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INSTRUCTIONS

INSTRUCTION MANUAL FOR AC-DC CONVERTER TYPE 3142

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Revision	4		1975.2				
	3		1970. 6				
	2		1965.12				
	1		1965. 6				
	Edit.	Page	Date				
			YOKOG	AWA	ELECTRIC	WORKS,	LTD.



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- CONTENTS -

		Page
1.	GENERAL DESCRIPTION	1
2.	FEATURES	1
3.	SPECIFICATIONS	1
4.	METHOD OF OPERATION	3
5.	OPERATIONAL FUNCTION	4
6.	EXPLANATION OF CONSTRUCTION AND OPERATION	5
7.	ADJUSTMENT	6
8.	SELECTION OF GALVANOMETER AND RECORDING SENSITIVITY	7
9.	CAUTIONS FOR USE	8

CIRCUIT DIAGRAM AND LIST OF PARTS

YOKOGAWA ELECTRIC WORKS, LTD.

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1. GENERAL DESCRIPTION

This equipment is manufactured as auxiliary equipment for the Photocorder (namely YEW Electromagnetic Oscillograph), This AC-DC Converter uses the G-170B GALVANOMETER to convert AC voltage to DC current and record on the electromagnetic oscillograph.

This equipment converts sine wave voltages of frequency 30 Hz to 20 kHz to 1.5 mA direct current. According to the current sensitivity of the galvanometer, with the use of the Type G-170A galvanometer, recording of about 200 mm is possible.

This equipment is also designed to extract 10mV output by using a slide switch as an accessory to the X-Y recorder.

In addition, there is another AC-DC Converter (Type 3/47) in our product line, of the peak value rectifying type, with excellent linearity and frequency characteristics.

2. FEATURES

The features of this equipment are as follows:

- 1) The rectifying type is half-wave rectification. By using a negative feedback amplification, excellent linearity is obtained.
- 2) The operation of this equipment is very stable, since it is entirely transistorized.
- 3) It can serve as an accessory to a servo-recorder as well as electromagnetic oscillograph.
- 4) It can measure up to a maximum of 250V/20cm, since a correcting attenuator is provided in the input circuit.

3. SPECIFICATIONS

Rectifying type:	Half-wave rectification				
Voltage scale range:	10, 25, 50, 100, 250 mV/cm 0.5 \downarrow 2.5 5 10 and 20 V/cm in \downarrow represe				
	0.5, 1, 2.5, 5, 10 and 20 V/cm in 11 ranges				

Frequency characteristics of amplitude: Within ±1% of output full scale at 30 Hz to 20 kHz

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	l.5mA ((GALVA l0mV (r (XY RE)	1.5mA (maximum), when using (GALVANOMETER) side. 10mV (maximum), when using (XY RECORDER) side.			
Linearity:	Within ±	$_{21\%}$ (at 30 Hz to 20 kHz of full scal			
Accuracy of am	plitude: ±1% (at	20°C ±5°C)			
Impedance:	Input impedance; Input capacity; Output impedance	Approximately 100 kΩ Less than 50 pF e; Approximately 1 kΩ, when usin (GALVANOMETER) side. Approximately 100Ω, when using (XY RECORDER) side.			
Response:	In the ev recordin rise tim	ven of - recording on an direc ng electromagnetic oscillograph, ne for 90% is 0.5 sec.			
Influence of pow	er fluctuation on Within J fluctuat	ation on output: Within $\pm 0.5\%$ within respect to power fluctuation of 100V $\pm 10\%$.			
Ambient temper	ature range:	0 to 45°C			
Noise:	Within I input ci	P-P $50\mu V$ of the output when the rcuit is short circuitted.			
Meter:	By selec can be 1	ction, outputs of $1.5mA$ and $10mV$ read from the DC $100\mu A$ ammeter			
Power supply:	100 VAC	C ±10V, 50 Hz, 60 Hz			
Power consump	tion: Approxi	mately 7VA			
Transistor:	Amplifi	er section 2SA603 (x 4) 2SA546 (x 1) 2SB462 (x 1)			
	Power s	$\frac{25B463 (x 1)}{2SA603 (x 1)}$			
Dimensions and	weight: Approxi	mately 87.5 (width)mm 216 (height)mm 400(depth)			
	Approxi	mately 4.5 kg			

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4. METHOD OF OPERATION

1) Power on

For the power supply, 100V (50 Hz or 60 Hz) is used, turn the power supply switch to the "on" position, following the connection to the power receptacle, so that the equipment immediately starts operating since it is entirely transistorized.

- 2) Insert the AC input to be measured into the input connecting terminal of the front panel.
- 3) Set the slide switch of the rear panel approximately, depending on whether the output is recorded by electromagnetic oscillograph or by X-Y recorder.
- 4) Adjust the input signal so that the output meter "VOLT SCALE" will indicate within 1.5mA (red line) in case of recording by the X-Y recorder, within 10mV (blue line)
- 5) Because current sensitivity of galvanometer (G-170B) is $\pm 10\%$ a precision, that error is calibrated by GALV CAL of the front panel.



Fig. 1 Front and rear panels

1) Front panel

$\underline{OUTPUT} \binom{mA}{mV}$

In the output meter, the upper side of the scale indicates mA output, and the lower side the mV output.

VOLT SCALE

Each step indicates the input voltage for the length on the output recording paper, by means of the input voltage attenuator.

INPUT

Input connecting terminal.

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GALV CAL

For the calibration of current sensitivity of galvanometer (G-170B)

ON, OFF

Connection of power supply circuit.

2) Rear panel

OUTPUT

Output connecting terminal.

100 VAC

Connector used when applying an 100 VAC power line as the power supply.

6. EXPLANATION OF CONSTRUCTION AND OPERATION



Fig. 2 Diagram of construction

(Input attenuator)

The input impedance is $100 k\Omega$, with the voltage ratio in 11 ranges from $10 \, mV/cm$ to $20 \, V/cm$.

(High input impedance circuit)

The circuit employs the Darlington connection for input transistors, thus increasing the AC input impedance; the input impedance at the normal temperature is more than $1M\Omega$.

(Amplifier)

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Though the amplification factor is reduced, the equipment uses a negative feedback amplifier, thus obtaining a flat gain with respect to the frequency change from approximately 30 Hz to 20 kHz and also the linearity to the nonlinearity of the diode rectification. The half-wave rectified voltage becomes output, and the combined sine wave is negatively fed back and is thus provided with linearity.

7. ADJUSTMENT

After finishing the adjustment the test results were recorded. However, should a trouble be encountered or an accurate measurement be required, the following adjustment should be performed: All the adjusting portions are concentrated on the printed circuit board BEW-323A and Front panel, and the associated adjustment is performed by the following three volume controls.

RV1: Output regulated volume (at the X-Y recorder side)

RV2: Output regulated volume (at the GALVA side)

RV3 : DC power supply voltage regulated volume

Adjustment of RV3 (set on printed circuit board)

RV3 should be adjusted so that the DC power supply voltage becomes -24V with the load connected.

Adjustment of RV1 (set on printed circuit board)

At the range of 10mV/cm of the "VOLT SCALE", apply sine wave input of 0.2V, 1 kHz, to the input terminal and connect the X-Y recorder to the output terminal, and calibration should be made so that deflection of 20 cm can be made at the 0.5mV/range.

Adjustment of RV2 (set on front panel)

Apply the sine wave of 0.2V, 1 kHz, to the input terminal at the range of 10mV/cm of the "VOLT SCALE", and connect the DC ammeter to the output terminal (GALVANOMETER side); adjust the RV2 so as to obtain approximately 1.5mA. But RV2 is used to caribrate the sensitivity of each galvanometer.



8. SELECTION OF GALVANOMETER AND RECORDING SENSITIVITY

Galvanometer Type G-170B, the products of YEW, are the most suitable ones for this equipment. This type have sensitivity of 20 cm deflection at the current sensitivity when using the external damping resistance at 1.5mA output, thus permitting use of the (VOLT SCALE) of the front panel as it is.

The characteristics of other types, such as the G-100A and G-170C galvanometers, are given below;

Type Number	Flat (±5%) Frequency Response	Current Sensitivity	Nominal Coil Resistance	Required External Damping Resistance	Maximum Saje Current	Linearity Within Allowed Deflection
	c/s	µA/mm	n	Ω	mА	m m
G – 100A	50	1.25	33	120	. 1	100
G - 170 B	100	3.3	22	17	1	100
G - 170 C	100	2.0	75	93	1	100

Galvanometer characteristics.

The above describes the characteristics of the galvanometer. The following list shows the overall characteristics when using the $T_{ype} = 3.142$

Ty <u>p</u> e Number	Coil Current of 3142 at 1.5mA Output (With the damping resistance insterted)	Coil Current Type 2902	Input Voltage Multiplier cf Type 2902	
	AU	µА/20ст	Indication	
G - 100A	1170	250	4	
G - 170B	654	660	10	
G - 170C	830	400	5	

Characteristics of this equipment used with the galvanometer.

P. 7



9. CAUTIONS FOR USE

- In the case where the output meter deflects more than 1.5mA (red line) or 10mV (blue line) the amplifier is saturated. Thus, the wave form becomes distorted and it is impossible to obtain accurate measurement.
- 2) Connect X-Y Recorder or Galvanometer to the output connecting terminal on the rear panel. Also set the slide switch on the corresponding side.
- 3) When using the electromagnetic oscillograph, it is possible to obtain approximately 20 cm deflection by using the G-170B galvanometer at $3.3 \mu A/cm$ current sensitivity (coil resistance 22Ω) and 1.5mA power supply with 17 Ω damping resistance.

When another type of galvanometer is used, due to the difference of current sensitivity, the deflection changes. Therefore, if galvanometer other than the G-170B type is used, the value of the (VOLT SCALE) should not be read as it is. In this case, the input voltage can be obtained by calculation.

For example;

"VOLT SCALE"0.5V/cm rangeOutput terminal"GALVANOMETER" is used.Galvanometer G-100A (coil resistance 33 Ω, the externaldamping resistance 120 Ω, current sensitivity 1.25 µA/mm)

When the above instruments are used, and 15 cm deflection is obtained, the current of galvanometer is $1.25 \,\mu\text{A} \ge 150 = 188 \,\mu\text{A}$, total current is $188 + \frac{33}{120} \ge 188 = 238 \,\mu\text{A}$.

The input voltage is $\frac{10V}{1500\mu A} \ge 238 = 1.58 V$.

4) This converter is the balanced type so that the power supply grounded can be measured in a direct means.



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Main Products

Electrical Measuring and Recording Instruments: Electrical Indicating Instruments; Laboratory Standard. Portable Instruments, Panel & Switchboard Instruments. Transducers: AC Voltage, AC Current, Watt, Reactive Power, Phase, and Frequency Transducers. Tachometers; Photo Tachometers, Panel & Switchboard Tachometers. Temperature Measuring Instruments; Thermocouple Thermometers, Thermistor Thermometers, Optical Pyrometers, Surface Temperature Indicators. Precision Measuring Instruments; DC Galvanometers, DC Potentiometers, DC & AC Bridges. Resistors; Standard Resistors, Dial Resistors, Slide Resistors. Digital Measuring Instruments; Digital Voltmeter, Digital Ohmmeter, Digital Multimeter. Standard Instruments; DC & AC Voltage & Current Standards, Standard Watt Converter. Oscillographs; Photocorders (Electromagnetic Oscillographs), Micro Pen-Oscillograph. Recorders; Direct-Acting Electrical Recorders, Laboratory Recorders, X-Y Recorders. Peripheral Equipment for Oscillographs and Recorders; Series Resistor, Shunt Resistor, DC Amplifiers, Strain Amplifiers, Logarithmic Converter, F-V Converter. Field Testers; Circuit Testers, Insulation Testers, Earth Resistance Testers, Portable Luxmeter, Sound Level Meter, Cycle Counter. Magnetic Material Testing Equipment; Gauss Meter, Electronic Fluxmeter, Epstein Iron Loss Test Sets, AC & DC Hysteresis Loop Tracers. Analog Computers: Analog Computer, Logic Assembly.

Industrial Process Instruments:

EBS Series Electronic Instruments, ERB Series Electronic Instruments, PCI Series Pneumatic Instruments, for measurement and control of Temperature, Pressure, Flow, Liquid Level, Density, Humidity, Dewpoint, Displacement, Velocity, Electrical Quantity, etc.

Analytical Instruments:

Instruments for Liquid Analysis; pH Meters, Turbidity Measuring Instruments, Liquid Density Measuring Instruments, Solution Conductivity Measuring Instruments, Viscosity Measuring Instruments, Process Titrator, Residual Chlorin Analyzer. Instruments for Gas Analysis; Chromatographs, Petroleum Sulfur Analyzer. Radiation Instruments; β Ray Thickness Gauge, γ Ray Density Meter.

Digital Control Systems:

Direct Digital Control Systems, Computer Control Systems, Digital Blending Control Systems.

