

TN-115



Automatic positioning series
Image processing

IMAGE PROCESSOR

SHORTFORM for OPERATION

ONO SOKKI

TN-115 IMAGE PROCESSING
ALIGNMENT SYSTEM

INSTRUCTION MANUAL

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1. INTRODUCTION

The TN-115 provides the functions required for image processing and measurement, stage control, interfacing functions, and alignment in a single compact unit. Two TN-042 CCD TV cameras measure the center coordinates of two alignment marks on a workpiece and the TN-115 then calculates the amount of movement on three axes X, Y, and θ in order to align each of these marks with their specified positions and thereby controls a three-axis stage for high-speed, high-accuracy alignment.

2. FEATURES

■ Improved alignment speed

- Dedicated processor computes stage movement in real time (approximately 30 ms)
- Three-channel pattern generator for stage drive control enables optimal drive simultaneously on three axes.

■ High-accuracy positioning

- CCD TV cameras are used for sensing, enabling input of high-quality images with good reproducibility.
- Learning can be used to optimize illumination, and the gain and offset of the video amplifiers.
- Shading compensation can be performed to compensate for non-uniform illumination.
- Filters eliminate errors caused by scratches on the workpiece and noise.
- The center is measured from the center of gravity, providing an accuracy of one-third pixel.
- Averaging can be used to prevent reduction in accuracy due to factors such as vibration and noise.
- Amount of movement is measured and the stage is moved repeatedly to compensate for errors in the optical system and the mechanical system.

■ Easy application and operation

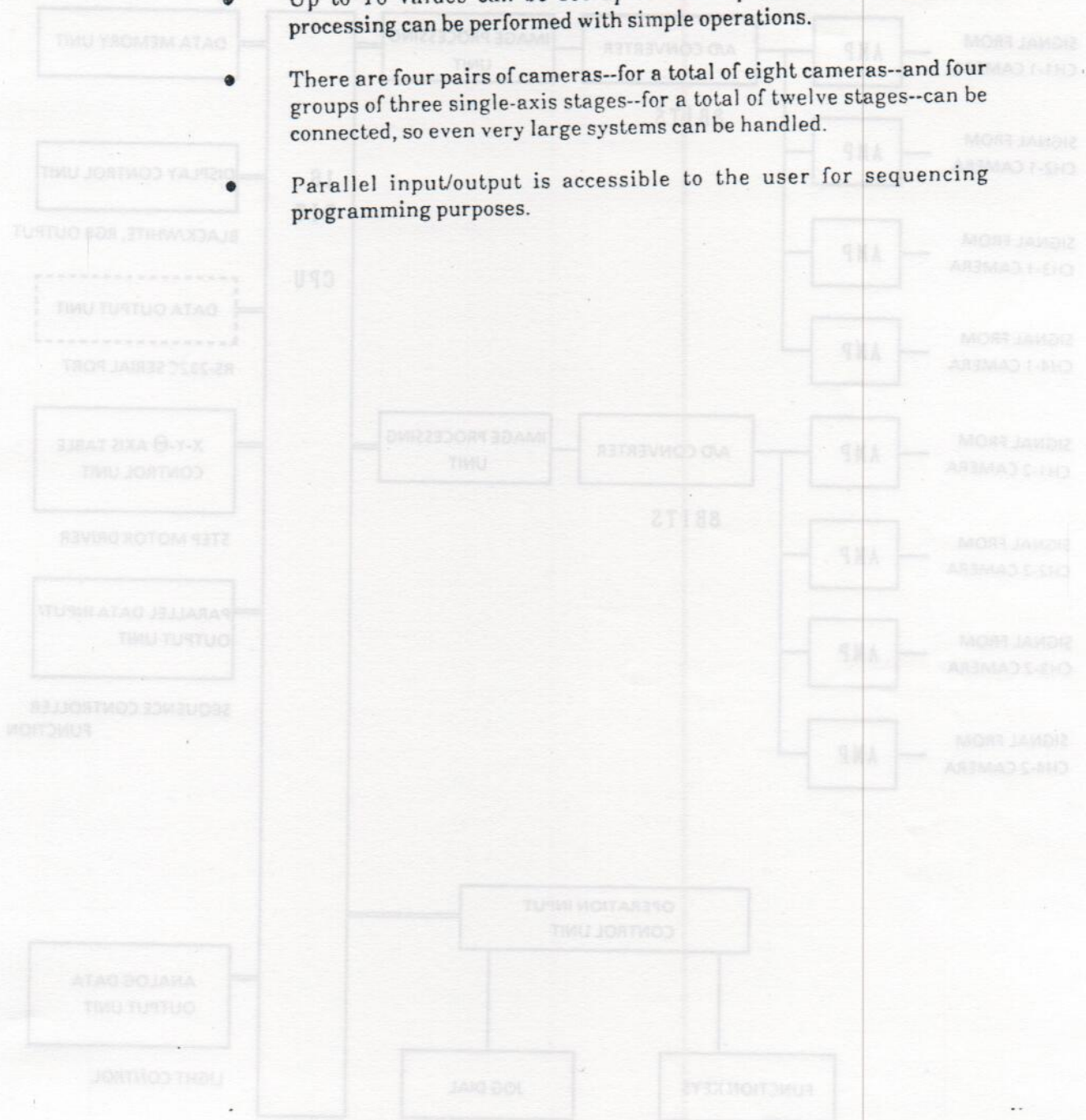
- Learning is used to measure the relations between the positions of the two cameras and the stage and to compensate these positions. This also means that there are no limitations on the positioning of the cameras and the alignment marks on the workpieces.

- Automatic learning functions for troublesome operations like setting parameters for image processing make for stable and secure image processing.

- Up to 16 values can be set up for each parameter, so complex processing can be performed with simple operations.

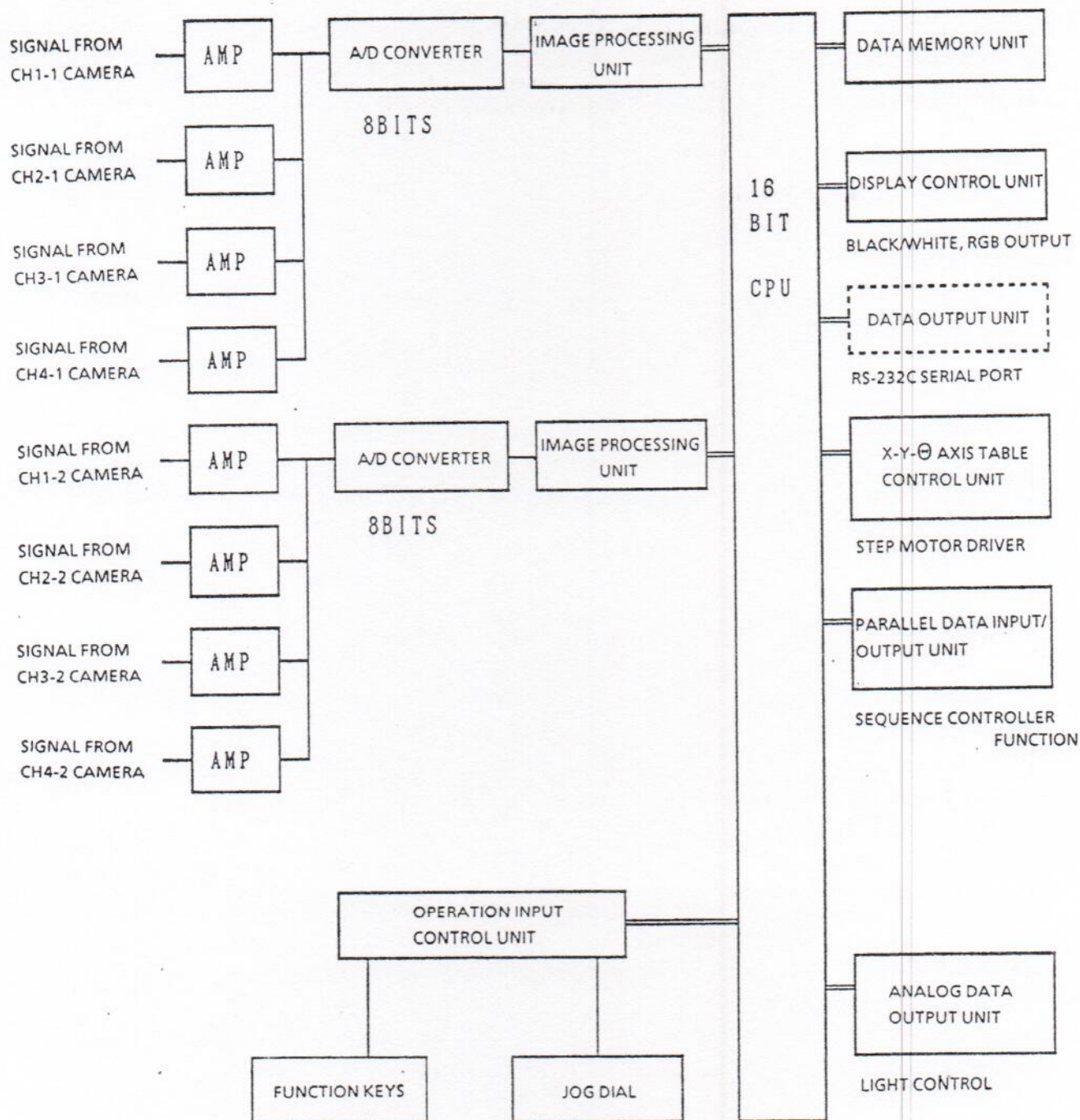
- There are four pairs of cameras--for a total of eight cameras--and four groups of three single-axis stages--for a total of twelve stages--can be connected, so even very large systems can be handled.

- Parallel input/output is accessible to the user for sequencing programming purposes.



3. CONFIGURATION

3.1 Block Diagram



3.2

System Configuration Example

TN-115 Image Processing System	1
TN-060 Light Source	2
TN-042 CCD Camera	2
TN-210 three-axis (X, Y, and θ) stage	1

An alignment system can be configured from these units.

Three pairs of TN-060 units and TN-042 units and an external driver for the TN-210 can be used to control three groups of stages for nine axes.

4. SPECIFICATIONS

4.1 Input and Preprocessing

4.1.1 Sensors

Model	TN-042 TV camera
Signal format	Composite video signal (1.0 V _{p-p} with negative syncing into 75 Ω unbalanced)
Sync system	External (gen-lock)
Scanning system	2:1 interlacing 525(H), 59.94 Hz(V)
No. of channels connected	2 \times 4 max. (8 channels)

4.1.2 Lens

Focal length	40 mm
F-stop	F8
Optical magnification	$\times 1$
Workpiece distance	65 mm
Field of view	8.7(H) \times 6.5(V) mm

4.1.3 A/D Convertor

Levels	8-bit resolution
Conversion accuracy	$\pm 0.2\%$
Sampling rate	7.16 MHz

4.1.4 Illumination

Light source	TN-060 halogen lamp
Illumination system	Optical fiber, ring illumination at an angle
Life	2000 h

4.1.5 Illumination Brightness Control

Control system	Analog reference voltage output (0 to 6 V)
Setting systems	Automatic and manual
Setting range	0 to 100% (voltage)
No. of channels	8 max.

4.2 Stage Control Section

4.2.1 Pattern Generator

Number of circuits	3 channels
Output frequency setting range	100 to 80,000 Hz
Drive system	Trapezoidal drive Min. and max. frequencies and acceleration are settable.

4.2.2 Internal Driver

Number of circuits	3 channels
Applicable motor	2-phase stepping motors
Drive system	Constant-current bipolar (2, 1.25, 1, 0.5 A switchable)
Excitation system	Phases 1-2 or phases 2-3 switchable
Current reduction	100, 81, 43, 0% switchable

4.2.3 Interface for External Driver

Number of circuits	3 channels \times 4
Output signal	Forward/reverse pulses, 3 each 4 channel selection signals TTL open collector (74LS06 or equivalent)
Input signal	Forward/reverse limit signals Sender must have open-collector output or a contact output. Limit point is indicated by an on output.
Pulse duty cycle	50%

4.2.4 Operating Modes

Fixed-point movement	Limit switch position and 6 other points
Constant movement amount	7 movement amount values
Manual movement	
Aligning movement	

4.3 Setting Section

4.3.1 Positioning Conditions

Alignment modes	3
Number of positioning repetitions	1 to 64
Positioning allowable error	0.001 to 9.999 mm (1- μ m steps)
Number of measurement averages	1 to 64
Standard mark area	0 to 99.999 mm ²
Mark area upper limit	100.0 to 999.6%
Mark area lower limit	0.0 to 100.0%
Positioning point	Within camera field of view (-32.767 to 32.767 mm)
Stage number	1 to 4

4.3.2 Density Image Processing Conditions

Number of summation averages	1 to 64
Processing area	Rectangular on diagonal between two points specified using cursor
Shading compensation	On/off
Illumination intensity	0 to 100.0%
Contrast compensation value minimum level	0 to 100.0%
Contrast compensation value maximum level	0 to 100.0%

4.3.3 Binary Image Processing Conditions

Segment division conditions	4
Threshold value 1	0 to 100.0%
Threshold value 2	0 to 100.0%
Density of image	3 levels
Density of background	3 levels
Noise elimination filter	6 and off

4.3.4 Setting Conditions for Each Channel in Groups of 4

Sensor channels	4
Shading compensation value	6 points 0 to 100.0%
Optical magnification	0.5 to 9.999
Coordinate axis rotation angle	-180.000 to +180.000 deg
Sensor position coordinates	-999.999 to 999.999 mm

4.3.5 Conditions for Each Stage

Drive setting	Internal/external
Absolute position movement	
Second point position	-999.999 to 999.999 mm
Setting coordinates	5 points numbered 1 to 5 -999.999 to 999.999 mm
Constant movement amount	7 settings DIS1 to DIS7 -999.999 to 999.999 mm
Movement amount per pulse	-999.999 to 999.999 μ m
Starting frequency (X, Y, θ)	100 to 80,000 Hz
Maximum frequency (X, Y, θ)	100 to 80,000 Hz
Acceleration/deceleration time	10 to 9999 ms
Stage types	6
Angle conversion counting range	100.00 to 999.999 mm

4.3.6 Counters

Counter preset values	7 values for channels 0 to 6 0 to 99,999
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4.4 7-Inch B/W CRT Display

4.4.1 Gray Image (Density Image Monitor)

Dense images (currently selected camera channels plus binary level displayed)

Target position

Cursor

Measurement window

Density at cursor position

- Cursor position
- Stage position
- Counter values
- Density image processing conditions
- 4.4.2 Binary Image Monitor
 - Binary image
 - Target image
 - Cursor
 - Measurement window
 - Mark center coordinate
 - Mark area
 - Mark equivalent diameter
 - Stage position
 - Counter values
 - Binary image processing conditions
- 4.4.3 Density Histogram Display
 - Histogram
 - Cursor
 - Frequency of cursor positions
 - Cursor position density
 - Threshold value
 - Contrast compensation value
 - Density images
 - Binary images
- 4.4.4 Parameter Display
 - Positioning conditions
 - Density image processing conditions
 - Binary image processing conditions
 - Camera conditions
 - Stage conditions

4.5	Input/Output	
4.5.1	Image Output (Camera Output)	
	Number of channels	2
	Composite video signal	1.0 Vp-p with negative syncing into 75 Ω unbalanced
4.5.2	Image Output (Same display as TN-115 built-in CRT)	
	Number of channels	1
	Composite video signal	1.0 Vp-p with negative syncing into 75 Ω unbalanced
4.5.3	Parallel Input/Output Control Interface	
	Insulated using photocouplers	
	Input signals	16
	Output signals	16, open collector
	Sequencing program	Details at the end of this document
	Program generation	Performed at the host computer using the RS-232C
4.5.4	RS-232C (Option)	
	• Sequencing program generation and loading	
	• Data read/write, command execution	
4.6	Performance	
4.6.1	Measurement	
	Center coordinate measurement	$\pm 5 \mu\text{m}$ (for optical magnification of 1)
	Area measurement accuracy	$\pm 0.5\%$
	Measurement time	Approx. 30 ms
4.6.2	Alignment	
	Alignment accuracy	$\pm 5 \mu\text{m} \pm$ stage resolution (2 or more steps)
	Positioning time	60 ms \times no. of steps + stage movement time

4.7 General Specifications

- Power Requirements

Input voltage	100 VAC ($\pm 10\%$), 200 VAC ($\pm 10\%$) switch selected at fuse section
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Power consumption	Approx. 200 VA
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- Operating Environment

Operating temperature	0 to 40°C
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Storage temperature	-10 to 70°C
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- Outer Dimensions

	420(W) × 213(H) × 500(D) mm
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- Weight

	Approx. 20 kg
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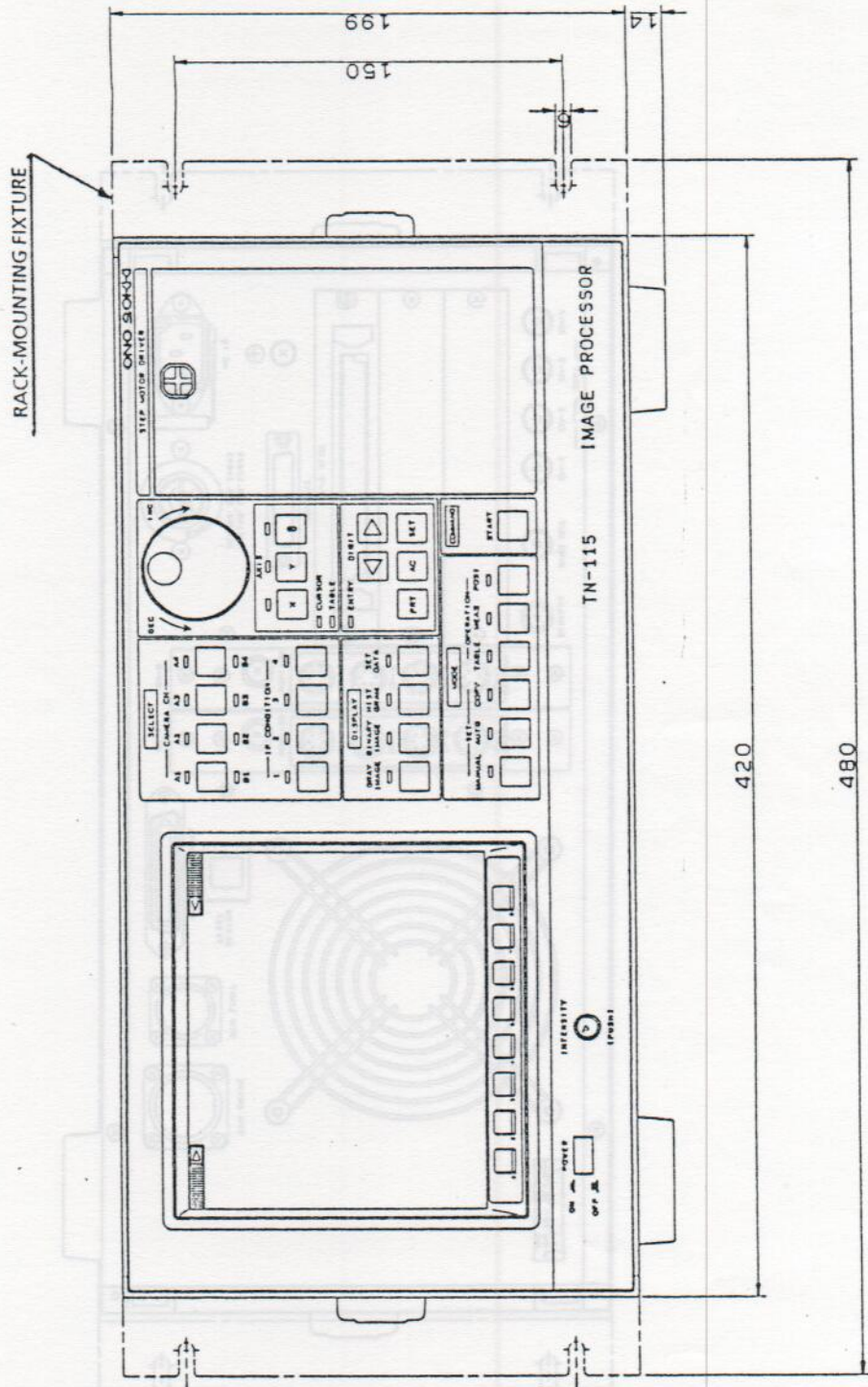
- Accessories

Power cable	1
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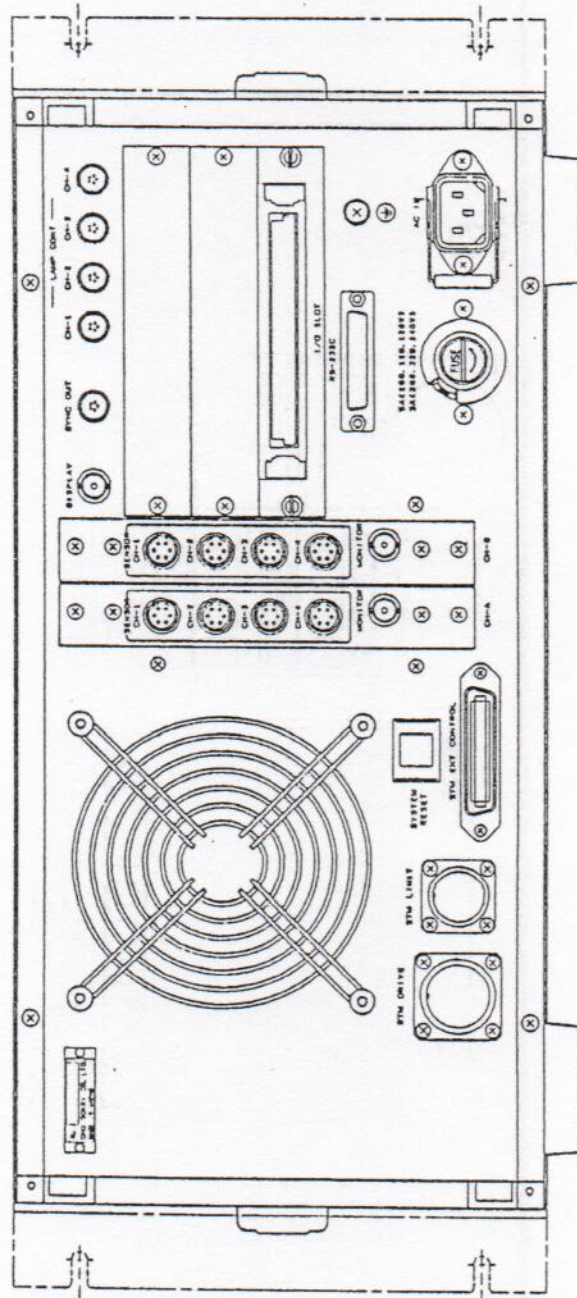
Instruction Manual	1
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5. OPERATION

Front Panel



Rear Panel



Note

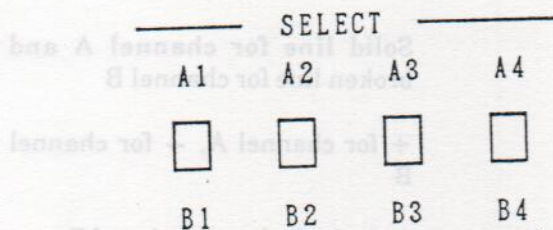
Remove the stand legs and attach the rack-mounting fixtures to mount the TN-115 on a rack.

5.1 Camera Channel and Image-Processing Condition Switches

5.1.1 CAMERA CH Switches

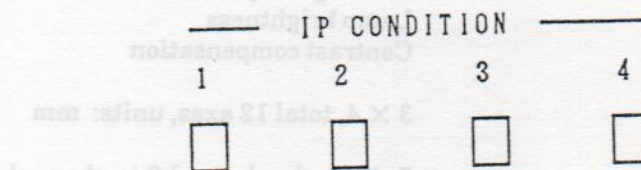
These four key switches are used to select which of the four pairs of TN-042 CCD TV Cameras (total of 8 cameras) is to be controlled. The switches cycle through the A, B, and AB conditions as they are pressed.

The lamps above and below the switches flicker to indicate the current settings.



5.1.2 IP CONDITION Switches

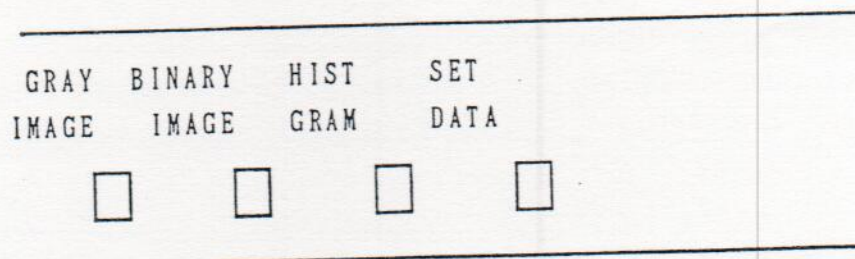
These switches are used to select any of the four sets of image processing conditions for the pair of cameras specified by the CAMERA CH switch selection.



5.2 DISPLAY Switches

The following four display settings can be made.

- GRAY IMAGE (dense images)
- BINARY IMAGE
- HIST GRAM (density histogram)
- SET DATA (setting values)



5.2.1 GRAY IMAGE

The dense images and image processing conditions, measurement data, and other necessary data for channels A and B of the selected camera are displayed together. The amount of data displayed can be switched through four levels by pressing the GRAY IMAGE switch in the DISPLAY group of switches.

Channel A and B screens can be displayed together by setting the CAMERA CH switch to the AB condition (when both upper and lower LEDs will light).

The following items are displayed.

- Density image
- Windows
 - Solid line for channel A and broken line for channel B
- Alignment point
 - + for channel A, - for channel B
- Cursor
 - + for both channels A and B
- Cursor coordinates
- Density of image at cursor position in %
- Multivalue image processing conditions
 - Number of averages
 - Shading compensation
 - Lamp brightness
 - Contrast compensation
- Stage position data
 - 3 × 4, total 12 axes, units: mm
- Counter values
 - 7 channels, channel 0 to channel 6
 - Incrementing by sequencer