IA2007
Shizuoka, Japan

7th International Abilympics

Vocational Skills Contest

V12. Electronic Assembly and Testing

1. Task

Assemble a photodetector according to the following specifications and instructions, and confirm that it functions properly.

2. Allocated time

Standard time: 2 hours

3. Instructions

(a) Contestants should first confirm that the items, quantities, etc., of the provided materials are those specified in Section 8 Materials to be provided on site. Contestants should not use any materials other than the ones provided by the organizer.

(b) When a contestant points out that any one of the materials has a significant defect before the contest starts, and the judge recognizes it, a replacement will be provided. In addition, after the contest has started, a provided material will be replaced upon request by a contestant. However, such case is subject to deduction of marks for grading.

(c) Contestants are not allowed to use tools, etc., other than those designated in Sections 9 and 10 below.

(d) Contestants are not allowed to lend or borrow tools during the contest.

(e) Contestants must make sure that they do not leave fingerprints or create flaws on the surface of the chassis, printed circuit board (hereafter, printed board), etc. If the chassis is covered with protective film, the film must be removed before using it.

(f) Contestants shall pay full attention to safety while working on the task. Clothing, etc., to be worn during the contest should be suitable for the work.

(g) When soldering, contestants are recommended to wear eye protection.

(h) Contestants shall notify the judge when they finish the task.

(i) When the contest is finished, contestants should clean the worktable following the instructions given by the judge.

(j) Contestants must not write notes on the previously provided task assignment sheet or bring onto the site any other papers with notes, reference books, etc.

4. Specifications

The specifications shall be defined as follows.

4-1 Circuit diagram and part terminal diagram

Circuit diagram shall be as indicated in Section 5-1 Diagram of Photodetector Circuit, and Section 5-2 Part Terminal Diagram.

4 - 2 Assembly of chassis

(a) The chassis shall be assembled according to the instructions given in Section 6 Assembly Drawing of Chassis".

(b) Screw Tightening torque

Screws shall be tightened using a proper torque so that they will not become loose or be damaged. The rubber leg should be tightened in a way that it will not be turned around when touched by a finger tip.

(c) How to tighten the screws

Screws with a designated nominal diameter shall be used, and the combination with a washer, etc., shall be as specified in Fig.1-1a, Fig.1-1b, Fig.1-1c.

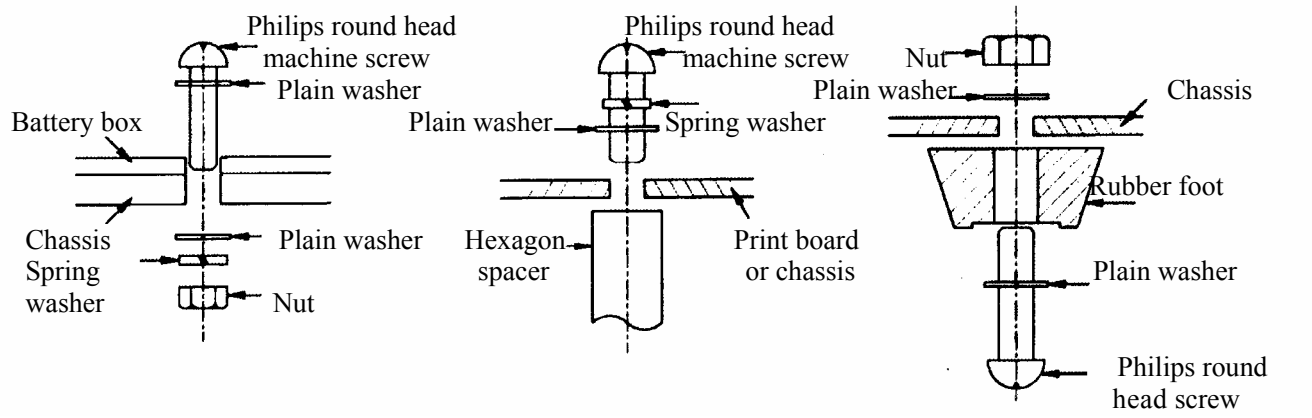


Fig. 1-1a **Fig.1-1b** **Fig.1-1c**

(d) Mounting of parts

[a] Parts to be mounted on the chassis shall be mounted horizontally or vertically based on the edge face of the chassis. The range of allowable bending of each part shall be within 0.5mm. Please refer to Fig.1-2 below as an example.

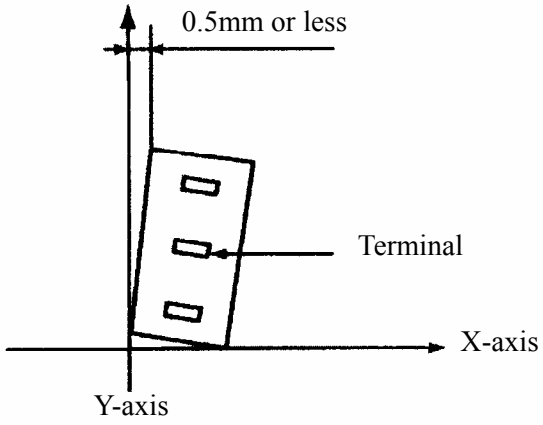


Fig.1—2

[b] Toggle switch (S1) shall be mounted as illustrated in Fig.1-3 and Fig.1-4.

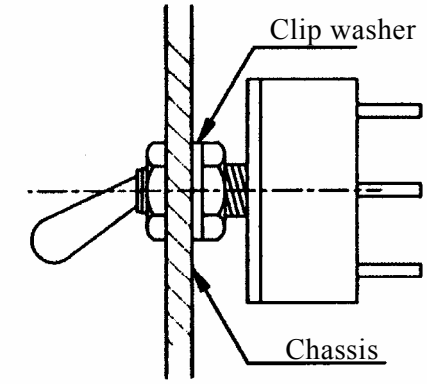


Fig.1-3

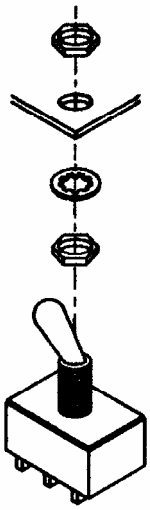


Fig.1-4

[c] The terminal shall be mounted as illustrated in Fig.1-5.

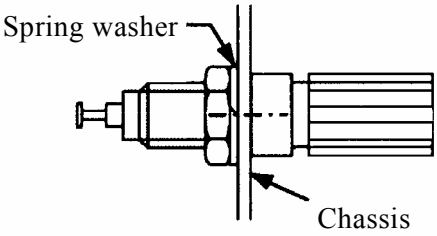


Fig. 1-5

4-3 Assembly of printed board

(a) The printed board shall be assembled as illustrated in Section 7 Assembly Drawing of Printed Board (PB).

(b) Direction in which parts are mounted and indication of parts

[a] Parts (including soft copper wire) shall be mounted horizontally or vertically on the printed board, and the allowable range of bending shall be within 1mm.

[b] Parts shall be mounted in a way that the indication or rating of each part can be identified.

[c] Resistors (including chip resistors) and ceramic capacitors shall be mounted in a way that the Assembly Drawing of Printed Board can be read from bottom to up and from left to right when viewed from the front.

[d] Polarized parts shall be mounted as designated in the circuit diagram.

(c) How to mount parts

[a] The resistor (including chip resistor), diode, electrolyte capacitor, tantalum capacitor, soft copper wire, and check terminal shall be loosely mounted on the printed board. Note that the limit of uplift shall be as illustrated in Fig.2-1.

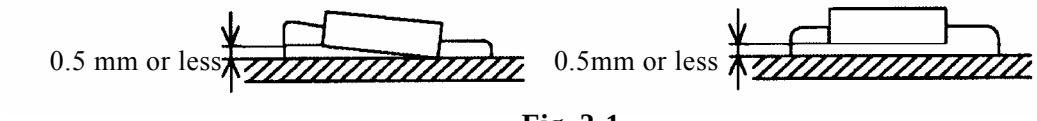


Fig. 2-1

[b] As for parts such as the trimmer potentiometer, relay, and IC, those having a stopper shall be mounted in a way that they are inserted as far as the stopper, and those with no stopper shall be mounted by adhering them. Note that the limit of uplift shall be as illustrated in Fig.2-2, and in the case of parts with a protrusion at the bottom, it shall be the dimension from the tip of the protrusion.

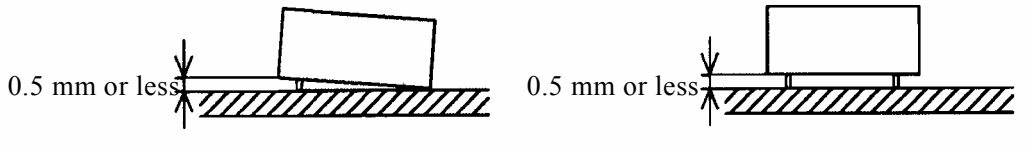


Fig. 2-2

[c] The lead wires on the right and left sides shall be mounted in a well-balanced manner, and excessive force shall not be applied as illustrated in Fig.2-3 and Fig.2-4.

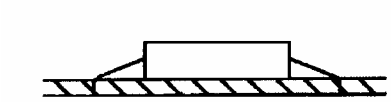


Fig. 2-3

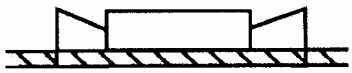


Fig. 2-4

[d] The transistor, IC4 (Photo IC), light-emitting diode, and ceramic capacitor shall be mounted based on the method as shown in Fig.2-5, and the lead wire shall be covered with an insulating tube.

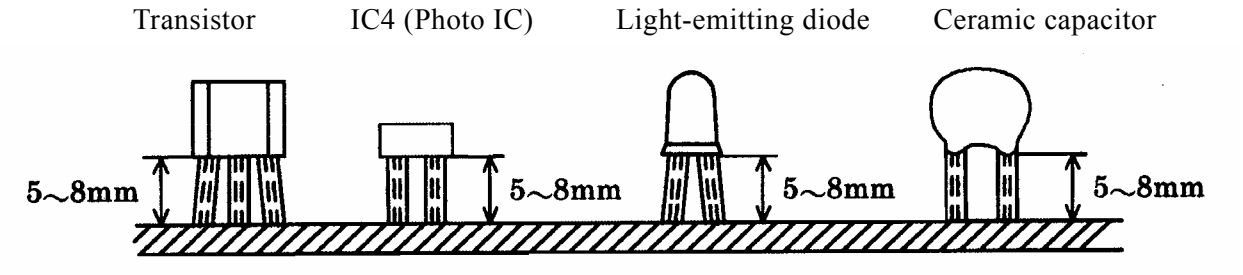


Fig. 2-5

[e] The displacement of the chip resistor (R3, R4, R5, C4) against the land shall be as illustrated in Fig. 2-6 (a) and they shall not contact the adjacent pattern and part. Note that the chip resistor shall not be mounted in a way making it stand as illustrated in Fig. 2-6 (d).

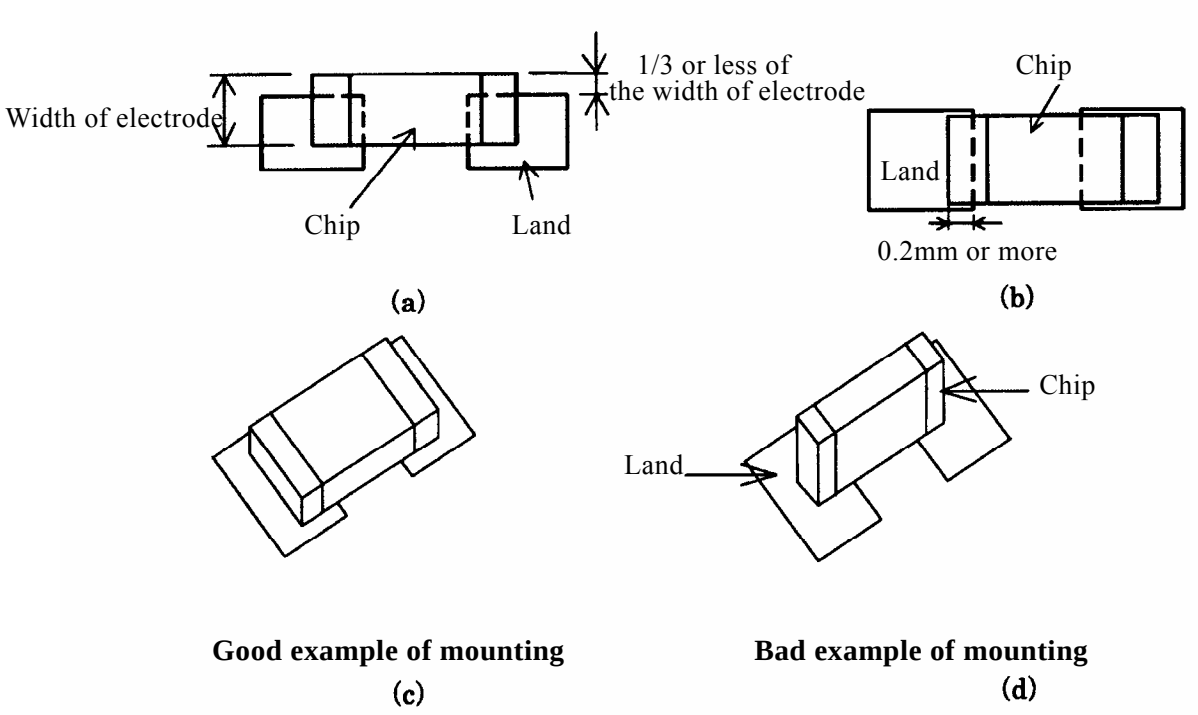


Fig. 2-6

(d) Folding and treatment of component lead wires and soft copper wires

[a] The lead wire and soft copper wire of the resistor, capacitor, diode, transistor, and IC4 (photo IC) shall be bent at the point nearly touching the land and cut according to the standard of the land's circumference. Note that the relevant dimension shall be as illustrated in Fig.2-7, and the dedicated land shall be bent as illustrated in Fig.2-8.

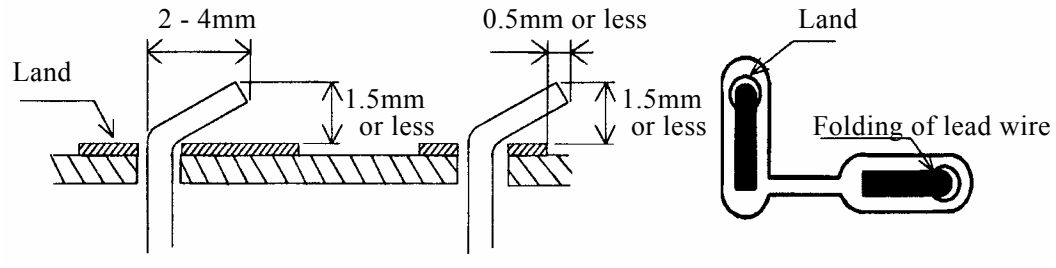


Fig. 2-7 **Fig. 2-8**

[b] IC1, IC2, IC3, check terminal, semi-fixed resistor, and relay shall be inserted in the printed board and the lead wire shall be soldered without being folded. The protrusion shall be between 0.5 and 2.5mm and those that exceed 2.5mm shall be cut and soldered.

4-4 Wiring

(a) Wiring of vinyl electric wire

[a] The color of electric wire shall be designated as indicated in the circuit diagram.

[b] The extra length of wiring shall be 10mm or longer.

[c] As for the connection to the terminal, it shall be connected to perforated terminal by binding using hooking as illustrated in Fig. 3-1, and connected to the non-perforated terminal by binding using winding as illustrated in Fig. 3-2. Note that the directions of binding and winding may be determined discretionarily but they shall be the same on each part.

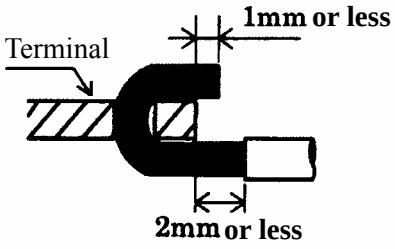


Fig. 3-1

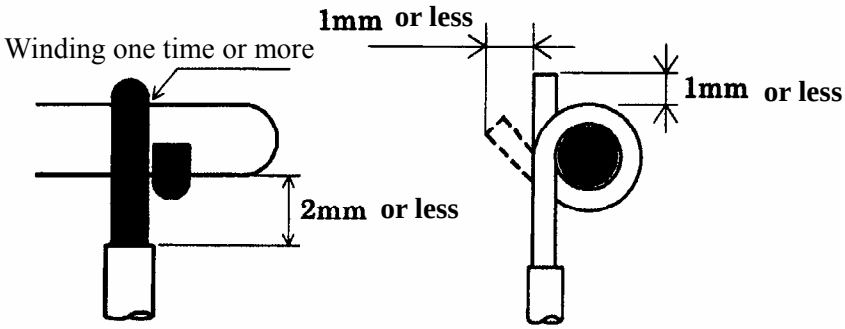


Fig. 3-2

[d] The lead wire of the battery snap shall be wound any number of times between 5 and 15, and the wiring shall be adjusted in a way that it will not protrude from beyond the chassis edge face.

4-5 Soldering

(a) Solder wettability

[a] The solder shall be substantially spread on the surface of the bonded metal with its outer edge extending broadly.

[b] When soldering part holes, the solder wettability shall be retained on the surface of the land.

(b) Solder quantity

[a] The part of lead wire of the part where it is bent, part of wire where it is bound, cut section of wire, etc., shall be covered by solder, but the solder shall be thin enough for the shape of the wire, etc., to be recognizable. A relevant example is shown in the "Criteria for soldering quantity" in Fig. 4 below. However, in the case of a soldering part lead wire that is mounted without being bent or cut, the entire area including the tip need not be covered by solder. The solder quantity for surface-mounted part shall be as specified in Fig. 5.

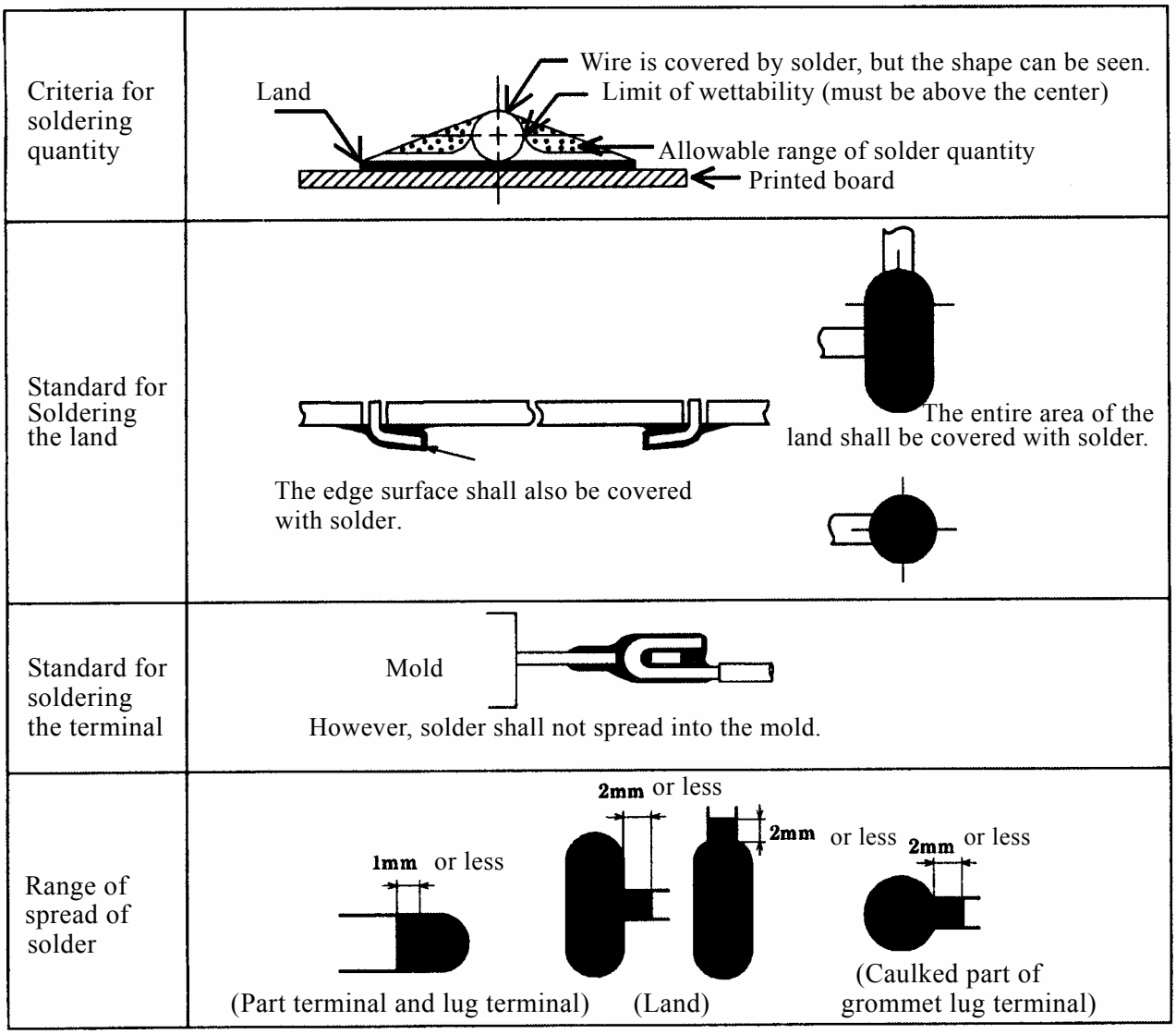


Fig. 4

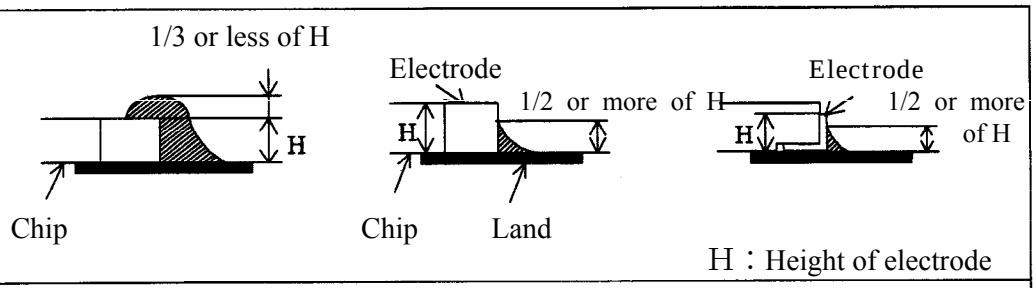
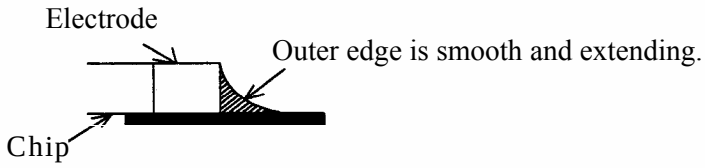
Allowance range for solder quantity of the chip	
Solder fillet of the chip	

Fig. 5

(c) Other

[a] The caulked part of the grommet lug terminal shall be soldered on the solder face.

[b] The parts on the grommet terminal and part terminal where the wire is connected shall be soldered without any holes. A relevant example is shown in Fig. 6. The caulked hole of the grommet lug terminal need not be filled with solder.

[c] In doing soldering work, contestants shall not damage the vinyl electric wires or any other part.

[d] Contestants shall not connect wires or part lead wires where there is no land.

[e] Land shall not be separated.

[f] The electrode of chip shall not be dissolved or damaged.

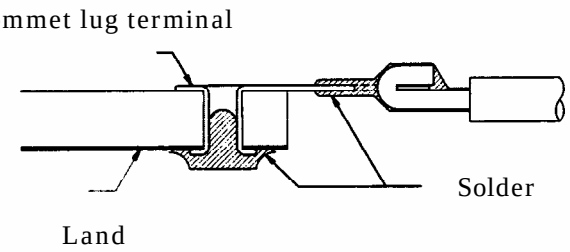
Standard for soldering the grommet lug terminal and Caulked part	

Fig. 6

4-6 Checking of function

(a) Overall function

[a] Circuit controls blinking of LED1 and ON and OFF of RLY1 by sensing luminance.

[b] Circuit consists of a comparator circuit which has hysteresis and non-stable oscillating circuit of timer IC.

[c] The oscillating frequency of the oscillating circuit is determined by R1, R2, andC1, and the duty ratio is determined by R1 and R2.

[d] The amount of hysteresis in the comparator circuit is determined by R3, R4, and R5.

[e] When light is shut out, the electric current at IC4 decreases, voltage at the second pin of IC2 rises, and the output voltage of the comparator circuit is reversed, and when RLY1 is switched ON, LED1blinks.

[f] The blinking cycle of LED1 is determined by the non-stable oscillating circuit of timer IC.

(b) How to check the function

[a] Set S1 to OFF (downside) and turn VR1 counterclockwise to the full.

[b] Insert batteries into battery box B1.

[c] Connect the tester with TP1 and TP2 and set the voltage range.

[d] Set S1 to ON (upper side).

[e] While the light shines on the head of IC4, turn VR1 clockwise little by little until the voltage display shows 1±0.1[V]. (Take care lest the head of IC4 enters the shadow of the contestant's hand, screwdriver, etc.)

[f] Cover the head of IC4 with the contestant's finger, etc., to shut out the light, and check if LED1 blinks when RLY1 is switched ON.

[g] Alternately repeat the condition in which the light shines on the head of IC4 and the condition in which the light is shut out, and check the electric continuity between T1-T2 and T2-T3 using the tester to confirm that it is switched.

[h] Set S1 to OFF (downside) and present the work.

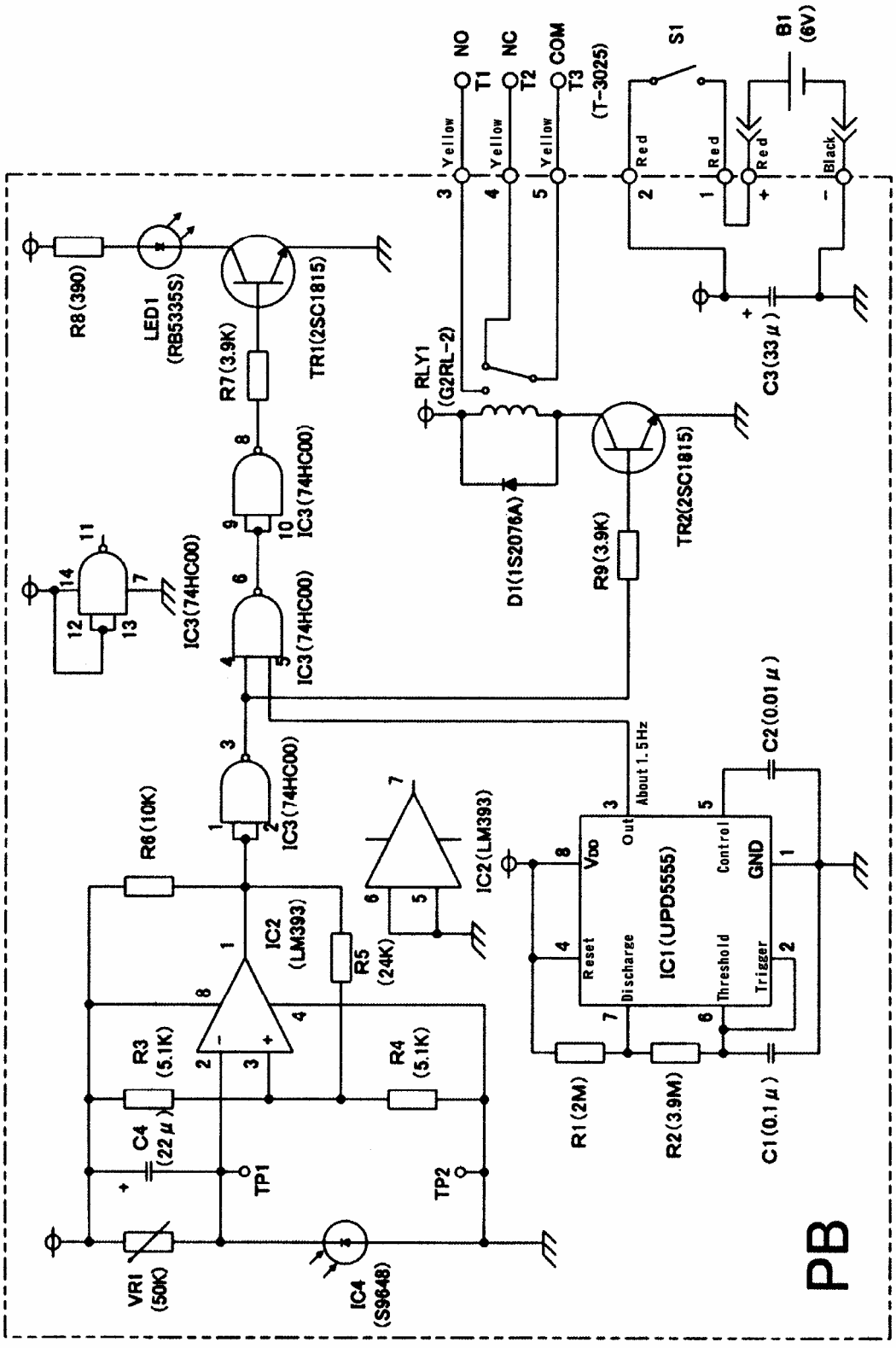
4 -7 Instructions to be observed when the work is submitted

(a) Remove debris, stains, etc., such as wire debris, solder balls, etc.

(b) Part lead wires, etc., must be modified.

(c) Check that the switch is on the downside and the knob of the terminal is tightened without any gap.

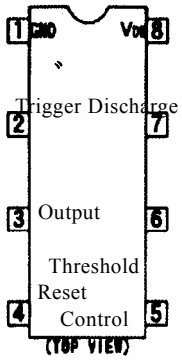
5 -1 Circuit Diagram of Photodetector



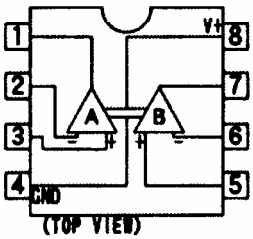
5 - 2 Part Terminal Diagram

IC1 (μPD5555 or similar)

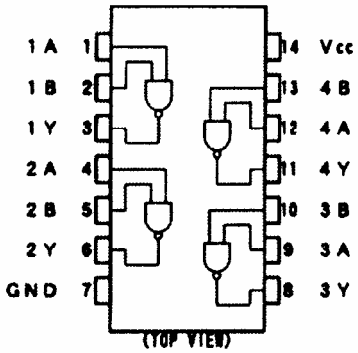
(LMC555CN or similar)



IC2 (LM393 or similar)

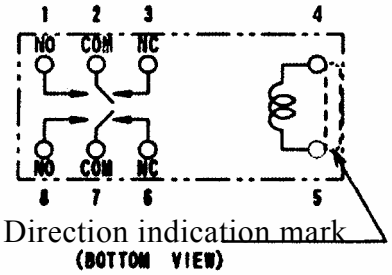


IC3 (TC74HC00 or similar)

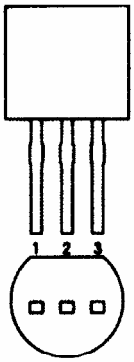


RLY1 (G2RL-2 or similar)

(FTR-F1C or similar)

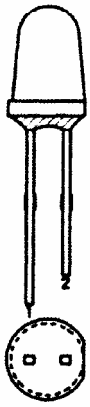


TR1 - 2 (2SC1815(C) or similar)



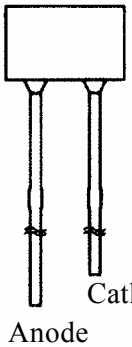
1. Emitter
2. Collector
3. Base

LED1 (BR5333S or similar)



1.Anode
2.Cathode

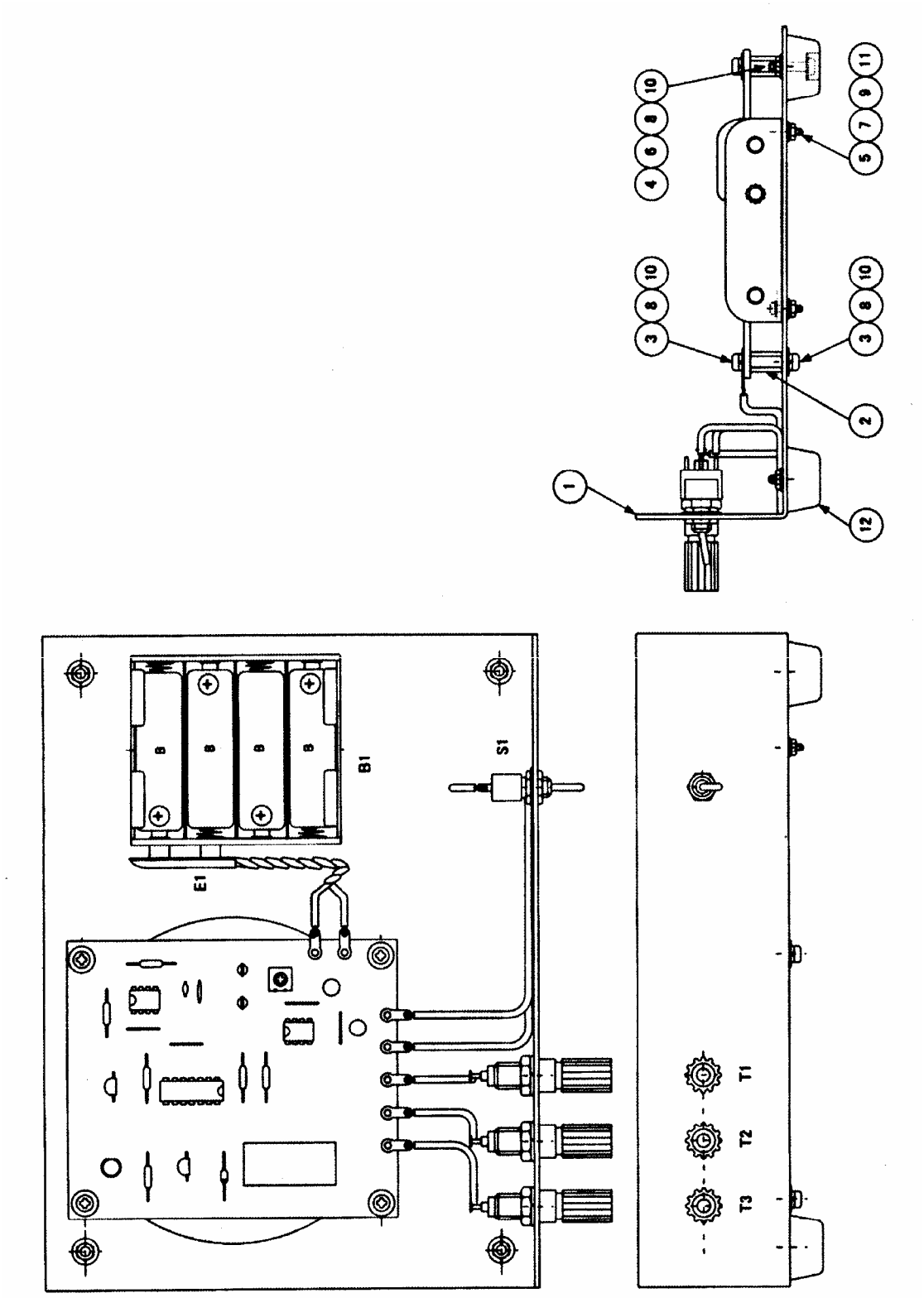
IC4 (S9648 or similar)



Cathode

Anode

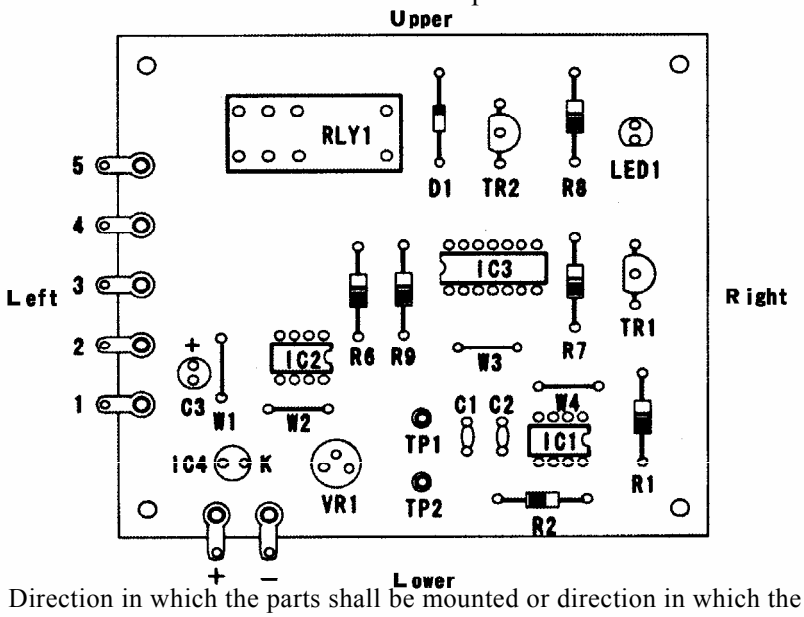
6. Assembly Drawing of Chassis



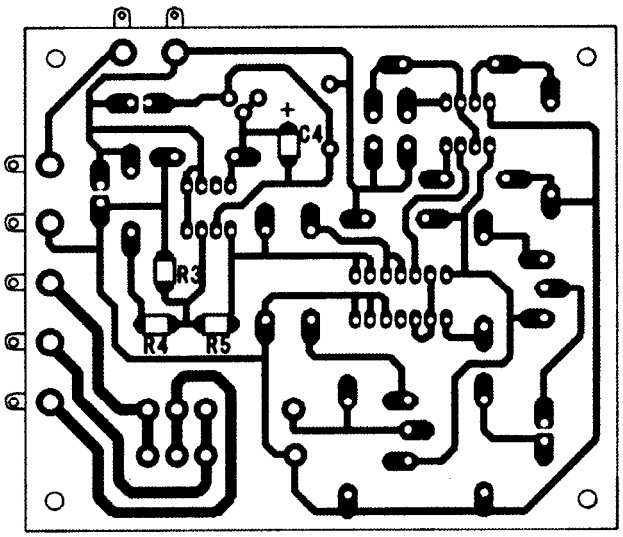
7. Assembly Drawing of Printed Board (PB)

The parts shall be mounted and assembled on the printed board (dedicated pattern).

Surface for parts



Direction in which the parts shall be mounted or direction in which the model number of the rating shall be indicated (This shall not apply to ICs and polarized parts).



Direction in which the parts shall be mounted or direction in which the model number of the rating shall be indicated (This shall not apply to polarized parts).

8. Materials to be provided on site

(a) Related to the assembly of electronic parts

Part code	Items	Model number/Rating	Qty	Remarks
IC1	Timer	μPD5555	1	μPD5555 or similar LMC555CN or similar
IC2	Comparator	LM393	1	LM393N or similar
IC3	2 input NAND	74HC00	1	TC74HC00 or similar
IC4	Photo IC diode	S9648	1	S9648 or similar
LED1	Light-emitting diode	Red	1	BR5335S or similar
TR1～2	Transistor	NPN	2	2SC1815(C) or similar
D1	Diode	For swithing	1	1S2076A or similar
C1	Ceramic capacitor	0.1〔μF〕 25〔V〕	1	DSXC75SJYF104Z or similar
C2	Ceramic capacitor	0.01〔μF〕 25〔V〕	1	DSTC50SJYF103K or similar
C3	Electrolytic capacitor	33〔μF〕 16〔V〕	1	ECA1CM330 or similar
C4	Tantalum solid electrolytic capacitor	22〔μF〕 16〔V〕 3.5mm×2.8mm	1	F931C226MB or similar 267E1602226M or similar TAJB226M016 or similar
R1	Resistor	2〔MΩ〕 1/4〔W〕	1	CF1/4C205J or similar
R2	Resistor	3.9〔MΩ〕 1/4〔W〕	1	CF1/4C395J or similar
R3,4	Rectangular chip resistor	5.1〔KΩ〕 1/4〔W〕 3.2 ㎜×2.5 ㎜	2	ERJ14YJ512 or similar
R5	Rectangular chip resistor	24〔KΩ〕 1/4〔W〕 3.2 ㎜×2.5 ㎜	1	ERJ14YJ243 or similar
R6	Resistor	10〔KΩ〕 1/4〔W〕	1	CF1/4C103J or similar
R7,9	Resistor	3.9〔KΩ〕 1/4〔W〕	2	CF1/4C392J or similar
R8	Resistor	390〔Ω〕 1/4〔W〕	1	CF1/4C390J or similar
VR1	Trimmer potentiometer	50〔KΩ〕	1	TM64K2(PV) or similar
RLY1	Power relay	Operating voltage5〔V〕 Contact current5〔A〕 Bipolar c Contact point	1	G2RL-2 or similar FTR-F1C or similar
TP1	Check pin	Yellow	1	LC-2-S-Yellow or similar
TP2	Check pin	Black	1	LC-2-S-Black or similar
T1	Terminal	Red (Blue also allowed)	1	T-3025-Red(Blue) or similar
T2	Terminal	Yellow (Green also allowed)	1	T-3025-Yellow(Green) or similar
T3	Terminal	Black	1	T-3025-Black or similar
PB1	Print board		1	
S1	Toggle switch	125 V 5A	1	M-2012 or similar 8A1011 or similar
E1	Battery snap	For 006P	1	MC-1S or similar
B	Battery	UM-3	4	UM-3 or similar
	Vinyl electric wire	KV0.3mm2 (12/0.18) Red	50cm	AWG22(17/0.16) allowed
	Vinyl electric wire	KV0.3mm2 (12/0.18) Yellow	50cm	AWG22(17/0.16) allowed
	Soft copper wire	φ0.4	15cm	Tinned wire also allowed
	Insulating tube	φ1.0 For heat resistance	15cm	Yellow
	Lead-free solder	Sn-3.0Ag-0.5Cu φ0.8	120cm	Resin-core
		Sn-3.0Ag-0.5Cu φ0.6	15cm	Containing 3~6% flux

(2) Chassis assembly related

Part No.	Items	Model number/Rating	Qty	Remarks
1	Chassis	A5052P 1.6t HardnessH83or similar	1	
2	Hexagon spacer	6 x 10 M3 Tap attached	4	SP-10 or similar
3	Philips round head screw	M3 x 6	8	
4	Philips round head screw	M3 x 12	4	
5	Philips round head screw	M2 x 6	2	For battery box
6	Nut	M3	4	
7	Nut	M2	2	For battery box
8	Spring washer	M3	8	
9	Spring washer	M2	2	For battery box
10	Plain washer	Polished round x 3	16	
11	Plain washer	Polished round x 2	4	For battery box
12	Rubber foot	Rubber foot for chassis	4	BU692B or similar
	Tag		1	To be attached to the work

9. Tools, etc., to be brought by each contestant

Class	Item	Dimension or specification	Qty	Remarks
Tools	Lead wire cutter		As appropriate	Needle-nose pliers or other pliers are also allowed. However, those that have been reworked to given them a level difference, grooves, etc., are not allowed.
	Nipper		1-2	
	Print board support		1	
	Ruler		1-2	
	Wire stripper		1-2	
	Philips screwdriver	For M2, M3	1 each	Electric-powered not allowed
	Box driver	For M2, M3	1 each	
	Spanner	Nominal 8	1	For S1
	Spanner	Nominal10	1	For terminals
	Electric-powered soldering iron		As appropriate	Only commercialized products allowed. Iron rest, iron head cleaner, temperature controller, iron head thermometer, reserve iron can be included.
	Solder absorbing equipment		As appropriate	Electric-powered also allowed. Nozzle cleaner, reserve filter, nozzle can be included.
	Tweezers		1-4	
	Table tap		1	
	Hand file		1	
	Work table mat		As appropriate	
Gauge	Tester (circuit gauge)		1-2	

Others	Cleaning tools		As appropriate	Cleaning solvent not allowed
	Glovers		As appropriate	
	Gauze		1	
	Eye protection		1	Except those wearing glasses
	Magnifying glass		1	One with a scale not allowed. One with light allowed.
	Lighting equipment		A set	

（Note 1） Contestants who wish to bring their own tools are requested to prepare a list of such tools and present it to the organizer for approval in advance. The organizer reserves the right not to allow the use of any tools that are considered to give the contestant an unfair advantage.

（Note 2） Though the items to be brought by each contestant shall be limited to those listed above, contestants need not bring tools, etc., that they consider unnecessary among those listed in 7. above, however, all contestants shall bring eye protection and wear it during the contest.

（Note 3） Tools that have been processed for a contestant's exclusive use or those that can measure torque shall not be brought, but this shall not apply to tools that the relevant contestant must adapt because of the contestant's disability.

10. Items to be prepared on site

Unless otherwise specified, the quantity shows the number for one contestant.

Items	Dimension or specification	Qty
Work table	750 x 1800mm or similar	1
Outlet	AC100 V (2 receptacles or more)	1
A set of 10 files		As appropriate
Tester (circuit gauge)		As appropriate
Operation checker	One that can check IC, LED, etc.	As appropriate
Table light		

11. Evaluation criteria

Items to be evaluated	Marks allotted
Submission and appearance	15
Operating function	20
Cleaning	10
Mounting of parts to chassis	10
Wiring for other than printed boards	10
Mounting of parts to printed boards	20
Soldering	15
Total	100