

AC BATTERY CHARGER

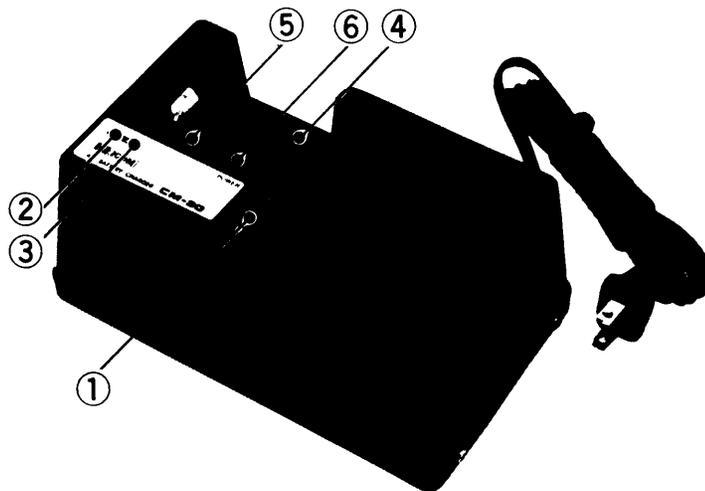
CM-30

MAINTENANCE MANUAL

SPECIFICATIONS

Applicable Battery Packs	IC-CM2, IC-CM3, IC-CM5 IC-CM4 (applies only with Nickel-Cadmium batteries inserted)
Number of Semiconductors	Transistor 9 IC 2 Diode 12
Power Supply Requirement	100/117/230V AC 50/60Hz (Input voltage can be selected by changing internal wiring.)
Charging Current	600mA for IC-CM2 and IC-CM5 25mA for IC-CM3 45mA for IC-CM4 (Nickel-Cadmium inserted)
Usable Temperature	0°C ~ +45°C for IC-CM3 and IC-CM4 +10°C ~ 40°C for IC-CM2 and IC-CM5
Dimensions	72mm(H) x 172mm(W) x 104mm(D)
Weight	Approx. 1.0kg

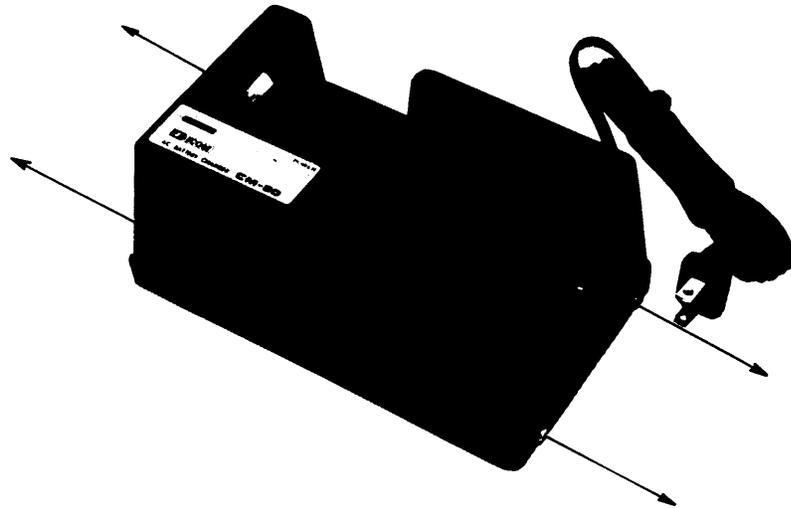
DESCRIPTION OF CONTROLS



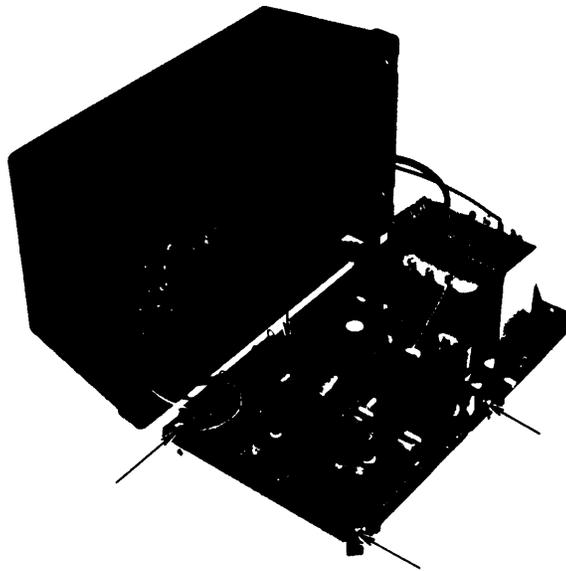
- 1. Power Switch**
When the charger is connected to a wall outlet, it turns the charger on.
- 2. Power Lamp**
Indicates power is on.
- 3. Charge lamp**
Indicates charging is underway, goes out then charging of rapid-charge packs is completed.
- 4. Insertion slot for battery packs.**
- 5. Charging terminal**
Correspond to the terminals on the bottom of the battery packs.
- 6. Microswitches.**
Since the current and capacity for each battery pack is different, these microswitches select the proper factors for each one.

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1. Remove the four screws which have retained the cover of the unit as shown in the figure.



2. Remove the cover from the chassis with taking care to donot make damage to the internal wirings as shown. When you wish to remove the PC Board, remove the four screws at each end of the board as shown in the figure.



This charger provides proper charging current for various battery packs which is selected by charging current selector on the bottom of the battery pack.

Also a constant charging current is provided by controlling conducting phase angle of the SCR in the circuit. It keeps the current constant even if various battery packs which have different output voltage, has been used.

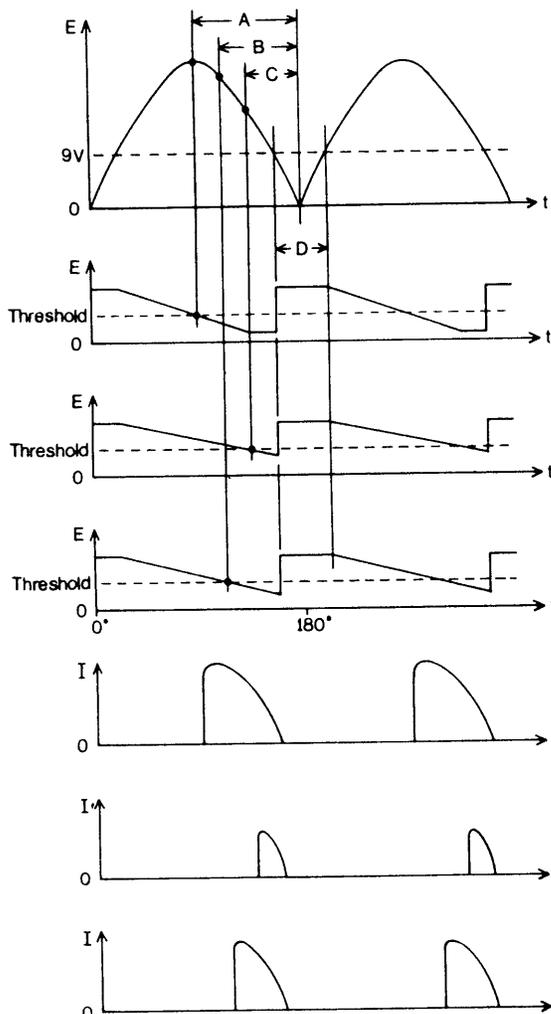
1. CONDUCTING ANGLE CONTROL CIRCUIT

A gate pulse is used to control the thyristor (SCR) in the circuit. This gate pulse is a part of a full-wave rectified wave and its phase angle is controlled by a saw tooth pulse which is synchronized to the full-wave rectified wave.

The pulse falltime of the saw tooth pulse is controlled by an actual charging current, and it decides the phase angle of the gate pulse of between 40 degrees and 160 degrees.

The saw tooth pulse generate circuit consists of Q2, Q5 and C9.

A full-wave rectified voltage is applied to the base of Q2 through R4 and turns Q2 on at near its base line (D portion in the figure), and charges C9 to +9V which from regulator Q1. When the rectified voltage exceeds +9V (out of D portion), Q2 is turned off and the charged voltage of C9 is discharged through Q5, and a saw tooth wave is generated across C9. This saw tooth pulse is fed to Pin 12 of IC2.



When the pulse voltage decreases less than gate's threshold voltage, Pin 11 of IC2 puts out H level voltage. This turns Q4 and Q3 on, and a portion of full-wave rectified voltage is fed to the gate of D6 SCR through Q3, and D6 is turned on.

When the SCR has been turned on, it holds this condition until the power source voltage becomes zero or its cathode is biased by reverse voltage. Thus, when the full-wave rectified voltage becomes less than +9V (D portion in the figure), the SCR will be turned off.

Rated charging current is decided by R37 ~ R42. R37 ~ R42 are selected by S3 ~ S5 which are turned on or off by a battery pack's charging current selector, and are in series with the charging battery.

A voltage across R37, R38 or R39 ~ R42 is integrated by R14 and C16, then fed to the base of Q6. Q5 and Q6 compose a differential amplifier. A reference voltage which is divided from +9V by R11 and R12, is applied to the base of Q5, thus the collector current of Q5 is varied by the base voltage of Q6, and controls discharging time of C9.

For example, when the charging current increases more than the specified charging current, Q6 collector current increases, Q5 collector current decreases, C9 discharging time becomes longer, the phase angle of D6 gate pulse delays (the pulse width becomes narrower), and the charging current decreases.

When the charging current decreases less than the specified charging current, the circuit functions the opposite way and keeps the charging current constant.

2. LOGIC CIRCUIT

The logic circuit is controlled by the charging current select switches S3 ~ S5, and the charging detector Q10.

When charging IC-CM2 or IC-CM5, S5 is turned on by the charging current selector on the battery pack.

The charging current (600mA) flows through R39 ~ R42, and a voltage across these resistors is applied to the base of Q10 and turns it on. Thus, a gate input Pin 1 and 2 of IC2 becomes L level, its output Pin 3 H level. This puts out H level at Pin 4 of IC1, output of a flip-flop consisting of a gate of IC1 and a gate of IC2. Also Pin 10 of IC1 puts out H level and Pin 10 of IC2 L level.

This grounds the emitter of Q4 through R10 and Pin 10 of IC2, and Q3 is turned on during Pin 11 of IC2 is H level and charges the battery pack.

When the battery pack is fully charged, the built-in thermal switch in the pack is turned off and cuts off the ⊖ charging terminal. Thus, H level is applied to Pin 1 and 2 of IC2, Pin 5 of IC1 and the flip-flop is turned to reverse condition and Pin 4 of IC1 becomes L level. This puts out H level at Pin 10 of IC2 and turns Q4 off, and any charging current does not flow even if the thermal switch has been turned on when the battery pack is cooled.

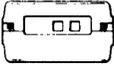
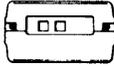
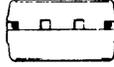
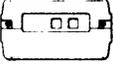
When the battery pack is removed from the charger, S5 is turned off and Pin 5 of IC1 is grounded through S5. This resets the flip-flop for another charging.

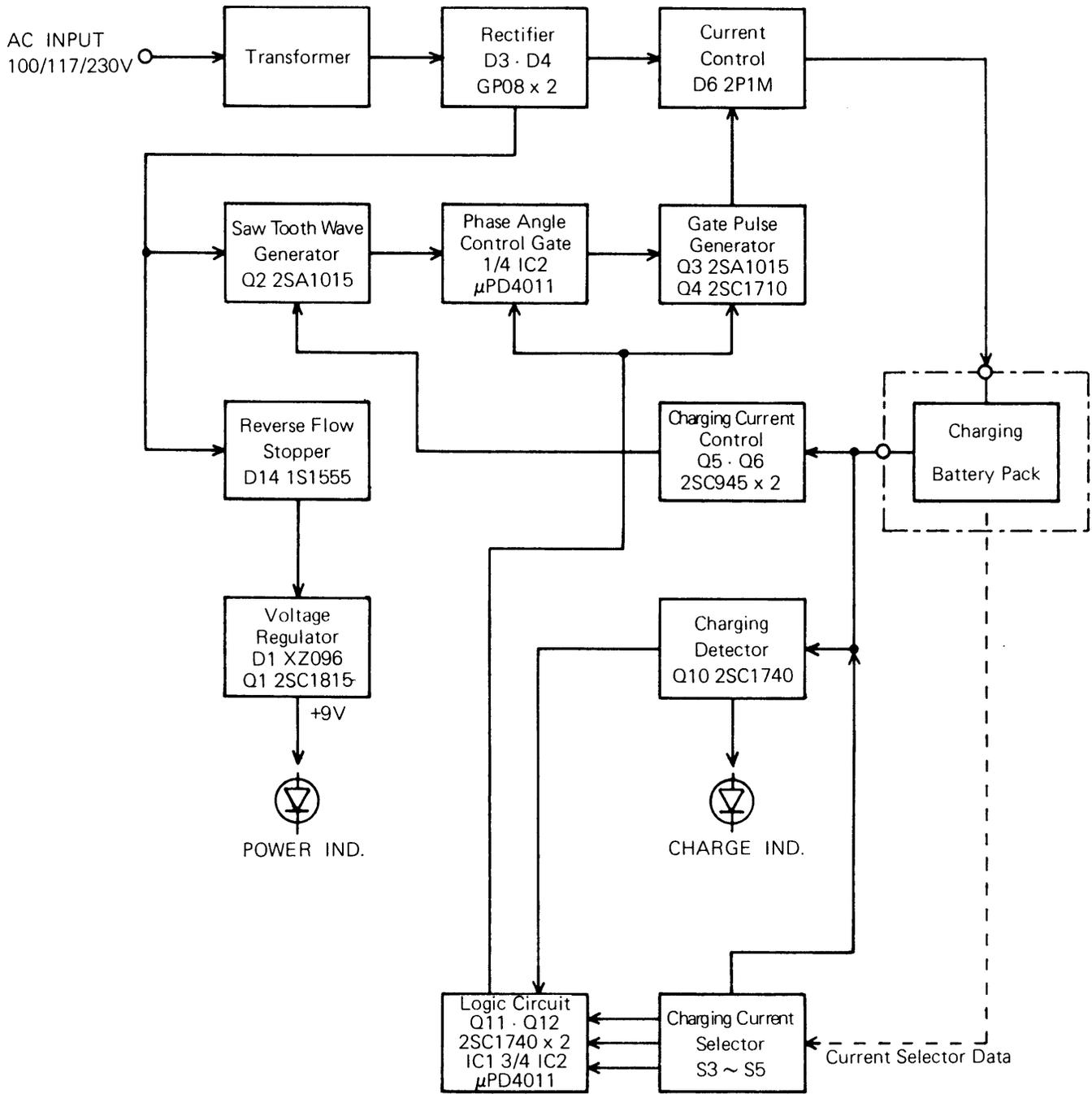
When charging IC-CM3, S3 is turned on and the charging current (25mA) flows through R37.

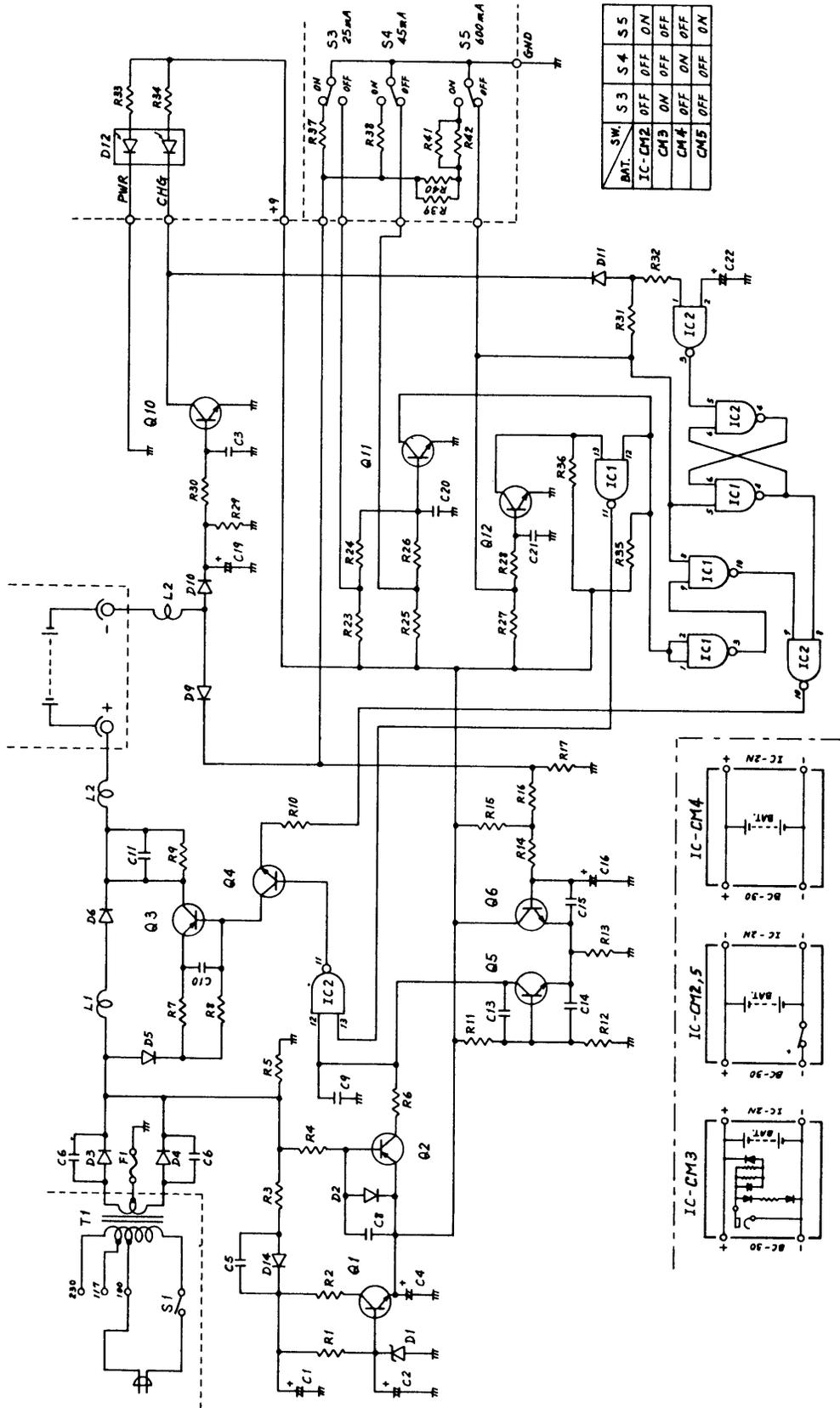
Pin 5 and 8 of IC1 are grounded through S5, Pin 10 of IC2 is L level and Q4 emitter is grounded through R10. Thus, the charging current flows until the battery pack is removed from the charger.

When charging IC-CM4 inserted nickel-cadmium batteries S4 is turned on and the charging current (45mA) flows through R38. The logic circuit works the same as charging IC-CM3.

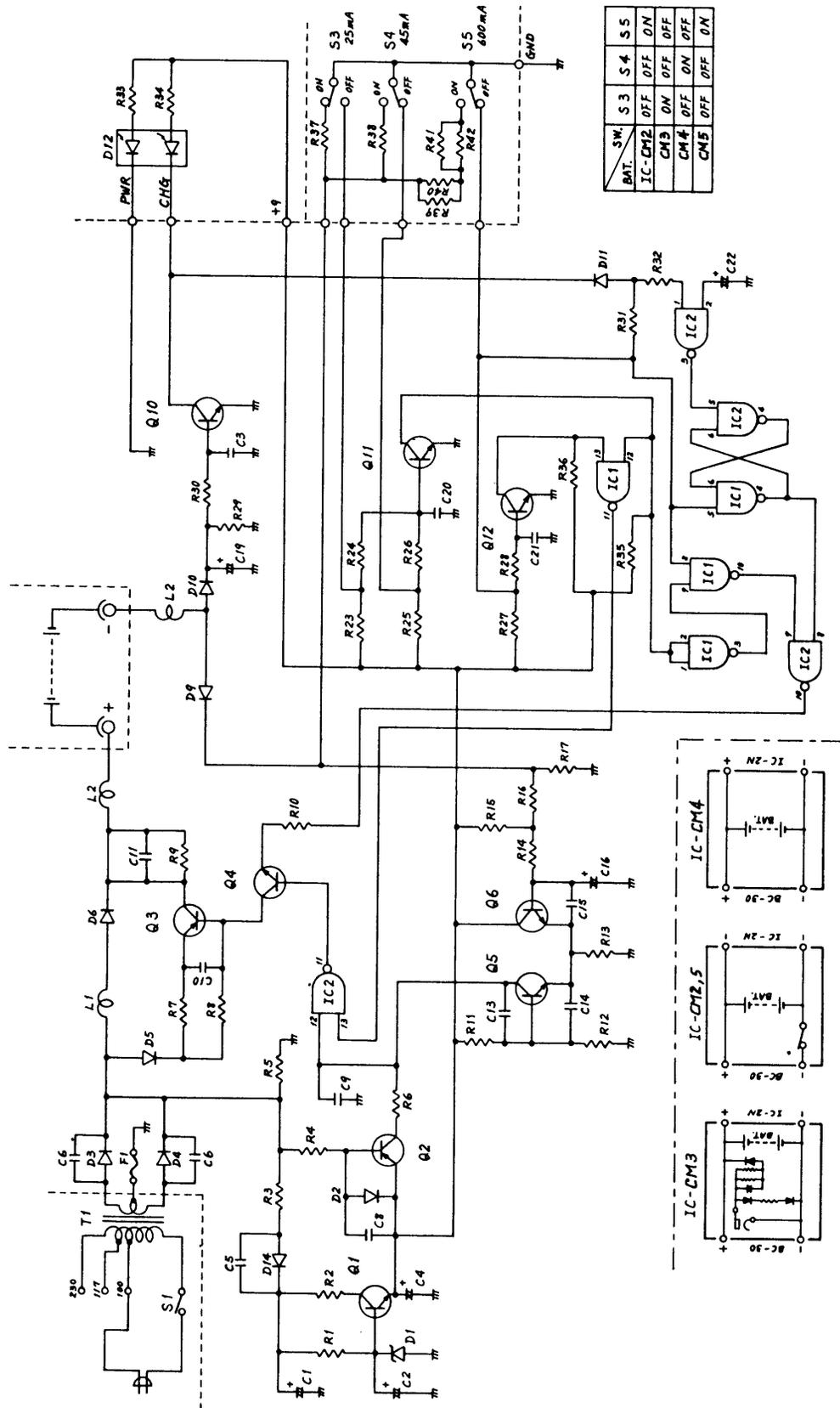
SPECIFICATIONS OF BATTERY PACKS

	IC-CM2	IC-CM3	IC-CM4	IC-CM4	IC-CM5
Cells [Capacity]	N-425A R (X 6) [400mAH]	N-250A A (X 7) [250mAH]	AA Size Alkaline (X 6)	AA Size Nickel-Cadmium (X 6)	N-425A R (X 9) [400mAH]
Voltage	7.2V	8.4V	9.0V	7.2V	10.8V
RF Output	1.0W	1.5W	1.5W	1.0W	2.3W
Charging	Rapid	Normal		Normal	Rapid
Charging Time	1 ~ 1.5H	15H		15H	1 ~ 1.5H
Suitable Charger	CM-30	CM-30 CM-25U IC-CM1		CM-30	CM-30
Charging Current	600mA	25mA		45mA	600mA
Ambient Temperature	+10°~+40°C	0°~+45°C		0°~+45°C	+10°~+40°C
Overcharge Protect	○	X		X	○
Current Selector					
Height	39m/m	39m/m	49m/m	49m/m	60m/m
Battery Replace	X	X	○	○	X

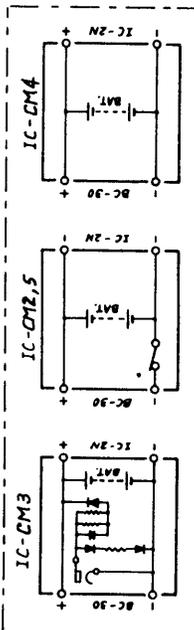




BAT.	S 3	S 4	S 5
IC-CM2	OFF	OFF	ON
CM3	ON	OFF	OFF
CM4	OFF	ON	OFF
CM5	OFF	OFF	ON



SW.	S3	S4	S5
BAT.	S3	S4	S5
IC-CM2	OFF	OFF	ON
CM3	ON	OFF	OFF
CM4	OFF	ON	OFF
CM5	OFF	OFF	ON



Note: Measuring instrument is a 50KΩ/V multimeter.

TRANSISTOR

BATTERY	No connection			IC-CM3 (25mA)			IC-CM4 (45mA)			IC-CM2/CM5 (600mA)		
	Tr. NO.	BASE	COLLECTOR	EMI TTER	BASE	COLLECTOR	EMI TTER	BASE	COLLECTOR	EMI TTER	BASE	COLLECTOR
Q 1	9.8	18.0	9.2	9.8	14.5	9.1	9.8	14.5	9.2	9.8	13.0/20.0	9.2
Q 2	9.4	2.9	9.2	9.4	6.2	9.1	9.4	6.2	9.2	9.4	5.2/4.4	9.2
Q 3	16.5	15.0	17.0	16.0	2.7	3.2	16.0	2.4	2.6	14.0	5.0/7.8	14.0
Q 4	9.1	16.5	8.5	1.75	16.0	1.65	1.6	16.0	1.7	3.6/4.8	14.0	3.3/4.4
Q 5	0.9	2.4	0.32	1.0	6.0	0.45	1.0	6.2	0.45	1.0	4.9/3.9	0.44/0.42
Q 6	0.7	9.2	0.32	1.05	9.1	0.45	1.0	9.2	0.45	1.0	9.1	0.44/0.42
Q10	0	7.6	GND	0.75	0.1	GND	0.74	0.1	GND	0.75	0.1	GND
Q11	0	9.0	GND	0.65	0.1	GND	0.65	0.1	GND	0	8.9	GND
Q12	0	9.0	GND	0	9.0	GND	0	9.0	GND	0.65	0.1	GND

IC

IC NO.	Condition	PIN NO.													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
IC1	—	9.0	9.0	0	9.0	0	0	GND	0	0	9.0	0	9.0	9.0	9.0
	25mA	0	0	9.0	9.0	0	0	GND	0	9.0	9.0	9.0	0	9.0	9.0
	45mA	0	0	9.0	9.0	0	0	GND	0	9.0	9.0	9.0	0	9.0	9.0
	600mA	9.0	9.0	0	9.0	9.0	0	GND	9.0	0	9.0	9.0	9.0	0	9.0
	CUT	9.0	9.0	0	0	9.0	9.0	GND	9.0	0	9.0	9.0	9.0	0	9.0
IC2	—	0	0	9.0	0	9.0	9.0	GND	9.0	9.0	0	*1.0	*6.0	9.0	9.0
	25mA	0	0	9.0	0	9.0	9.0	GND	9.0	9.0	0	*1.0	*5.0	9.0	9.0
	45mA	0	0	9.0	0	9.0	9.0	GND	9.0	9.0	0	*3.5	*5.0	9.0	9.0
	600mA	0.8	0.8	9.0	0	9.0	9.0	GND	9.0	9.0	0	6.0	4.2	9.0	9.0
	CUT	4.3	4.3	0	9.0	0	0	GND	0	9.0	9.0	6.0	4.2	9.0	9.0

*Will be varied by battery voltage and/or charging conditions.

REF. NO.	DESCRIPTION		
IC1	IC μ PD4011		
IC2	IC μ PD4011		
Q1	Transistor	2SC1815-O, Y, GL, BL	
Q2	Transistor	2SA1015-Y	
Q3	Transistor	2SA1015-Y	
Q4	Transistor	2SC1740-Q, R, S, E	
Q5	Transistor	2SC945-P	
Q6	Transistor	2SC945-P	
Q10	Transistor	2SC1740-Q, R, S, E	
Q11	Transistor	2SC1740-Q, R, S, E	
Q12	Transistor	2SC1740-Q, R, S, E	
D1	Zener	XZ-096	
D2	Diode	1S1555	
D3	Diode	GP-08B	
D4	Diode	GP-08B	
D5	Diode	1S1555	
D6	SCR	2P1M	
D9	Diode	GP-08B	
D10	Diode	1S1555	
D11	Diode	1S1555	
D12	LED	LD-002R	
D14	Diode	1S1555	
L1	Choke	LW-16	
L2	Choke	LW-9	
L3	Choke	LW-9	
R1	Resistor	820	ELR25
R2	Resistor	220	ELR25
R3	Resistor	33	ELR25
R4	Resistor	22K	ELR25
R5	Resistor	2.2K	ELR25
R6	Resistor	3.3K	ELR25
R7	Resistor	1K	R25
R8	Resistor	10K	R25
R9	Resistor	1K	ELR25
R10	Resistor	47K	R25
R11	Resistor	22K	ELR25
R12	Resistor	2.7K	ELR25
R13	Resistor	1.5K	ELR25
R14	Resistor	22K	ELR25
R15	Resistor	15K	ELR25
R16	Resistor	680	ELR25
R17	Resistor	820	ELR25
R23	Resistor	10K	ELR25
R24	Resistor	100K	ELR25
R25	Resistor	10K	ELR25
R26	Resistor	100K	ELR25
R27	Resistor	10K	ELR25
R28	Resistor	100K	ELR25

REF. NO.	DESCRIPTION		
R29	Resistor	100K	R25
R30	Resistor	5.6K	R25
R31	Resistor	470K	R25
R32	Resistor	22K	R25
R33	Resistor	680	R25
R34	Resistor	680	R25
R35	Resistor	10K	ELR25
R36	Resistor	10K	ELR25
R37	Resistor	27	R25
R38	Resistor	15	R25
R39	Resistor	1	R25
R40	Resistor	1	R25
R41	Resistor	1	R25
R42	Resistor	1	R25
C1	Electrolytic	47 μ F/25V	
C2	Electrolytic	10 μ F/16V	
C3	Ceramic	470P	
C4	Electrolytic	100 μ F/10V	
C5	Ceramic	0.0047	
C6	Ceramic	0.0047	
C7	Ceramic	0.0047	
C8	Ceramic	470P	
C9	Barrier Lay	0.047	
C10	Ceramic	470P	
C11	Ceramic	470P	
C13	Ceramic	470P	
C14	Ceramic	470P	
C15	Ceramic	470P	
C16	Electrolytic	47 μ F	10V
C19	Electrolytic	22 μ	16V
C20	Ceramic	470P	
C21	Ceramic	470P	
C22	Electrolytic	2.2 μ	50V
S1	Switch	SDJ2S	
S3	Switch	D2MS	
S4	Switch	D2MS	
S5	Switch	D2MS	
	PC Board	B-439B	
	HEATSINK	41912	
	Fuse Holder	S-N5051	
	Fuse	2A	
T1	Transformer	TP-25	
	Power Cord	OPC-013	