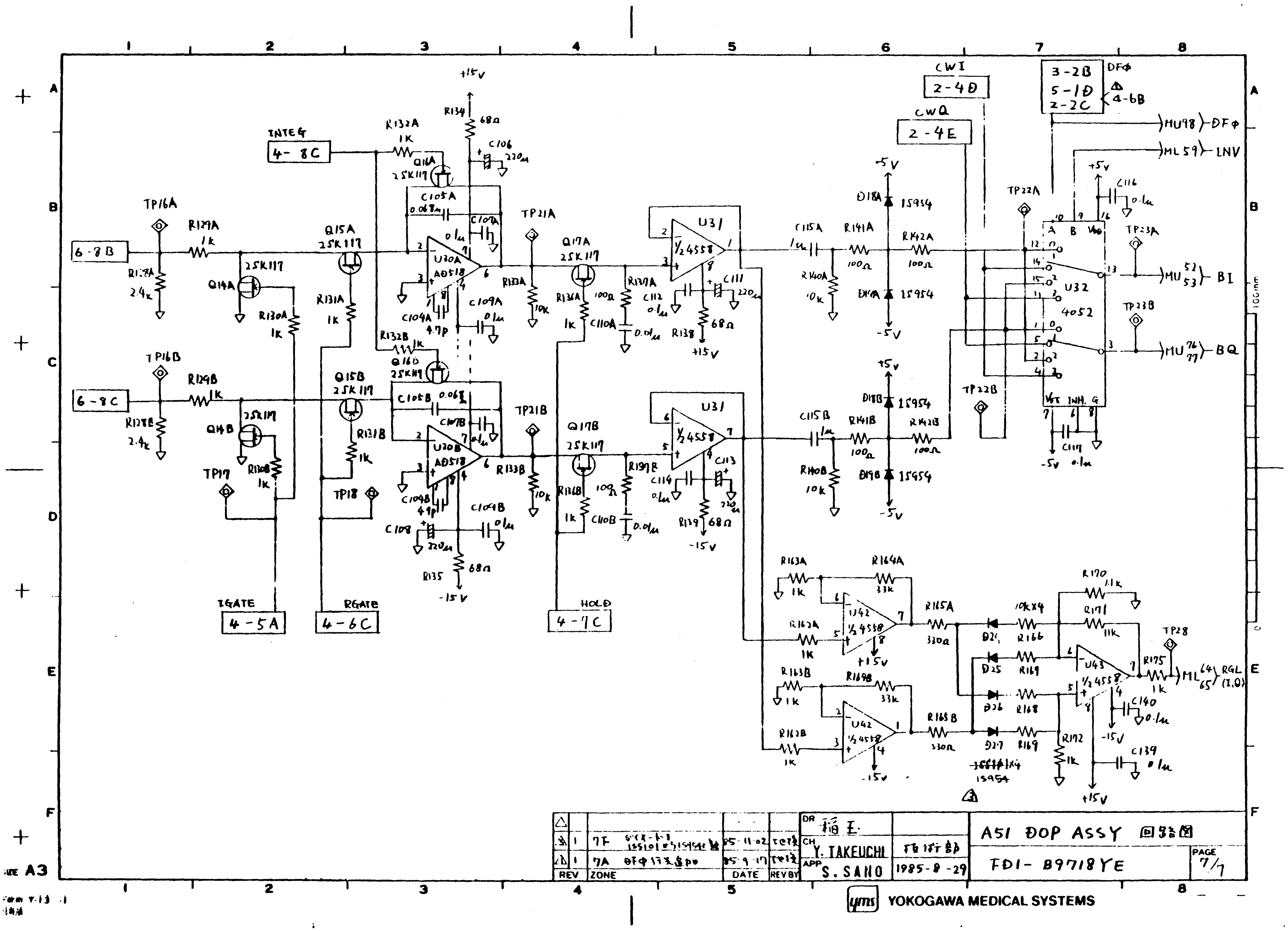
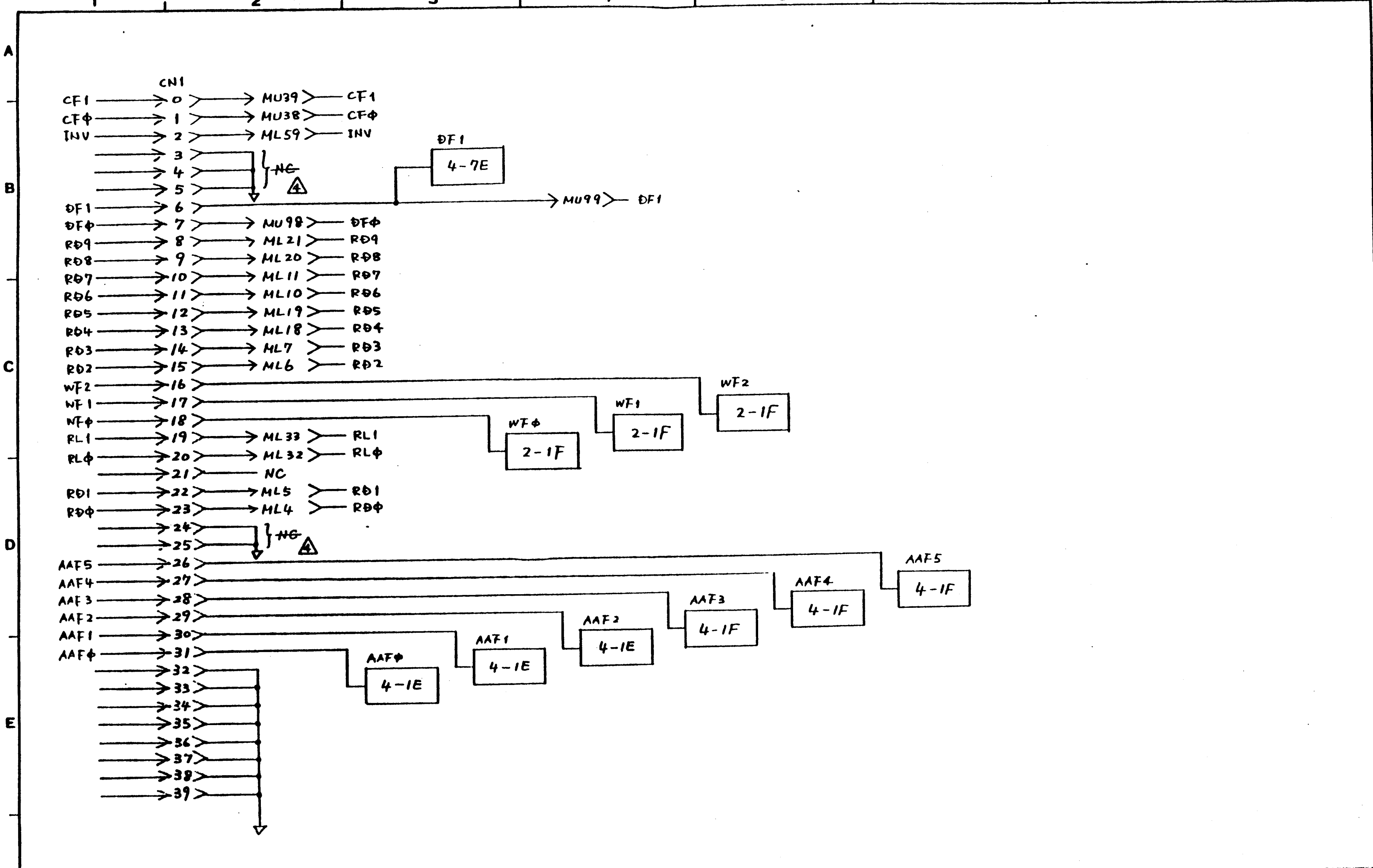
YOKOGAWA MEDICAL SYSTEMS


U28A LM1496H
U28 LM1496H
U14 1/2 ALS74
U15 5/6 HC04
U13 1/4 LS00
ACOHO 3-8B
COTR 3-8D
RFP 5-8C
RFM 5-8C
7-1B
7-1C
A51 DOP ASSY 回路図
FDI-B9718YE
PAGE 6/7
DR 稲王
CH Y. TAKEUCHI
APP S. SANO
1985-8-29
YOKOGAWA MEDICAL SYSTEMS


A51 DOP ASSY 回路図
FDI- B9718YE
PAGE 7/7
DR 梅 王.
CH Y. TAKEUCHI
APP S. SANO
1985-8-29
YOKOGAWA MEDICAL SYSTEMS
REV
ZONE
DATE
REVBY
INTEG 4-8C
IGATE 4-5A
RGATE 4-6C
HOLD 4-7C
CWI 2-4D
CWQ 2-4E
3-2B
5-1D
2-2C
DFΦ
4-6B
6-8B
6-8C
U30A AD518
U30B AD518
U31 1/2 4558
U32 4052
U42 1/2 4558
U43 1/2 4558
MU98 DFΦ
ML59 LNV
MU52 53 BI
MU76 77 BQ
ML64 65 RGL (I,Q)
A3

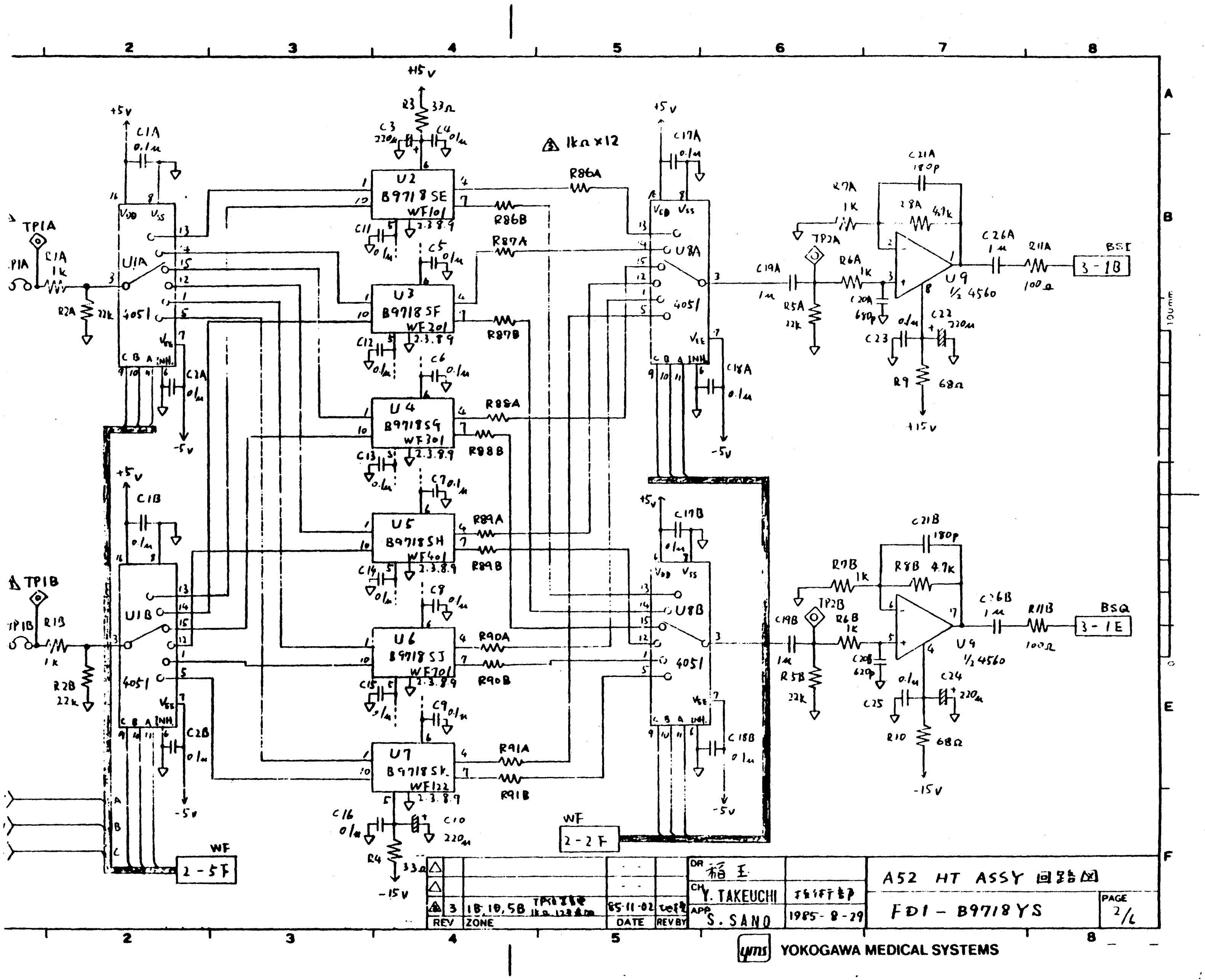


△			· ·		DR 稲玉	A52 HT ASSY 回路図
△			· ·		CH Y. TAKEUCHI 1985-8-29	
4	2	2B.2D GND 追加	85-11-15		APP S. SANO 1985-8-29	FDI-B9718YS PAGE 1/6
REV		ZONE	DATE	REV BY		

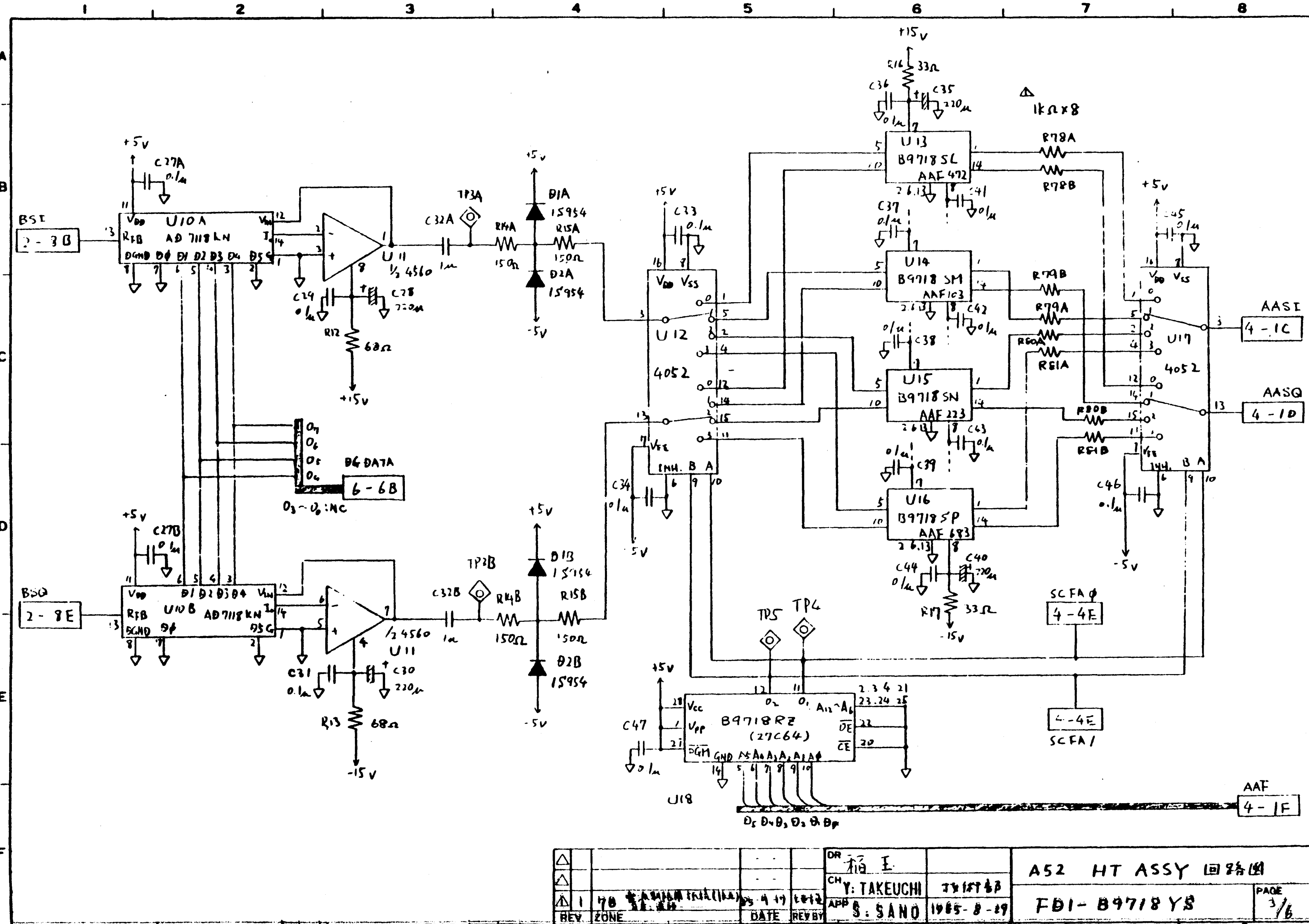
YOKOGAWA MEDICAL SYSTEMS

SIZE A3

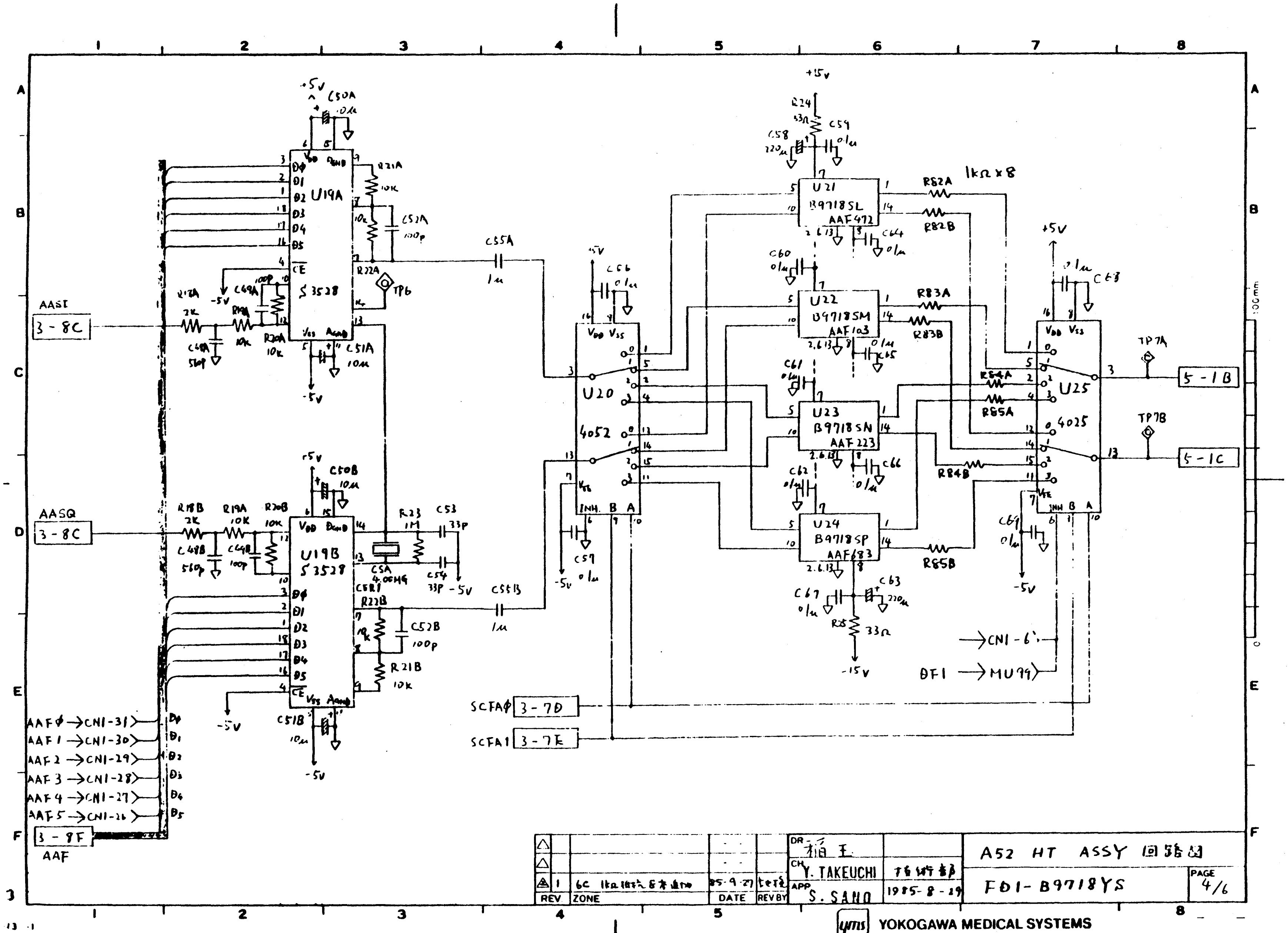
Form Y-13-1



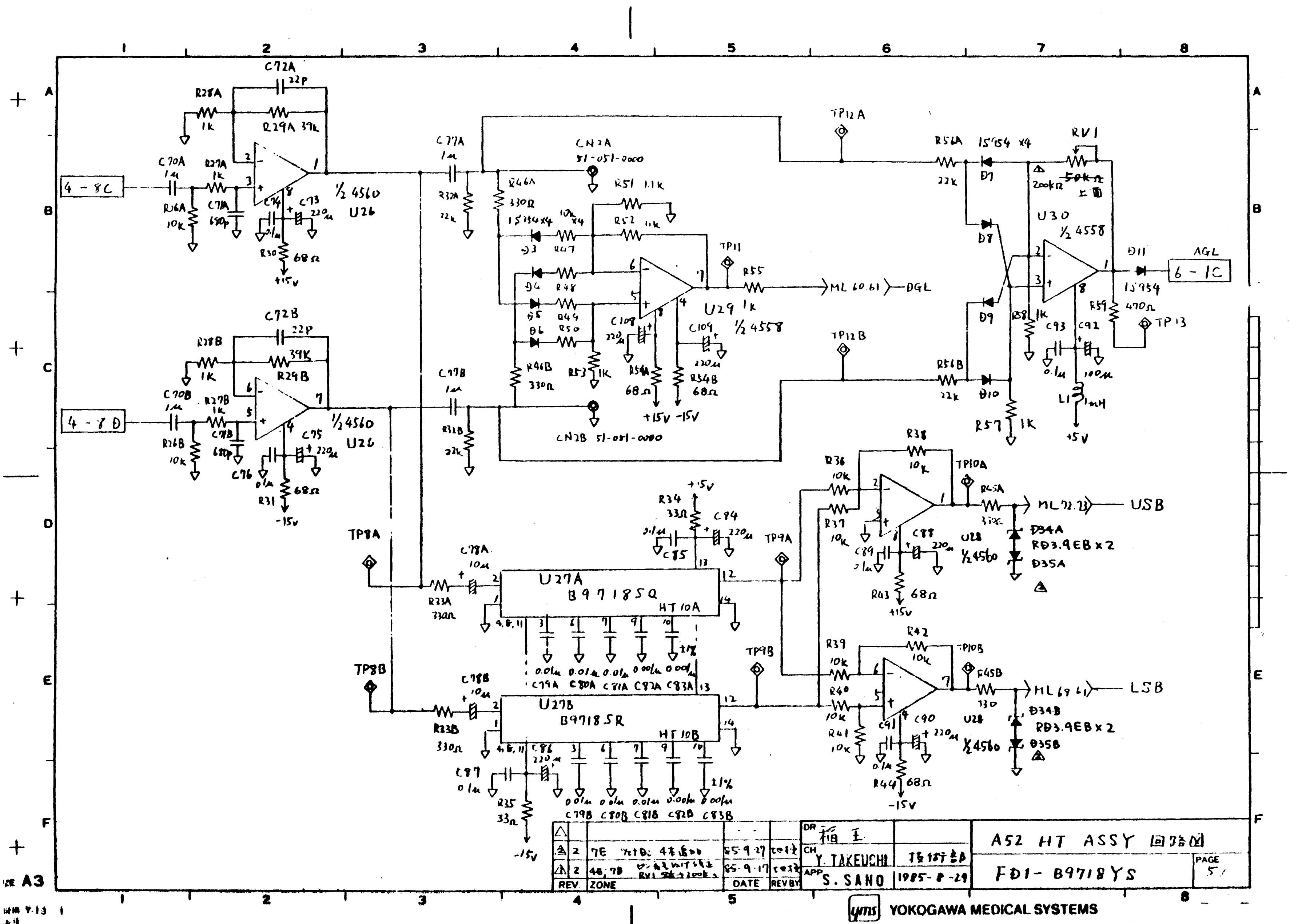
A52 HT ASSY 回路図
FDI - B9718YS
PAGE 2/6
DR 稲王
CH Y. TAKEUCHI
APP S. SANO
1985-8-29
YOKOGAWA MEDICAL SYSTEMS



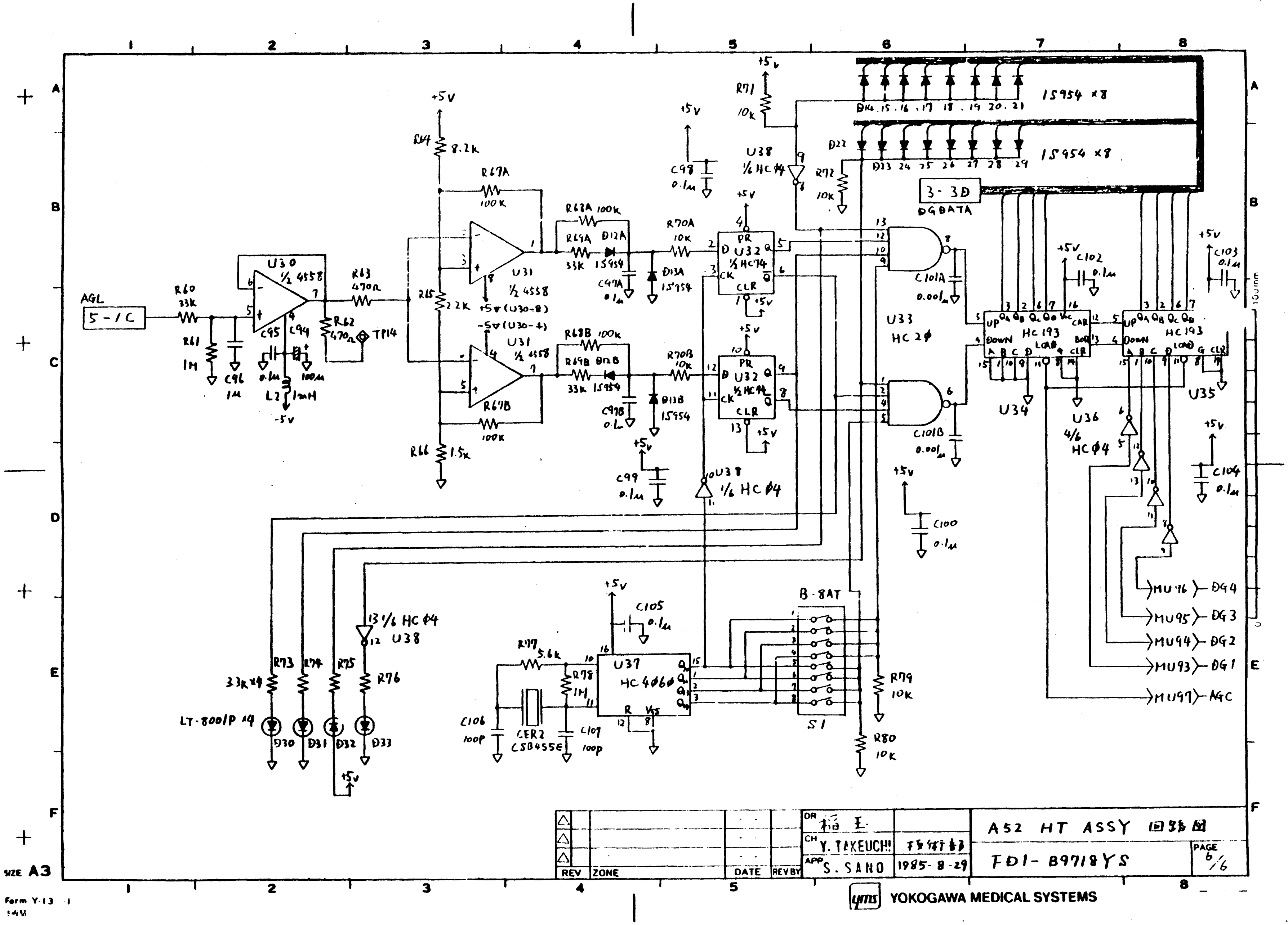
BSI 2-3B
BSQ 2-8E
U10A AD7118LN
U10B AD7118KN
U11 1/2 4560
D4 DATA 6-6B
D3~D0 : NC
TP3A
TP3B
D1A 1S954
D2A 1S954
D1B 1S954
D2B 1S954
U12 4052
U17 4052
U13 B9718SL AAF472
U14 B9718SM AAF103
U15 B9718SN AAF223
U16 B9718SP AAF683
1kΩ×8
R78A
R78B
R79A
R79B
R80A
R80B
R81A
R81B
AASI 4-1C
AASQ 4-1D
SCFA0 4-4E
SCFA1 4-4E
TP5
TP4
U18 B9718RZ (27C64)
AAF 4-1F
A52 HT ASSY 回路図
FB1-B9718YS
PAGE 3/6
Y. TAKEUCHI
S. SANO
1985-8-29
YOKOGAWA MEDICAL SYSTEMS
A3

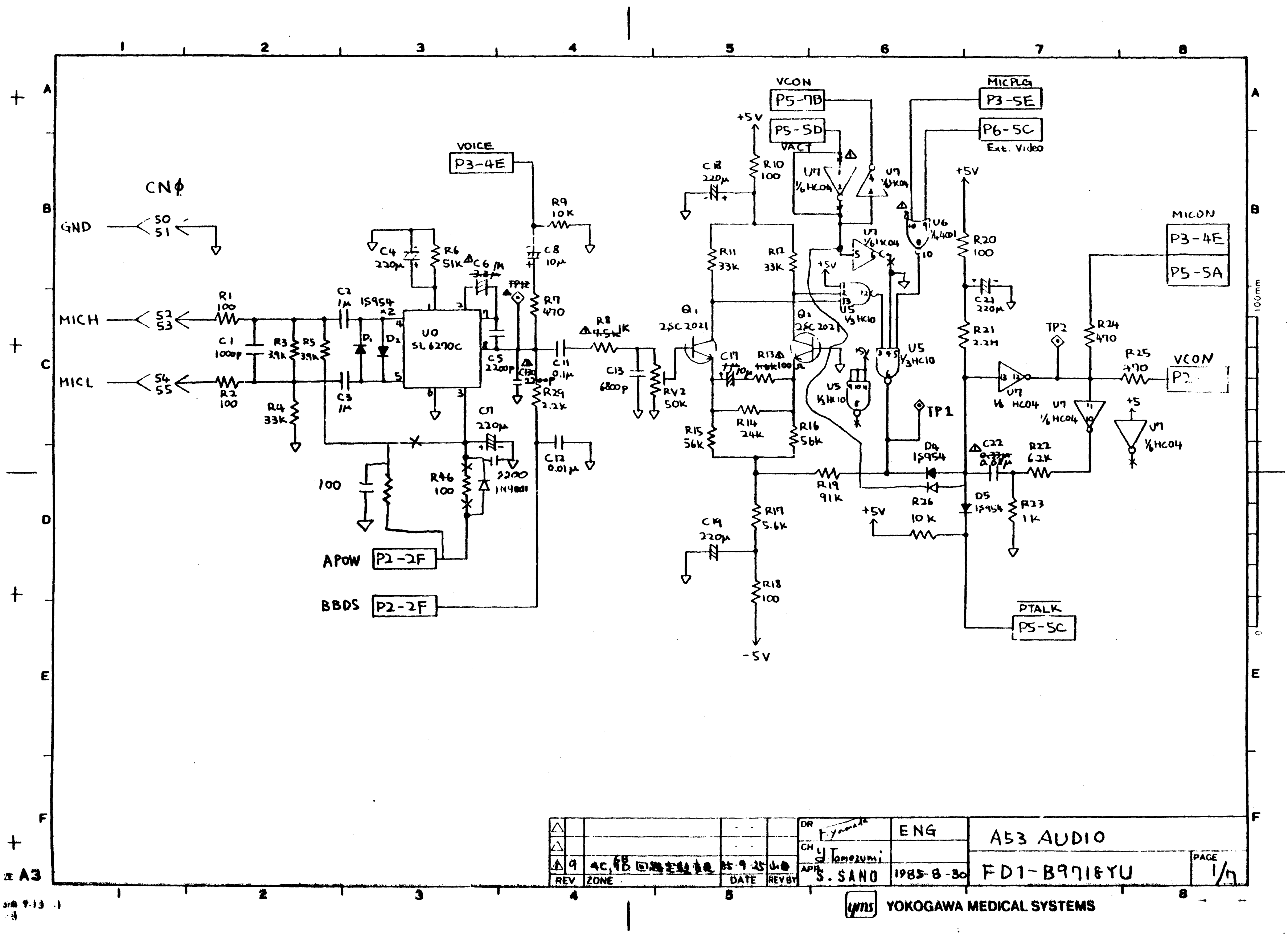


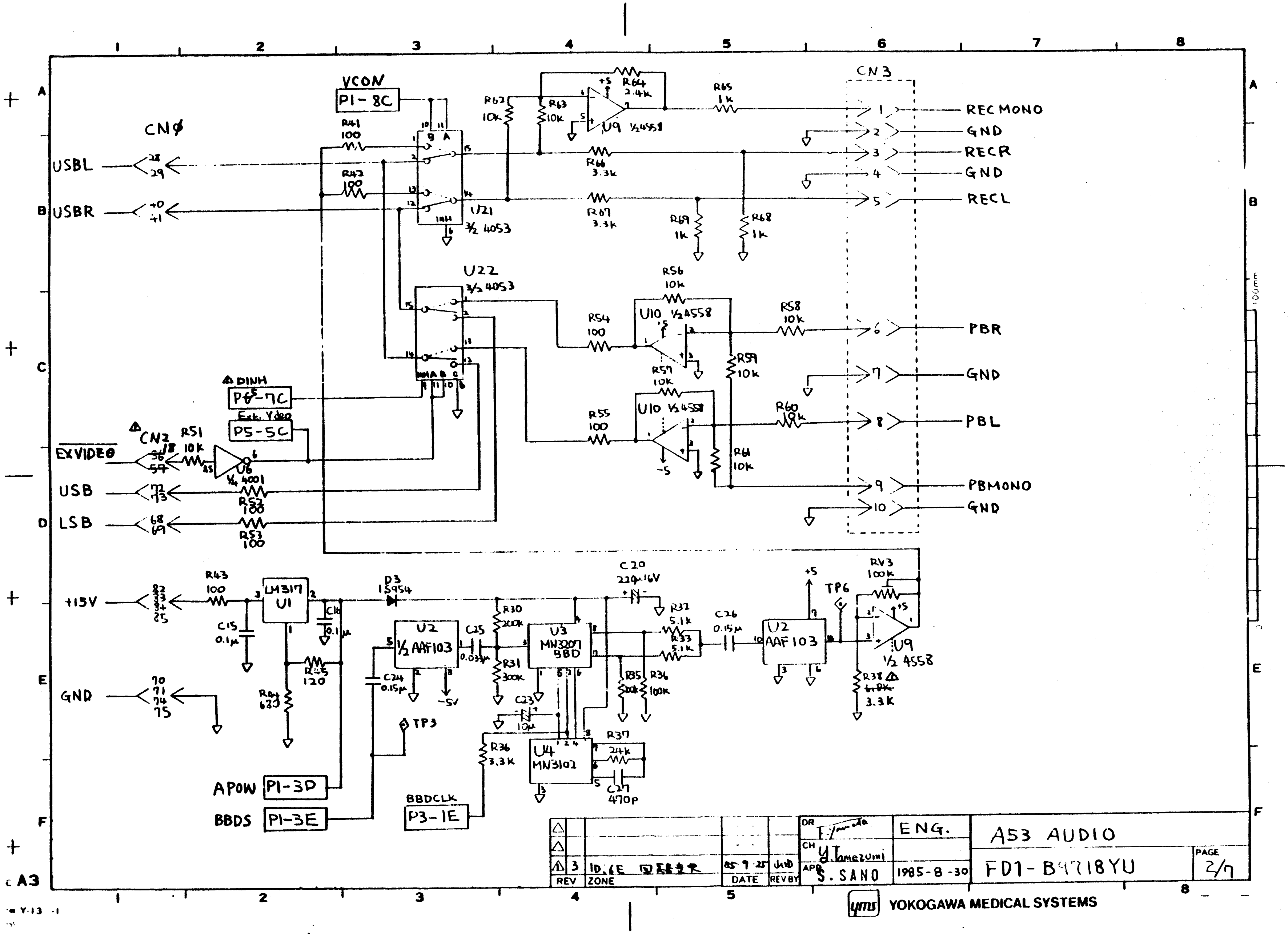
A52 HT ASSY
FD1-B9718YS
PAGE 4/6
DR
CH Y. TAKEUCHI
APP S. SANO
1985-8-29
REV ZONE DATE REVBY
1 6C 85-9-27
YOKOGAWA MEDICAL SYSTEMS
U19A S3528
U19B S3528
U20 4052
U21 B9718SL AAF472
U22 B9718SM AAF103
U23 B9718SN AAF223
U24 B9718SP AAF683
U25 4025
1kΩ×8
AASI 3-8C
AASQ 3-8C
AAF 3-8F
AAF0 → CN1-31
AAF1 → CN1-30
AAF2 → CN1-29
AAF3 → CN1-28
AAF4 → CN1-27
AAF5 → CN1-26
SCFA0 3-7D
SCFA1 3-7E
5-1B
5-1C
TP6
TP7A
TP7B
→ CN1-6
DF1 → MU99
+5V
-5V
+15V
-15V

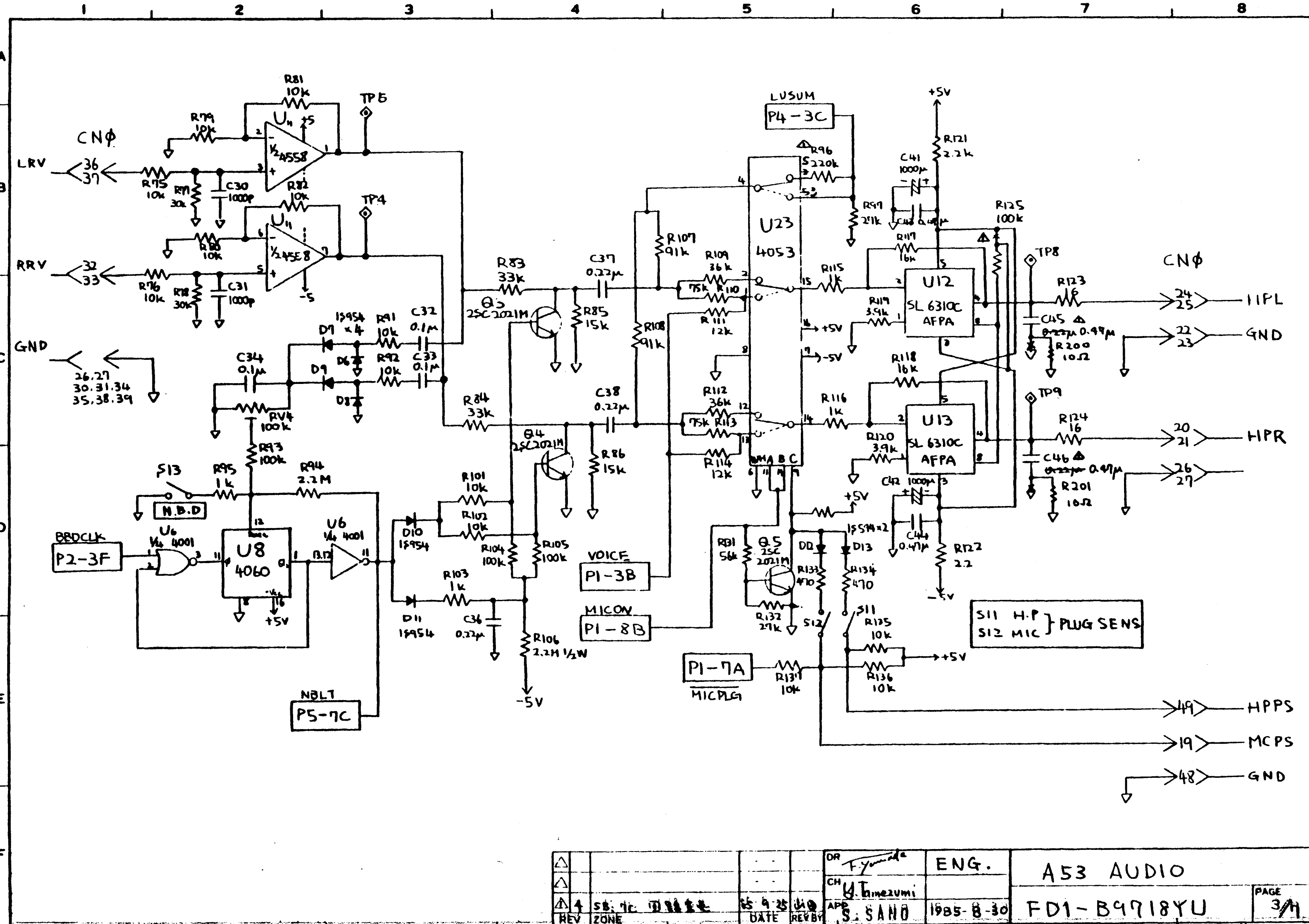


4 - 8C
4 - 7D
U26
1/2 4560
U27A
B97185Q
HT10A
U27B
B9718SR
HT10B
U29
1/2 4558
U30
1/2 4558
U28
1/2 4560
CN2A 51-051-0000
CN2B 51-051-0000
ML 60.61
DGL
AGL
6 - 1C
ML 72.73
USB
ML 69.61
LSB
RD3.9EB x 2
A52 HT ASSY
FD1- B9718YS
PAGE 51
Y. TAKEUCHI
S. SANO
1985-8-29
YOKOGAWA MEDICAL SYSTEMS


A52 HT ASSY 回路図
FD1-B9718YS
PAGE 6/6
DR 稲王
CH Y. TAKEUCHI
APP S. SANO
1985-8-29
REV ZONE DATE REV BY
YOKOGAWA MEDICAL SYSTEMS
SIZE A3
Form Y-13
AGL 5-1C
U30 1/2 4558
U31 1/2 4558
U32 1/2 HC74
U33 HC20
U34
U35
U36 4/6 HC04
U37 HC4060
U38 1/6 HC04
HC193
1S954 x8
3-3D DGDATA
B-8AT
S1
CER2 CSB455E
LT-8001P x4
MU96 DG4
MU95 DG3
MU94 DG2
MU93 DG1
MU97 AGC


CNϕ
GND
MICH
MICL
VOICE
P3-4E
U0
SL6270C
APOW
P2-2F
BBDS
P2-2F
Q1
2SC2021
Q2
2SC2021
RV2
50K
VCON
P5-7B
P5-5D
VACT
MICPLG
P3-5E
P6-5C
Ext. Video
MICON
P3-4E
P5-5A
TP1
TP2
PTALK
P5-5C
+5V
-5V
ENG
A53 AUDIO
FD1-B9716YU
PAGE
1/7
S. SANO
1985-8-30
REV
ZONE
DATE
REV BY
YOKOGAWA MEDICAL SYSTEMS
A3


CN3
REC MONO
GND
RECR
GND
RECL
PBR
GND
PBL
PBMONO
GND
CNØ
USBL
USBR
CN2
EXVIDEO
USB
LSB
+15V
GND
VCON
P1-8C
U21 3/2 4053
U22 3/2 4053
U9 1/2 4558
U10 1/2 4558
U6 1/4 4001
DINH
P6-7C
Ext. Video
P5-5C
LM317 U1
D3 1S954
U2 1/2 AAF103
U3 MN3207 BBD
U4 MN3102
U2 AAF103
TP3
TP6
APOW
P1-3D
BBDS
P1-3E
BBDCLK
P3-1E
A53 AUDIO
FD1-B9718YU
ENG.
PAGE 2/7
DR
CH Y. Tamezumi
APR S. SANO
1985-8-30
REV ZONE DATE REVBY
3 1D, 6E 85-9-25
YOKOGAWA MEDICAL SYSTEMS
A3


CNϕ
LRV
RRV
GND
U1 ½ 4558
U8 4060
U6 ¼ 4001
U23 4053
U12 SL 6310C AFPA
U13 SL 6310C AFPA
BBDCLK P2-3F
NBLT P5-7C
VOICE P1-3B
MICON P1-8B
LUSUM P4-3C
P1-7A MICPLG
S13 N.B.D
S11 H.P
S12 MIC
PLUG SENS
HPL
HPR
HPPS
MCPS
TP4
TP5
TP8
TP9
A53 AUDIO
FD1-B9918YU
ENG.
1985-8-30
S. SANO
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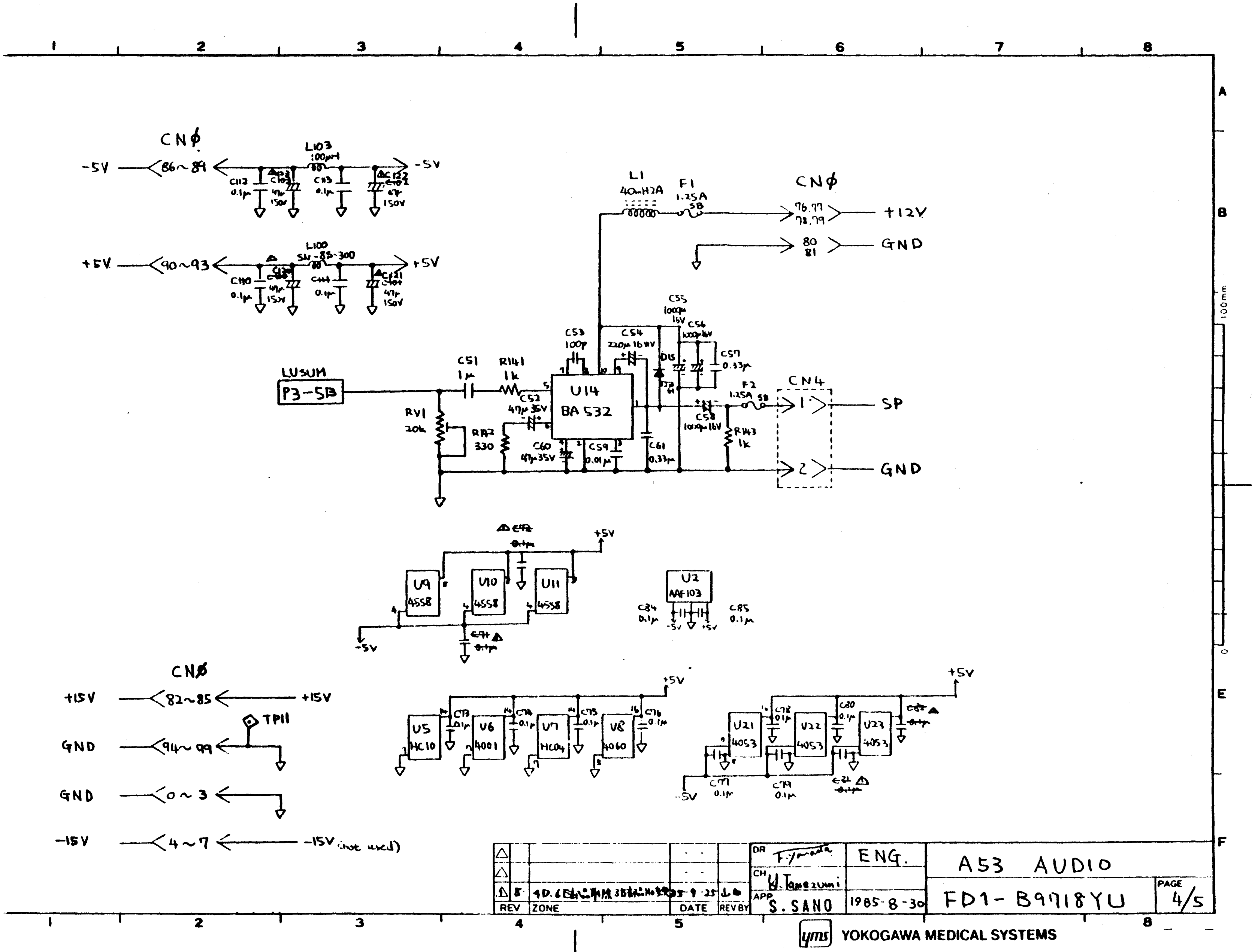
YOKOGAWA MEDICAL SYSTEMS



CNφ
-5V
86~89
L103
100μH
C112 0.1μ
C103 47μ 15V
C113 0.1μ
C122
C102 47μ 15V
+5V
90~93
L100
SN-8S-300
C110 0.1μ
C120
C100 47μ 15V
C114 0.1μ
C121
C104 47μ 15V
L1
F1
1.25A
5B
76,77
78,79
+12V
80
81
GND
LUSUM
P3-5B
C51
1μ
R141
1k
RV1
20k
R142
330
C52
47μ 35V
C53
100p
C54
220μ 16V
C55
1000μ
16V
C56
1000μ 16V
C57
0.33μ
D15
U14
BA532
C60
47μ 35V
C59
0.01μ
C61
0.33μ
C58
1000μ 16V
F2
1.25A
5B
R143
1k
CN4
1
2
SP
GND
+5V
-5V
U9
4558
U10
4558
U11
4558
U2
AAF103
C84
0.1μ
C85
0.1μ
+15V
82~85
GND
94~99
TP11
GND
0~3
-15V
4~7
-15V (not used)
U5
HC10
U6
4001
U7
HC04
U8
4060
C73
0.1μ
C74
0.1μ
C75
0.1μ
C76
0.1μ
U21
4053
U22
4053
U23
4053
C72
0.1μ
C30
0.1μ
C77
0.1μ
C79
0.1μ
REV
ZONE
DATE
REV BY
DR
CH
APP
S. SANO
ENG.
1985-8-30
A53 AUDIO
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PAGE
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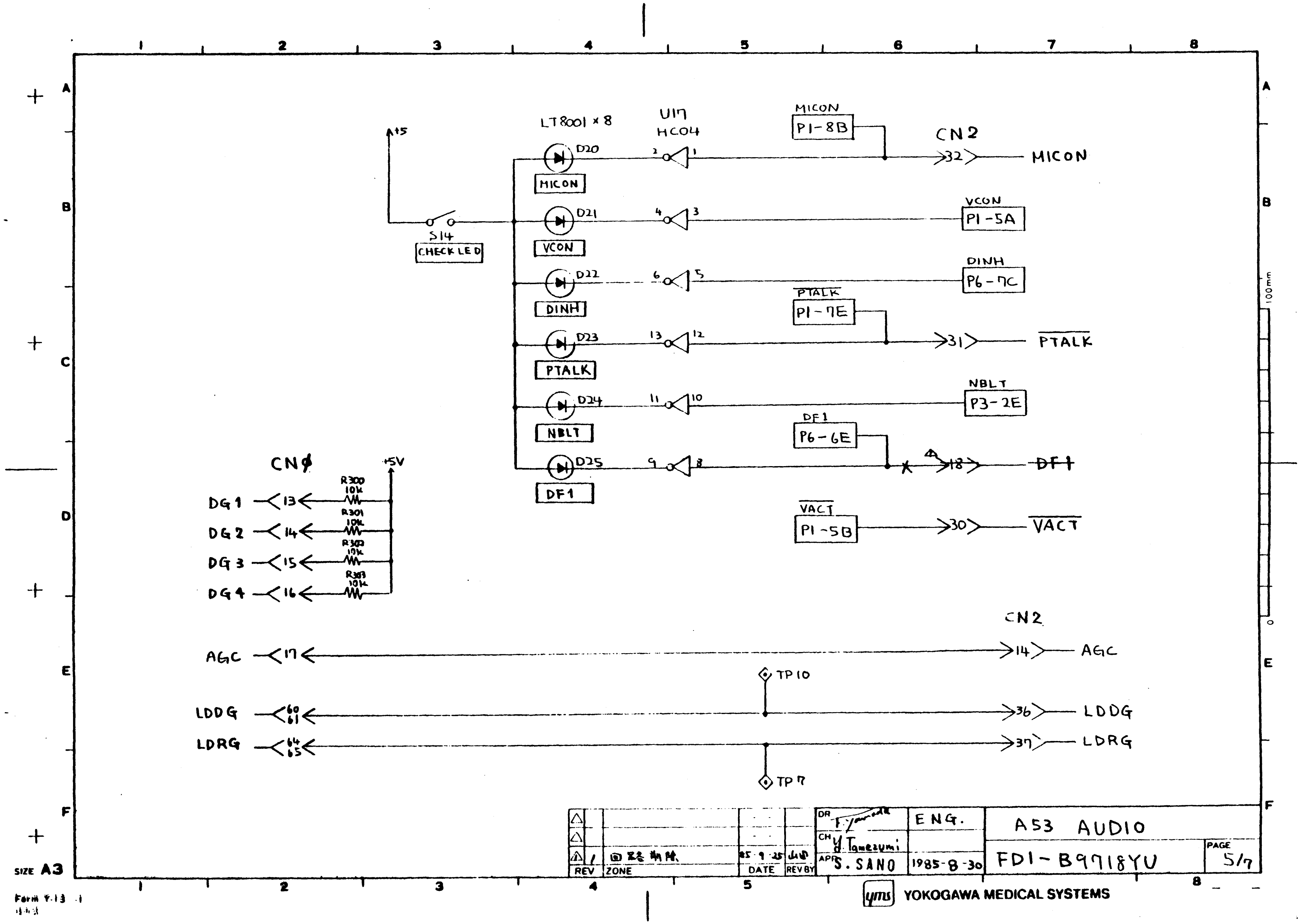
YOKOGAWA MEDICAL SYSTEMS



LT8001 × 8
U17
HC04
D20
D21
D22
D23
D24
D25
MICON
VCON
DINH
PTALK
NBLT
DF1
S14
CHECK LED
+5
CN2
MICON
P1-8B
VCON
P1-5A
DINH
P6-7C
PTALK
P1-7E
NBLT
P3-2E
DF1
P6-6E
VACT
P1-5B
CNφ
+5V
R300 10k
R301 10k
R302 10k
R303 10k
DG 1
DG 2
DG 3
DG 4
AGC
LDDG
LDRG
TP10
TP7
ENG.
DR
CH Y. Tamezumi
APR S. SANO
1985-8-30
REV
ZONE
DATE
REVBY
A53 AUDIO
FDI-B9718YU
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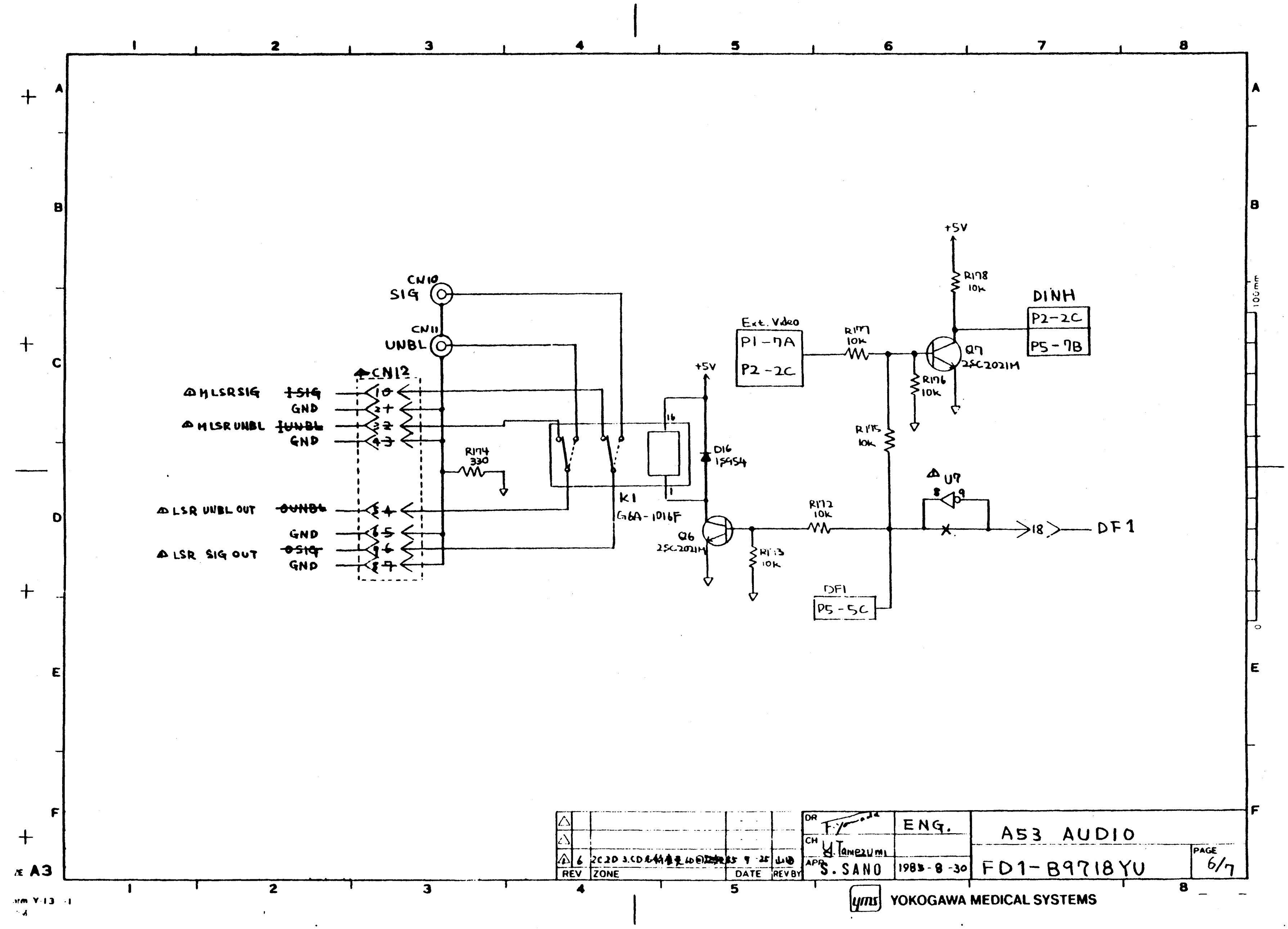
YOKOGAWA MEDICAL SYSTEMS
SIZE A3


CN10
SIG
CN11
UNBL
CN12
ΔHLSRSIG
GND
ΔHLSRUNBL
GND
ΔLSR UNBL OUT
GND
ΔLSR SIG OUT
GND
R174
330
K1
G6A-1016F
+5V
D16
1S454
Q6
2SC2021M
R173
10k
Ext. Video
P1-7A
P2-2C
R177
10k
R176
10k
R175
10k
R172
10k
+5V
R178
10k
Q7
2SC2021M
DINH
P2-2C
P5-7B
ΔU7
DF1
P5-5C
18
DF1
ENG.
S.SANO
1983-8-30
A53 AUDIO
FD1-B9718YU
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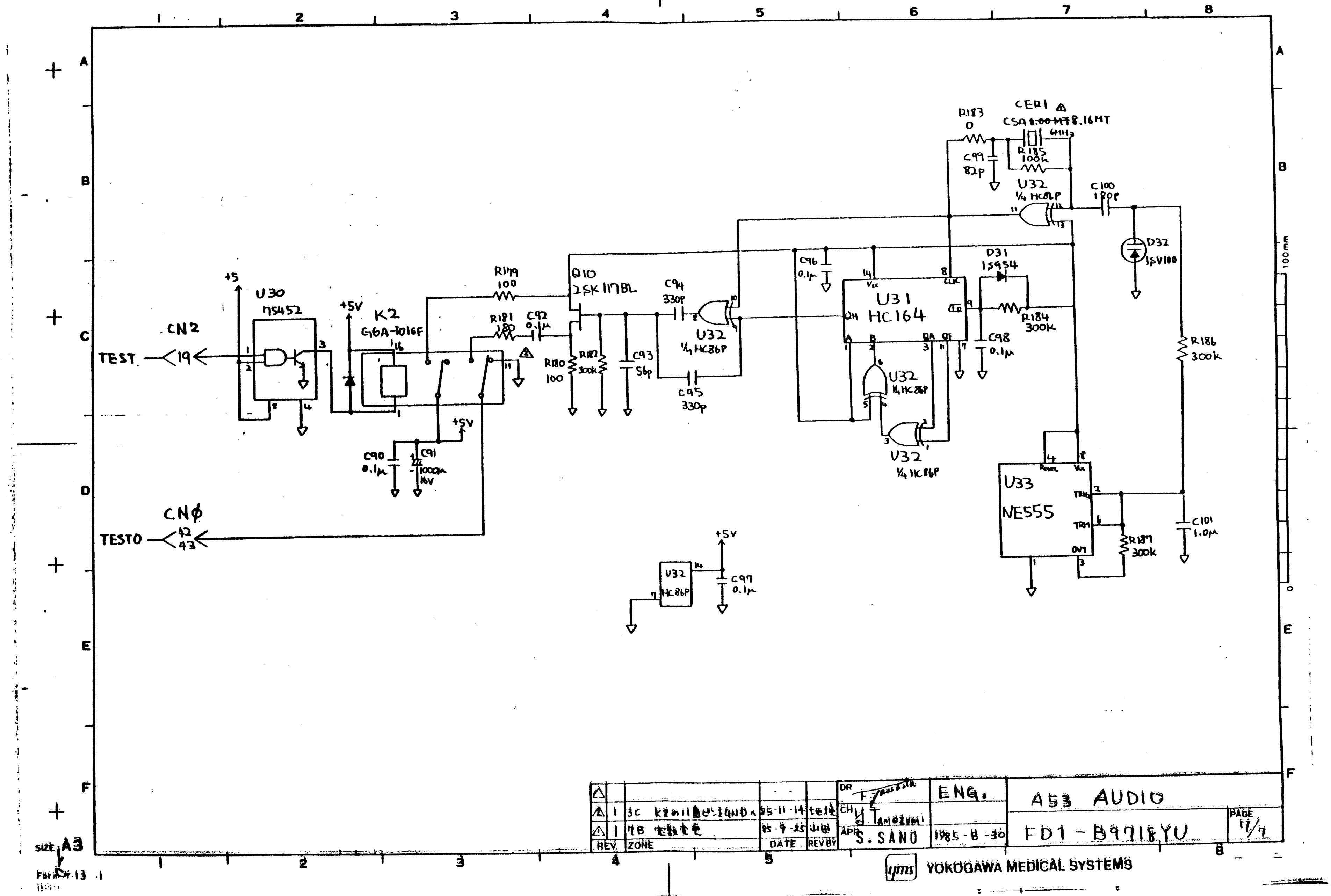
REV
ZONE
DATE
REV BY
YOKOGAWA MEDICAL SYSTEMS
A3



TEST
CN2
19
+5
U30
75452
+5V
K2
G6A-1016F
R179
100
R181
180
C92
0.1μ
C90
0.1μ
C91
1000μ
16V
+5V
CNϕ
42
43
TESTO
Q10
2SK117BL
R180
100
R182
300k
C93
56p
C94
330p
U32
1/4 HC86P
C95
330p
C96
0.1μ
U31
HC164
U32
1/4 HC86P
U32
1/4 HC86P
R183
0
CER1
CSA 8.16MT
C99
82p
R185
100k
U32
1/4 HC86P
C100
180p
D32
1SV100
D31
1S954
R184
300k
C98
0.1μ
R186
300k
U33
NE555
R187
300k
C101
1.0μ
+5V
U32
HC86P
C97
0.1μ
REV
ZONE
DATE
REV BY
DR
CH
APR
S. SANO
1985-8-30
ENG.
A53 AUDIO
FD1-B9918YU
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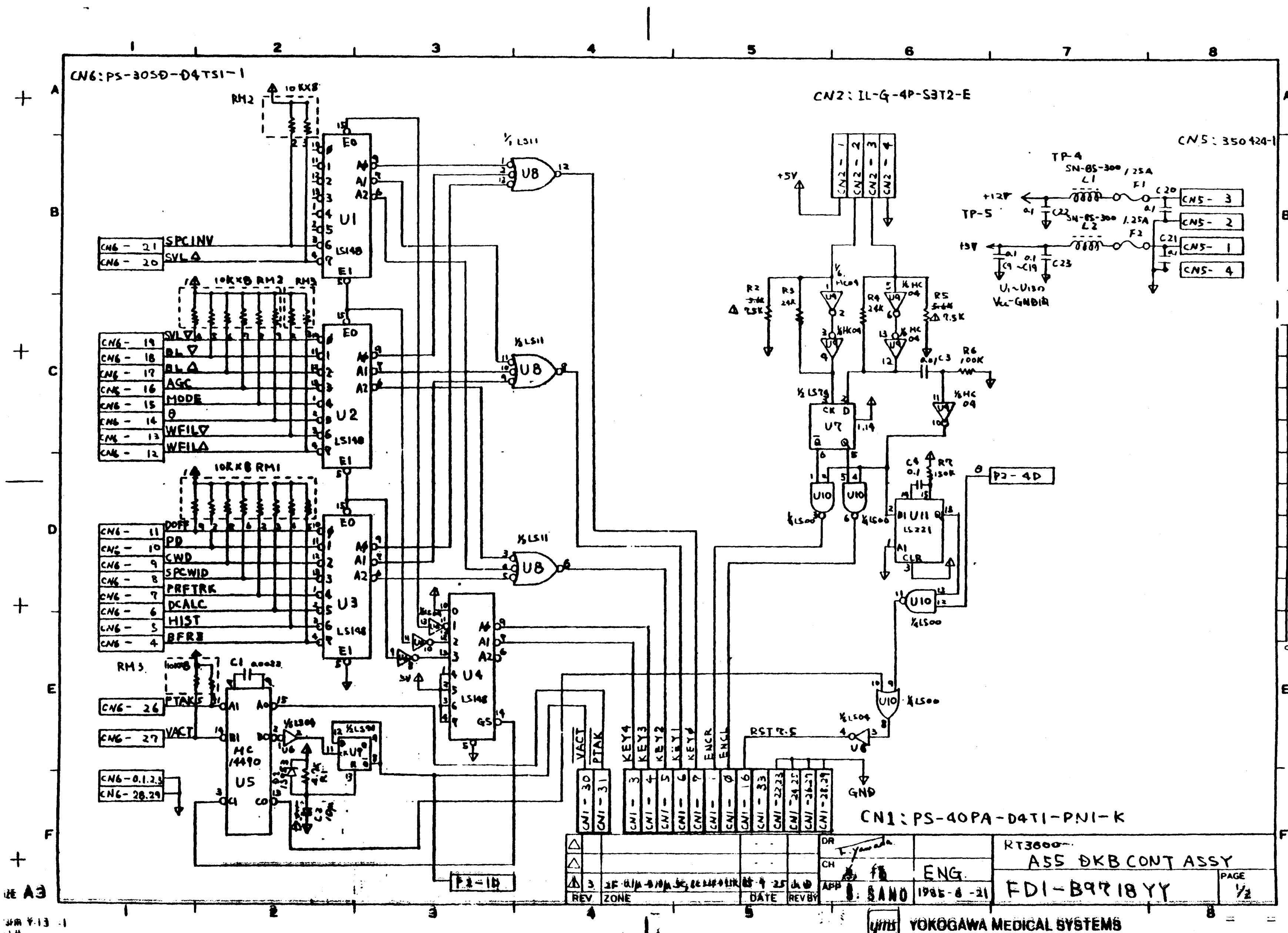
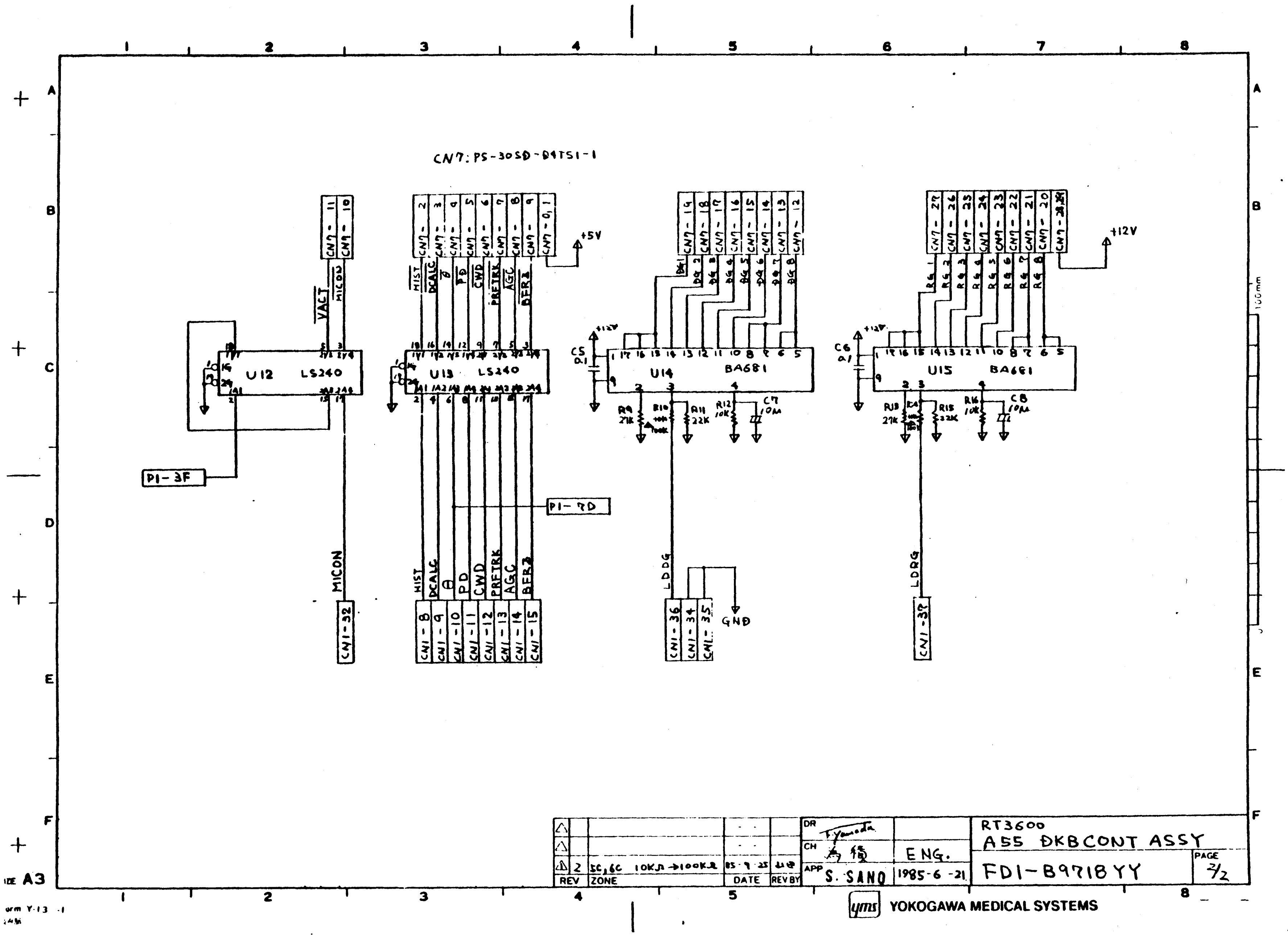
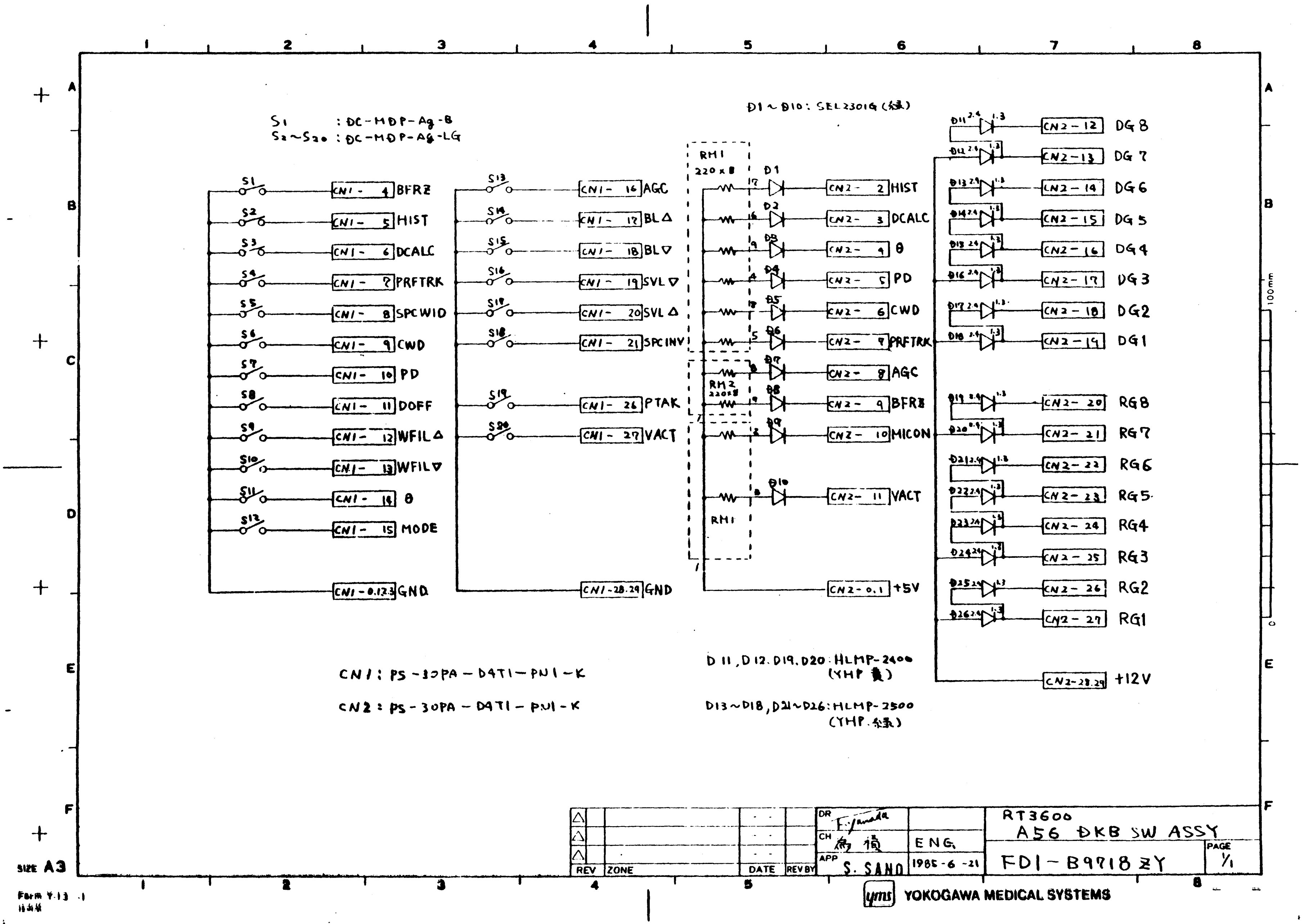
YOKOGAWA MEDICAL SYSTEMS
SIZE A3



CN6: PS-30SD-D4TS1-1
CN2: IL-G-4P-S3T2-E
CN5: 350424-1
CN1: PS-40PA-D4T1-PN1-K
U1 LS148
U2 LS148
U3 LS148
U4 LS148
U5 MC 14490
U8
U10
U11 LS221
SPCINV
SVL
AGC
MODE
PD
CWD
SPCWID
PRFTRK
DCALC
HIST
BFRZ
PTAK
VACT
KEY4
KEY3
KEY2
KEY1
ENCR
ENCL
GND
+5V
+12V
TP-4
TP-5
RT3600
A55 DKB CONT ASSY
FD1-B9718YY
ENG.
SANO
1985-8-21
PAGE 1/2
YOKOGAWA MEDICAL SYSTEMS


CN7: PS-30SD-D4TS1-1
U12 LS240
U13 LS240
U14 BA681
U15 BA681
P1-3F
P1-7D
VACT
MICON
HIST
DCALC
PD
CWD
PRETRK
AGC
BER2
LDDG
LDRG
GND
+5V
+12V
CN1-32
CN1-36
CN1-34
CN1-35
CN1-37
RT3600
A55 DKBCONT ASSY
FDI-B9718YY
PAGE 2/2
ENG.
S. SANO
1985-6-21
5C,6C 10KΩ→100KΩ
REV ZONE DATE REV BY
YOKOGAWA MEDICAL SYSTEMS
A3

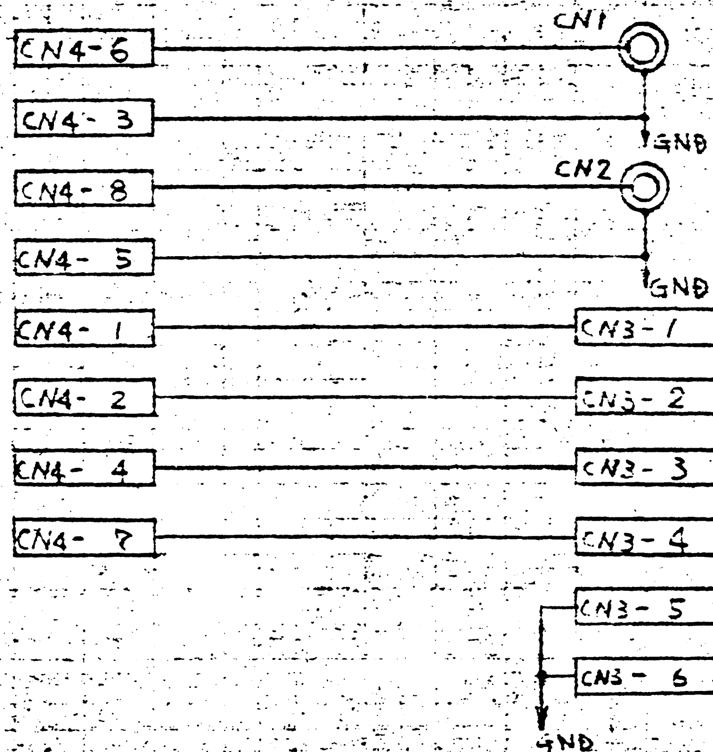

S1 : DC-MDP-Ag-B
S2~S20 : DC-MDP-Ag-LG
D1~D10: SEL2301G (緑)
RM1 220×8
RM2 220×8
S1 CN1-4 BFRZ
S2 CN1-5 HIST
S3 CN1-6 DCALC
S4 CN1-7 PRFTRK
S5 CN1-8 SPCWID
S6 CN1-9 CWD
S7 CN1-10 PD
S8 CN1-11 DOFF
S9 CN1-12 WFIL△
S10 CN1-13 WFIL▽
S11 CN1-14 θ
S12 CN1-15 MODE
CN1-0.1.2.3 GND
S13 CN1-16 AGC
S14 CN1-17 BL△
S15 CN1-18 BL▽
S16 CN1-19 SVL▽
S17 CN1-20 SVL△
S18 CN1-21 SPCINV
S19 CN1-26 PTAK
S20 CN1-27 VACT
CN1-28.29 GND
D1 CN2-2 HIST
D2 CN2-3 DCALC
D3 CN2-4 θ
D4 CN2-5 PD
D5 CN2-6 CWD
D6 CN2-7 PRFTRK
D7 CN2-8 AGC
D8 CN2-9 BFRZ
D9 CN2-10 MICON
D10 CN2-11 VACT
CN2-0.1 +5V
D11 CN2-12 DG8
D12 CN2-13 DG7
D13 CN2-14 DG6
D14 CN2-15 DG5
D15 CN2-16 DG4
D16 CN2-17 DG3
D17 CN2-18 DG2
D18 CN2-19 DG1
D19 CN2-20 RG8
D20 CN2-21 RG7
D21 CN2-22 RG6
D22 CN2-23 RG5
D23 CN2-24 RG4
D24 CN2-25 RG3
D25 CN2-26 RG2
D26 CN2-27 RG1
CN2-28.29 +12V
CN1: PS-30PA-D4T1-PN1-K
CN2: PS-30PA-D4T1-PN1-K
D11, D12, D19, D20: HLMP-2400 (YHP 黄)
D13~D18, D21~D26: HLMP-2500 (YHP 緑)
REV ZONE DATE REV BY
DR
CH
APP S. SANO
ENG.
1985-6-21
RT3600
A56 DKB SW ASSY
FD1-B9718 ZY
PAGE 1/1
YOKOGAWA MEDICAL SYSTEMS
SIZE A3
Form Y-13

CN1 : SMB 51-051-0000

CN2 : SMB 51-051-0000

CN3 : IL-G-6P-S3T2-E

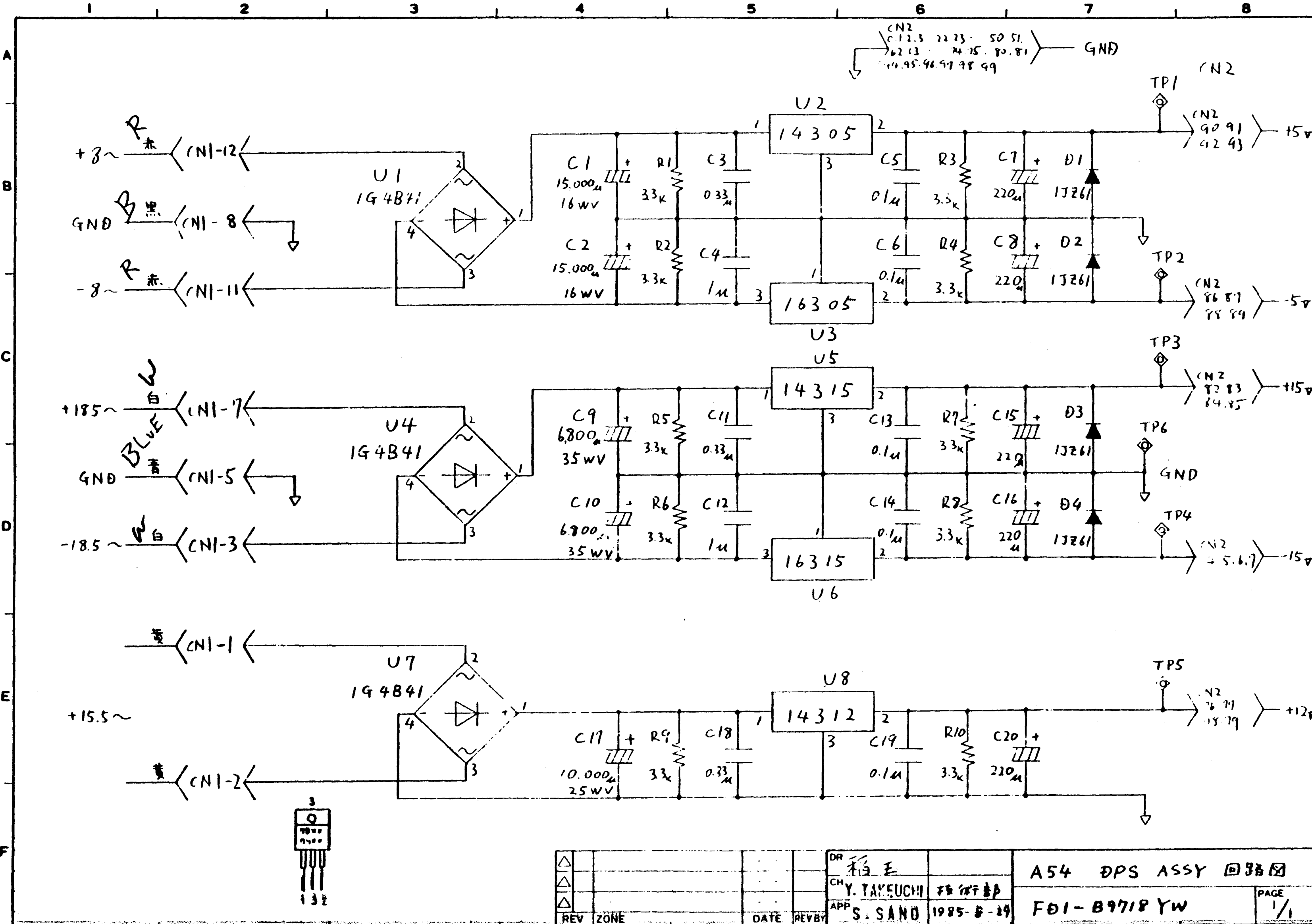
CN4 : TCS7680-01-201



REV.	PAGE	DESCRIPTION	DATE	REV. BY	CH.
△					
△					
△					
△					
△					

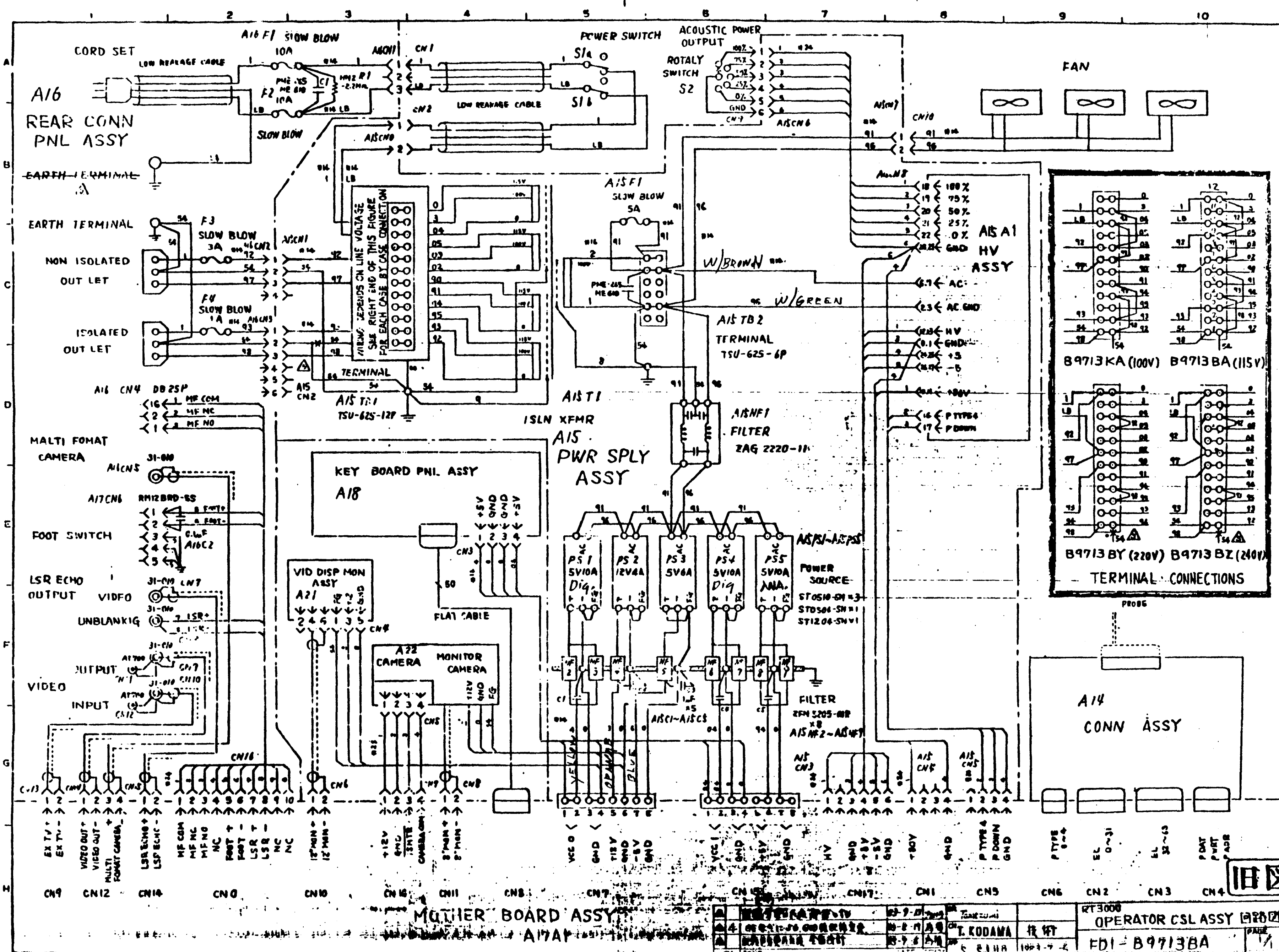
△	DR. F. Yamada	技術	RT3600 CWCON ASSY		
△	CH. U. Tamaizumi				
△	APP. 佐野	1985-9-5	FD1-B9718ZQ	PAGE 1 OF 1	
△					

SIZE A4



YOKOGAWA MEDICAL SYSTEMS

SIZE A3



BG:0YGBVGW
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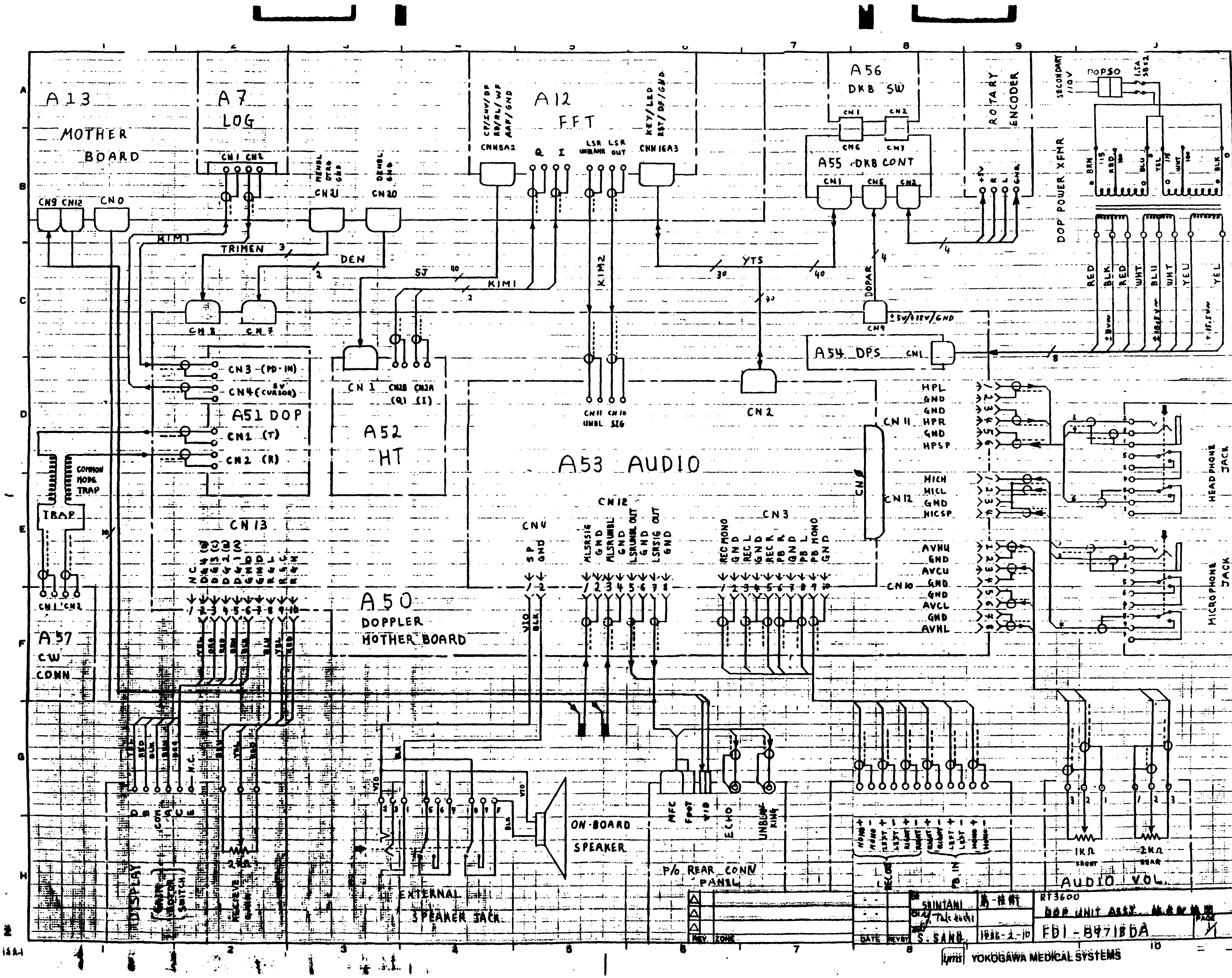
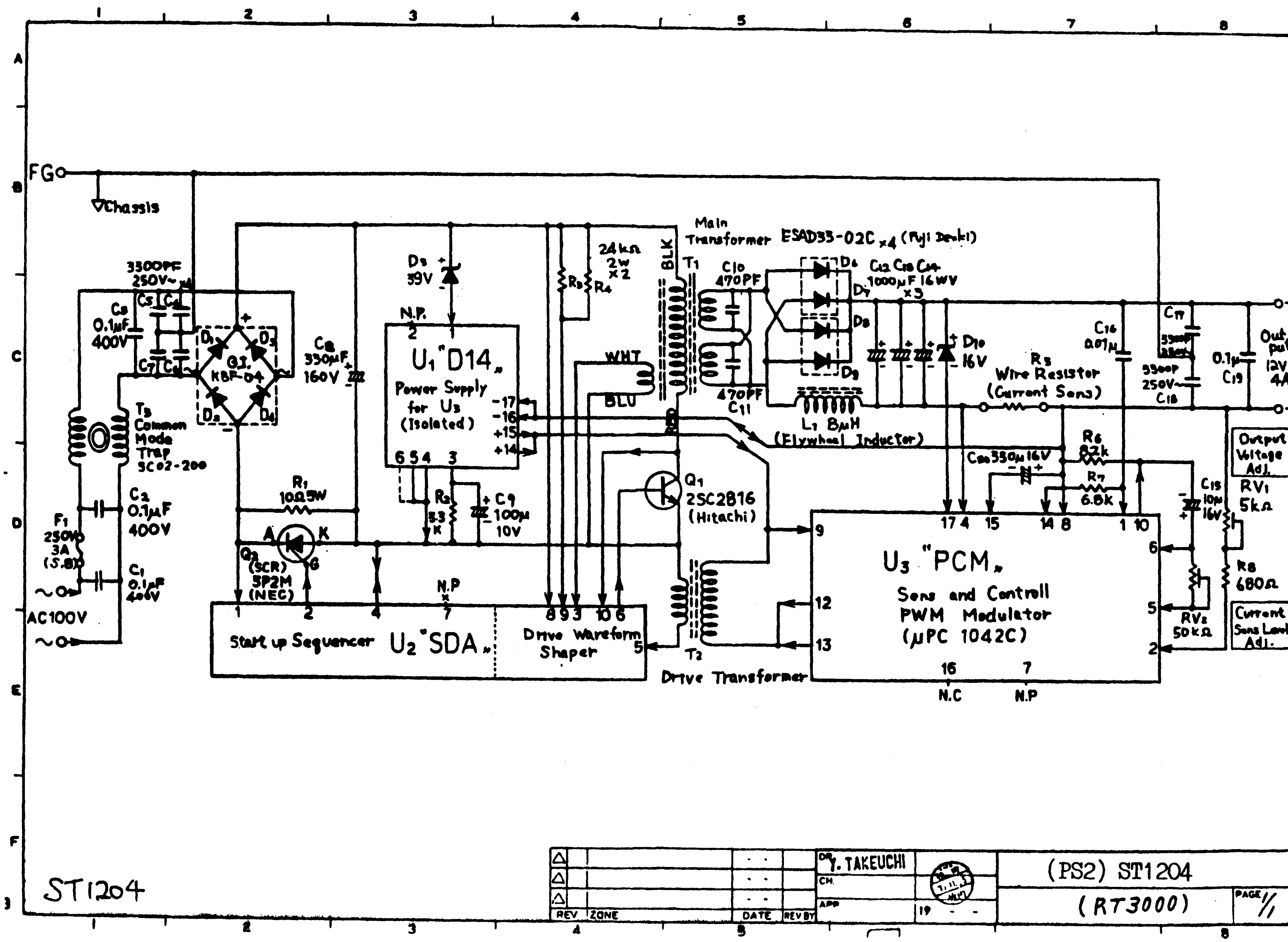
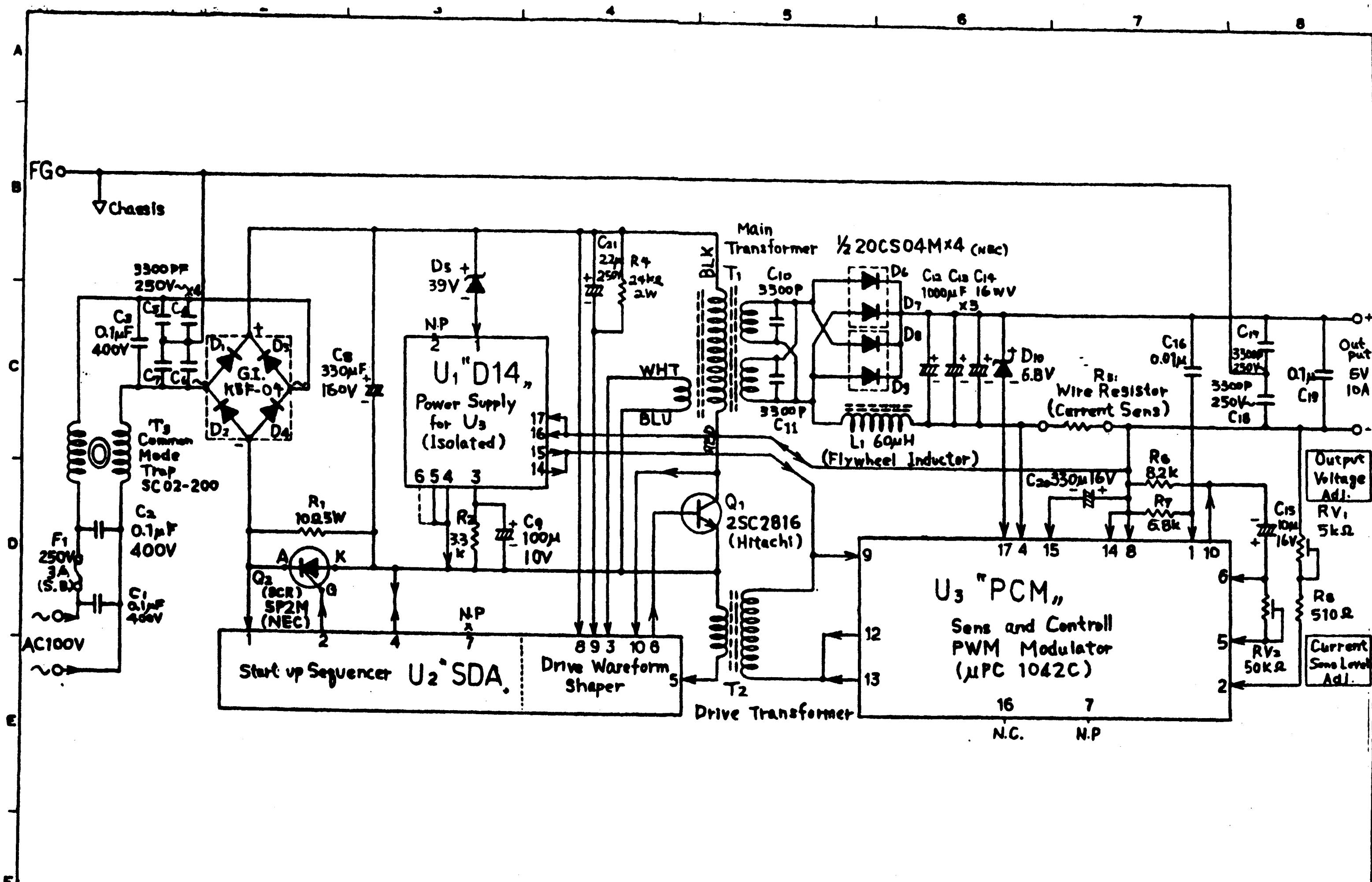


A13
MOTHER
BOARD
CN9 CN12 CN0
A7
LOG
CN1 CN2
CN21
CN20
KIM1
TRIMEN 3
DEN
SJ 40
A12
FFT
CNN5A2
Q I
LSR UNBLANK
LSR OUT
CNN16A3
KEY/LED RST/DF/GND
KIM2
YTS
A56
DKB SW
A55 DKB CONT
CN1 CN5 CN3
CN6 CN7
ROTARY
ENCODER
+5V R L GND
DOP POWER XFMR
SECONDARY 110V
RED BLK RED WHT BLU WHT YEU YEL
DOPAR
CN9
+5V/±12V/GND
A54 DPS
CN1
CN3 (PD-IN)
CN4 (CURSOR)
A51 DOP
CN1 (T)
CN2 (R)
CN1
CN2B CN2A
(Q) (I)
A52
HT
CN11 UNBL
CN10 SIG
CN2
A53 AUDIO
CN 11
HPL GND GND HPR GND HPSP
CN 12
MICH MICL GND MICSP
CN10
AVHU GND AVCU GND GND AVCL GND AVHL
HEADPHONE JACK
MICROPHONE JACK
COMMON MODE TRAP
TRAP
CN1 CN2
A57
CW
CONN
CN13
CN4
SP GND
CN12
ALSRSIG GND ALSRUNBL GND LSRUNBL OUT GND LSRSIG OUT GND
CN3
REC MONO GND REC L GND REC R PB R GND PB L PB MONO GND
A50
DOPPLER
MOTHER BOARD
ON-BOARD
SPEAKER
EXTERNAL
SPEAKER JACK
MFC FOOT VIB ECHO UNBLANKING
P/O REAR CONN PANEL
RECORD
PB IN
1KΩ FRONT
2KΩ REAR
AUDIO VOL.
DISPLAY
RECEIVE
SHINTANI
TAKeuchi
S. SANO
1986-2-10
RT3600
DOP UNIT ASSY
FD1-B9718DA
YOKOGAWA MEDICAL SYSTEMS


FG
Chassis
3300PF 250V~
C5 C6 C7 C8
C3 0.1μF 400V
T3 Common Mode Trap SC02-200
F1 250V 3A (S.B)
C2 0.1μF 400V
C1 0.1μF 400V
AC100V
D1 D2 D3 D4
G.I. KBP-04
C8 330μF 160V
R1 10Ω 5W
Q2 (SCR) 5P2M (NEC)
D5 39V
U1 "D14"
Power Supply for U3 (Isolated)
N.P.
R3 33K
C9 100μ 10V
Start up Sequencer
U2 "SDA"
Drive Waveform Shaper
24kΩ 2W ×2
R3 R4
WHT
BLU
BLK
RED
Main Transformer
T1
ESAD33-02C ×4 (Fuji Denki)
C10 470PF
C11 470PF
D6 D7 D8 D9
C12 C13 C14 1000μF 16WV ×3
D10 16V
L1 8μH (Flywheel Inductor)
Q1 2SC2816 (Hitachi)
T2
Drive Transformer
R5 Wire Resistor (Current Sens)
C16 0.01μ
C17
3300P 250V~ C18
0.1μ C19
Output 12V 4A
C20 330μ 16V
R6 82k
R7 6.8k
C15 10μ 16V
Output Voltage Adj.
RV1 5kΩ
R8 680Ω
RV2 50kΩ
Current Sens Level Adj.
U3 "PCM"
Sens and Controll PWM Modulator (μPC 1042C)
N.C
N.P
ST1204
DR Y. TAKEUCHI
CH.
APP
REV ZONE DATE REV BY
(PS2) ST1204
(RT3000)
PAGE 1/1

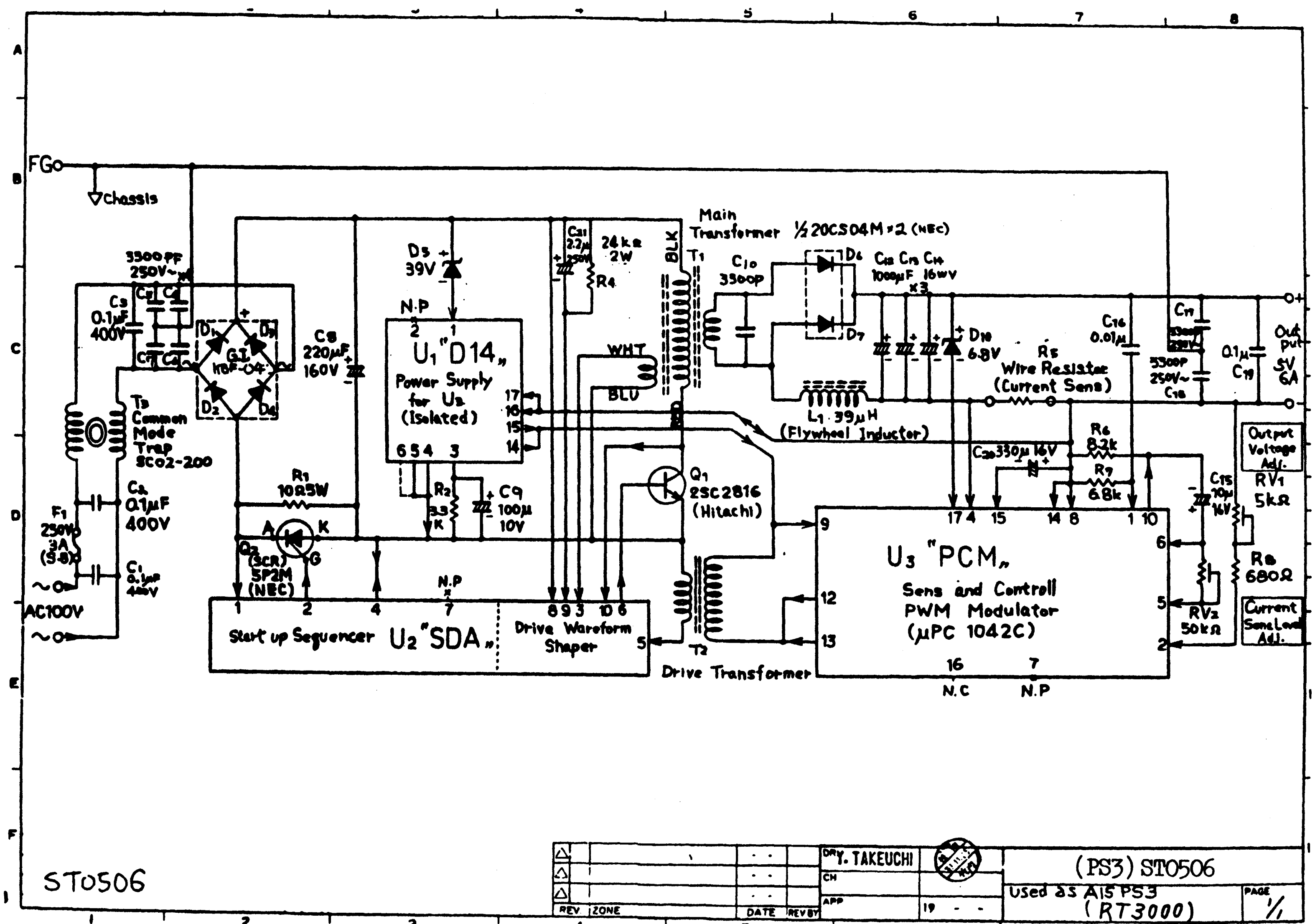


REV	ZONE		DATE	REV BY
			. .	
			. .	
			. .	

DR Y. TAKEUCHI
CH
APP
19 -

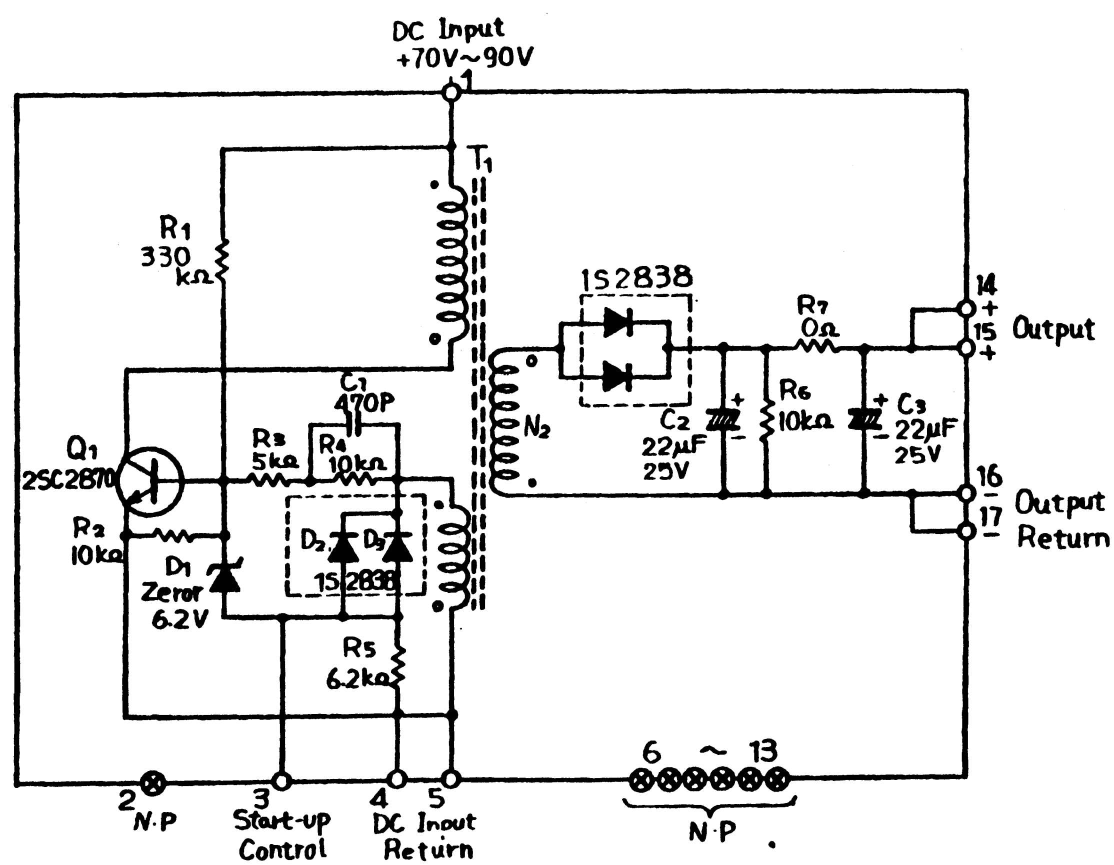
(PS1, PS4, PS5) ST0510
Used as A1s PS1, 4 and 5
(RT3000)
PAGE 1/1

ST0510

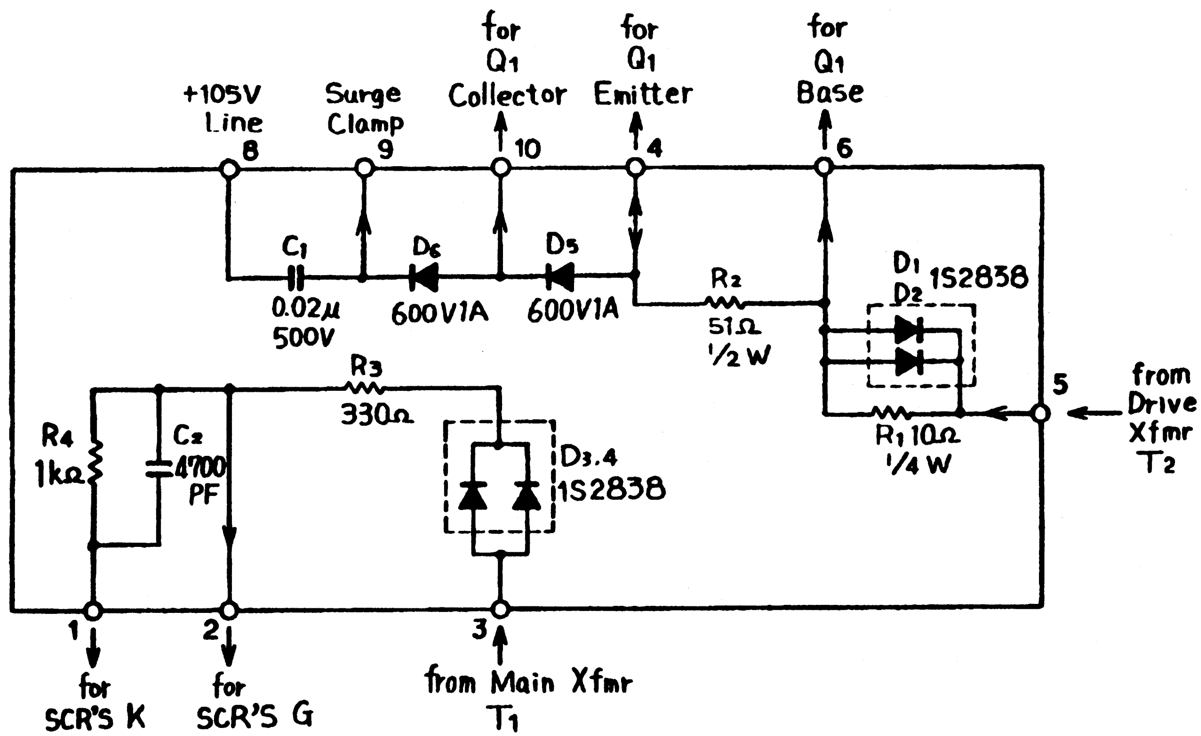


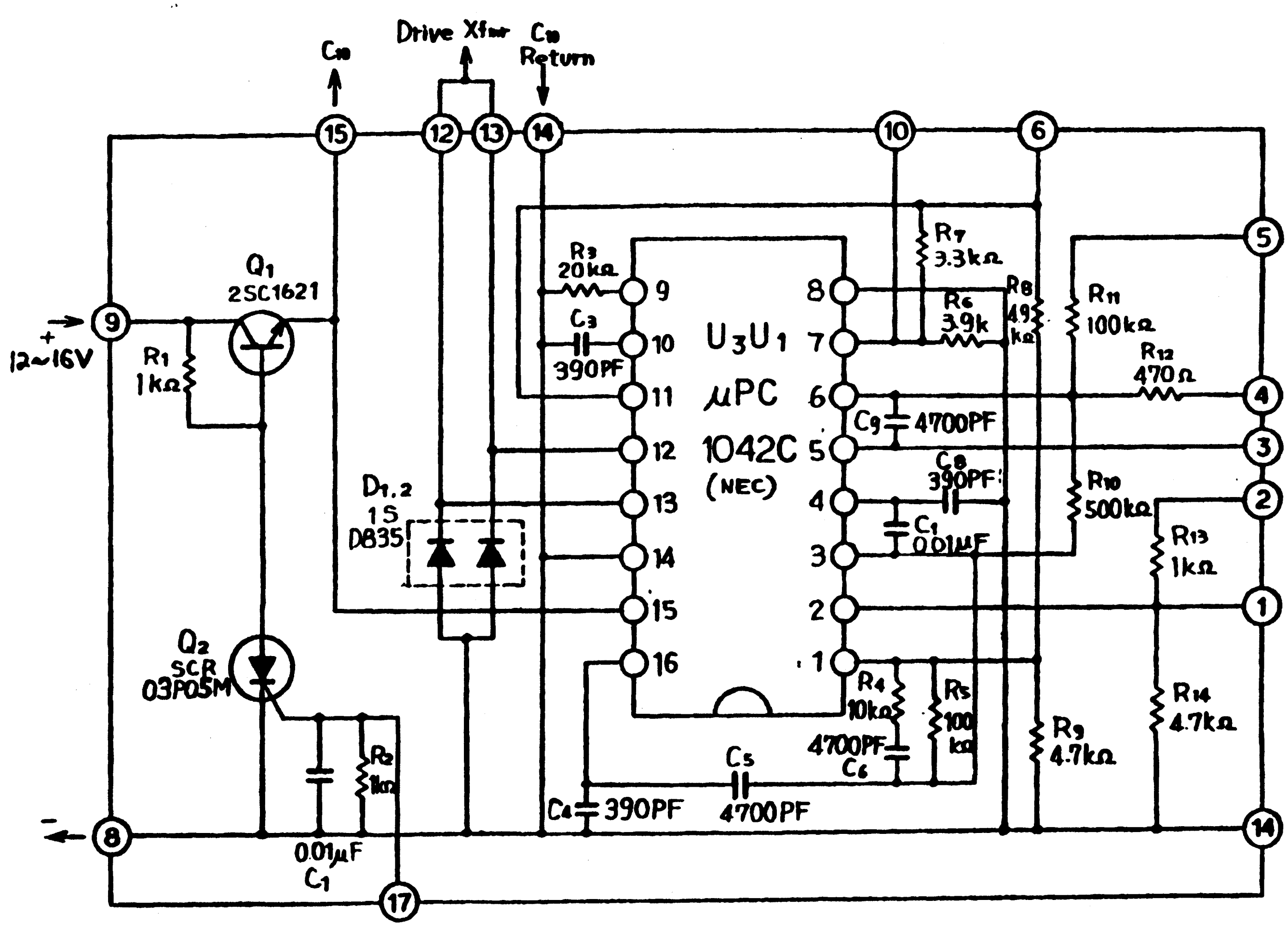
			DR Y. TAKEUCHI		(PS3) ST0506	
			CH		Used as A15 PS3 (RT3000)	PAGE 1/1
REV	ZONE	DATE	REV BY	APP	19 - -	

U1: "D14-12R1" CIRCUITRY

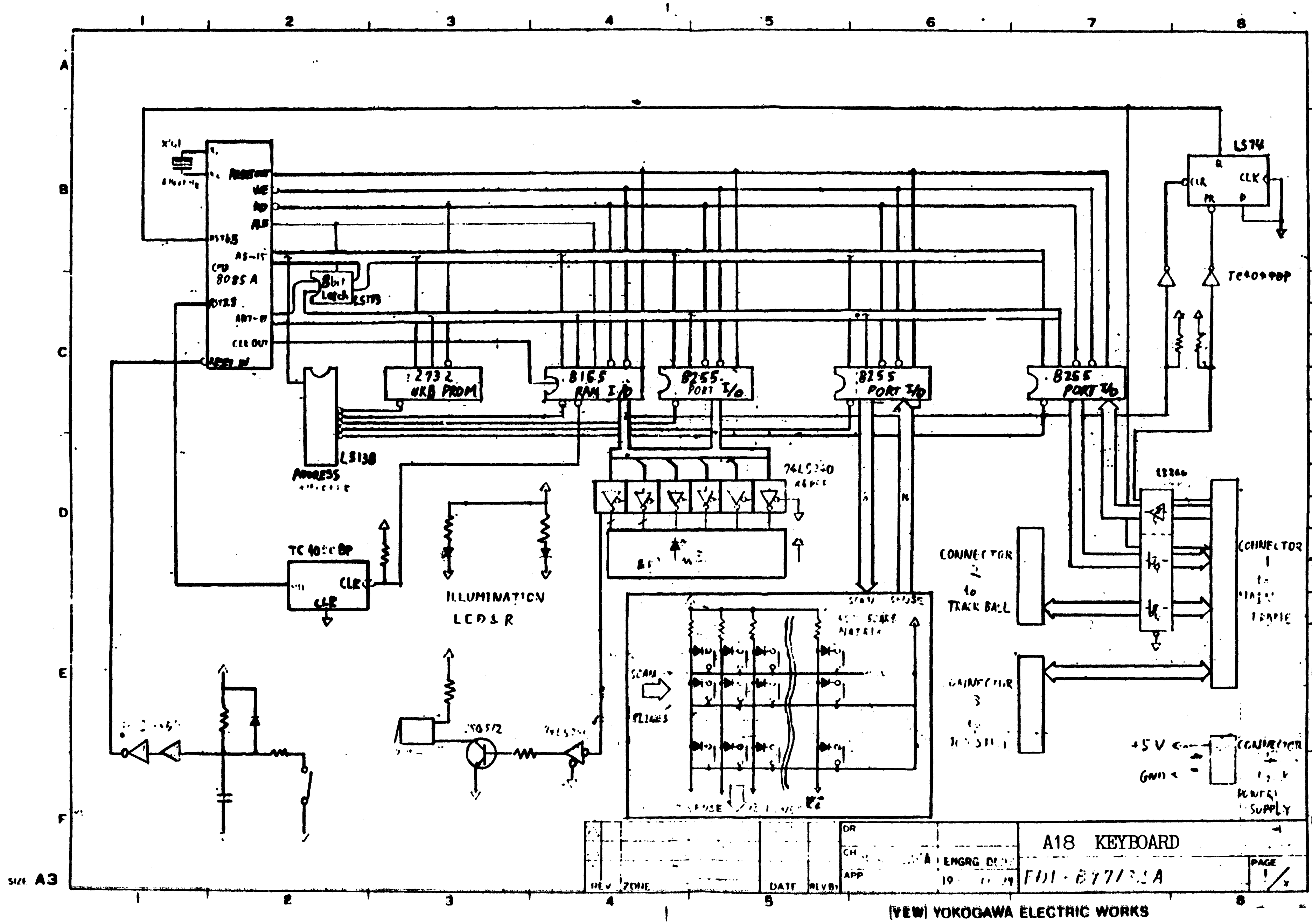


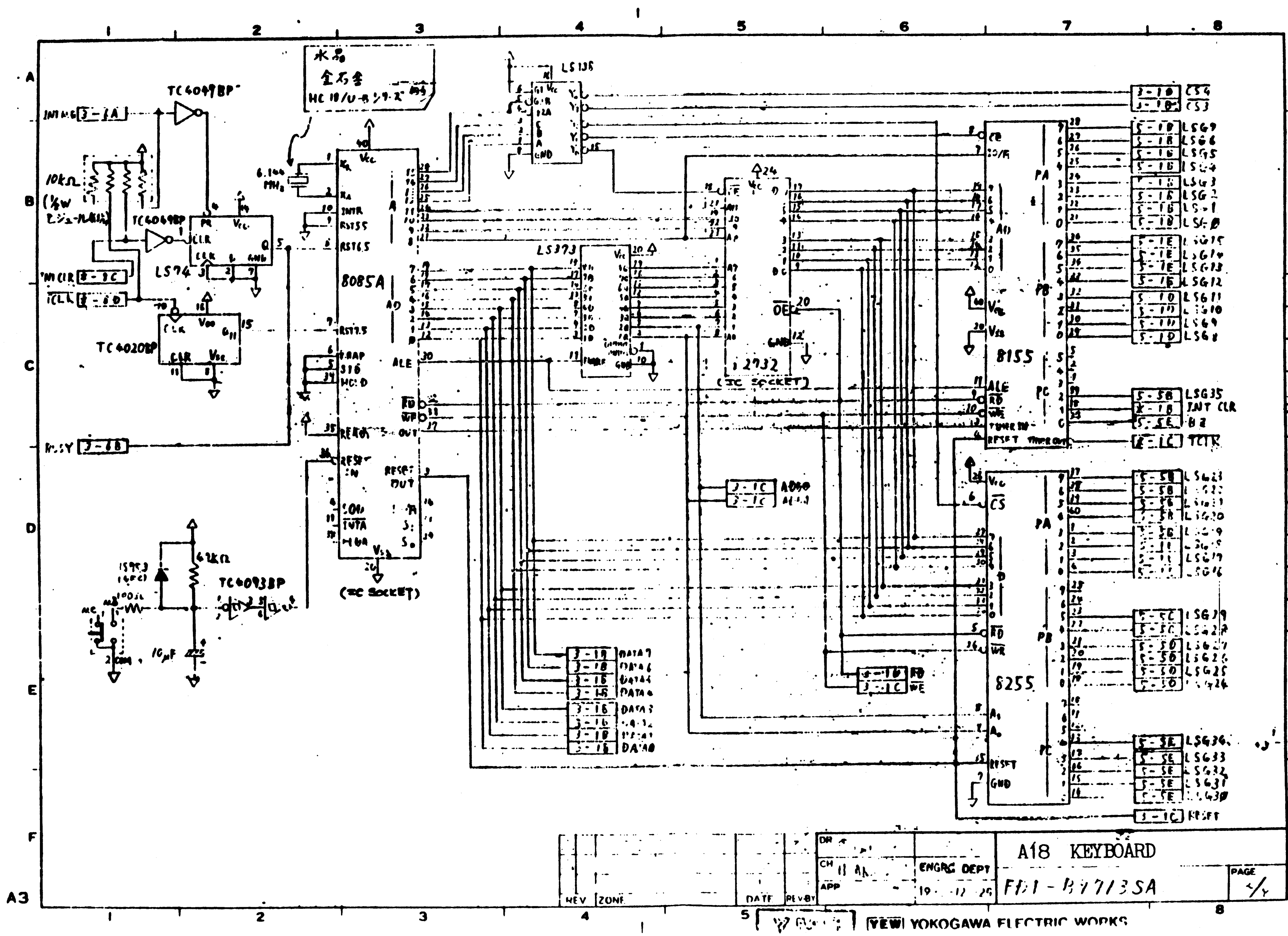
U_2: "SDA-001" CIRCUITRY

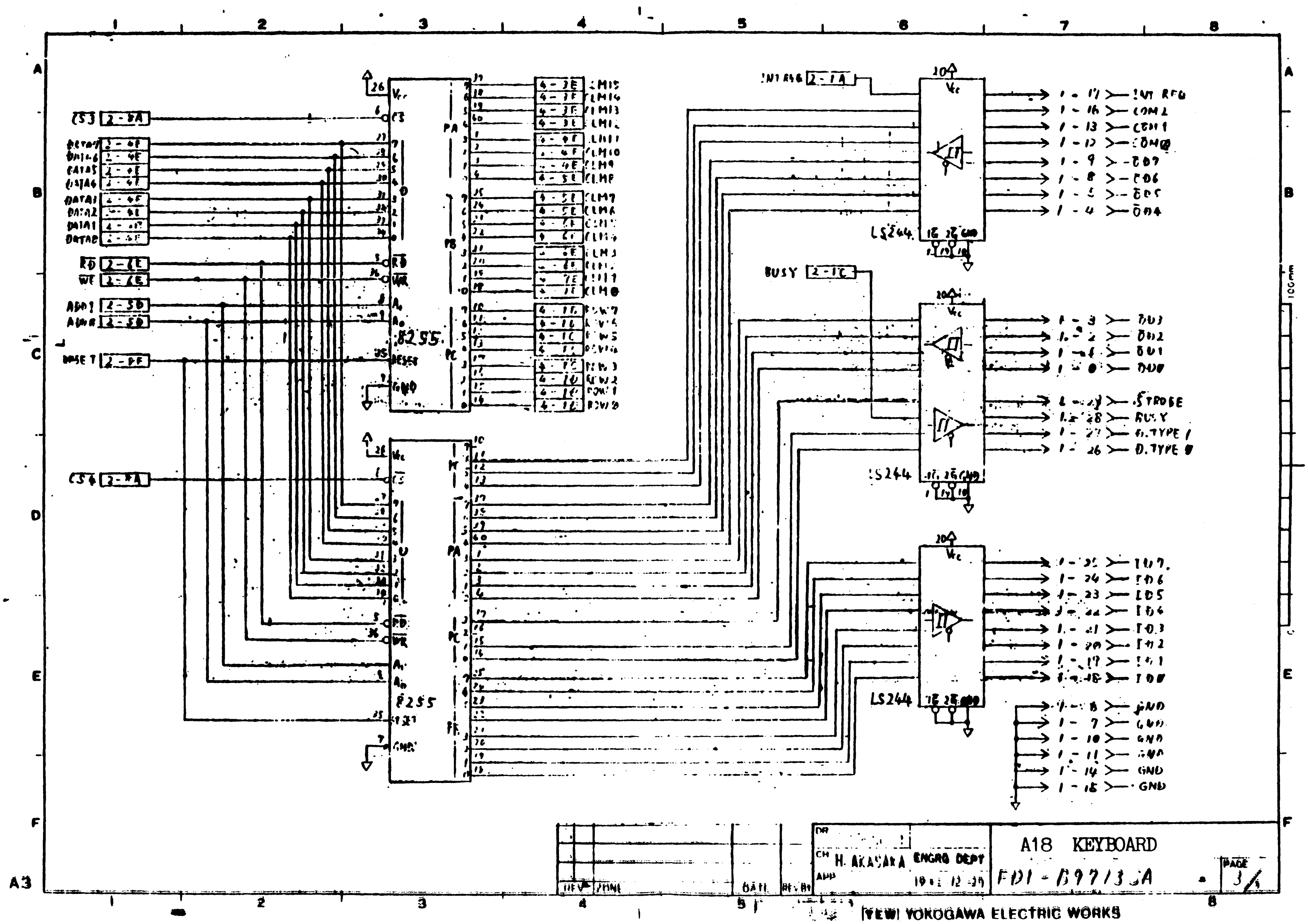


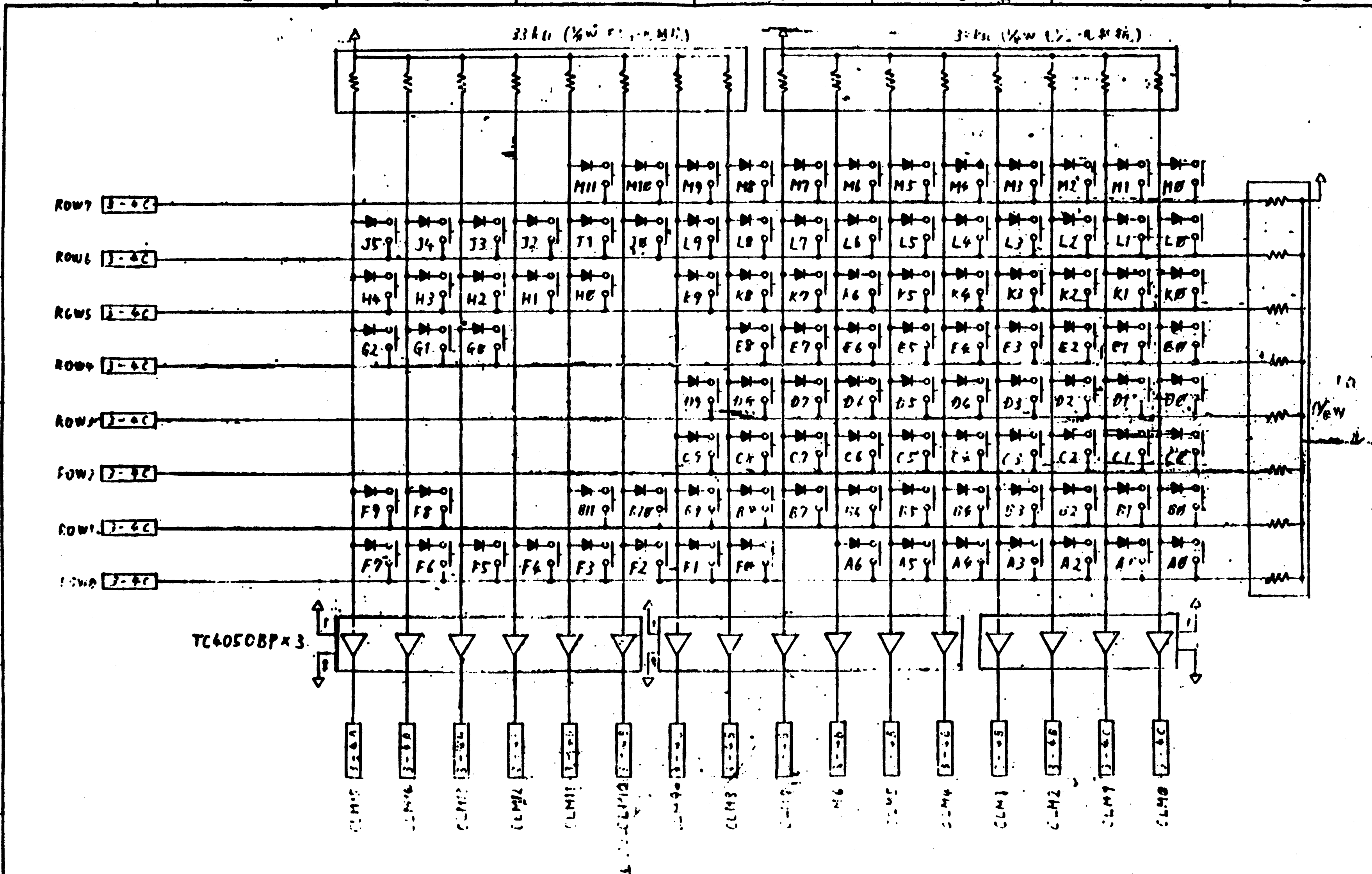


U3: "PCM-102" CIRCUITRY


LS74
CLK
CLR
TC4049BP
8085 A
8 bit Latch
LS373
2732
8KB PROM
8155
RAM I/O
8255
PORT I/O
LS138
ADDRESS
TC4020BP
CLK
CLR
74LS240
ILLUMINATION
LEDS R
CONNECTOR 1
CONNECTOR 2
to
TRACK BALL
CONNECTOR 3
+5 V
GND
POWER SUPPLY
SCAN
SENSE
SCAN LINES
A18 KEYBOARD
DR
CH
APP
ENGRG DEPT
REV
ZONE
DATE
PAGE
1/1
SIZE A3
(YEW) YOKOGAWA ELECTRIC WORKS


8085A
8155
8255
2732
LS373
LS138
LS74
TC4049BP
TC4020BP
TC4093BP
(IC SOCKET)
A18 KEYBOARD
FB1-B7713SA
ENGRG DEPT
YEW YOKOGAWA ELECTRIC WORKS


8255
8255
LS244
LS244
LS244
INT REQ
COM 2
BUSY
STROBE
D.TYPE 1
D.TYPE 0
GND
A18 KEYBOARD
H. AKASAKA
ENGRG DEPT
FD1 - B9713 A
PAGE 3/4
YEW YOKOGAWA ELECTRIC WORKS
A3



ALL DIODES 1S953 (NEC) OR EQUIV.
ALL REGISTERS 1/4W ±5% MODULE REG.

REV	ZONE	DATE	REV.BY

DR
CH
APP
ENGRG DEP.
19_-12-_

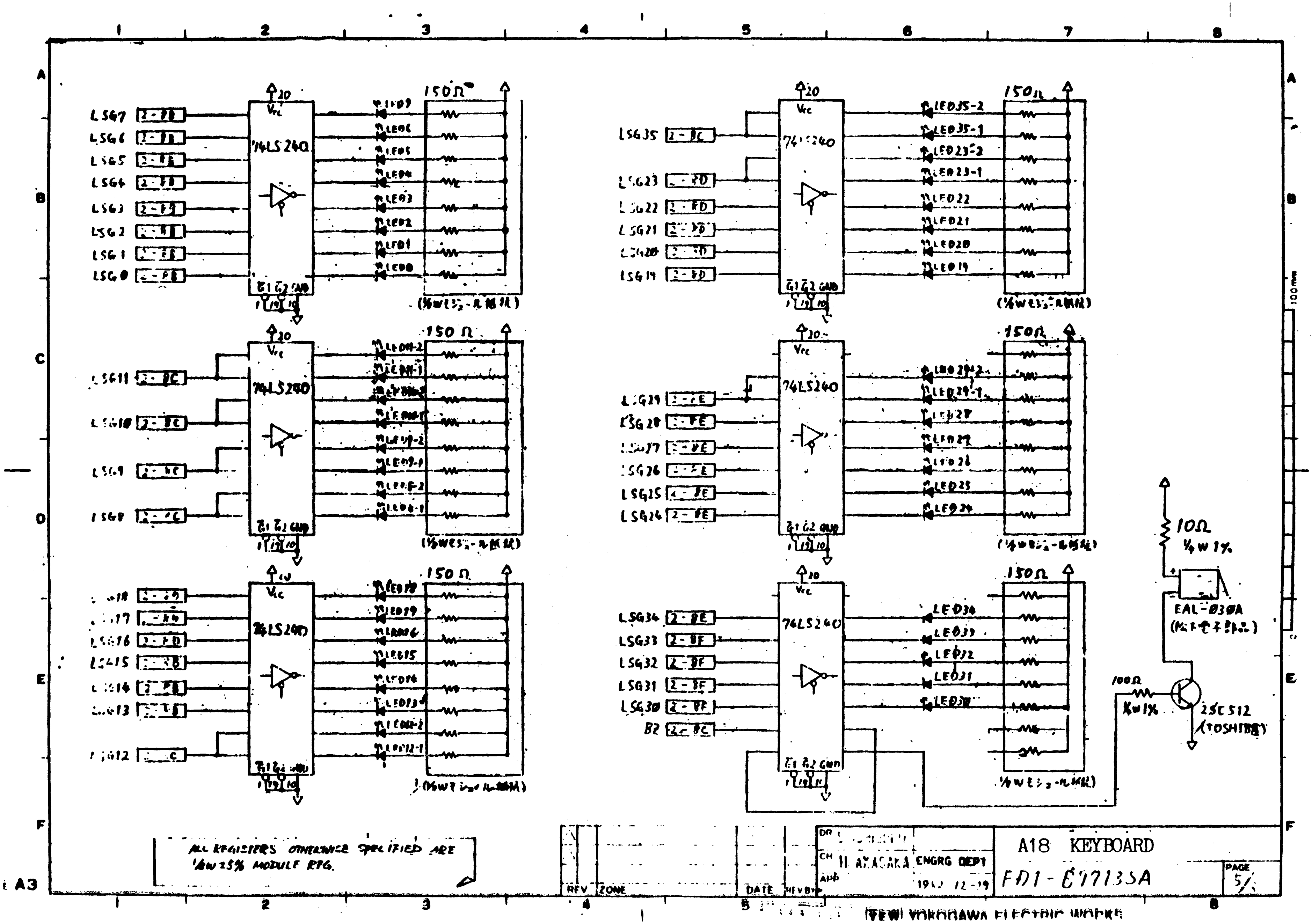
A18 KEYBOARD

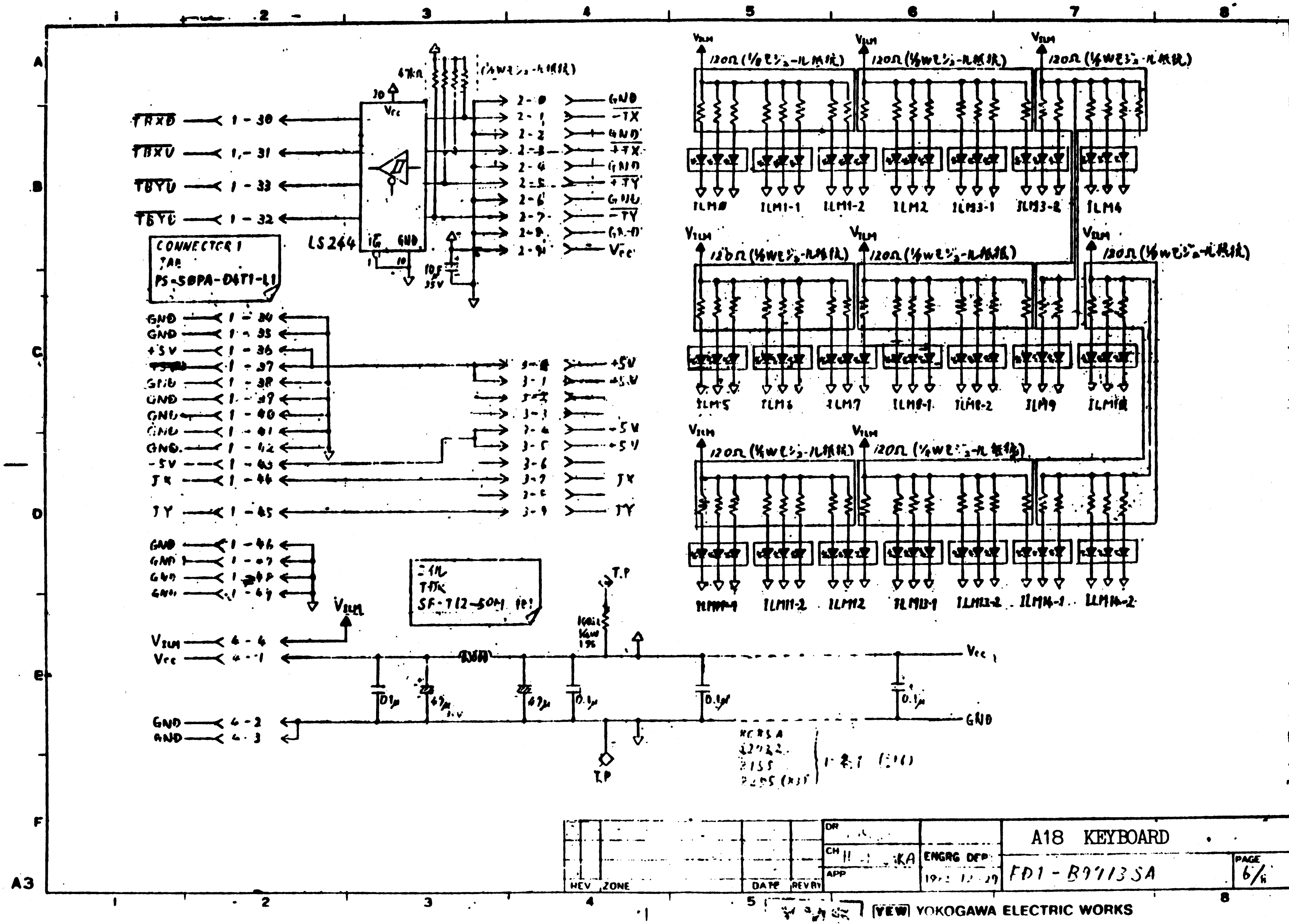
FD1-69713SA

PAGE 4/8

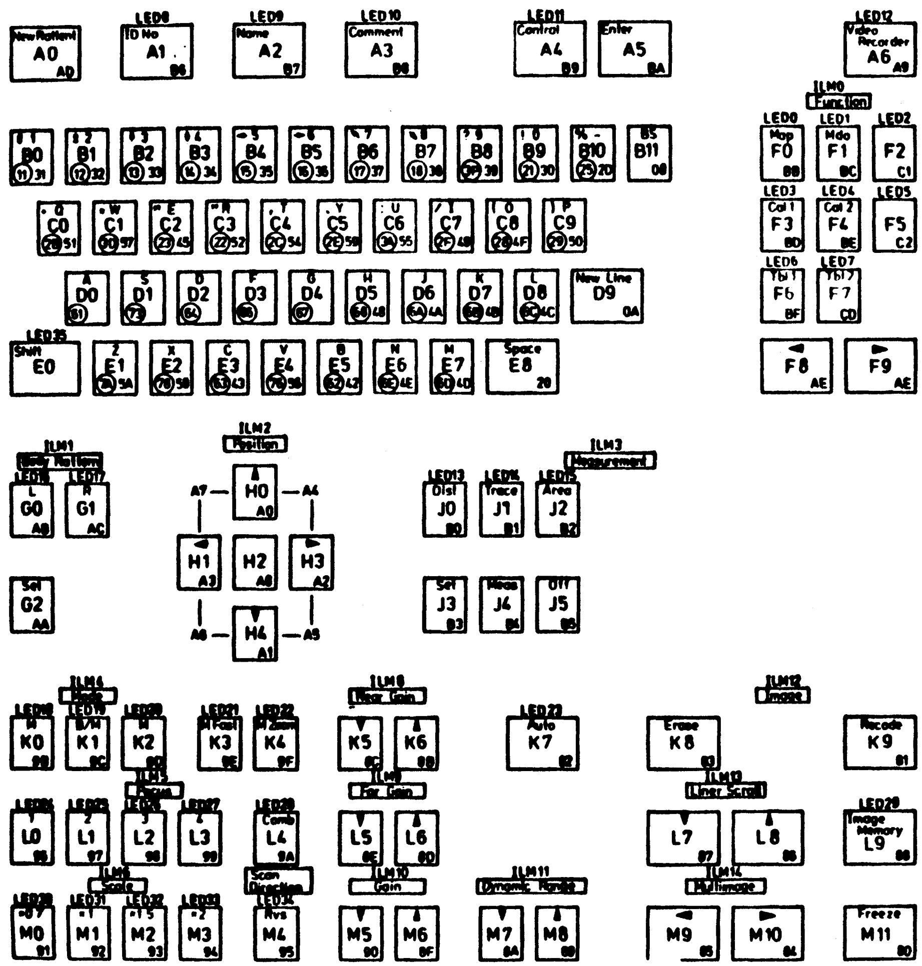
YEW YOKOGAWA ELECTRIC WORKS

A3


74LS240
150Ω
LSG7
LSG6
LSG5
LSG4
LSG3
LSG2
LSG1
LSG0
LSG11
LSG10
LSG9
LSG8
LSG35
LSG23
LSG22
LSG21
LSG20
LSG19
LSG28
LSG25
LSG24
LSG34
LSG33
LSG32
LSG31
LSG30
B2
LED35-2
LED35-1
LED23-2
LED23-1
LED22
LED21
LED20
LED19
LED34
LED33
LED32
LED31
LED30
10Ω
¼W 1%
EAL-030A
100Ω
¼W1%
2SC512
(TOSHIBA)
ALL REGISTERS OTHERWISE SPECIFIED ARE
¼W ±5% MODULE RPG.
A18 KEYBOARD
FD1-E7713SA
ENGRG DEPT
H. AKASAKA
PAGE 5/
YEW YOKOGAWA ELECTRIC WORKS
REV
ZONE
DATE
REV BY
A3



TRXD
TBXU
TBYU
TBYC
CONNECTOR 1
TAB
PS-50PA-D4T1-L1
LS244
GND
GND
+5V
GND
GND
GND
GND
GND
-5V
JX
JY
GND
GND
GND
GND
VILM
Vcc
GND
GND
-TX
+TX
+TY
-TY
Vcc
+5V
-5V
T.P
0.1μ
47μ
GND
ILM1-1
ILM1-2
ILM2
ILM3-1
ILM3-2
ILM4
ILM5
ILM6
ILM7
ILM8-1
ILM8-2
ILM9
ILM11-2
ILM12
ILM13-1
ILM13-2
ILM14-1
ILM14-2
A18 KEYBOARD
FD1-B9713SA
PAGE 6/6
DR
CH
APP
ENGRG DEP
REV
ZONE
DATE
REV'BY
YOKOGAWA ELECTRIC WORKS
A3



REV.	ZONE	DATE	REV. BY	DR. T. SAKAMOTO	ENGRG DEPT	KEYBOARD	
				CH.			
				APP	1983-11-12	FD1-B9713SA	PAGE 7/8

SIZE A3

Form V.13

Connector 1

Pin No.	Signal	Pin No.	Signal
Ø	ODØ	1	OD1
2	OD2	3	OD3
4	OD4	5	OD5
6	GND	7	GND
8	OD6	9	OD7
10	GND	11	GND
12	COMØ	13	COM1
14	GND	15	GND
16	COM2	17	INT REQ
18	IDØ	19	ID1
20	ID2	21	ID3
22	ID4	23	ID5
24	ID6	25	ID7
26	D.TYPEØ	27	D.TYPE1
28	BUSY	29	STROBE
30	TBxD	31	TBxU
32	TByD	33	TByU
34	GND	35	GND
36	+5V	37	+5V
38	GND	39	GND
40	GND	41	GND
42	GND	43	GND
44	Jx	45	Jy
46	GND	47	GND
48	GND	49	GND

Connector 2

Pin No.	Signal	Pin No.	Signal
Ø	GND	1	-Tx
2	GND	3	+Tx
4	GND	5	+Ty
6	GND	7	-Ty
8	GND	9	Vcc

Connector 3

Pin No.	Signal	Pin No.	Signal
Ø	+5V	1	+5V
2		3	
4	-5V	5	-5V
6		7	Jx
8		9	Jy

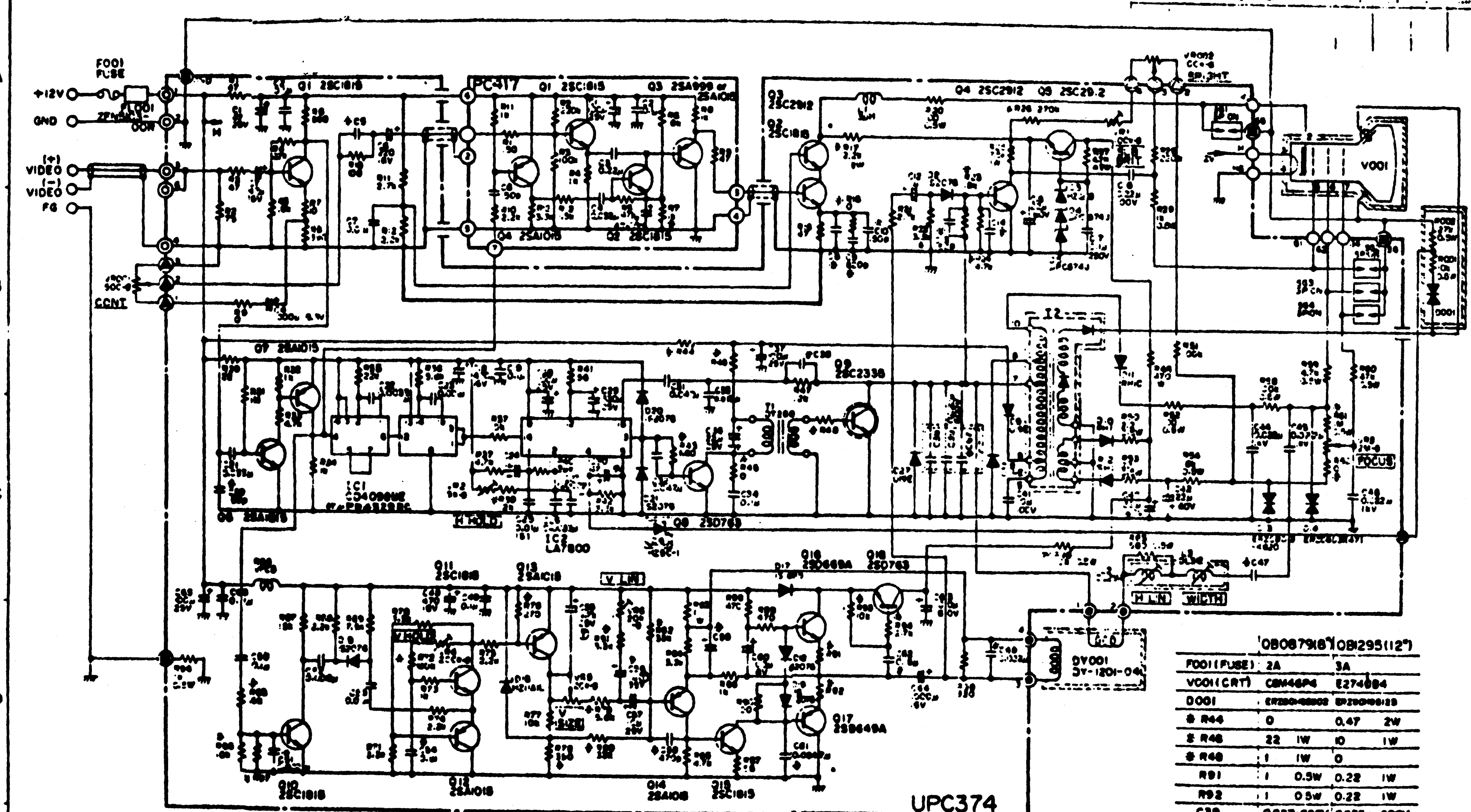
Connector 4

Pin No.	Signal	Pin No.	Signal
1	Vcc	2	GND
3	GND	4	Vcc

REV	ZONE	DATE	REV BY	DR. T. SAKAMOTO	ENGRG DEPT	KEYBOARD	
				CH.			
				APP	1983-11-12	FD1-B9713SA	PAGE 8/8

SIZE A3

Form Y-13



	QB0879(8")	QB1295(12")
F001(FUSE)	2A	3A
V001(CRT)	CBM46P4	E2748B4
D001		
※R44	0	0.47 2W
※R46	22 1W	10 1W
※R48	1 1W	0
R91	1 0.5W	0.22 1W
R92	1 0.5W	0.22 1W
C38	0.027µ 600V	0.033µ 600V
※C47	5.6µ 100V	8.2µ 100V
※C67		
T2	DH-1200-05	DH-1200-06
C59	220µ 16V	330µ 16V

NOTES 1. Unless otherwise specified: Resistance values are in ohms(Ω), 0.25W watt. Capacitance values are in microfarads(µF), 50WV.
2. Components marked with a ※ is to change at adjustment.
3. ① Indicates CN1
② Indicates CN2
③ Indicates CN3
④ Indicates CN4
⑤ Indicates One pin terminal
4. Components enclosed with ▭ mark are critical for X-radiation safety. When replacing any of these components, replace with identical ones.

QB0879,1295 CIRCUIT DIAGRAM

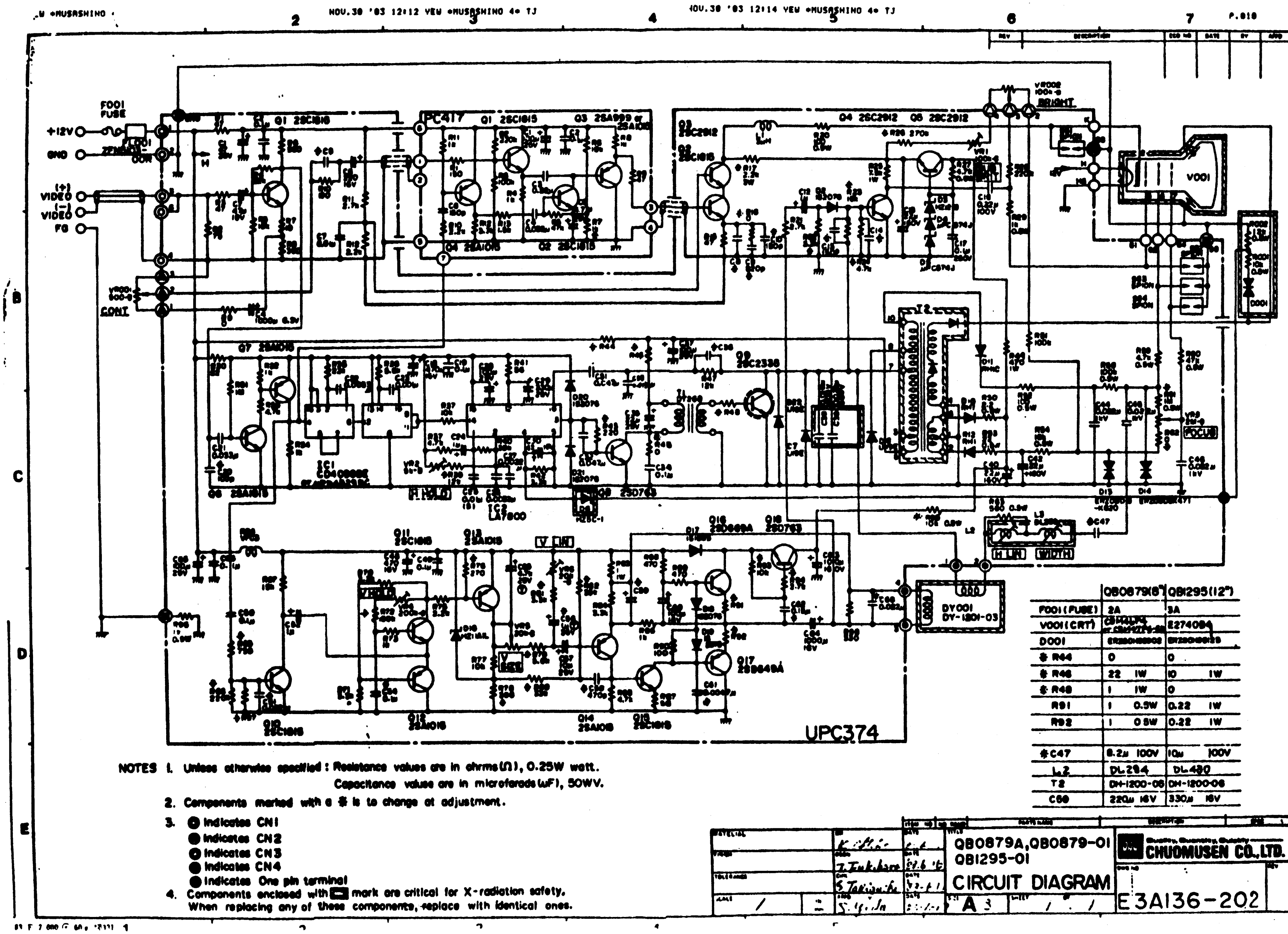
CHUOMUSEN CO.,LTD.

E3A136-201

For RT3000L

QB1295 = Viewing Monitor A21

QB0879 = Polaroid Monitor A22



NOTES
1. Unless otherwise specified : Resistance values are in ohms(Ω), 0.25W watt. Capacitance values are in microfarads(uF), 50WV.
2. Components marked with a $ is to change at adjustment.
3. ● Indicates CN1
● Indicates CN2
● Indicates CN3
● Indicates CN4
● Indicates One pin terminal
4. Components enclosed with ▭ mark are critical for X-radiation safety. When replacing any of these components, replace with identical ones.

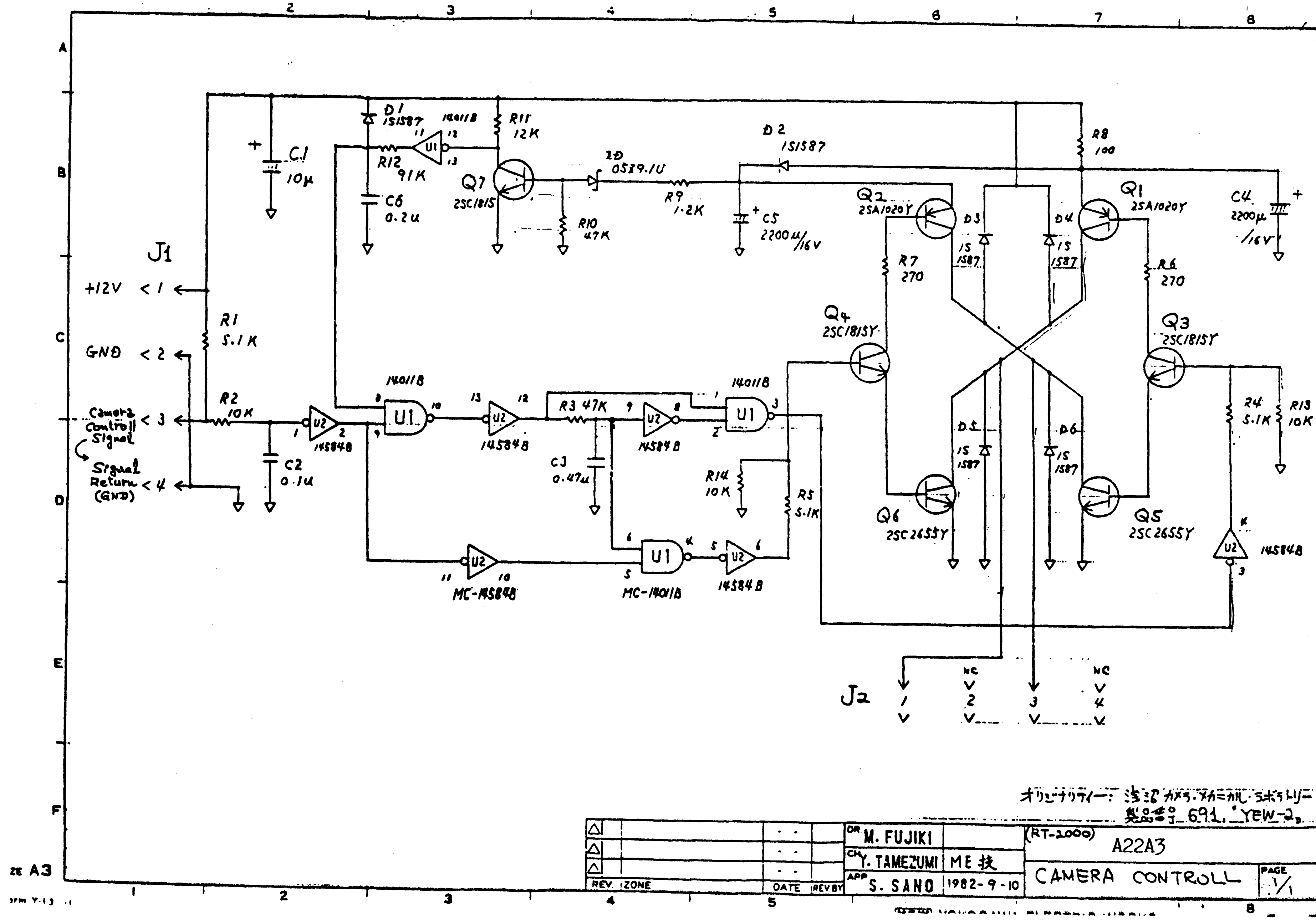
	QB0879(8")	QB1295(12")
F001 (FUSE)	2A	3A
V001 (CRT)	[illegible]	E27408A
D001	[illegible]	[illegible]
$ R44	0	0
$ R46	22 1W	10 1W
$ R48	1 1W	0
R91	1 0.5W	0.22 1W
R92	1 0.5W	0.22 1W
$ C47	8.2μ 100V	10μ 100V
L2	DL-294	DL-480
T2	DH-1200-06	DH-1200-06
C60	220μ 16V	330μ 16V

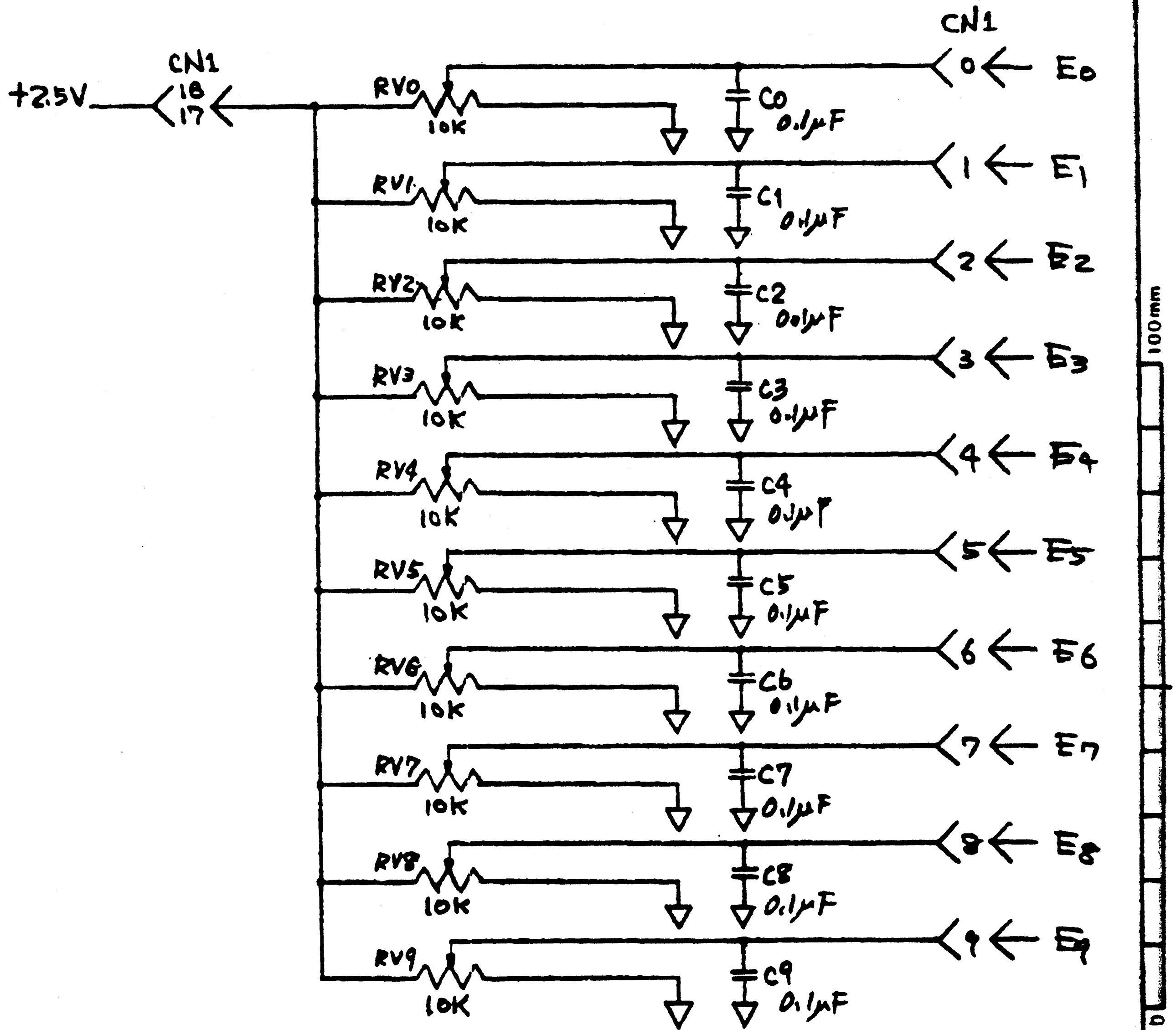
QB0879A, QB0879-01
QB1295-01
CIRCUIT DIAGRAM
A3
CHUOMUSEN CO., LTD.
E3A136-202

For RT3000S/L

QB1295-01 = Viewing Monitor A21

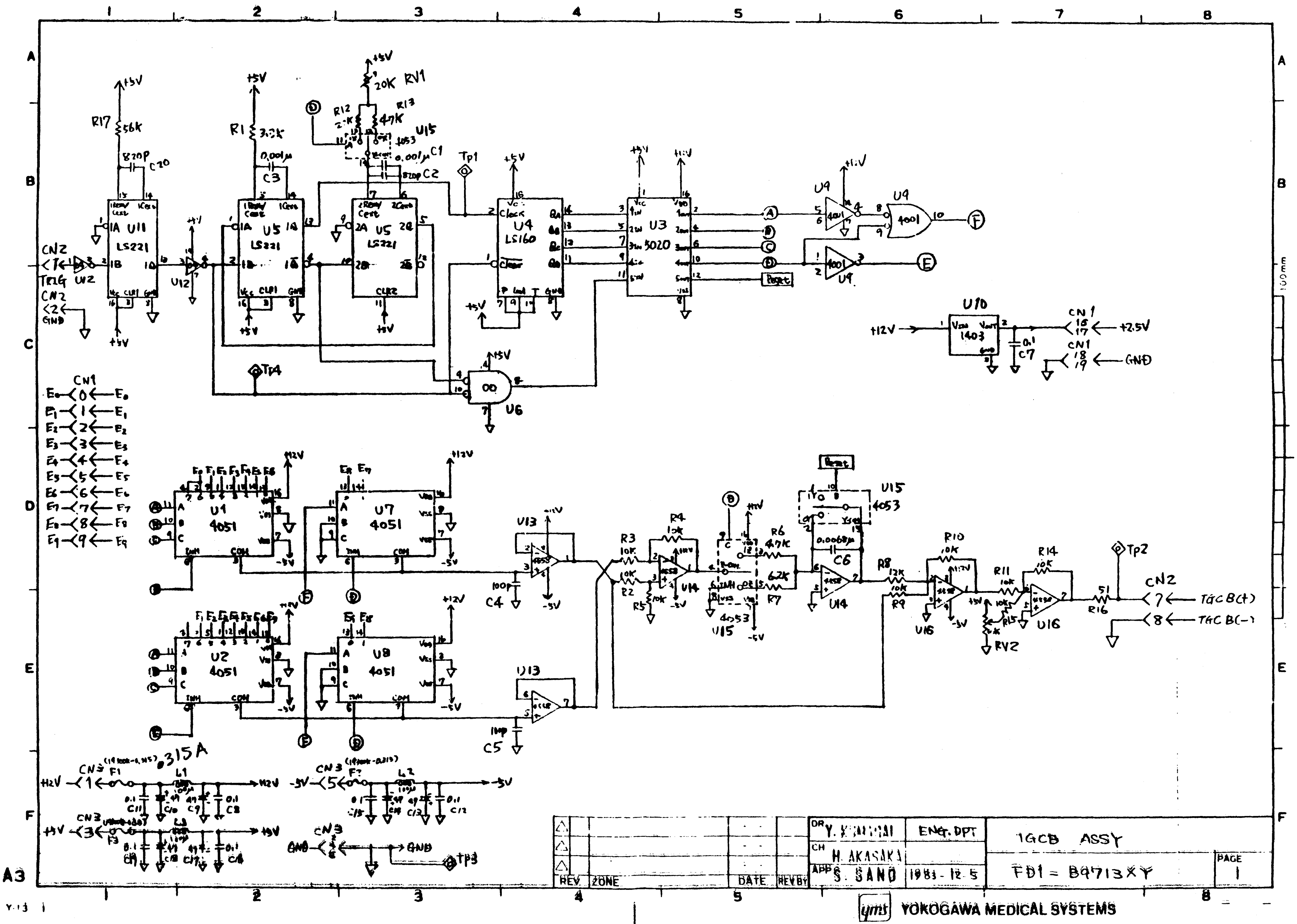
QB0879A = Polaroid Monitor A22


J1
+12V < 1
GND < 2
Camera Controll Signal < 3
Signal Return (GND) < 4
R1 5.1K
R2 10K
C1 10μ
C2 0.1U
D1 1S1587
R12 91K
C6 0.2U
R11 12K
Q7 2SC1815
R10 47K
ZD 05Z9.1U
R9 1.2K
D2 1S1587
C5 2200U/16V
R8 100
Q1 2SA1020Y
Q2 2SA1020Y
Q3 2SC1815Y
Q4 2SC1815Y
Q5 2SC2655Y
Q6 2SC2655Y
D3 1S1587
D4 1S1587
D5 1S1587
D6 1S1587
R7 270
R6 270
C4 2200μ /16V
R4 5.1K
R13 10K
R3 47K
C3 0.47U
R14 10K
R5 5.1K
14011B
14584B
MC-14584B
MC-14011B
J2
NC
1
2
3
4
オリジナリティー: 渡辺 カメラ・メカニカル・ラボラトリー
製品番号 691, YEW-2
DR. M. FUJIKI
CH. Y. TAMEZUMI
APP. S. SANO
ME 技
1982-9-10
(RT-2000)
A22A3
CAMERA CONTROLL
PAGE 1/1
REV. ZONE DATE REV BY



DR Y. KUMAGAI	ENG. DPT	TGCA ASSY
CH		
APP	1983-12-2	FD1- B9713WY — PAGE 1

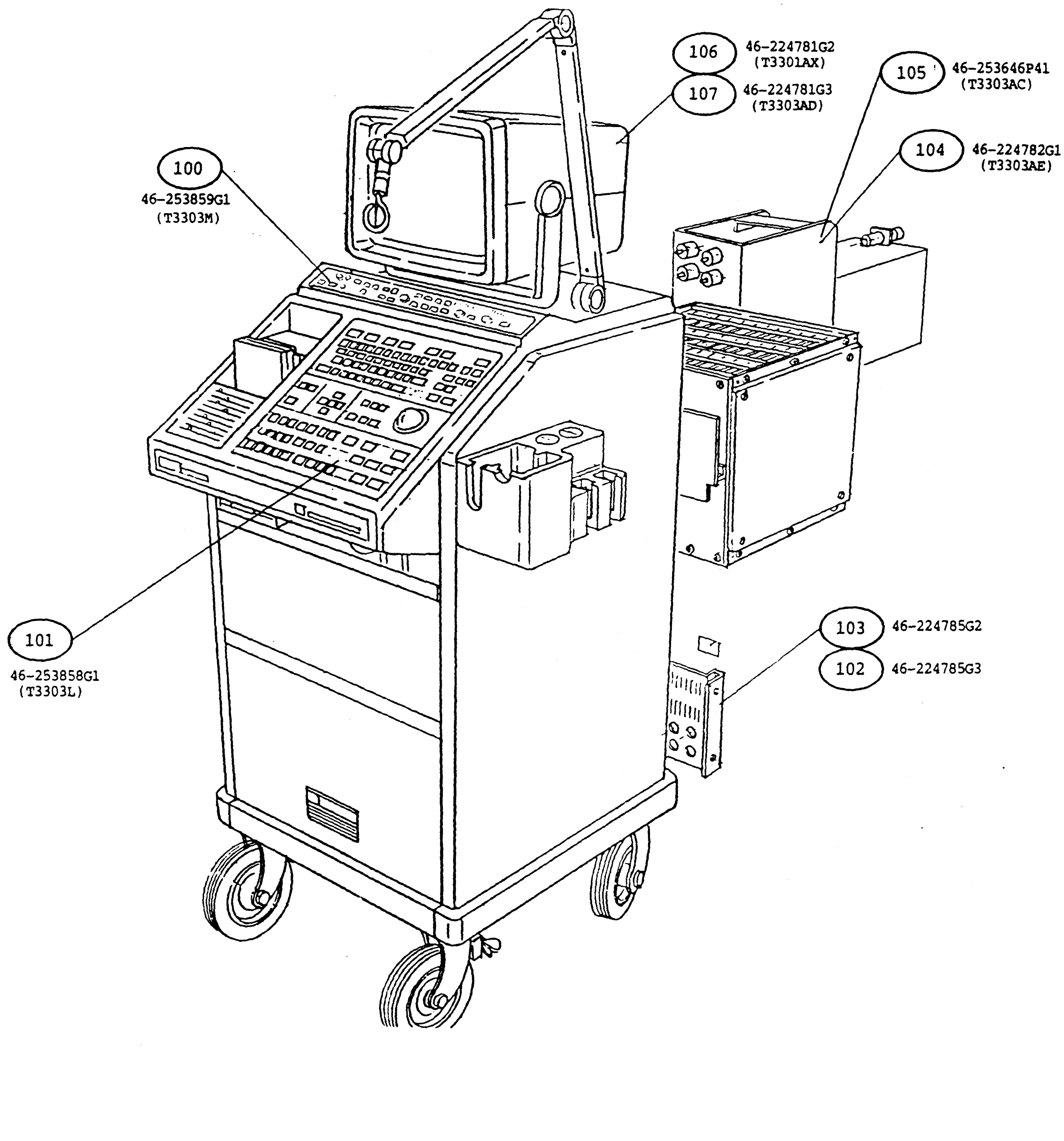
4/1

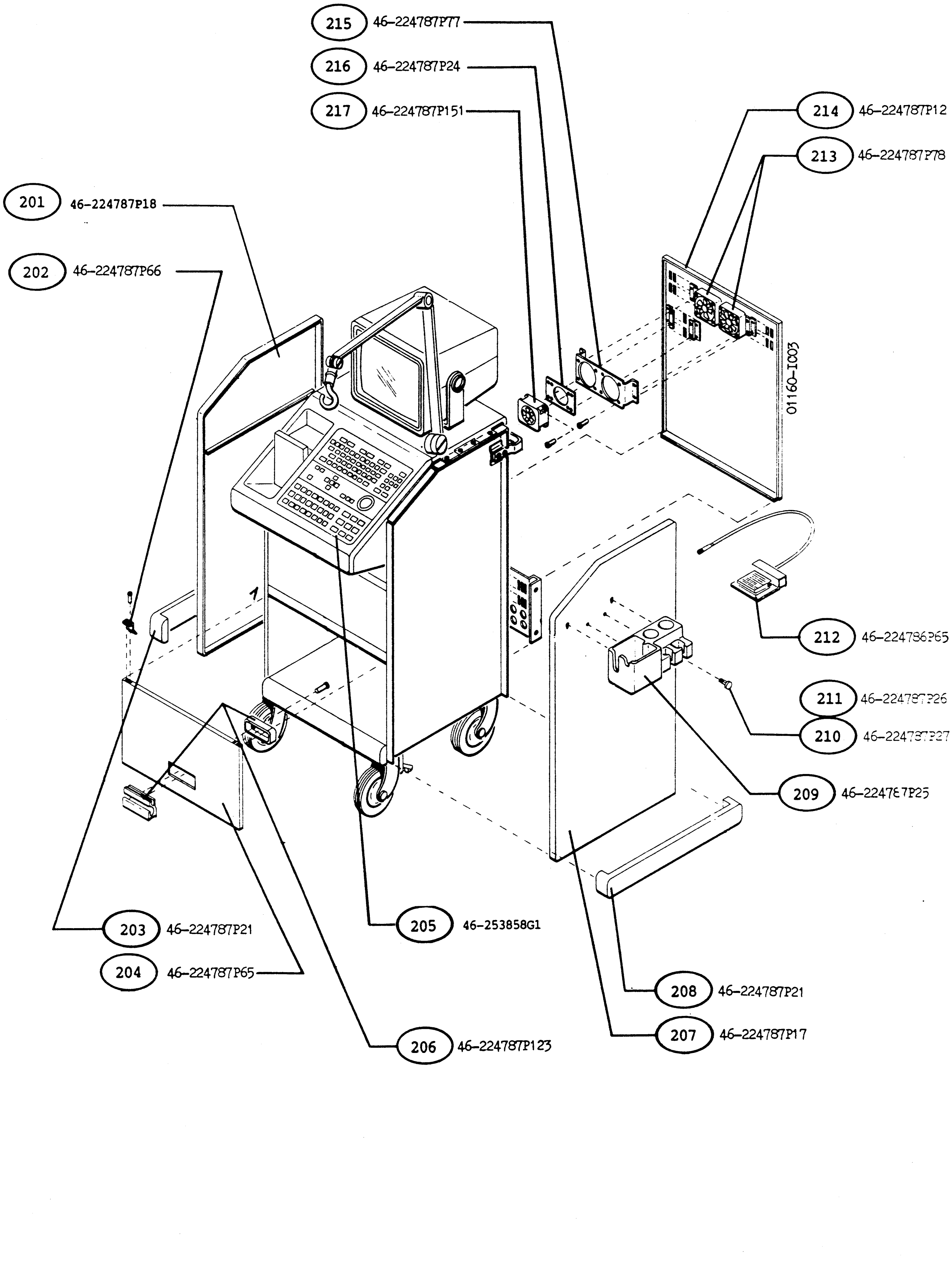

1GCB ASSY
FD1 = B9713XY
DR Y. [illegible]
CH H. AKASAKA
APP S. SANO
ENG. DPT
1983-12-5
PAGE 1
REV ZONE DATE REVBY
A3
YOKOGAWA MEDICAL SYSTEMS

REPLACEMENT PARTS

Chapter 9

Replacement Parts


106
46-224781G2
(T3301AX)
107
46-224781G3
(T3303AD)
105
46-253646P41
(T3303AC)
104
46-224782G1
(T3303AE)
100
46-253859G1
(T3303M)
101
46-253858G1
(T3303L)
103
46-224785G2
102
46-224785G3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46-224787P77
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46-224787P24
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46-224787P151
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46-224787P12
213
46-224787P78
201
46-224787P18
202
46-224787P66
01160-I003
212
46-224786P65
211
46-224787P26
210
46-224787P27
209
46-224787P25
203
46-224787P21
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46-224787P65
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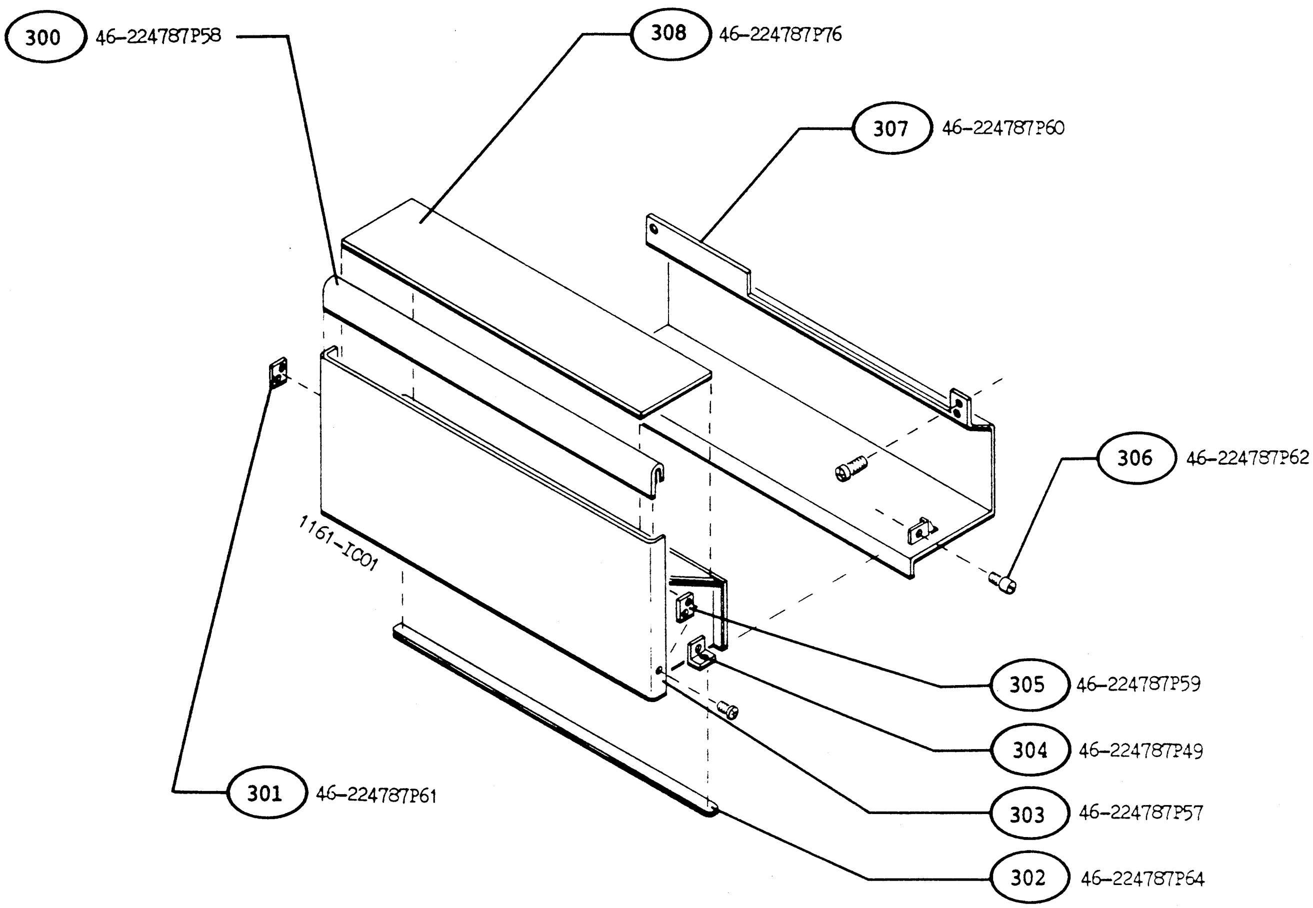
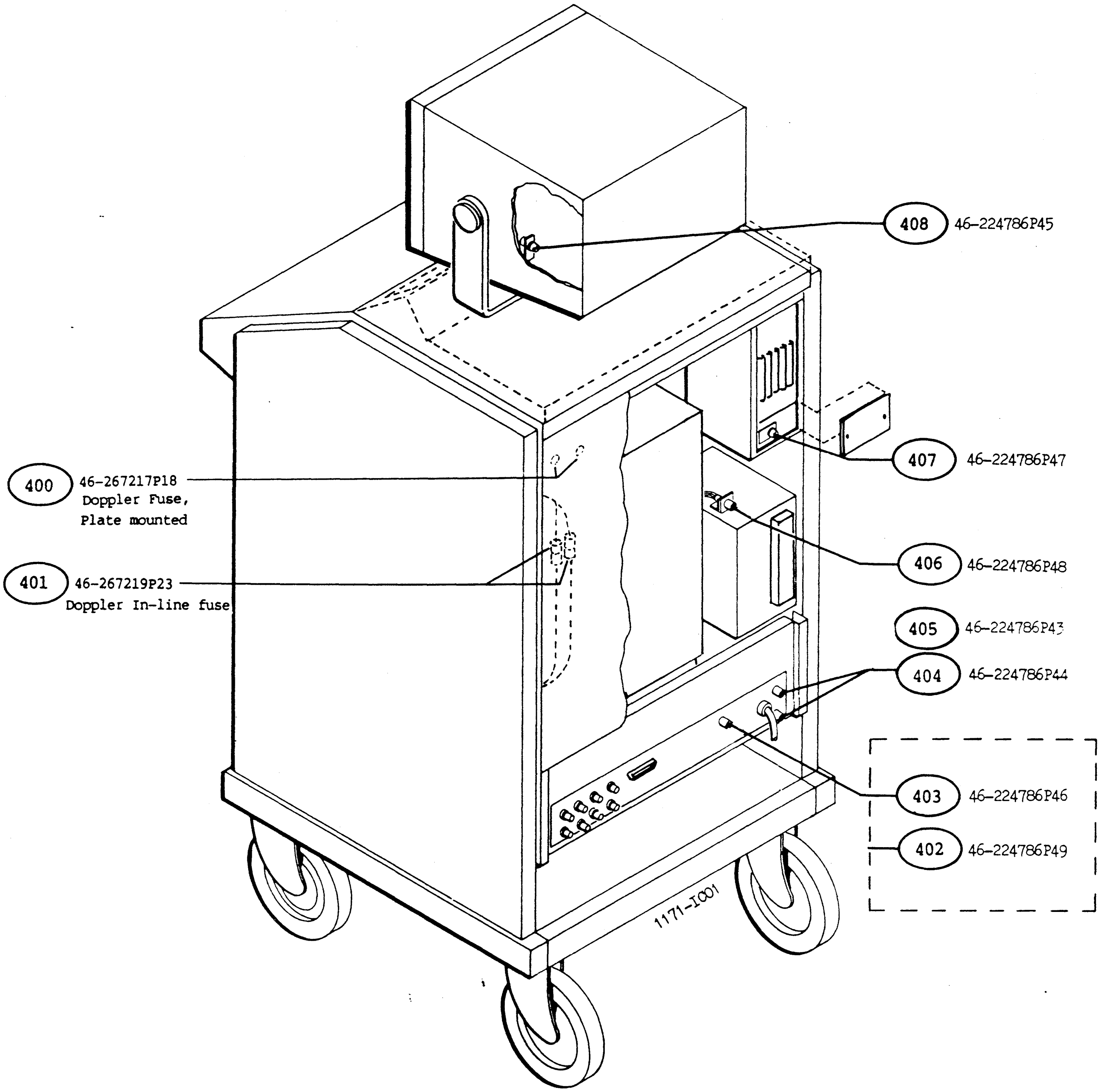
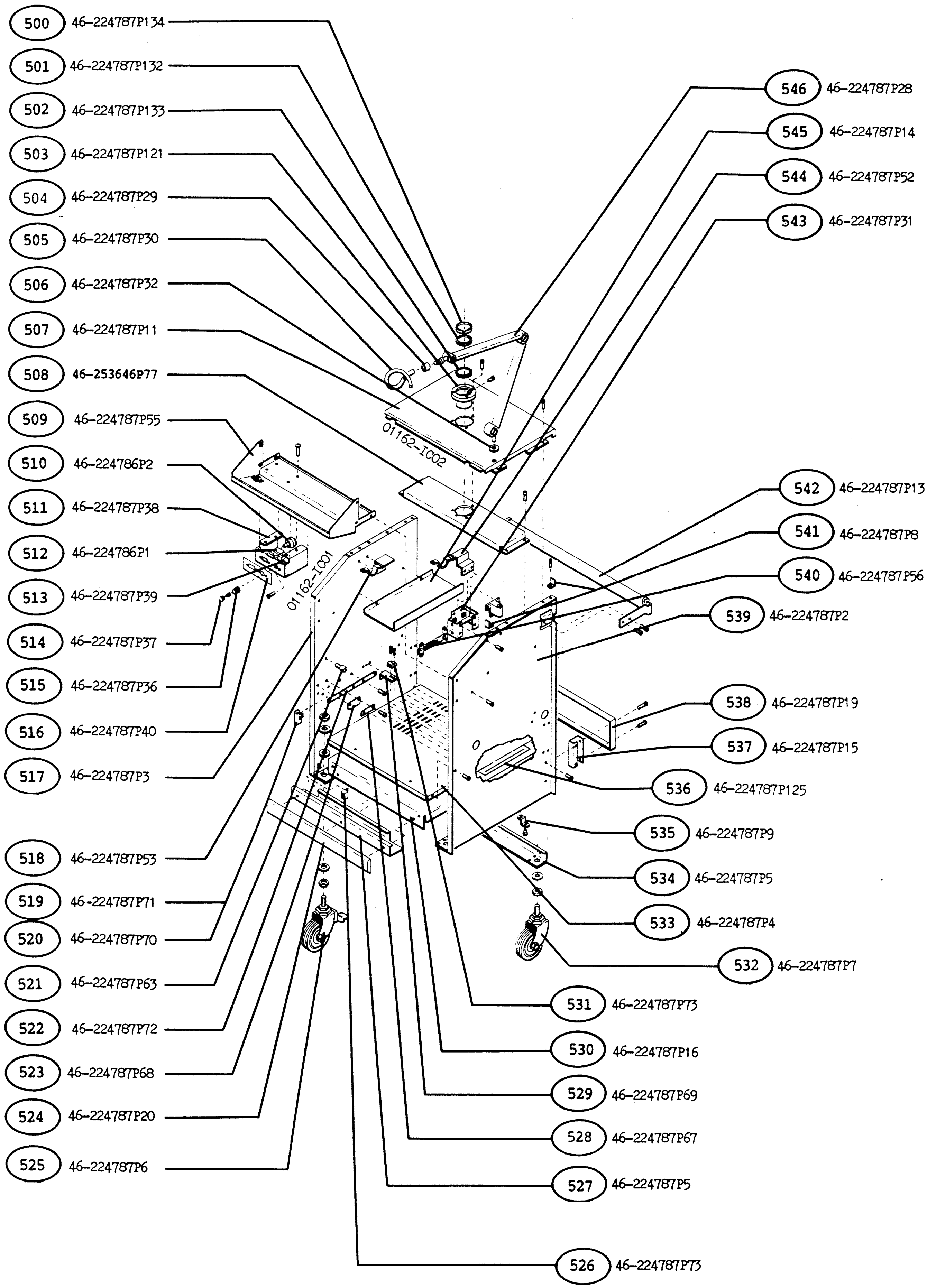
46-253858G1
208
46-224787P21
207
46-224787P17
206
46-224787P123



ACCESSORY BOX ASSEMBLY
46–224787P57



408 46-224786P45
407 46-224786P47
400 46-267217P18
Doppler Fuse,
Plate mounted
406 46-224786P48
401 46-267219P23
Doppler In-line fuse
405 46-224786P43
404 46-224786P44
403 46-224786P46
402 46-224786P49
1171-I001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503 46-224787P121
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505 46-224787P30
506 46-224787P32
507 46-224787P11
508 46-253646P77
509 46-224787P55
510 46-224786P2
511 46-224787P38
512 46-224786P1
513 46-224787P39
514 46-224787P37
515 46-224787P36
516 46-224787P40
517 46-224787P3
518 46-224787P53
519 46-224787P71
520 46-224787P70
521 46-224787P63
522 46-224787P72
523 46-224787P68
524 46-224787P20
525 46-224787P6
526 46-224787P73
527 46-224787P5
528 46-224787P67
529 46-224787P69
530 46-224787P16
531 46-224787P73
532 46-224787P7
533 46-224787P4
534 46-224787P5
535 46-224787P9
536 46-224787P125
537 46-224787P15
538 46-224787P19
539 46-224787P2
540 46-224787P56
541 46-224787P8
542 46-224787P13
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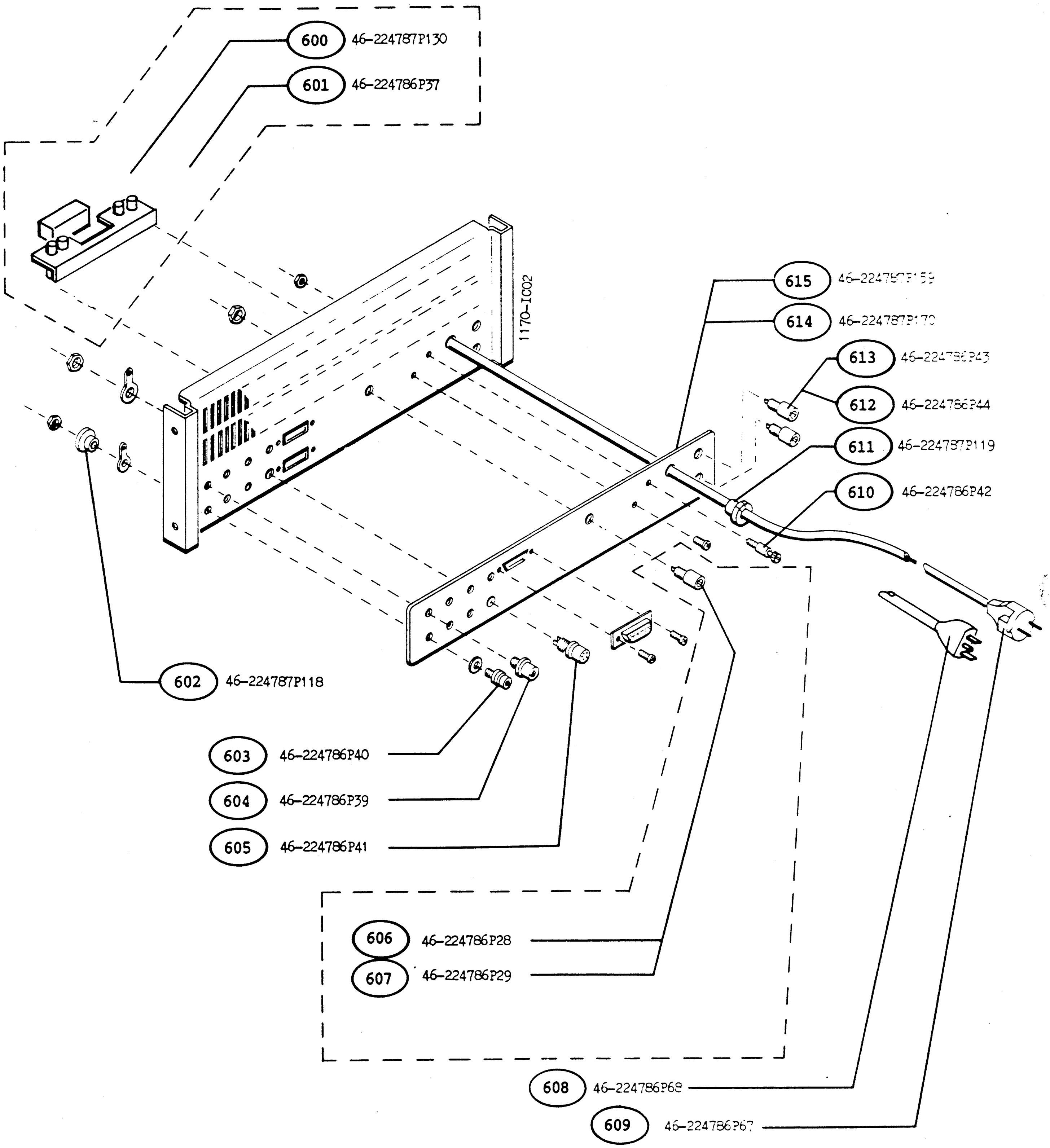
545 46-224787P14
546 46-224787P28
01162-IC02
01162-IC01



600
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46-224786P37
1170-IC02
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614
46-224787P170
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46-224786P43
612
46-224786P44
611
46-224787P119
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46-224786P42
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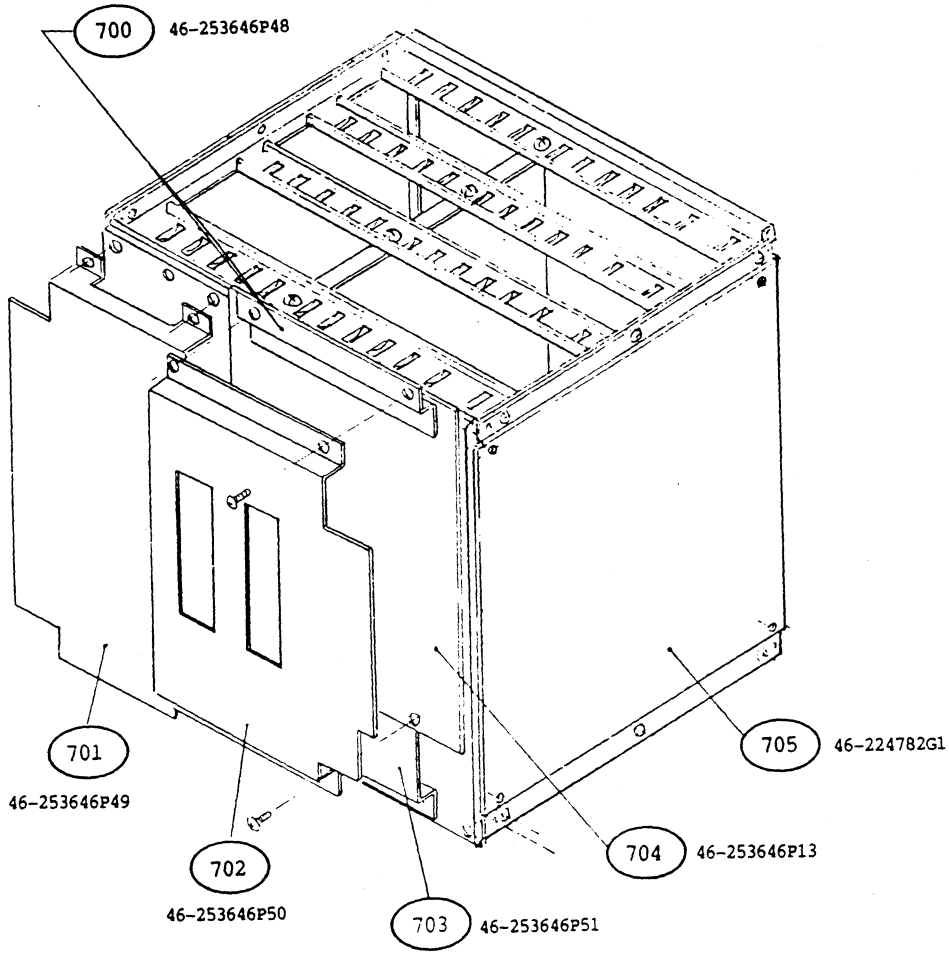
46-224786P67



700
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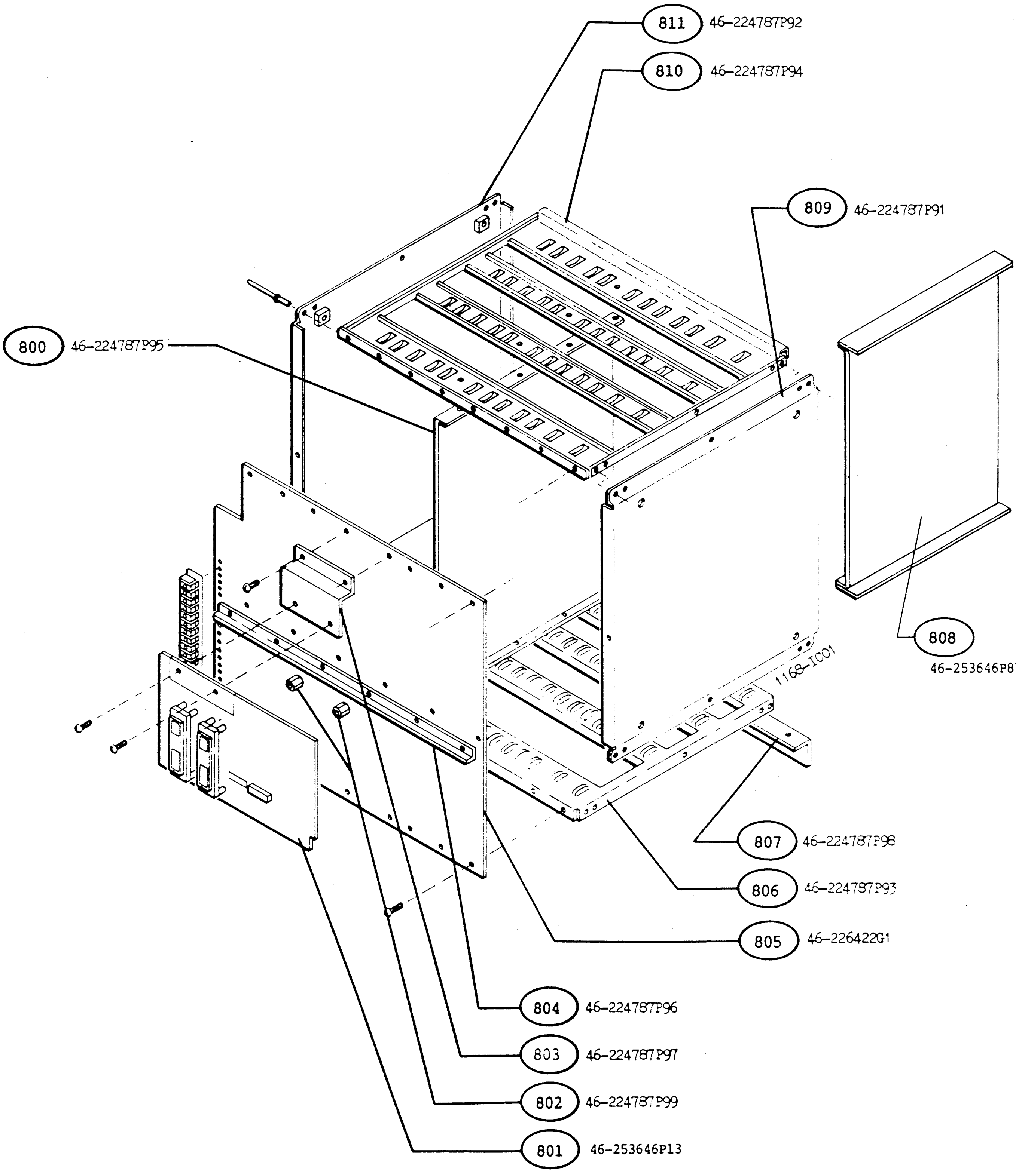
702
46-253646P50
703
46-253646P51
704
46-253646P13
705
46-224782G1



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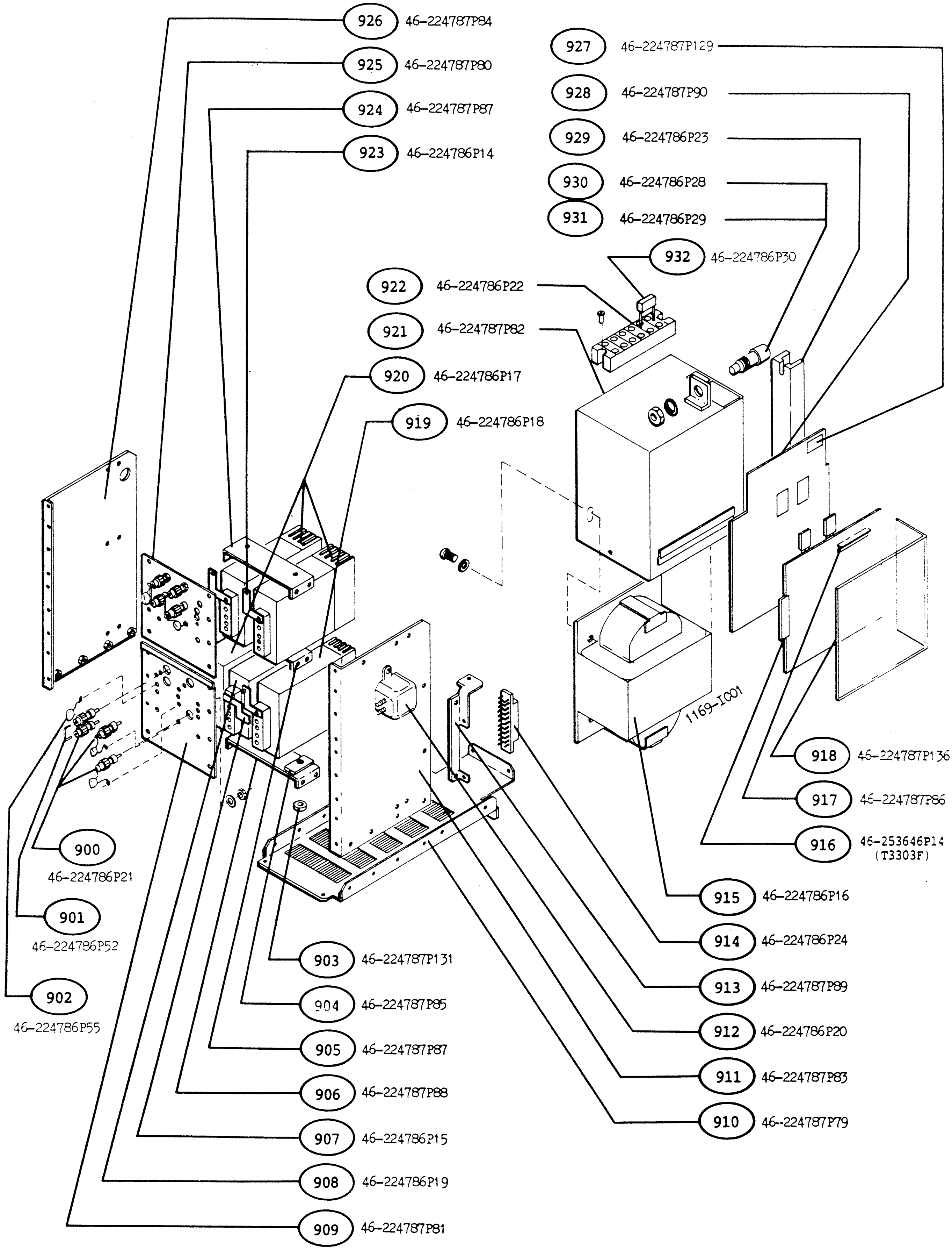
810 46-224787P94
809 46-224787P91
800 46-224787P95
808 46-253646P87
1168-IC01
807 46-224787P98
806 46-224787P93
805 46-226422G1
804 46-224787P96
803 46-224787P97
802 46-224787P99
801 46-253646P13


926 46-224787P84
925 46-224787P80
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923 46-224786P14
927 46-224787P129
928 46-224787P90
929 46-224786P23
930 46-224786P28
931 46-224786P29
932 46-224786P30
922 46-224786P22
921 46-224787P82
920 46-224786P17
919 46-224786P18
1169-I001
918 46-224787P136
917 46-224787P86
916 46-253646P14 (T3303F)
915 46-224786P16
914 46-224786P24
913 46-224787P89
912 46-224786P20
911 46-224787P83
910 46-224787P79
900 46-224786P21
901 46-224786P52
902 46-224786P55
903 46-224787P131
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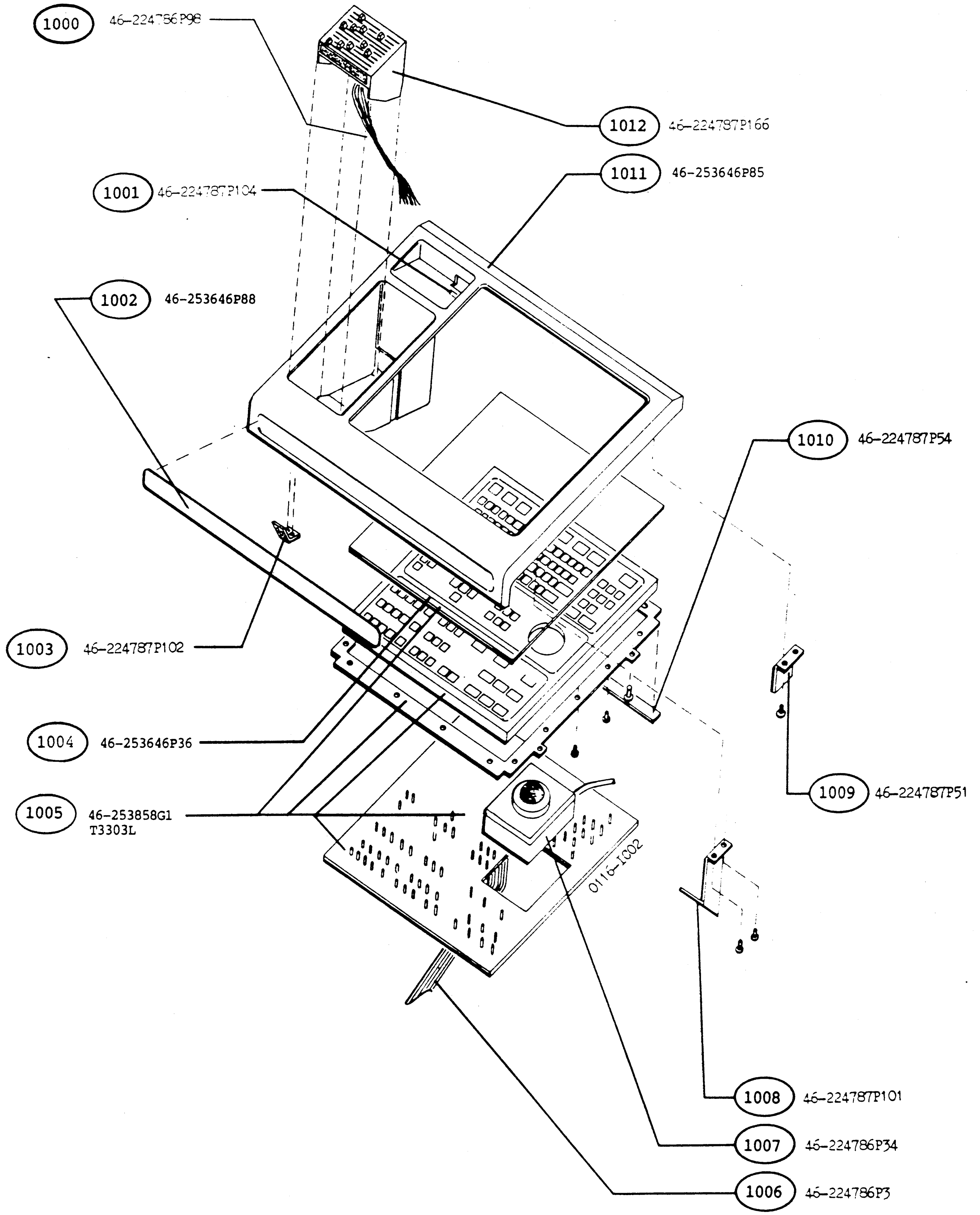
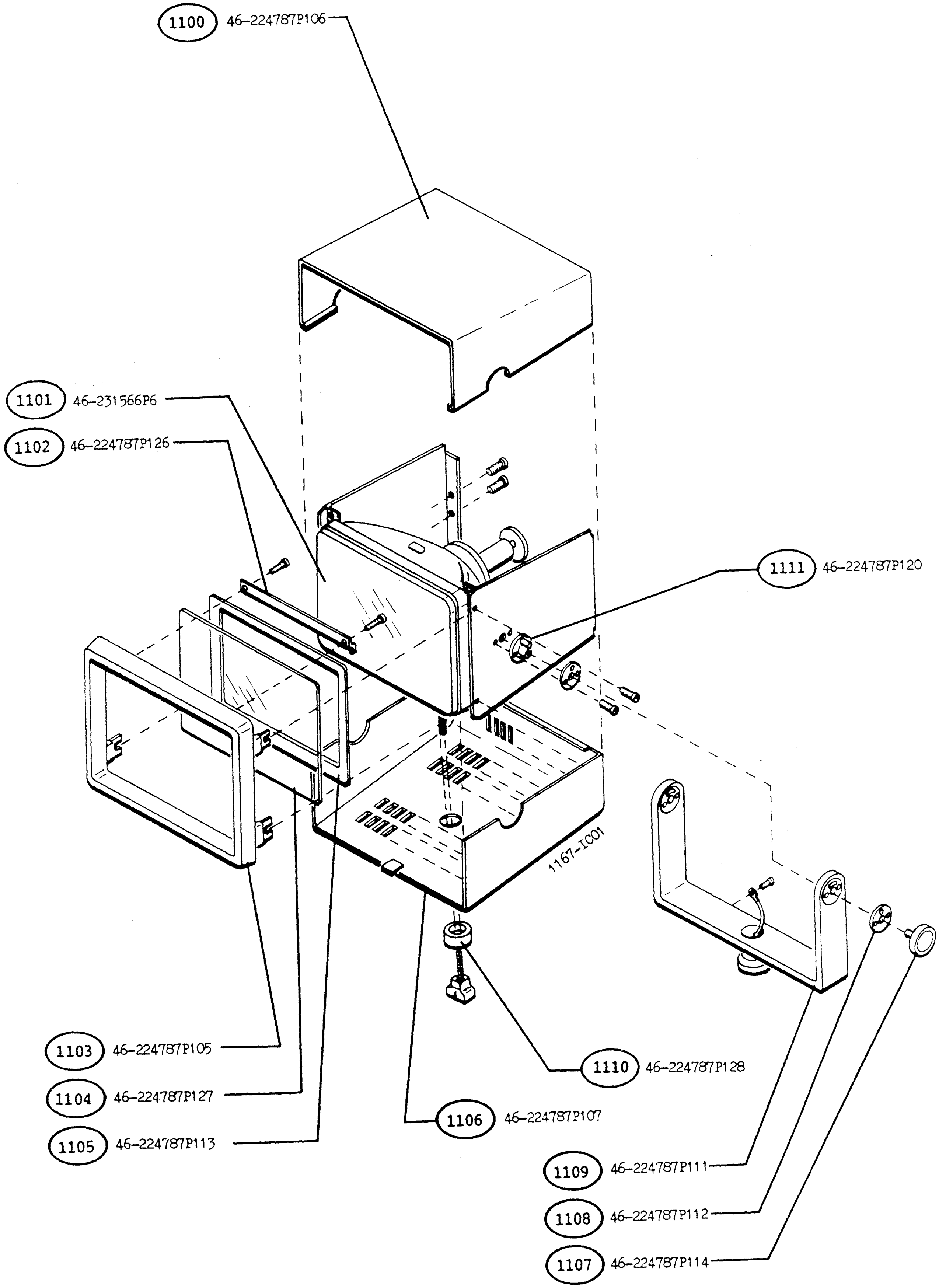
908 46-224786P19
909 46-224787P81



1000 46-224756P98
1012 46-224787P166
1011 46-253646P85
1001 46-224787P104
1002 46-253646P88
1010 46-224787P54
1003 46-224787P102
1004 46-253646P36
1005 46-253858G1
T3303L
0116-I002
1009 46-224787P51
1008 46-224787P101
1007 46-224786P34
1006 46-224786P3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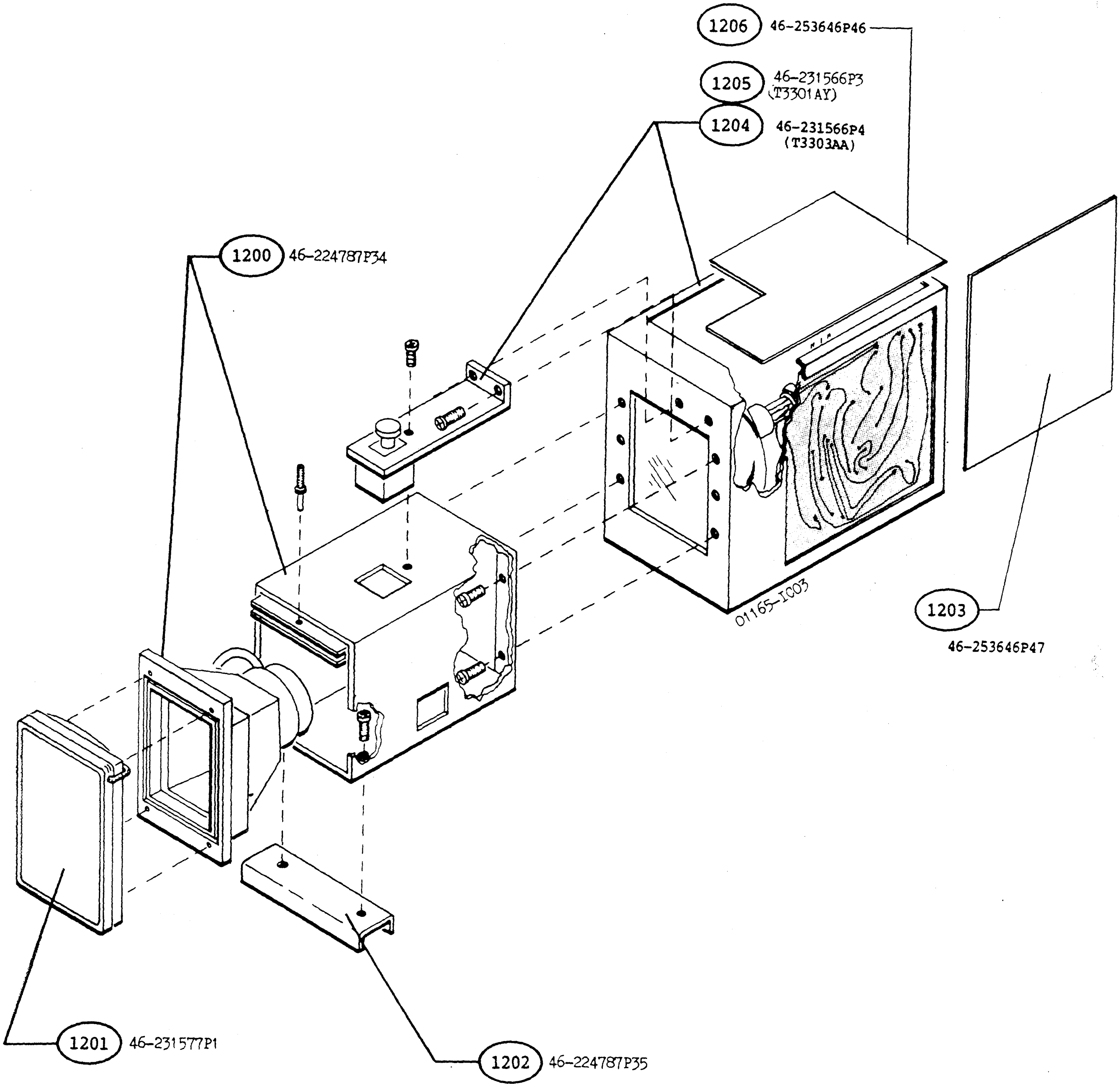
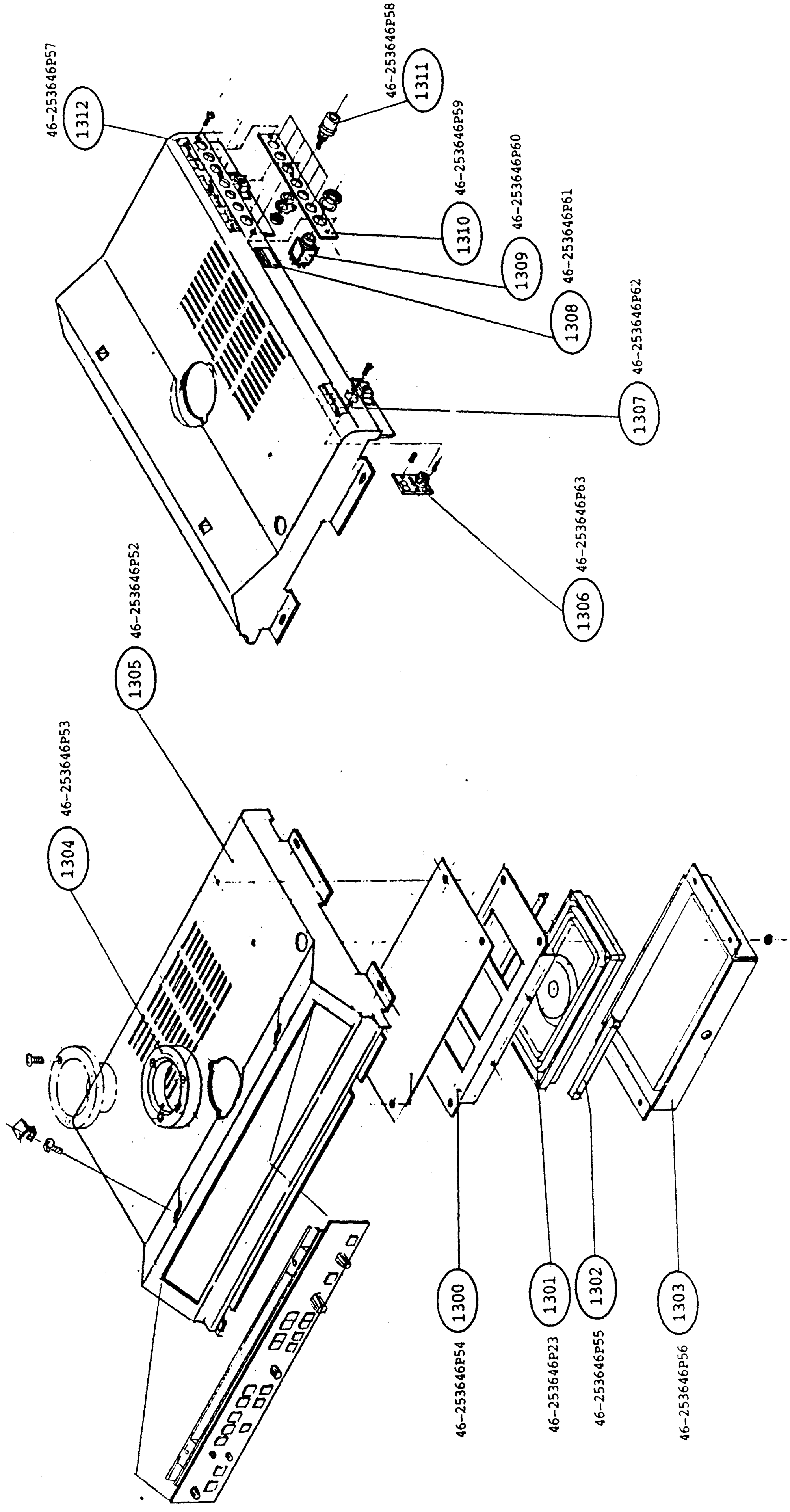
1101 46-231566P6
1102 46-224787P126
1111 46-224787P120
1167-IC01
1103 46-224787P105
1104 46-224787P127
1105 46-224787P113
1110 46-224787P128
1106 46-224787P107
1109 46-224787P111
1108 46-224787P112
1107 46-224787P114


1206 46-253646P46
1205 46-231566P3 (T3301AY)
1204 46-231566P4 (T3303AA)
1200 46-224787P34
01165-IC03
1203 46-253646P47
1201 46-231577P1
1202 46-224787P35



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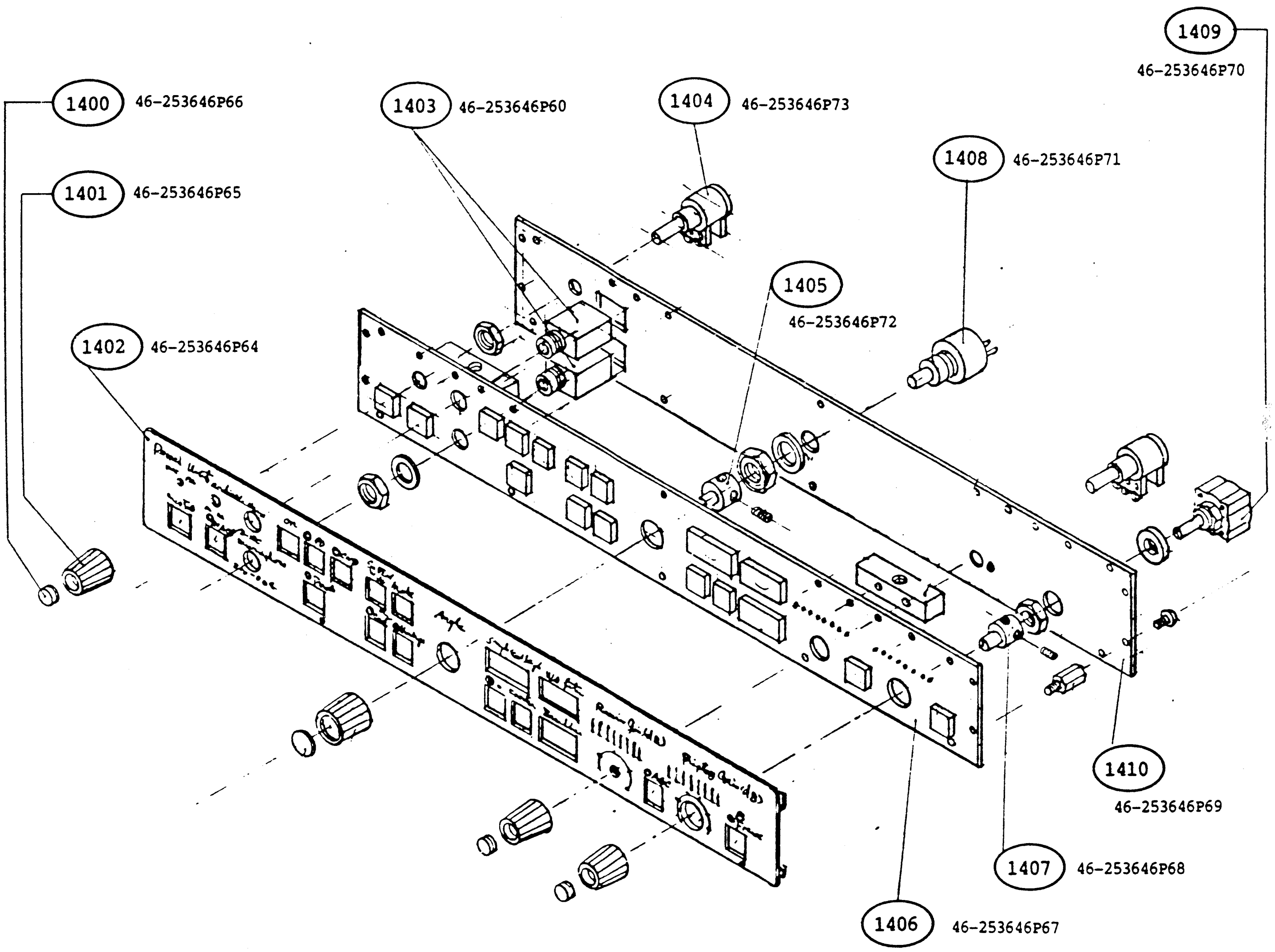
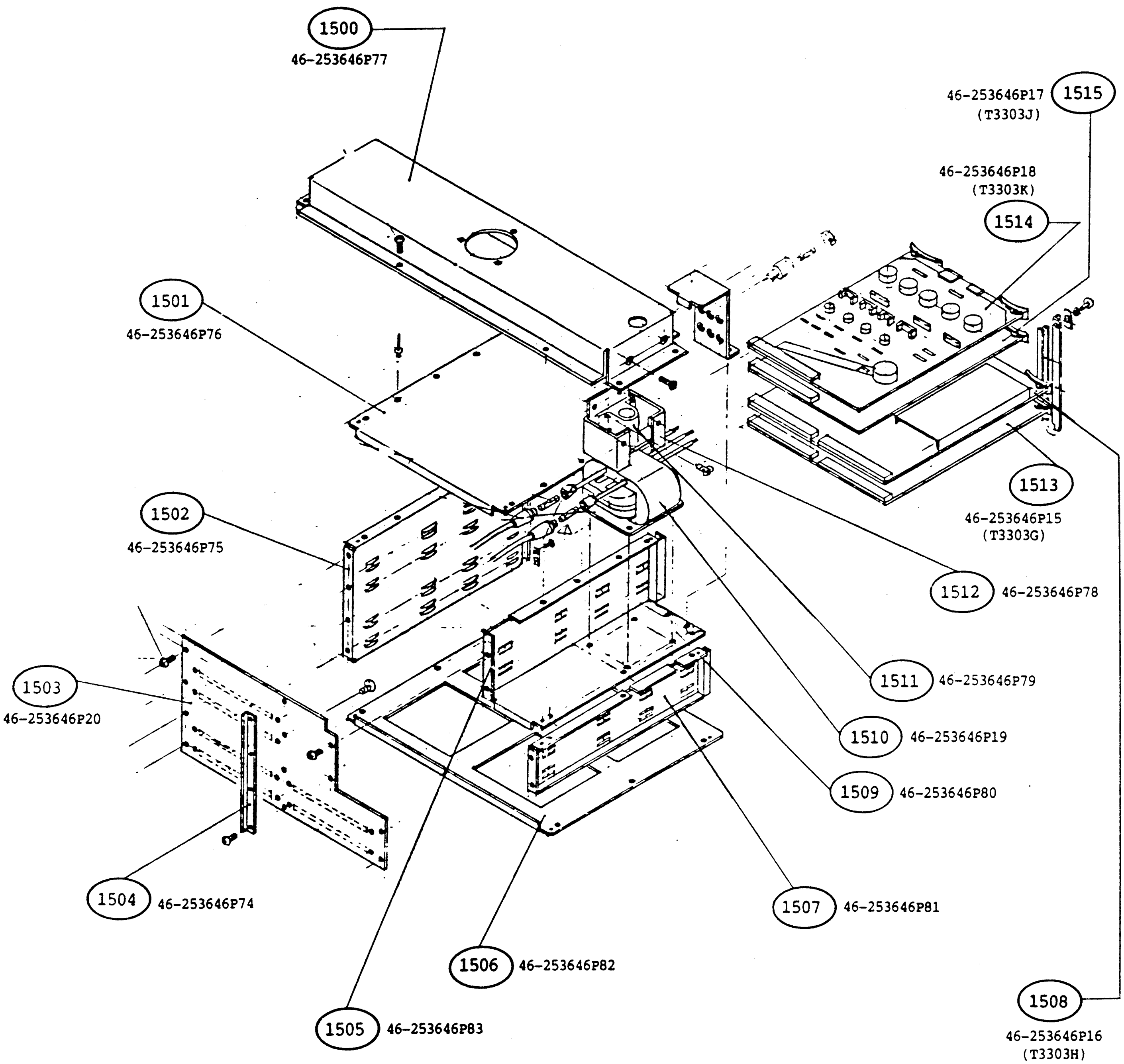
1311 46-253646P58
1310 46-253646P59
1309 46-253646P60
1308 46-253646P61
1307 46-253646P62
1306 46-253646P63
1305 46-253646P52
1304 46-253646P53
1300 46-253646P54
1301 46-253646P23
1302 46-253646P55
1303 46-253646P56



DOPPLER KEYBOARD ASSEMBLY
46-253859G1
(T3303M)


1500
46-253646P77
46-253646P17
1515
(T3303J)
46-253646P18
(T3303K)
1514
1501
46-253646P76
1502
46-253646P75
1513
46-253646P15
(T3303G)
1512
46-253646P78
1503
46-253646P20
1511
46-253646P79
1510
46-253646P19
1509
46-253646P80
1504
46-253646P74
1507
46-253646P81
1506
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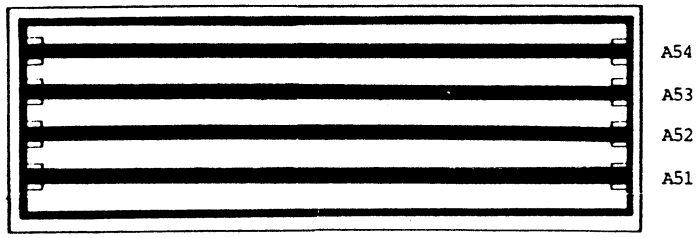
1508
1505
46-253646P83
46-253646P16
(T3303H)



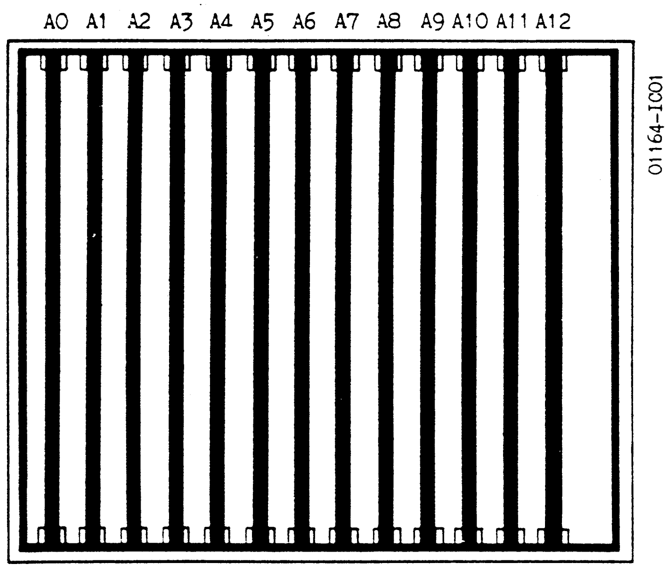
ITEM
Not Shown:

1600 ● Connector Board
46-253646P13 (YMS B9713XU)

1601 ● Doppler Motherboard
46-253646P20

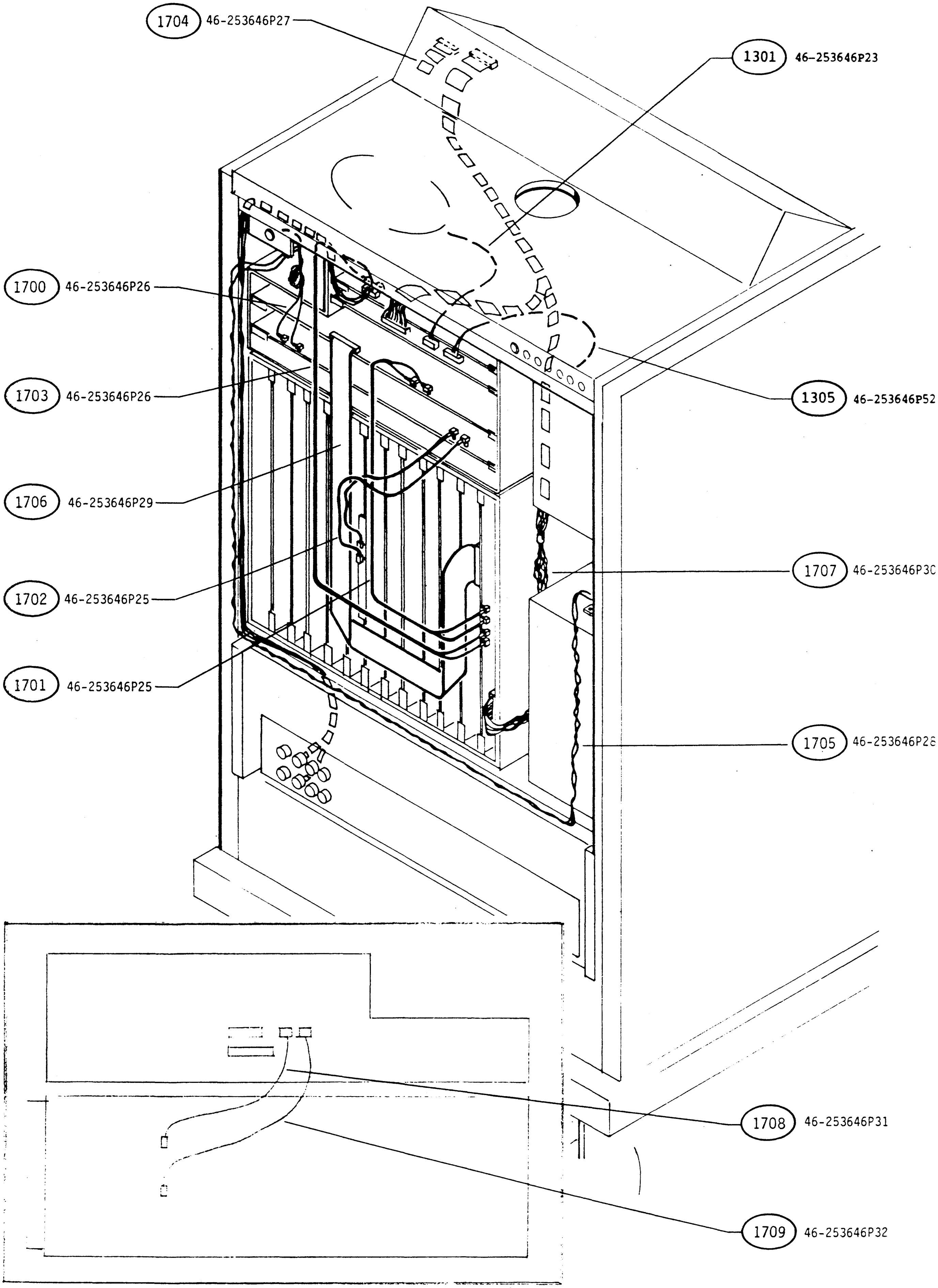
1602 ● System Motherboard
46-226422G1

1603 ● High Voltage Assy
46-253646P14
(T3303F)



BOARD # DESCRIPTION	ITEM #	PART #
A0 REAL TIME CONT. RTC	1604	46-253646P3 (T3303A)
A1-2 TRANSMIT/REC'V T/R	1605	46-253646P4 (TR1: T3303B) 46-253646P5 (TR2: T3303C)
A3-6 CROSS POINT SW. XPSW	1606	46-226430G1 (T3301G)
A7 LOG ASSEMBLY (AMP) LOG ASS'Y	1607	46-253646P6 (T3303D)
A8 MASTER CONTROLLER MST	1608	46-253646P7 (115V: T3303P) 46-253646P37 (220V: T3303W)
A9 SCAN CONVERTER SCC	1609	46-253646P8 (115V: T3303R) 46-253646P38 (220V: T3303X)
A10 FRAME MEMORY FM	1610	46-253646P9 (115V: T3303S) 46-253646P39 (220V: T3303Y)
A11 VIDEO PROCESSOR VDO	1611	46-253646P11 (115V: T3303T) 46-253646P40 (220V: T3303Z)

BOARD # DESCRIPTION	ITEM #	PART #
A12 FFT ASSY	1612	46-253646P12 (T3303E)
A51 DOPPLER ASSY	1513	46-253646P15 (T3303G)
A52 DOPPLER HT ASSY	1508	46-253646P16 (T3303H)
A53 DOPPLER AUDIO ASSY	1514	46-253646P17 (T3303J)
A54 DOPPLER P.S. ASSY	1515	46-253646P18 (T3303K)



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1301 46-253646P23
1700 46-253646P26
1703 46-253646P26
1305 46-253646P52
1706 46-253646P29
1707 46-253646P30
1702 46-253646P25
1701 46-253646P25
1705 46-253646P28
1708 46-253646P31
1709 46-253646P32

100	Doppler Keyboard Assy	46-253859G1 (T3303M)
101	Keyboard Panel Assy (Analog)	46-253858G1 (T3303L)
102	Rear Connector Panel Assy (220V 50Hz)	46-224785G3
103	Rear Connector Panel Assy (115V 60Hz)	46-224785G2
104	LV Power Supply (Dom)	46-224782G1 (T3303AE)
105	LV Power Supply (Int'l)	46-253646P41 (T3303AC)
106	Display Monitor Assy (115V/525/60 Format)	46-224781G2 (T3301AX)
107	Display Monitor Assy (220V/625/50 Format)	46-224781G3 (T3303AD)

201	Left Cover	46-224787P18
202	Spring Cover	46-224787P66
203	Side Bumper	46-224787P21
204	Front Cover	46-224787P65
205	Keyboard Panel Assy (Analog)	46-253858G1 (T3303L)
206	Handle	46-224787P123
207	Right Cover	46-224787P17
208	Side Bumper	46-224787P21
209	Probe Holder	46-224787P25
210	Nylon Latch	46-224787P27
211	Nylon Latch	46-224787P26
212	Footswitch (YMS B9686AF)	46-224786P65
213	Fan	46-224787P78
214	Rear Cover	46-224787P12
215	Fan	46-224787P151
216	Fan Plate	46-224787P24
217	Fan Bracket	46-224787P77

300	Cover Accessory	46-224787P58
301	Left Plate Hinge	46-224787P61
302	Magnet	46-224787P64
303	Accessory Box Assy	46-224787P57
304	Rubber Plate	46-224787P49
305	Right Plate Hinge	46-24787P59
306	Hinge Pin	46-224787P62
307	Bracket Box Mounting	46-224787P60
308	Sheet Accessory	46-224787P76

400	Plate mounted Doppler Fuse	46-267217P18
401	In-line Doppler Fuse	46-267219P23
402	0.5A Slow Blow Fuse	46-224786P49
403	1.5A Slow Blow Fuse	46-224786P48
404	5A Slow Blow	46-224786P44
405	10A (115V) Slow Blow Fuse	46-224786P43
406	1A Slow Blow Fuse	46-224786P48
407	2A Slow Blow Fuse	46-224786P47
408	3A Slow Blow Fuse	46-224786P45

500	Strip - NAR	46-224787P134
501	Ring	46-224787P132
502	Strip - W	46-224787P133
503	Bushing	46-224787P121
504	Block Arm	46-224787P29
505	Hook Arm	46-224787P30
506	Plate Arm	46-224787P32
507	Top Cover	46-224787P11
508	Top Frame	46-253646P77

509	Bracket Panel Support	46-224787P55
510	Rotary Switch	46-224786P2
511	Bracket Power Switch	46-224787P38
512	Switch	46-224786P1
513	Bracket Rotary Switch	46-224787P39
514	Cap	46-224787P37
515	Knob	46-224787P36
516	Power Switch Nameplate	46-224787P40
517	Left Frame	46-224787P3
518	Left Hinge	46-224787P53
519	Left Hinge Bracket	46-224787P71
520	Right Hinge Bracket	46-224787P70
521	Rod Stopper	46-224787P63
522	Slide Rail	46-224787P72
523	Spacer Slide	46-224787P68
524	Front Bumper (Rear)	46-224787P20
525	Caster Lock	46-224787P6
526	Magnet	46-224787P73
527	Base Channel	46-224787P5
528	Block Slide	46-224787P67
529	Bracket Mounting	46-224787P69
530	Base Plate	46-224787P16
531	Magnet	46-224787P73
532	Caster	46-224787P7
533	Middle Frame	46-224787P4
534	Base Channel	46-224787P5
535	Bottom Hook	46-224787P9
536	Air Filter	46-224787P125
537	Rear Bracket	46-224787P15
538	Rear Cover Bottom	46-224787P19

539	Right Frame	46-224787P2
540	Rotary Stay	46-224787P56
541	Top Hook	46-224787P8
542	Handle	46-224787P13
543	Probe Arm	46-224787P28
544	Bracket Arm	46-224787P31
545	Right Hinge	46-224787P52
546	Bracket Shield	46-224787P14

600	Outlet Bracket	46-224787P130
601	Outlet	46-224786P37
602	Spacer	46-224787P118
603	Connector (A16 CN11 and 12)	46-224786P40
604	Connector (A16 CN5, 7, 10)	46-224786P39
605	Connector (A17 CN6)	46-224786P41
606	Fuse Holder	46-224786P28
607	Fuse Carrier	46-224786P29
608	Cord Set 115V 60Hz	46-224786P68
609	Cord Set 220V/240V	46-224786P67
610	Ground Terminal	46-224786P42
611	Busing	46-224787P119
612	Fuse 5A Slow Blow	46-224786P44
613	Fuse 10A Slow Blow	46-224786P43
614	Fuse 1A Slow Blow	46-224786P48
615	Nameplate Rear Panel (115V 60 Hz)	46-224787P159

700	Bracket Connector Board (A)	46-253646P48
701	Right Bracket Shield	46-253646P49
702	Left Bracket Shield	46-253646P50
703	Bracket Connector Board (B)	46-253646P51
704	RL Connector Assy	46-253646P13
705	Card Cage Assy	46-224782G1

800	Plate Shield	46-224787P95
801	Connector Board (A14 - YMS B9713WU)	46-253646P13
802	Stud	46-224787P99
803	Bracket Connector Board	46-224787P97
804	Bracket Support	46-224787P96
805	Motherboard (A13 - YMS B9713WS)	46-226422G1
806	Base Bracket	46-224787P93
807	Angle Mounting	46-224787P98
808	A0/A1 Shield	46-253646P87
809	Left Plate	46-224787P91
810	Top Bracket	46-224787P94
811	Right Plate	46-224787P92

900	Filter	46-224786P21
901	Bus Bar 5V	46-224786P52
902	Cap Film	46-224786P55
903	Fabric Washer	46-224787P131
904	Plate	46-224787P85
905	Top Bracket	46-224787P87
906	Bottom Bracket	46-224787P88

907	Bus Bar Terminal	46-224786P15
908	Power Source	46-224786P19
909	Bottom Cover	46-224787P81
910	Base	46-224787P79
911	Right Plate	46-224787P83
912	Filter	46-224786P20
913	Bracket Connector	46-224787P89
914	Connector (A15 CN8)	46-224786P24
915	Isolation Transformer	46-224786P16
916	HV (A15) PWB (YMS B9713WW)	46-253646P14 (T3303F)
917	Bracket Xstr.	46-224787P86
918	Plate Protection	46-224787P136
919	Power Source	46-224786P18
920	Power Source	46-224786P17
921	Transformer Case	46-224787P82
922	Terminal	46-224786P22
923	Bus Bar Filter	46-224786P90
924	Top Bracket	46-224787P87
925	Top Cover	46-224787P80
926	Left Plate	46-224787P84
927	Nameplate - "DANGER"	46-224787P129
928	Plate Transformer	46-224787P90
929	Terminal	46-224786P23
930	Fuse Holder	46-224786P28
931	Fuse Carrier	46-224786P29
932	Cap Film	46-224786P30

1000	TGC Control Cables	46-224786P98
1001	Nameplate Contrast	46-224787P104
1002	Nameplate	46-253646P88
1003	Bracket Support	46-224787P102
1004	Keyboard Sheet, Analog	46-253646P36
1005	Front Keyboard Assy (Analog)	46-253858G1 (T3303L)
1006	Flat Cable	46-224786P3
1007	Trackball	46-224786P34
1008	Bracket Support	46-224787P101
1009	Bracket Stay	46-224787P51
1010	Plate Hinge	46-224787P54
1011	Front Panel (Cosmetic)	46-253646P85
1012	TGC Box (YMS B9713JJ)	46-224787P166

1100	Top Housing	46-224787P105
1101	Display Monitor (CRT 115V - YMS B9713TR)	46-231566P6 (T3301AX)
1102	Filter Bracket	46-224787P126
1013	Protective Shield	46-224787P105
1014	CRT Filter	46-224787P127
1105	Plate Filter	46-224787P113
1106	Housing Bottom	46-224787P107
1107	Ring	46-224787P114
1108	Plate	46-224787P112
1109	Stay	46-224787P111
1110	Bushing BSE-2	46-224787P128
1111	Boss Assy	46-224787P120

1200	Camera	46-224787P34
1201	Polaroid Film Holder	46-231577P1
1202	Camera Support	46-224787P35
1203	Right Shield, Polaroid Monitor	46-253646P47
1204	Polaroid Monitor Assy (220V, YMS B9713UQ)	46-231566P4 (T3303AA)
1205	Polaroid Monitor Assy (115V, YMS B9713TQ)	46-231566P3 (T3303AY)
1206	Top Shield, Polaroid Monitor	46-253646P46

1300	Doppler Speaker Plate	46-253646P54
1301	Doppler Speaker	46-253646P23
1302	Speaker Bracket	46-253646P55
1303	Speaker Box Shield	46-253646P56
1304	Stay Ring	46-253646P53
1305	Top Cover (Doppler)	46-253646P52
1306	CW Probe Connector Assy	46-253646P63
1307	CW Probe Connector Assy Label	46-253646P62
1308	Nameplate	46-253646P61
1309	Jack	46-253646P60
1310	Plate Connector	46-253646P59
1311	Connector	46-253646P58
1312	Rear Name Plate	46-253646P57

1400	Knob Cap	46-253646P66
1401	Doppler Keyboard Knob	46-253646P65
1402	Doppler Front Panel	46-253646P64
1403	Jack	46-253646P60
1404	Rotary Switch	46-253646P73
1405	Volume Shaft	46-253646P72
1406	Dopp. Keyboard Switches Panel	46-253646P67
1407	Volume Control Shaft	46-253646P68
1408	Encorder	46-253646P71
1409	Rotary Switch	46-253646P70
1410	Doppler Control Assy	46-253646P69

1500	Top Frame	46-253646P77
1501	Top Nest Plate	46-253646P76
1502	Left Nest Bracket	46-253646P75
1503	Dopp. Motherboard Assy	46-253646P20
1504	Bracket Support	46-252646P74
1505	Bar Shield	46-253646P83
1506	Bottom Nest Plate	46-253646P82
1507	Right Nest Bracket	46-253646P81
1508	Doppler HT Assy (A52 PWB)	46-253646P16 (T3303H)
1509	Nest Bracket	46-253646P80
1510	Transformer	46-253646P19
1511	Probe Bracket	46-253646P79
1512	Bracket Arm Support	46-253646P78
1513	Doppler Assy (A51)	46-253646P15 (T3303G)
1514	Doppler Power Supply Assy (A54)	46-253646P15 (T3303K)
1515	Doppler Audio Assy (A53)	46-253646P17 (T3303G)

1600	RL Conn Assy	46-253646P13
1601	Dopp. Motherboard Assy	46-253646P20
1602	Motherboard (A13 YMS B9713WS)	46-226422G1
1603	High Voltage Assy	46-253646P14 (T3303F)
1604	Real Time Controller (A0)	46-253646P3 (T3303A)
1605	Transmitter/Receiver (A1-A2)	46-253646P5 (TR2:T3303C)
		46-253646P4 (TR1:T3303B)
1606	Cross Point Switch (A3-A6)	46-226430G1 (T3301G)
1607	Log Amplifier Assy (A7)	46-253646P4 (T3303D)
1608	Master Controller Assy (A8)	46-253646P7 (115V: T3303P)
		46-253646P37 (220V: T3303W)
1609	Scan Converter Controller (A9)	46-253646P8 (115V: T3303R)
		46-253646P38 (220V: T3303X)
1610	Frame Memory (A10)	46-253646P9 (115V: T3303S)
		46-253646P39 (220V: T3303Y)
1611	Video Processor (A11)	46-253646P11 (115V: T3303T)
1612	FFT Assy	46-253646P12

1700	TRAP	A51-CN1 CN2 CW CONN	46-253646P26
1701	KIM1	A52-CN2A CN2B A12-Q I	46-253646P25
1702	KIM1	A51-CN4 CN3 A7-CN1 CN1	46-253646P25
1703	KIM2	A53-DN10 CN11 A12-UNBL SIG	46-253646P26
1704	DOPAR	A55-CN5 A50-CN9	46-253646P27
1705	DOPSO	L.V. Power DOP. XFMR	46-253646P28
1706	SJ	A52-CN1 A12-CNN5A2	46-253646P29
1707	YTS	A12-CNN16A3 A53-CN2 A55-CN1	46-253646P30
1708	DEN	A50-CN7 A13-CN20	46-253646P31
1709	TRIMEN	A50-CN8 A13-CN21	46-253646P32

10-1 Abstract

This chapter presents information and procedures which are required to keep the RT3600 system operating correctly and safely.

Periodic maintenance consists of visual inspection, system performance checks and clean up of the required parts .

The service period is recommended to be once every 3 months. You can perform Periodic Maintenance completely when you refer to Chapter 4 Functional Checks, Chapter 6 Adjustments.

10-2 Checking of all Cable and Cord Connections

10- 2-1 Rear Panel Connection

Inspect power Cord (Refer to Fig. 10-1).

10-2-2 Front Face Connections

Inspect Transducer Cable and Footswitch Cable.

(Refer to Fig. 10-1).

10-2-3 Monitor Connection

Inspect Video Display Monitor Cable.

10-3 Functional Checks

Perform all Functional Checks.

(Refer to Chapter 4 Functional Checks).

10-4 Checking of Cooling Fans and Cleaning and of an Air Filter

10- 4-1 Inspect Cooling Fans located in the rear panel.

(Mainframe has three Cooling Fans).

10-4-2 Cleaning of an Air Filter and Reset

(Refer tro Figure 10-2).

NOTE: Air Filter is reusable.

10-5 Checking of Power Supply

Perform Power Supply Checks.

(Refer to Chapter 6 Adjustments).

10-6 Touch Up Paint

Touch up paint when requried.

Use color: YMS white and charcoal

YMS white spray	46-230666p1
YMS white brush on	46-230667p1
charcol gray	46-220224p1

10-7 Cleaning of Monitors

10-7-1 Cleaning of Video Display Monitor

Use a soft folded cloth and a glass cleaner solution. Apply the glass cleaner to the cloth and then GENTLY wipe the monitor face.

Note: Do not use a glass cleaner that has hydrocarbon base for monitors having an anti-glare shield on the monitor. Prolonged use of such cleaners will damage the anti-glare shield. Hard rubbing will also damage the shield.

10-7-2 Cleaning of Camera Monitor

Remove the Polaroid Camera and TGC box then clean the Camera Monitor.

Use a soft folded cloth and a glass cleaner solution. Apply the glass cleaner to the cloth and then GENTLY wipe the monitor face.

Note: Do not use a glass cleaner that has hydrocarbon base for monitors having an anti-glare shield on the monitor. Prolonged use of such cleaners will damage the anti-glare shield. Hard rubbing will also damage the shield.

10-8 Cleaning of Polaroid Rollers

Unload the film.

Suggested cleaning:

1. Release the film rollers from the roller snap-lock and clean the roller surfaces with an alcohol swab.

2. Check the corner of the film case and remove any jammed paper or excess dried developer.

3. Snap the cleaned rollers back into position and load a new film pack.

Chapter 10

Periodic Maintenance

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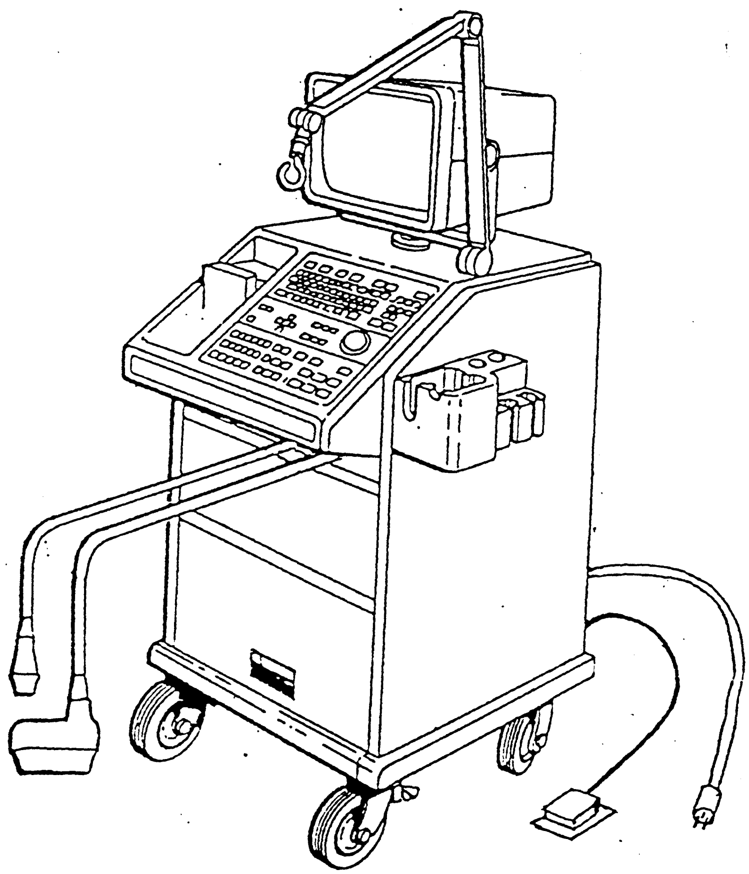

Figure 10-1

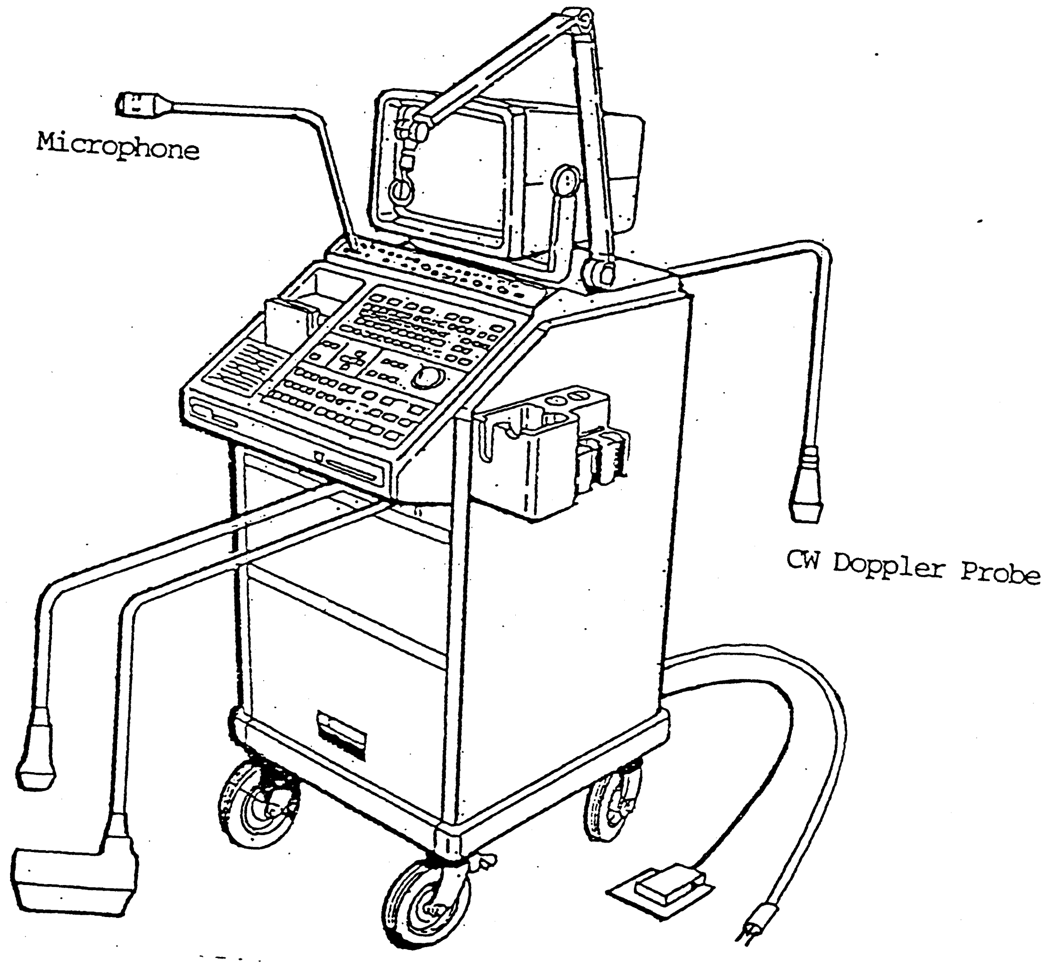

Figure 10-1'