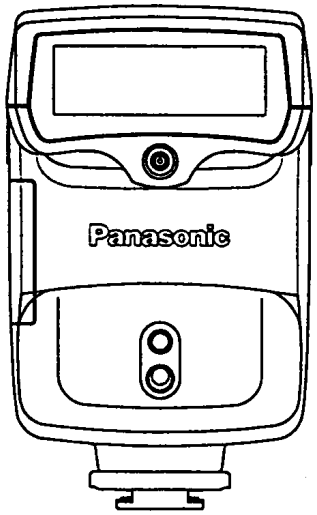
ORDER NO. DSC0411018C0
B26

Service Manual

Flash Unit



DMW-FL28PP
DMW-FL28E

Colour

(K).....Black Type

SPECIFICATIONS

ITEM	SPECIFICATION	ITEM	SPECIFICATION
Guide Number (ISO 100/m)	Without wide panel (35 mm lens): GN28/GN14/GN7 With wide panel (24 mm lens): GN20/GN10/GN5	Flash times	AA alkaline batteries (4 pcs): Approx. 280 - 1400 times (AUTO)/280 times (Manual) AA Ni-Cd batteries (4 pcs): Approx. 100 - 500 times (AUTO)/100 times (Manual) AA Ni-MH batteries (4 pcs): Approx. 200 - 1000 times (AUTO)/200 times (Manual)
Flash time	AUTO: Approx. 1/30,000 - 1/1,000 seconds Manual (with wide panel): GN28 (20) Approx. 1/1,000 seconds, GN14 (10) Approx. 1/3,000 seconds, GN7 (5) Approx. 1/8,000 seconds	Exposure angle	Without wide panel : up/down 45°/left and right 60° (35mm camera with 35 mm lens cover) With wide panel: up/down 60°/left and right 78° (35mm camera with 24 mm lens cover)
AUTO Effective range (ISO 100/m)	F5.6: 0.5 - 5 m (without wide panel/35 mm)/ 0.5 - 3.5 m (with wide panel/24 mm) F4.0: 0.7 - 7 m (without wide panel/35 mm)/ 0.5 - 5 m (with wide panel/24 mm) F2.8: 1.0 - 10 m (without wide panel/35 mm)/ 0.7 - 7 m (with wide panel/24 mm)	Bounce angle	Up/down -30° to 90° (-30°, -15°, 0°, 45°, 60°, 75°, 90°)
AUTO Light received angle	Approx. 20°	Power source	AA alkaline batteries (4 pcs)/ AA Ni-Cd batteries (4 pcs)/ AA Ni-MH batteries (4 pcs)
AUTO shortage range (ISO 100/m)	F16/11/8: 0.35 m - (with wide panel/bounce angle: -15°)/ 0.25 m - (with wide panel/bounce angle: -30°)	Sync. Voltage	6 V
Flash interval	AA alkaline batteries (4 pcs): Approx. 0.2 - 4 sec. (AUTO)/4 sec. (Manual) AA Ni-Cd batteries (4 pcs): Approx. 0.2 - 3 sec. (AUTO)/3 sec. (Manual) AA Ni-MH batteries (4 pcs): Approx. 0.2 - 3 sec. (AUTO)/3 sec. (Manual)	Light quality	Daylight (Colour (daylight type) and monochrome film is suitable.)
		Dimensions (W×H×D)	2 10/16"x3 12/16"x 2 13/16"/66x95x72 mm
		Weight	Approx. 6.5 oz./165 g (excluding batteries)

Weight and dimensions shown are approximate.
Specifications are subject to change without notice.

⚠ WARNING

This service information is designed for experienced repair technicians only and is not designed for use by the general public.
It does not contain warnings or cautions to advise non-technical individuals of potential dangers in attempting to service a product.
Products powered by electricity should be serviced or repaired only by experienced professional technicians. Any attempt to service or repair the product or products dealt with in this service information by anyone else could result in serious injury or death.

Panasonic

CONTENTS

1 GENERAL DESCRIPTION

Parts Identification

Front

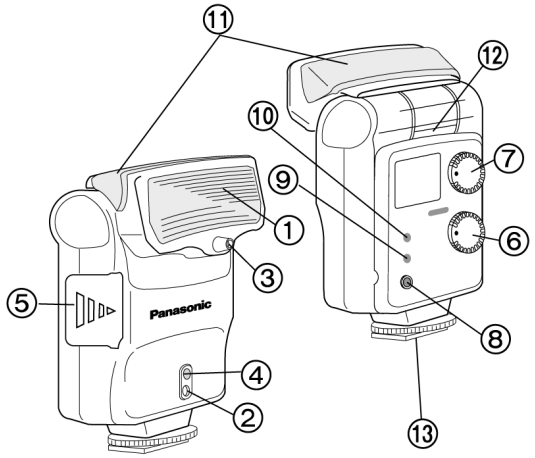
1. Flashtube
2. Auto photo-receptor A
3. Auto photo-receptor B (close-up recording)
4. Slave photo-receptor

Side

5. Battery compartment lid

Back

6. Rotary switch A (power/mode switching)
7. Rotary switch B (AUTO F/MANUAL GN)
8. Test flash button
9. Flash indicator
*10.*Auto check indicator
*11.*Wide panel
*12.*Bouncing angle indicator
*13.*Shoe lock nut



Precautions

When nicad batteries are used:

The batteries will deteriorate in performance if left unused for a long period. Discharge them by manually operating the flash (repeatedly making it light until the flash indicator does not light 30 seconds after blinking) and fully recharge the batteries.

When the flash is used in a low-temperature location:

The batteries will deteriorate in performance if used in temperatures below the normal temperature (68 F (20 °C)). This causes a reduction of the number of lighting times and/or a lengthening of the interval between flashes. It is recommended to prepare fully-charged spare batteries. However, battery performance will be restored when the ambient temperature rises to normal temperature.

Do not leave the flash in conditions of high temperature.

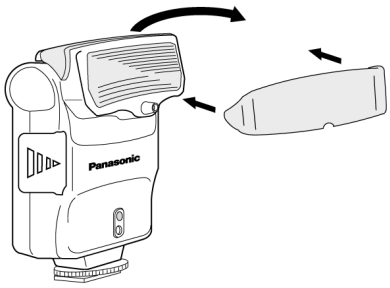
Do not leave or store the flash in a location where the temperature rises to 104 F (40 °C) or higher. High temperatures affect the internal structure of the flash. (In particular, never leave the flash in a car during summer.)

If the flash gets dirty, apply a small amount of neutral (mild) detergent and wipe the flash clean with a piece of soft cloth.

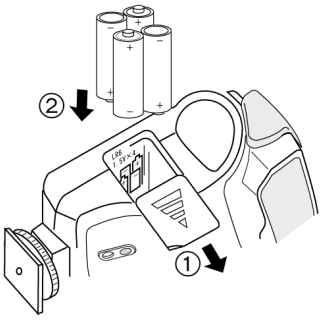
Do not use solvents such as thinners or benzines, as they will dissolve the surface of the resin coating of the flash unit.

Before using

This flash can be fitted with a wide panel (included) for a 24 mm lens (equivalent to 35 mm system) in front of the flashtube. When using a longer lens than 35 mm (equivalent to 35 mm system), set the wide panel on the top panel of the flash for storage.



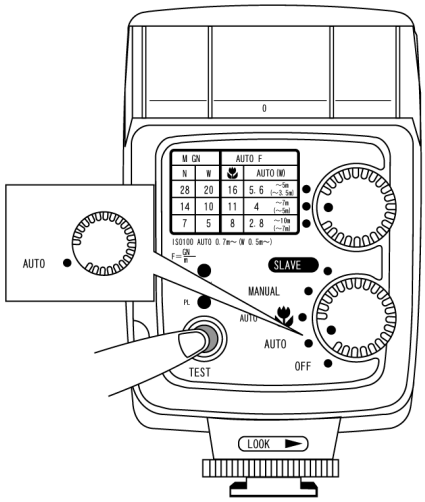
To install batteries (type used: four AA size alkaline, nicad or nickel metal hydride)



1. Slide the battery compartment lid to open as illustrated.
2. Put four batteries into the compartment correctly as indicated in diagram.
3. Close the battery compartment lid.

- Batteries are not supplied. Please purchase separately. (HHR-3UPA/4B: Panasonic AA Ni-MH (nickel-metal hydride) Battery 4pcs.)
- Be sure to use the same type of batteries.
- Make sure that the batteries are inserted with correct polarities. If they are inserted incorrectly, the flash will not light and leakage of liquid or an explosion may be caused.
- When using nicad or nickel metal hydride batteries, recharge them with dedicated chargers.

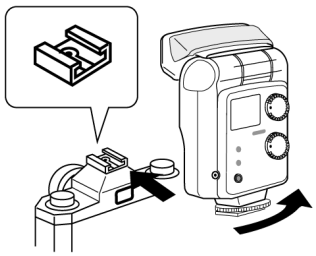
Test flash



1. Set the rotary switch A to [AUTO].
The flash is turned on and charging starts.
2. Check that the flash indicator lights.
3. Press the test flash button. If the flash lights, it works correctly.
4. After checking the flashing operation, set the rotary switch A to [OFF]. The flash is turned off.

Flash stop mechanism
If the flash is not being used temporarily while it is fitted to the camera, set the rotary switch A to [OFF]. The flash will not light even if the shutter button is pressed.

Connecting the flash to the camera

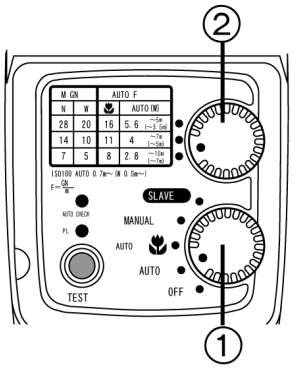


1. Insert the flash onto the shoe of the camera (DMC-LC5).
2. Tightly fasten the shoe lock nut.
- Some cameras do not allow the flash to be connected. Please refer to operating instructions for your camera.

Selecting the shutter speed and aperture (when using DMC-LC5)

When [EXT. FLASH] setting in the menu of DMC-LC5 is set to PRESET mode, set the rotary switch A ① to [AUTO] and rotary switch B ② to [F2.8] as illustrated.

- When [EXT. FLASH] setting of the DMC-LC5 is in PRESET mode, and DMW-FL28 is attached to the Camera, aperture, shutter speed and ISO sensitivity of DMC-LC5 are automatically set to F2.8, 1/60 and ISO 100.
- Please refer to operating instructions for DMC-LC5.
- When [EXT. FLASH] setting of the DMC-LC5 is in MANUAL mode, you can manually select the aperture, shutter speed and ISO sensitivity of the camera. Set the aperture and ISO sensitivity of DMW-FL28 in the same value as set in the Camera.



Selecting the shutter speed for use with Analog Cameras

For cameras with a focal plane shutter

Align the shutter speed selector to the X mark or set the strobe-synchronous shutter speed.

- The strobe-synchronous shutter speed varies depending on the camera in use. Please read the operating instructions for your camera carefully.

For cameras with a lens shutter

The flash is synchronous to the shutter speeds 1/500 sec or slower.

- When the shutter speed is 8, 1, 1/2, 1/4, 1/8 or 1/15, the camera jiggle may appear.
- When the shutter speed is 1/30, 1/60, 1/125, 1/250 or 1/500, the camera jiggle does not appear.

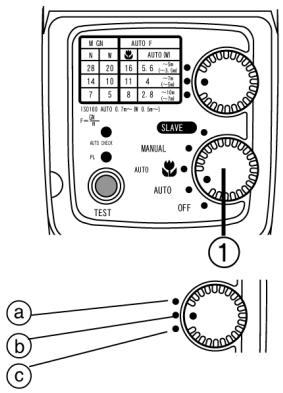
Selecting the aperture for use with Analog Cameras (for AUTO)

1. Set the rotary switch A ① to [AUTO] as illustrated.
2. Set the F number on the camera in accordance with ISO sensitivity in use.
As long as subjects are within the auto-effective distance, the flash automatically adjusts the amount of light. You do not have to vary the F number to get correct exposures.

- Auto-effective distance and ISO sensitivity are dependent on automatic aperture control

Ⓐ	Ⓑ	Ⓒ
F5.6	1.64~16.40 feet (0.5~5m)	1.64~11.48 feet (0.5~3.5m)
F 4	2.30~22.97 feet (0.7~7m)	1.64~16.40 feet (0.5 ~5m)
F2.8	3.28~32.81 feet (1.0~10m)	2.30~22.97 feet (0.7~7m)

Ⓓ	ISO25	ISO50	ISO100	ISO200	ISO400	ISO800	
Ⓔ	F2.8	F 4	F5.6	F 8	F11	F16	ⓐ
	F 2	F2.8	F 4	F5.6	F 8	F11	ⓑ
	F1.4	F 2	F2.8	F 4	F5.6	F 8	ⓒ

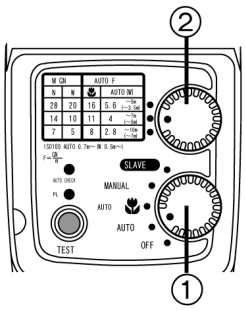


- Even if a different ISO sensitivity is set, the auto-effective distance is constant, while the F number should vary.

Ⓐ F number fitting
Ⓑ When not fitting the wide panel
Ⓒ When fitting the wide panel
Ⓓ ISO sensitivity
Ⓔ F number on the camera

Auto check indicator

If the auto check indicator lights at the instant of pressing the test flash button, it indicates that the auto circuit is operating. If the auto check indicator does not light, the subject is beyond the auto-effective distance. Adjust either the auto F number with the rotary switch B ② or the distance to the subject.



Selecting the aperture for use with Analog Cameras (for close-up AUTO recording (AUTO))

1. Fit the wide panel onto the flashtube and set the rotary switch A ① to [AUTO] as illustrated.

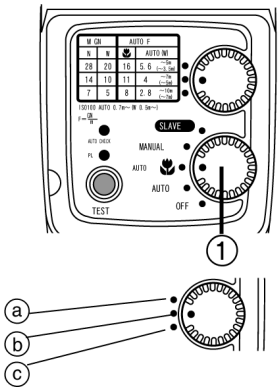
2. Set the F number on the camera in accordance with ISO sensitivity in use. As long as the subjects are within the auto-effective distance, the flash automatically adjusts the amount of light. You do not have to vary the F number to get correct exposures.

- Auto-effective distance and ISO sensitivity are dependent on automatic aperture control

Ⓐ	Ⓑ
F16	0.82～3.82 feet (0.25～1m)
F11	
F 8	

Ⓒ	ISO25	ISO50	ISO100	ISO200	ISO400	ISO800	
Ⓓ	F 8	F11	F16	F22	F32	—	ⓐ
	F5.6	F 8	F11	F16	F22	F32	ⓑ
	F 4	F5.6	F 8	F11	F16	F22	ⓒ

Ⓐ F number fitting
Ⓑ When fitting the wide panel
Ⓒ ISO sensitivity
Ⓓ F number on the camera



- Even if a different ISO sensitivity is set, the auto-effective distance is constant, while the F number should be varied.

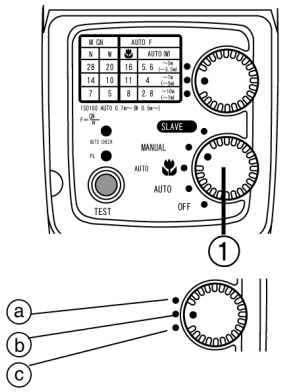
- Perform a test flash before the actual recording to ensure that the auto check indicator lights.

Notes for AUTO recording

- If the background is extremely dark compared to the subject and its reflectance is low, adjust the aperture setting down by approx. 1/2 EV. On the other hand, if the subject has a high reflectance like a white wall, adjust the aperture setting upward by approx. 1/2 EV. If the background is a mirror, etc., its excessively high reflectance causes a malfunction of the auto circuit. If this happens, switch to manual mode operation for the flash.
- If the AUTO recording is used outdoors in daytime, a malfunction of the auto circuit may occur as the ambient light is excessively bright.
- If there are any obstructive objects between the camera and the subject, the auto circuit will not operate properly.
- For special recording such as daylight recording, use the flash in the manual mode.

Selecting the aperture (for MANUAL)

1. Set the rotary switch A ① to [MANUAL] as illustrated.
2. Calculate the F number based on the Guide Number (GN) table below.



Guide Number (GN) table and F number calculation tab

Ⓐ	ISO25	ISO50	ISO100	ISO200	ISO400	ISO800	
Ⓑ	14 (10)	20 (14)	28 (20)	40 (28)	56 (40)	78 (56)	ⓐ
Ⓒ	7 (5)	10 (7)	14 (10)	20 (14)	20 (14)	40 (28)	ⓑ
	3.5 (2.5)	5 (3.5)	7 (5)	10 (7)	14 (10)	20 (14)	ⓒ

Ⓐ ISO sensitivity
Ⓑ FULL (When fitting the wide panel)
Ⓒ When switching MANUAL GN (When fitting the wide panel)

F number is Guide Number (GN)/distance (m)

Using the slave function (SLAVE)

(This function does not work with DMC-LC5's built in Flash)
Perform a test flash.

1. Determine the positions of the flash at the camera side and DMW-FL28 for slave.
2. Direct the slave photo-receptor of the slave unit so that it can receive either direct or reflected light from the flash at the camera side.
3. Turn on both the flash at the camera side and the slave (this flash). Set the rotary switch A to [SLAVE] on the unit.
4. Check that the flash indicator on both units light.
5. When pressing the test flash button on the flash at the camera side, it lights. The flash triggers the slave (this unit) causing it to flash almost simultaneously.
6. If the slave (this unit) does not light, check the facing direction of the slave and the operating distance.
7. DMW-FL28 (this unit) allows the Guide Number (GN) to be switched. In accordance with the recording condition, set the rotary switch B to GN 28, GN 14 or GN 7.

- Use the flash at the camera side in the manual mode. Use the slave (this unit) in the slave mode. DMW-FL28 (this unit) may slaveflash in response to the AF auxiliary light or preparatory lighting. Perform the test flash and test recording before the actual recording.

How to select aperture

F number is Guide Number / distance.
If the light source on the camera side alone is used, the subject receives only direct light from the front and very dark shadows may appear in the background. When adding one light in a slanting direction, the shadows will be softened.

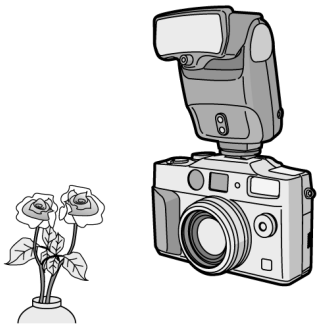
- The procedure to determine the shutter speed is the same as when only one flash is used.

Operating distance

The operating distance is the maximum distance between the flash at the camera side and the slave (this unit) when the flash and the photoreceptor of the slave face each other. The standard operating distance is approximately 32.81 feet/ 10 m when the Guide Number of the flash at the camera is more than GN 10.
*Indoor or night time at the ambient temperature 68 F (20 °C)

- The operating distance becomes shorter to a greater degree with the center of the photo-receptor of the slave being deflected more from the flashtube of the flash at the camera side.
- The operating distance becomes shorter outdoors (daytime) as the sensitivity of the slave is degraded.

Close-up recording



1. Fit the wide panel onto the flashtube and adjust bounce on the flash to –15° or –30° depending on the position of the subject.
2. Set the rotary switch A to [AUTO].
3. Set the rotary switch B to the desired value.
4. Set the same F number on the camera.

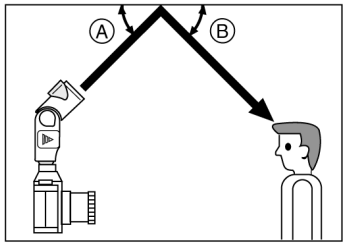
Auto F number and auto minimum distance

Ⓐ	Ⓑ	Ⓒ
F16	1.15 feet〜/ 0.35 m〜	0.82 feet〜/ 0.25 m〜
F11		
F 8		

Ⓐ F number of the flash's [AUTO] and the camera
Ⓑ Bounce angle –15° (With the wide panel)
Ⓒ Bounce angle –30° (With the wide panel)

*For close-up recording, direct the auto photo-receptor for close-up to the subject correctly. The auto minimum distance means the distance between the auto photo-receptor for close-up and the subject.
* The close-up magnification is supposed to be up to 1/2. If the close-up magnification is between 1/2 and real size, open the aperture by approx. 1/2 EV to 1 EV from those specified in the table.
*For close-up recording, keep the distance to the subject 3.28 feet/1.0 m or less.

Bounce recording



For bounce recording, the convenience of the [AUTO] operation can be exhibited. Bouncing the light off a reflective surface such as a ceiling, etc. above the flash obtains soft lighting.

Auto bounce recording

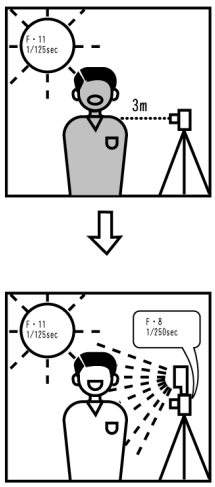
1. The operating procedure is the same as that for normal auto recording.
2. Determine the position of the subject and then determine the bounce angle of the flash.
(The flashtube can be tilted from 0° to 90° upward and the notches are provided at 0°, 45°, 60°, 75° and 90° for a click stop.)
3. Perform a test flash before the actual recording to see if the auto check indicator lights.

*For bounce recording, the recording distance is the sum of the distance between the flash and the reflective surface and that between the reflective surface and the subject. The auto-effective distance becomes shorter than normal auto recordings depending on the reflectance of the reflective surface.

*The bounce angle is in principle adjusted so that the angle of reflection Ⓑ is equal to the angle of incidence Ⓐ on the reflective surface. Take care that the flash does not strike directly on the subject.
*For color photos, if the reflective surface is other than white, the color balance will be lost.

Daytime recording

- This is a method, in which unnecessary shadows of subjects are removed by a flash and the brightness of the subjects and that of the background are kept in balance. In this case, use the flash light in the manual mode.



For cameras with a lens shutter

(Example) Recording in backlight condition

When using a 35-mm camera fitted with a 35-mm lens and a ISO sensitivity 100, normal exposure with available light indicated being F11, 1/125 sec (= F8, 1/250 sec) and the recording distance being 9.84 feet/3 m:

1. F number for using a flash light is GN/distance(m)=28/3 = about 8
Set F8 on the camera.

2. The shutter speed when the F number with available light is F8 is 1/250 sec.

Set 1/250 sec for the shutter speed on the camera. The settings will give a good balance of brightness between the subject and the background.

For cameras with a focal plane shutter

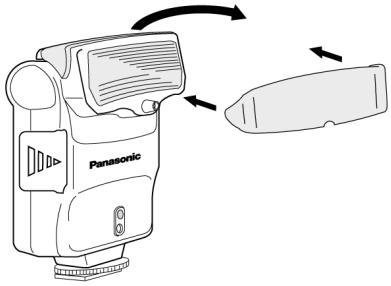
The same calculation can be used as that for cameras with a lens shutter, but the shutter speed should be at strobe-synchronous speed or slower.

*Some cameras allow 1/125 sec or 1/250 sec to be strobe-synchronous. Please read the operating instructions for your camera carefully.

Accessories

Wide panel

When to use: Use the wide panel when you fit a wide lens down to 24 mm to a 35-mm camera. This wide panel covers the angle of view of a 24-mm lens or narrower for a 35-mm camera.



2 DISASSEMBLY & ASSEMBLY PROCEDURE

Refer to the "DISASSEMBLY DIAGRAM".

2.1. DIASSEMBLY PROCEDURE

1. Remove the battery lid unit (Ref. No. 18).
2. Unscrewed 4 screws (B16 - B19), and then remove the shoe unit (Ref. No. 43).
3. Remove the side rubber 1 (Ref. No. 26) and side rubber 2 (Ref. No. 27).
4. Unscrewed 4 screws (B7 - B10), and then remove the main case (C) (Ref No.3).

   Caution

   - Be careful of the high voltage capacitor (Ref No. C3) when servicing.
   - Be sure to discharge the capacitor (Ref No. C3) to use the resistor for discharging (ERG5SJ102) after connecting between cathode of Ref No. D2 and battery terminal (-).
5. Remove the insulation sheet (Ref No. 24), and then unscrewed 3 screws (B3 - B5) with the battery case (Ref No. 14) is holding to up slightly. Remove the C.B.A. (A) and C.B.A. (B)..
6. Remove the 2 locking springs (Ref No. 44-1 and 44-2), and then unscrewed 2 screws (B20 and B21). Remove the main case (B) (Ref No. 2).

2.2. ASSEMBLY PROCEDURE

2.2.1. Assembly of the Dial Knob (Ref No. 8-1 and 8-2)

Apply the grease to the operation part of main case (D) (Ref No. 4) when assembling the click spring (Ref No. 10-1 and 10-2).

2.2.2. Assembly of the C.B.A.

When assembling the C.B.A., apply the grease to foil side of C.B.A. (A) where is located to jack spring and dial brush terminal after alcohol cleaning.

2.2.3. Assembly of the Main Case (B)

Apply the grease to the part of click mold (Ref No. 16) is touched to the main case (B) (Ref No. 2), and then install to the main case (A) (Ref No. 1). Screwed 2 screws (B20 and B21).

2.2.4. Installation of the Photo Transistor

Install the photo transistor (Ref No. PT2) to C.B.A. (A), and then confirm capacitor (Ref No. C11) is installed to the side of reflection umbrella to the main case (B) (Ref No. 2).

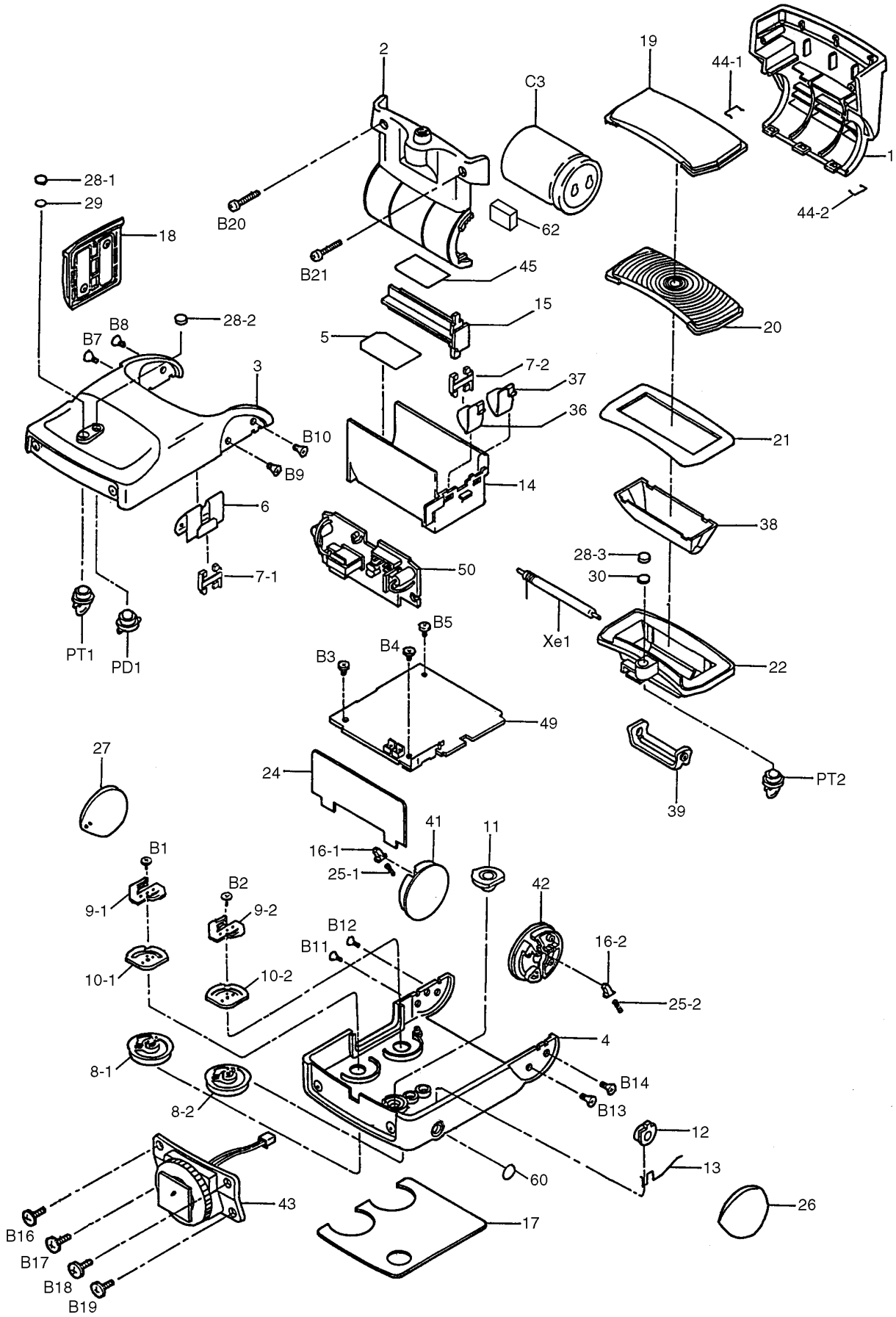
Install the photo diode (Ref No. PD1), and then confirm it to the battery case side of main case (C) (Ref No. 3).

Install the photo transistor (Ref No. PT1), and then confirm it to the side of shoe unit.

2.2.5. Layout of lead wire

The lead wire for SLAVE (black) and lead wire for AUTO (red and black) is located between the insulation sheet and C.B.A. (B).

2.3. DISASSEMBLY DIAGRAM



3 ELECTRICAL ADJUSTMENT

RELATION BETWEEN PARTS BEING REPLACED & NECESSARY ADJUSTMENT ITEMS

ADJUSTMENT ITEM	PARTS BEING REPLACED	ADJUSTMENT POINT
CHARGING VOLTAGE	*C3 (Charging Capacitor)	"VR3" adjustment
AUTO OPERATION	*PT1 (Photoreceptor 1)	ND Filter (ND0.2 – 0.4)
AUTO-MACRO OPERATION	*PT2 (Photoreceptor 2)	ND Filter (ND0.3 – 0.5)
MANUAL OPERATION (POWER CONTROL)	TH1	"VR1" adjustment (GN14)
	TH2	"VR2" adjustment (GN7)

3.1. PREPARATION & SETUP

[1].NECESSARY ITEMS

DESCRIPTION	PART No.	QTY	REMARKS
DIGITAL VOLT METER	-----	1	
DC POWER SUPPLY (5.6V)	-----	1	
ADJUSTMENT DRIVER	-----	1	Minus type
DSC (with Histogram & Hot Shoe)	------	1	One of the concerned DSC (Example:DMC-FZ10, FZ20, LC1)
ND0.3 FILTER	VFK1164ND03	1	1 EV Reduction
ND0.6 FILTER	VFK1164ND06	1	2 EV Reduction
18% GRAY CHART	VFK1772	1	

3.2. ADJUSTMENT PROCEDURES

<<COMMON FIGURES>>

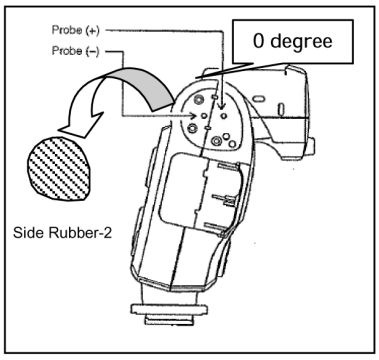


Fig.3-1

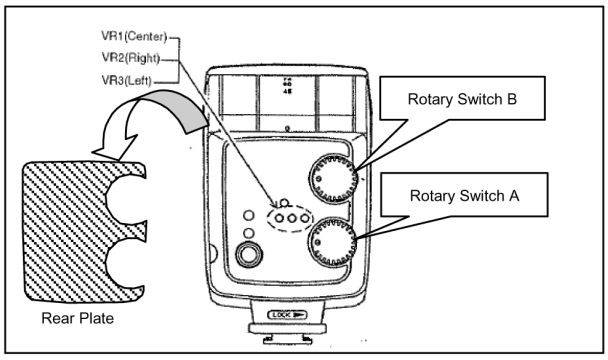


Fig.3-2

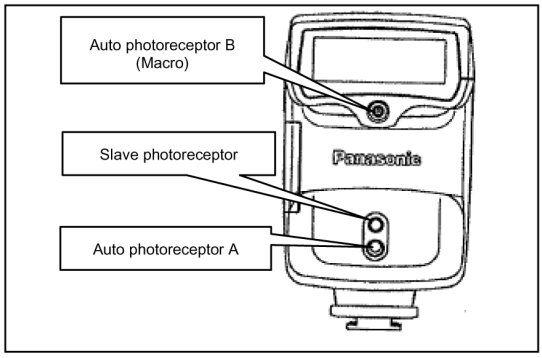


Fig.3-3

3.2.1. CHARGING VOLTAGE MEASUREMENT & ADJUSTMENT

[PURPOSE]

*The terminal voltage at “C3” (Flash charging capacitor) has to be kept maintaining at 330V +/- 5V.

Less than spec.; Flash light amount may be less.

Over than spec.; “C3” may be damaged / broken.

[PROCEDURES]

1. Peel off the ”Side rubber 2“ with tweezers. (See Fig.3-1)
2. Set the Bouncing angle at 0 degree. (See Fig.3-1)
   (Otherwise, it is unable to contact “C3 (Flash Charging Capacitor)” terminals.)
3. Set the Rotary switch A to “MANUAL” and Rotary switch B to TOP (Highest). (See Fig.3-2)
4. Peel off the Rear plate with tweezers. (See Fig.3-2)
5. Insert the tester probe by referring. (See Fig.3-1)
6. Adjust the VR3 so that the “C3” terminal voltage becomes within specification under the following condition.

   [MEASURING CONDITION] :

   Measure the Terminal voltage after 5 seconds from the TEST button is being pressed.

   [SPECIFICATION]:

   “C3” Terminal voltage = 330V +/- 5V

3.2.2. AUTO OPERATION CONFIRMATION & ADJUSTMENT

[PURPOSE]

*Adjust the sensitivity of Auto photoreceptor so that the flash fires with concerned light amount when the Rotary switch A is set to “AUTO”.

NOTE: As for “ROTARY SWITCH B”, there are 3 conditions depending on the F-value. (“F2.8”, “F4.0” and “F5.6”)

[PROCEDURES]

--- Preparation -----

1. Set the Bounce angle at 0 degree. (See Fig.3-1)
2. Set the Rotary switch A to “AUTO” position. (See Fig.3-2)
3. Attach the flash unit onto the “HOT SHOE” of the Digital Still Camera which has the “histogram” indicating function. (ex.DMC-FZ10/FZ20/LC1.)
4. Turns the POWER on both DSC and Flash unit.

(CAMERA SETTING)

5. Set the camera to the following settings.
   *EXTERNAL FLASH SETTING : “MANUAL”
   *MODE DIAL : “A” (Aperture Priority AE)
   *ISO SETTING : ISO100
   *METERING : “MULTIPLE”
6. Aim the VFK1772 (18% reflection chart) or Equivalent subject at 2m distance.

NOTE:
If you try this adjustment with other than VFK1772, try with the following way to decide the subject.
(1). Set the “COLOR EFFECT” mode to “B/W” position at the Digital Still Camera.
(2).Confirm that there are less “black” and/or “white” subject and less surface shining subject in the LCD frame.

[F2.8]

7. Set the Rotary switch B to the lowest position. (See Fig.3-2)
8. Set the Aperture of Digital Still Camera to “F2.8”.
9. Press the Shutter release button.

[F4.0]

10. Set the Rotary switch B to the middle position. (See Fig.3-2)
11. Set the Aperture of Digital Still Camera to “F4.0”.
12. Press the Shutter release button.

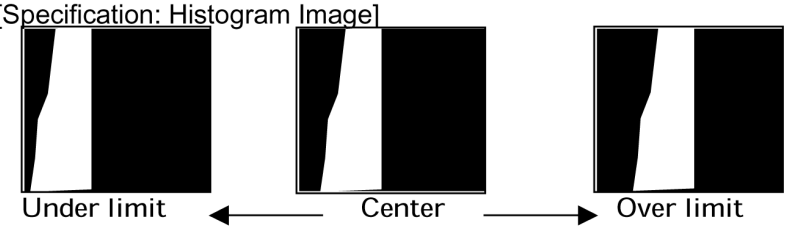
[F5.6]

13. Set the Rotary switch B to the highest position. (See Fig.3-2)
14. Set the Aperture of Digital Still Camera to “F5.6”.
15. Press the Shutter release button.

---- Confirmation/Adjustment -----

16. Playbacks the pictures captured in “F2.8”, “F4.0” and “F5.6” setting and confirm the shape of histogram.

[Specification: Histogram Image]



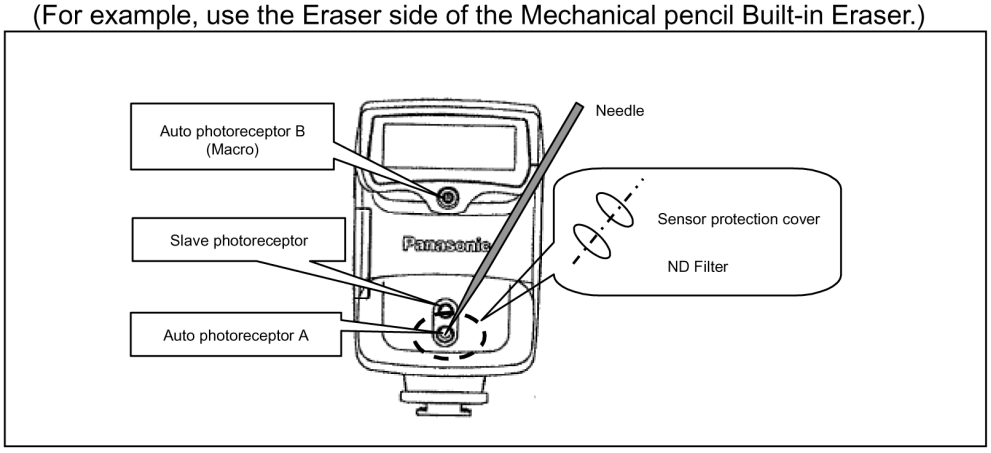
NOTE:
As for your reference the product specification is listed below.

Position of Mode dial B	Product specification
F2.8 (The lowest pos.)	F4.3 - F2.6 (F2.8; + 1.25EV / - 0.25EV)
F4.0 (Middle pos.)	F5.6 - F3.4 (F4.0; + 1.00EV / - 0.50EV)
F5.6 (The Highest pos.)	F8.0 - F4.8 (F5.6; + 1.00EV / - 0.50EV)

[OVER-EXPOSURE]
When the Histogram shows over exposure, replace the ND filters to “SS025-12” (ND0.2) and try this adjustment again.

[UNDER-EXPOSURE]
When the Histogram shows under exposure, replace the ND filters to “SS025-04” (ND0.4) and try this adjustment again.

---- Replacing Method for ND filters --------
Replace ND filter by Ordering the following procedures.
Pierced the ND filter and sensor protect cover with the needle then remove them.
Put the concerned ND filter and sensor protection cover, and press them with soft material.
(For example, use the Eraser side of the Mechanical pencil Built-in Eraser.)



NOTE:
1.Originally, the sensor is covered with “SS025-13”(ND0.3).
2.Even if the ND filter is replaced and nothing improved, check Flash lamp, Sensor, and related component / circuits.

3.2.3. MACRO-AUTO OPERATION CONFIRMATION & ADJUSTMENT

[PURPOSE]

*Adjust the sensitivity of Auto photoreceptor so that the flash fires with concerned light amount when the Rotary switch A is set to “MACRO-AUTO”.

NOTE: As for “ROTARY SWITCH B”, there are 3 conditions depending on the F-value. (“F8.0”, “F11.0” and “F16.0”)

[PROCEDURES]

--- Preparation -----

1. Set the Bounce angle at 0 degree. (See Fig.3-1)
2. Set the Rotary switch A to “MACRO-AUTO” position. (See Fig.3-2)
3. Attach the flash unit onto the “HOT SHOE” of the Digital Still Camera which has the “histogram” indicating function. (ex.DMC-FZ10/FZ20/LC1.)
4. Turns the POWER on both DSC and Flash unit.

(CAMERA SETTING)

5. Set the camera to the following settings.
   *EXTERNAL FLASH SETTING : “MANUAL”
   *MODE DIAL : “A” (Aperture Priority AE)
   *ISO SETTING : ISO100
   *METERING : “MULTIPLE
6. Aim the VFK1772 (18% reflection chart) or Equivalent subject at 0.5m distance.

NOTE:
If you try this adjustment with other than VFK1772, try with the following way to decide the subject.
(1). Set the “COLOR EFFECT” mode to “B/W” position at the Digital Still Camera.
(2).Confirm that there are less “black” and/or “white” subject and less surface shining subject in the LCD frame.

[F8.0]

7. Set the Rotary switch B to the lowest position. (See Fig.3-2)
8. Set the Aperture of Digital Still Camera to “F8.0”.
9. Press the Shutter release button.

[F11.0]

10. Set the Rotary switch B to the middle position. (See Fig.3-2)
11. Set the Aperture of Digital Still Camera to “F8.0”.
12. Put the VFK1164ND03 (ND0.3) onto the Lens unit.
13. Press the Shutter release button.

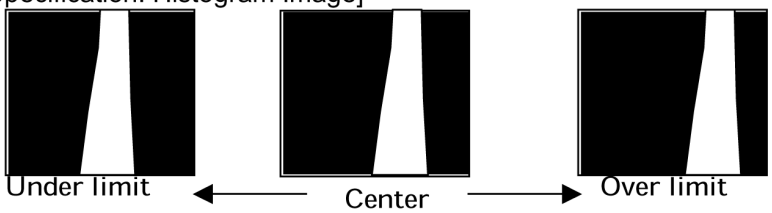
[F16.0]

14. Set the Rotary switch B to the highest position. (See Fig.3-2)
15. Set the Aperture of Digital Still Camera to “F8.0”.
16. Put the VFK1164ND06 (ND0.6) onto the Lens unit.
17. Press the Shutter release button.

---- Confirmation/Adjustment -----

18. Playbacks the pictures captured in “F8.0”, “F11.0” and “F16.0” setting and confirm the shape of histogram.

[Specification: Histogram Image]



NOTE:

As for your reference the product specification is listed below.

Position of Mode dial B	Product specification
F8.0 (The lowest pos.)	F16.0 - F8.0 (F8.0; + 2.00EV / -0.00EV)
F11.0 (Middle pos.)	F22.0 - F11.0 (F11.0; + 2.00EV / -0.00EV)
F16.0 (The Highest pos.)	F32.0 - F16.0 (F16.0; + 2.00EV / -0.00EV)

[OVER-EXPOSURE]

When the Histogram shows over exposure, replace the ND filters to “SS025-13” (ND0.3) and try this adjustment again.

[UNDER-EXPOSURE]

When the Histogram shows under exposure, replace the ND filters to “SS025-08” (ND0.5) and try this adjustment again.

---- Replacing Method for ND filters --------

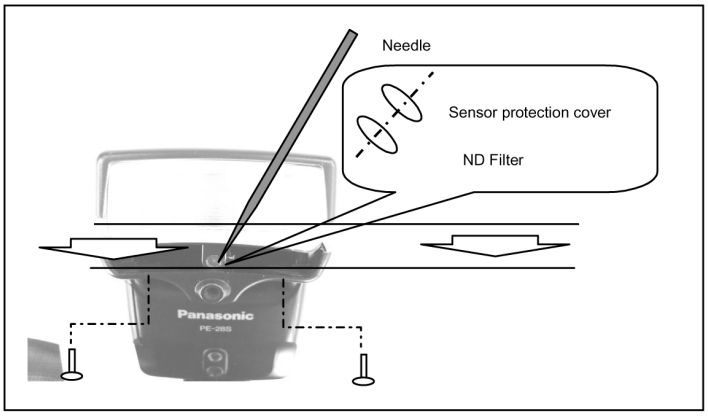
Replace ND filter by Ordering the following procedures.

1.Remove 2 screws and slightly open the flash case.

Pierced the ND filter and sensor protect cover with the needle then remove them.

Put the concerned ND filter and sensor protects cover, and press them with soft material.

(For example, use the Eraser side of the Mechanical pencil Built-in Eraser.)



NOTE:

1.Originally, the sensor is covered with “SS025-04”(ND0.4).

2.Even if the ND filter is replaced and nothing improved, check Flash lamp, Sensor, and related component / circuits.

3.2.4. MANUAL (POWER CONTROL) OPERATION CONFIRMATION & ADJUSTMENT

[PURPOSE]

*Adjust the sensitivity of Auto photoreceptor so that the flash fires with concerned light amount when the Rotary switch A is set to “MANUAL”.

NOTE: As for “ROTARY SWITCH B”, there are 3 conditions depending on the F-value. (“GN28”, “GN14” and “GN7”)

[PROCEDURES]

--- Preparation -----

1. Set the Bounce angle at 0 degree. (See Fig.3-1)
2. Set the Rotary switch A to “MANUAL” position. (See Fig.3-2)
3. Attach the flash unit onto the “HOT SHOE” of the Digital Still Camera which has the “histogram” indicating function. (ex.DMC-FZ10/FZ20/LC1.)
4. Turns the POWER on both DSC and Flash unit.

(CAMERA SETTING)

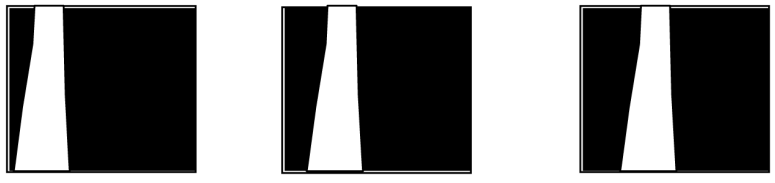
5. Set the camera to the following settings.
   *EXTERNAL FLASH SETTING : “MANUAL”
   *MODE DIAL : “A” (Aperture Priority AE)
   *ISO SETTING : ISO100
   *METERING : “MULTIPLE
6. Aim the VFK1772 (18% reflection chart) or Equivalent subject at 2m distance.

NOTE:
If you try this adjustment with other than VFK1772, try with the following way to decide the subject.
(1). Set the “COLOR EFFECT” mode to “B/W” position at the Digital Still Camera.
(2).Confirm that there are less “black” and/or “white” subject and less surface shining subject in the LCD frame.

---------Confirmation & Adjustment [GN28] ----------

7. Set the Rotary switch B to the highest position. (See Fig.3-2)
8. Set the Aperture of Digital Still Camera to “F8.0”.
9. Put the VFK1164ND06 (ND0.6) onto the Lens unit.
10. Press the Shutter release button.
11. Playback and confirm the histogram.

[SPECIFICATION]



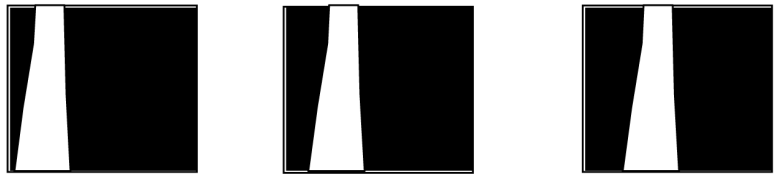
Position of Mode dial B	Product specification
GN28 (The Highest pos.)	F16.6 - F11.8 (F14; +/- 0.5EV)

12.When the Histogram shows under exposure, check the “Flash charging capacitor”, “Xenon Lamp” and/or concerned circuit.

---------Confirmation & Adjustment [GN14] ----------

13. Set the Rotary switch B to the middle position. (See Fig.3-2)
14. Set the Aperture of Digital Still Camera to “F8.0”.
15. Press the Shutter release button.
16. Playback and confirm the histogram.

[SPECIFICATION]



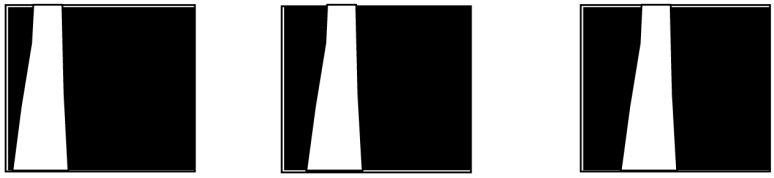
Position of Mode dial B	Product specification
GN14 (Middle pos.)	F8.3 - F5.9 (F7; +/- 0.5EV)

17. When the Histogram shows under/over exposure, adjust the flash power by rotating “VR1”.

---------Confirmation & Adjustment [GN7] ----------

18. Set the Rotary switch B to the lowest position. (See Fig.3-2)
19. Set the Aperture of Digital Still Camera to “F4.0”.
20. Press the Shutter release button.
21. Playback and confirm the histogram.

Specification : Histogram Image



NOTE:

As for your reference the product specification is listed below.

Position of Mode dial B	Product specification
GN7 (The lowest pos.)	F4.1 - F3.0 (F3.5; +/- 0.5EV)

22. When the Histogram shows under/over exposure, adjust the flash power by rotating “VR2”.

4 CIRCUIT DESCRIPTION

Refer to the "SCHEMATIC DIAGRAM".

4.1. Operation for control circuit power supply

When the position of the rotary switch A is changed from OFF to other position (AUTO/C AUTO/MANUAL/SLAVE), RQ2 turns ON. Then it starts to supply the control power.

4.2. Operation for converter oscillation circuit

When the position of the rotary switch A is changed from OFF to other position (AUTO/C AUTO/MANUAL/SLAVE), Q3 turns ON, and then Q1 and Q2 are started to oscillate. That is started to charge C3 through T1 and D2. Then power is supplied to control circuit through D1 and R53.

4.3. Operation for constant voltage control circuit

When charging voltage becomes 275±5 V after C3 is started to charge, the voltage between R6 and R32 is to be 2 V. That make 1 pin of IC2 be opened, then LD1 is lit up.

When charging voltage is 330±5 V by charging voltage of C3 is increased more, the voltage between R32 and R33 is to be 1.7 V. The voltage is detected, and then 7 pin of IC2 is L, RQ1 is ON. Between (E) and (B) of Q1 and Q2 is shorted, oscillation is stopped.

When the voltage between R32 and R33 is fallen to 1.65 V after oscillation is stopped, 7 pin of IC2 is opened. Then oscillate again. The voltage of C3 is maintained between 325 - 330 V because above operation is repeated.

4.4. Operation for flash circuit

Press the test flash button (SW3 is ON) or X terminal is to be L, Q7 is ON and SCR2 is ON through R26. Then electric charge of C14 is flowed the following.

・(A) of SCR2→ (C) of SCR2→T2 COM→Primary→C14

After that, trigger pulse is produced at secondary of T2 and XE1 is energized. Thus make a flash. At that time, gate circuit of IT1 is always ON because the voltage of C3 is supplied to it through R18 and R19.

4.5. Operation for modulated light circuit

Q4 is ON by the energy of C4 after XE1 is flashed, the electric charge of C6 is supplied to modulated light circuit. In case of AUTO mode, (E) of PT1 is connected to GND by the SW 1 and 2. then start to flash. When the received light of PT1 is proper, the base current of Q5 is flowed through R13.

SCR1 and Q6 is ON at the same time after Q5 is ON, gate voltage of IT1 is to be L and stop to flash. (C AUTO is the same.) In case of MANUAL mode, operation is almost the same. The base current of Q5 is flowed through TH1, TH2, VR1 and VR2, Q5 is ON and stop to flash.

SCR1 is also glow light protection circuit. XE current is flowed through R20 and SCR1, Q6 keep being ON until SCR1 is OFF. IT1 keep being OFF is operated glow light protection circuit.

4.6. Operation for SLAVE circuit

When SW1 and 2 to SLAVE mode, RQ3 and 5 is ON commonly. Modulated light circuit is the same for MANUAL mode. RQ6 is ON at the time RQ3 and 5 is ON, lock when received light is detected by other mode is canceled by Q10 is OFF.

When PD1 is received other flash light, 7 pin of IC3 is to be H and start to flash after SCR2 is ON through R44, D9. Change SW1 and 2 to GND, discharge the electric charge of C17 through D8 and make the flash stop by X contact between test flash button and shoe.

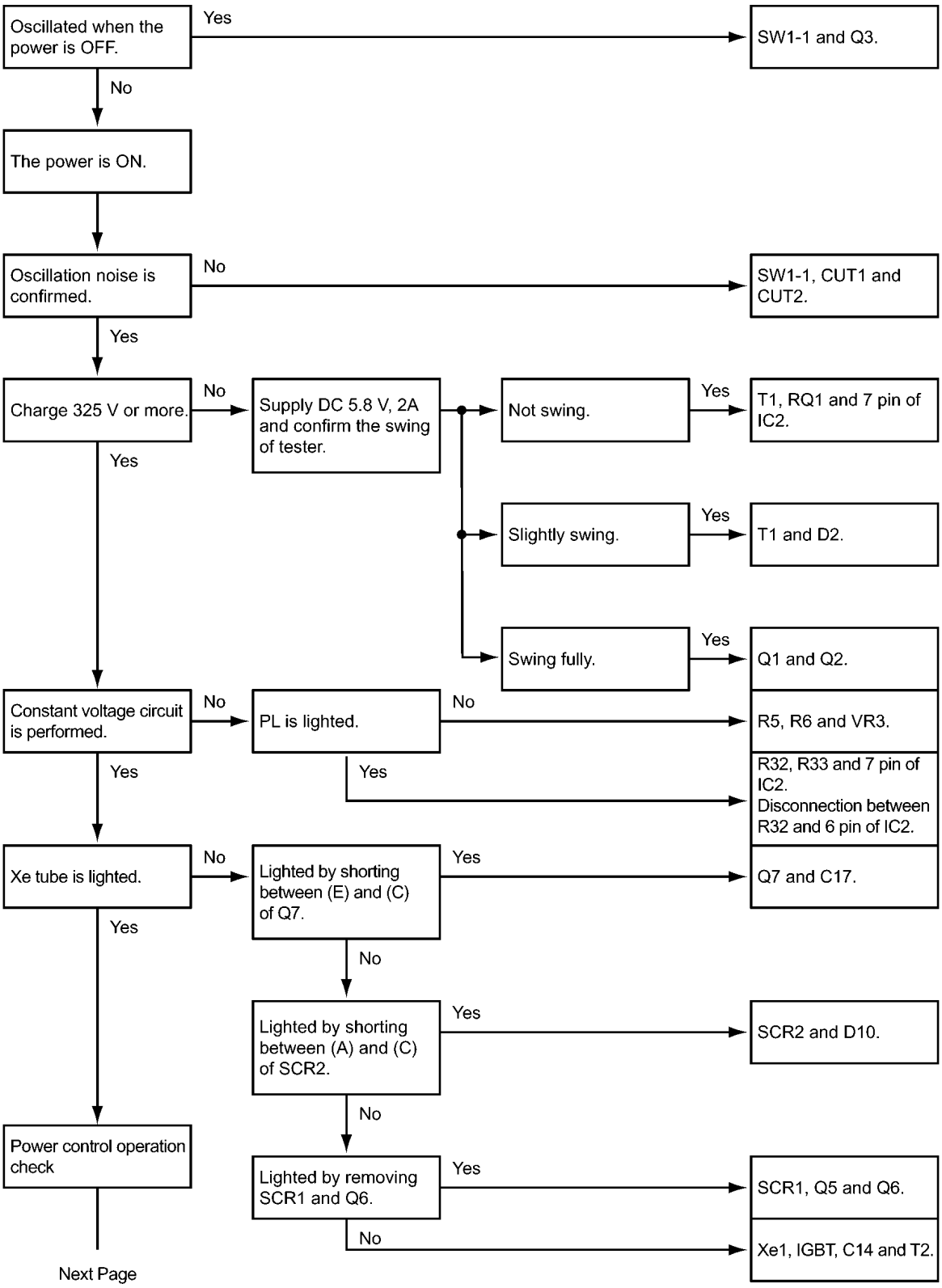
4.7. Operation for auto check circuit

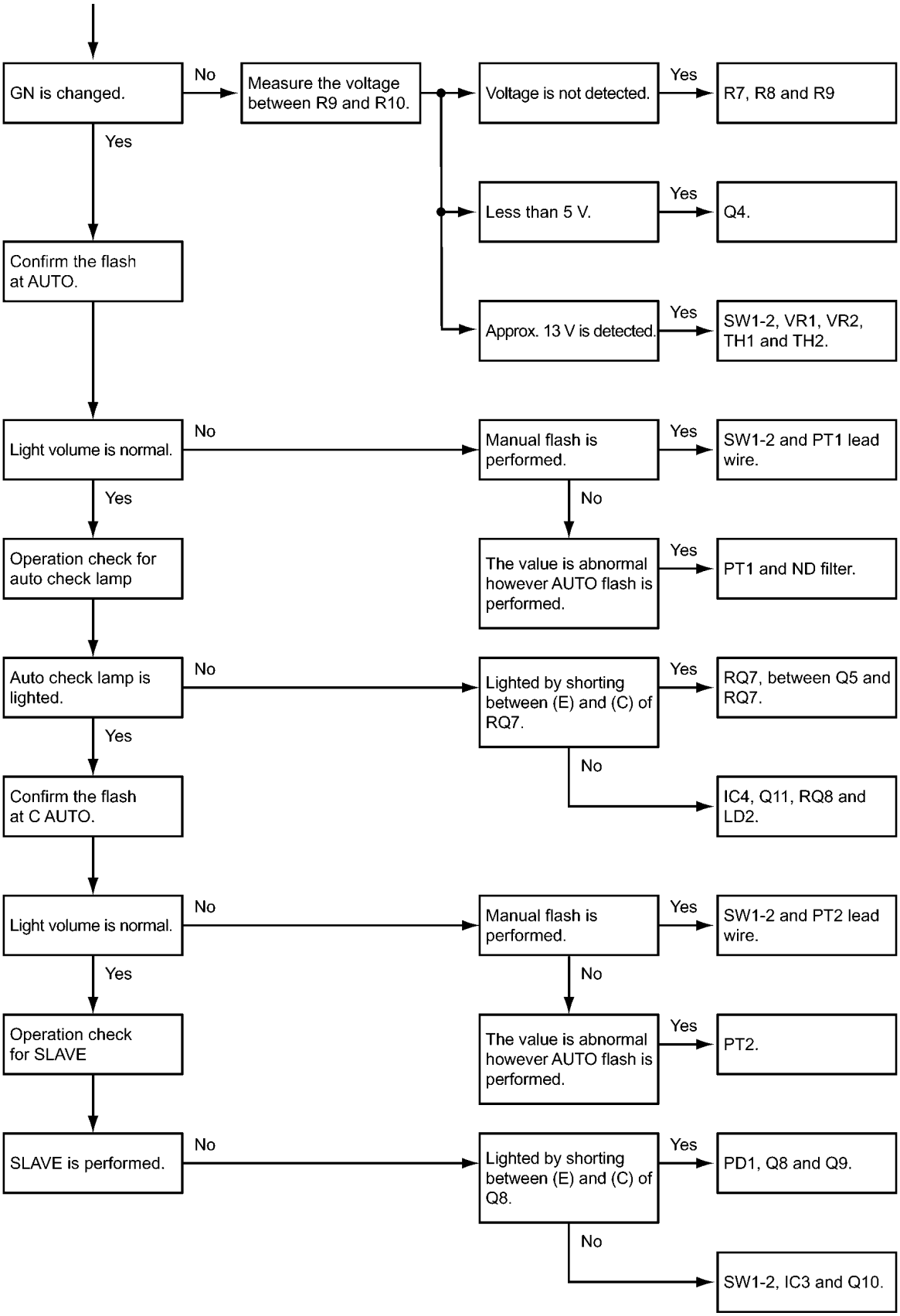
D3 is connected to GND through SW1 and 2 and RQ3 when the mode is selected except for AUTO and C AUTO. However RQ7 is locked, RQ7 is ON after Q5 is ON when the mode is selected AUTO and C AUTO. Then RQ8 is ON and auto check lamp is lighted (LD2 is ON) within the time constant between R49 and C22.

4.8. Operation for flash prohibition circuit

When SW1-1 is OFF, between (C) of Q7 and R26 is connected to GND. Thus SCR2 cannot be ON is prohibited to flash when the power is OFF.

5 TROUBLESHOOTING





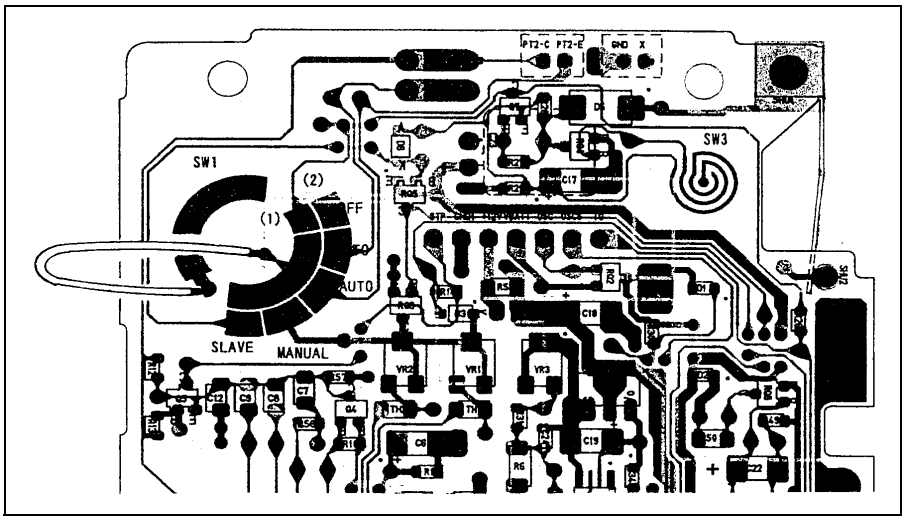
6 SERVICE HINT

Malfunction content:	Not oscillated.
Symptom:	1. Not oscillated when the power switch is ON. 2. Oscillated when shorting both terminal of CUT1, charging voltage is up to 150 - 250 V and then shorting. 3. Normal charging is performed by shorting CUT1 but flash repeatedly comes to above symptom. 4. Also comes to above symptom after flashed properly.
Cause:	T1 is rare shorting and disconnection of CUT1.
Service point:	Replace T1 and CUT1.
Remarks:	The bond which is fixed to CUT1 is lost color to brown, it may be heated Q1 and Q2. Replace Q1 and Q2 commonly. After replacing CUT1, Q1 and Q2, bond these parts and fixed.

Malfunction content:	Not oscillated.
Symptom:	1. Not oscillated when the power switch is ON. 2. When shorting both terminal of CUT1, oscillation is performed normally. (Also flash is normal)
Cause:	Disconnection of CUT1.
Service point:	Replace CUT1.
Remarks:	The bond which is fixed to CUT1 is lost color to brown, it may be heated Q1 and Q2. Replace Q1 and Q2 commonly. Not lost color to brown is only malfunction of CUT1. No replacement of Q1 and Q2 is required. After replacing CUT1, Q1 and Q2, bond these parts and fixed.

Malfunction content:	Not flashed.
Symptom:	1. Normal oscillation and charging is performed when the power switch is ON. 2. Not flashed. (test flash button, shoe, sync cord and SLAVE mode) 3. Output voltage of X terminal is normal. (Approx. 5 V is output at (+) terminal of C17.) 4. The voltage of SCR2 anode terminal is less than 280 V. (Almost the voltage is 0 - 230 V.)
Cause:	C15 is shorted. (It can be confirmed by tester.)
Service point:	Replace C15.

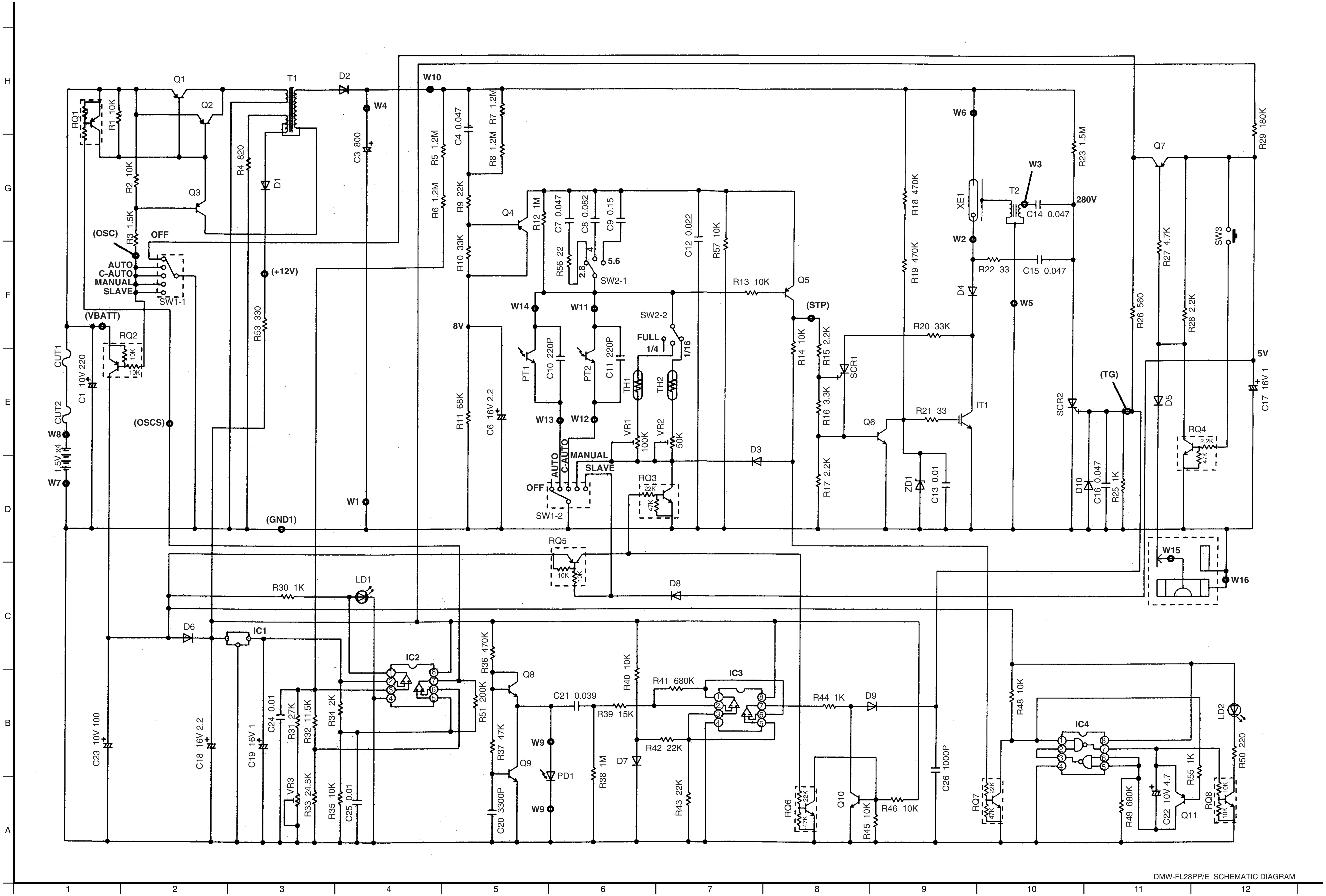
When C.B.A. (A) is removed from main case (D), charging is performed by shorting between 2 points shown below.



Malfunction content:	Not flashed.
Symptom:	1. Normal oscillation and charging is performed when the power switch is ON. 2. Not flashed. (test flash button, shoe and sync cord) Lighted. (SLAVE mode) In this case, it cause the sync circuit is malfunction. Trigger and flash circuit is not malfunction. 3. Output voltage of X terminal is abnormal. (Approx. 5 V is not output at (+) terminal of C17.)
Cause:	RQ4 is shorting.
Service point:	Replace QR4.

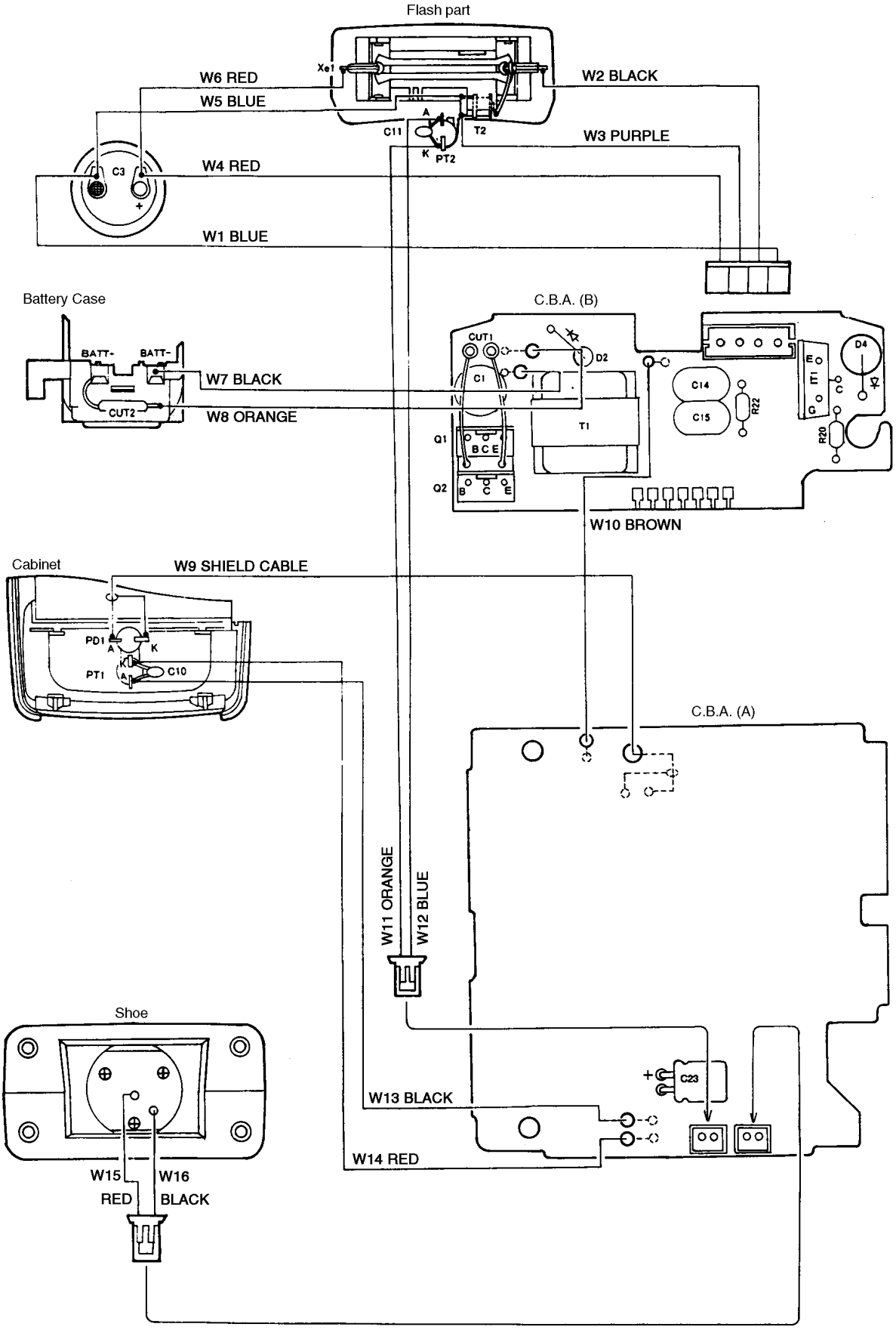
Malfunction content:	Oscillated when the power switch is changed to OFF.
Symptom:	1. Oscillation and charging is performed when supply the power at the condition the power switch is OFF. But pilot lamp is not lighted and flashed. 2. When the power switch is ON after above symptom, normal operation for oscillation, charging, lighting and flashing is performed. 3. When the power switch is OFF after symptom 2, it occurred symptom 1.
Cause:	Q3 is shorting.
Service point:	Replace Q3.

7 SCHEMATIC DIAGRAMS

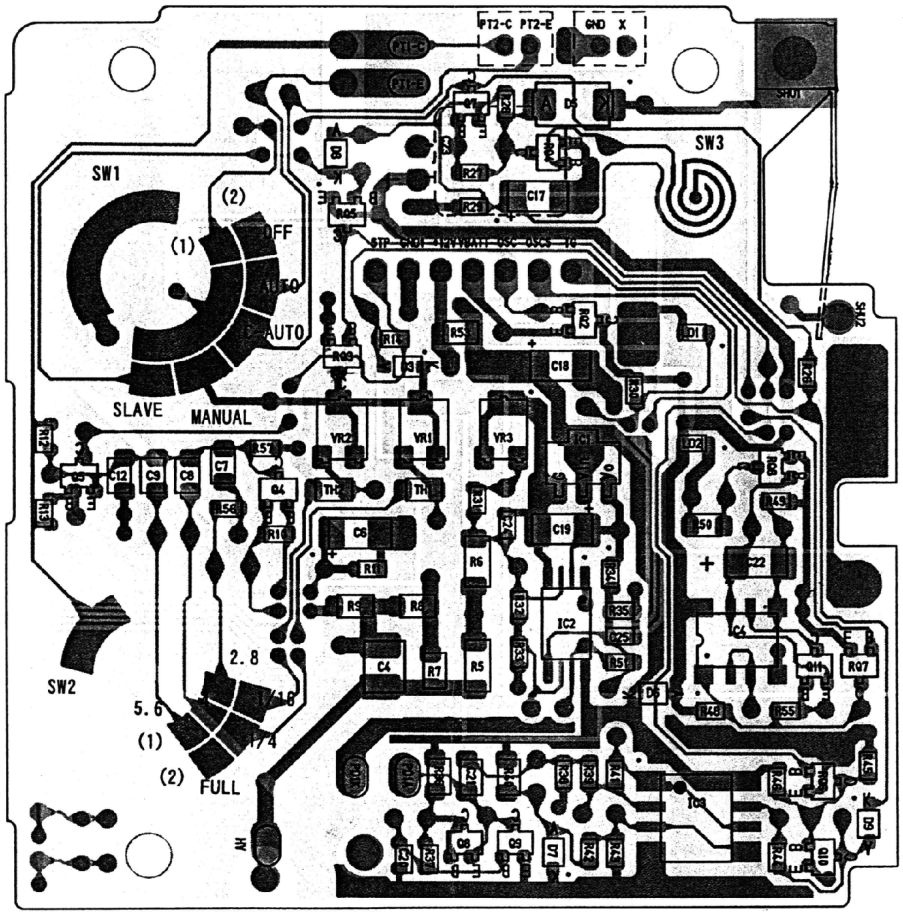


DMW-FL28PP/E SCHEMATIC DIAGRAM

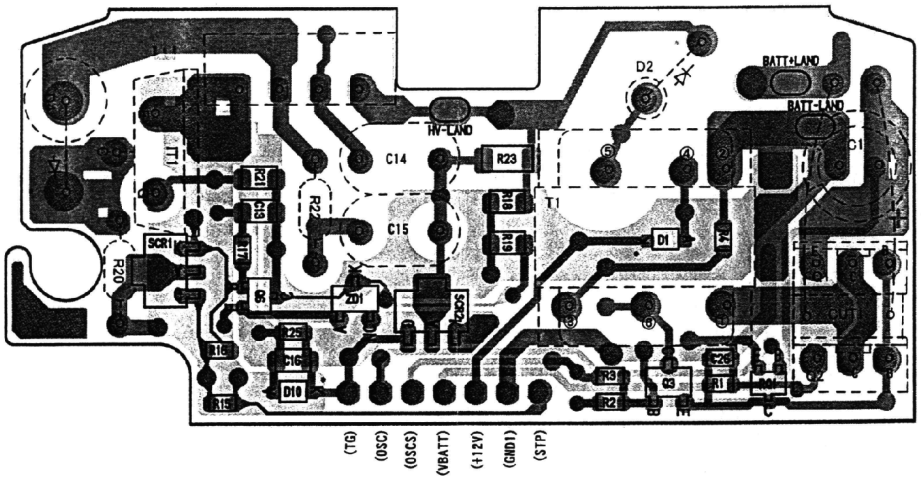
8 WIRING CONNECTION DIAGRAM



9 CIRCUIT BOARD ASSEMBLIES



< C.B.A. (A) >

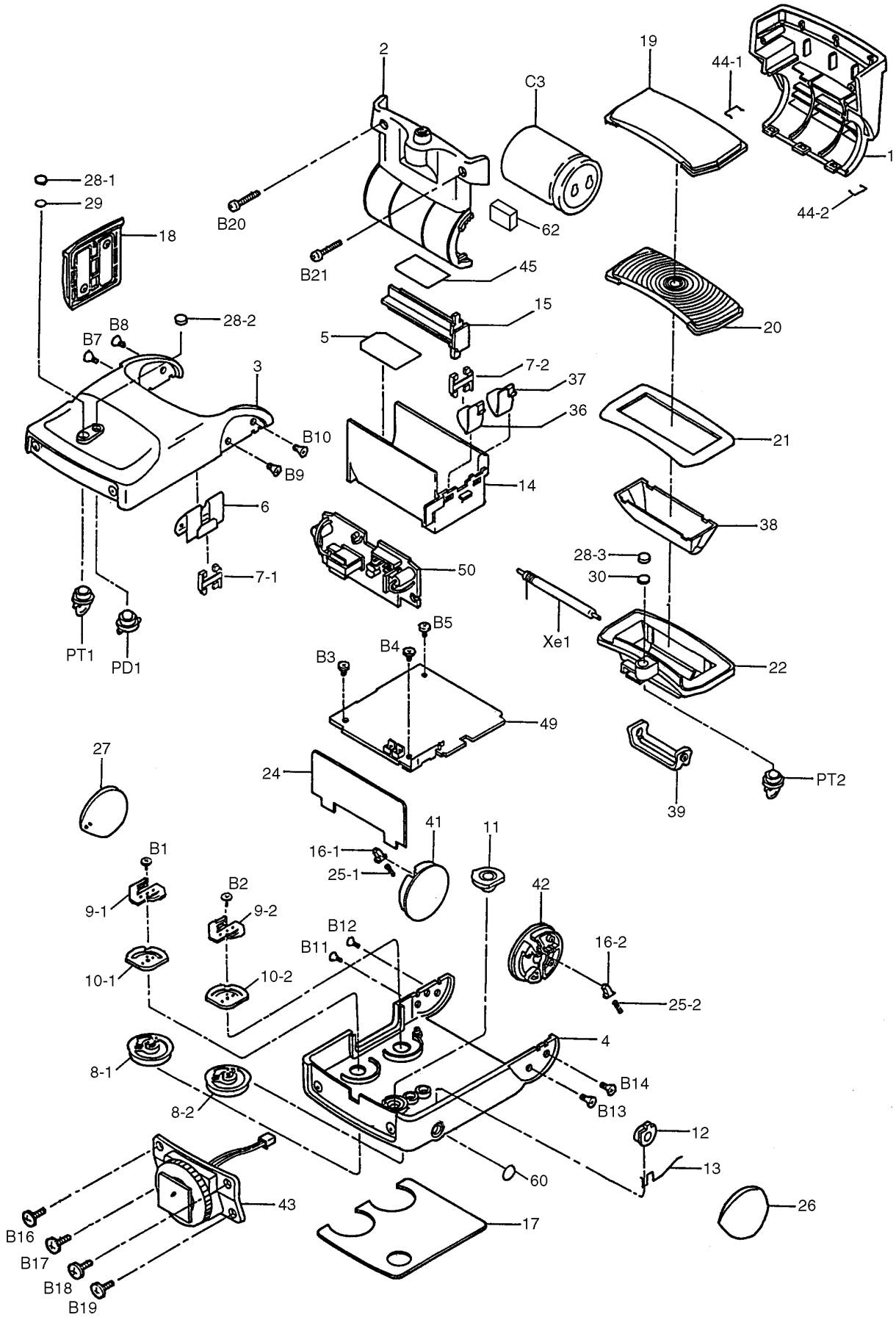


< C.B.A. (B) >

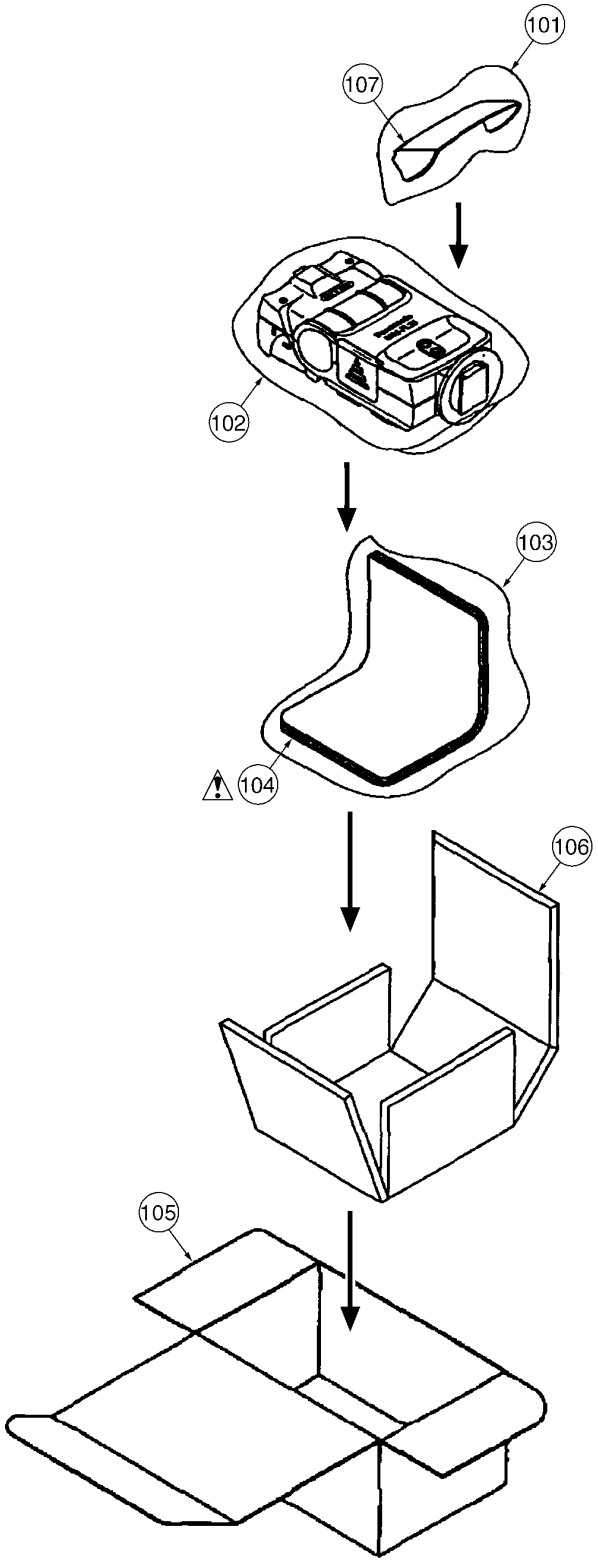
DMW-FL28PP/E C.B.A.

10 EXPLODED VIEWS

10.1. FRAME & CASING SECTION



10.2. PACKING PARTS & ACCESSORIES SECTION



11 REPLACEMENT PARTS LIST

11.1. MECHANICAL REPLACEMENT PARTS LIST

Notes: 1.* Be sure to make your orders of replacement parts according to this list.
2. IMPORTANT SAFETY NOTICE
Components identified with the mark ⚠ have the special characteristics for safety.
When replacing any of these components, use only the same type.
3. The marking(RTL) indicates the retention time is limited for this item. After the discontinuation of this assembly in production, it will no longer be available.
4. Supply of CD-ROM, in accordance with license protection, is allowable as replacement parts only for customers who accidentally damaged or lost their own.

11.1.1. FRAME & CASING SECTION PARTS LIST

Ref. No.	Part No.	Part Name & Description	Remarks
1	SS094-98	MAIN CASE (A)	
2	SS094-99	MAIN CASE (B)	
3	SS095-40	MAIN CASE (C)	
4	SS094-97	MAIN CASE (D)	
5	SS806-74	BATTERY SEAL	
6	SS209-73S	BATTERY TERMINAL	
7-1	SS040-03	TERMINAL GUARD	
7-2	SS040-03	TERMINAL GUARD	
8-1	SS058-58	DIAL KNOB	
8-2	SS058-58	DIAL KNOB	
9-1	SS162-08	DIAL BRUSH TERMINAL	
9-2	SS162-08	DIAL BRUSH TERMINAL	
10-1	SS162-09	CLICK SPRING	
10-2	SS162-09	CLICK SPRING	
11	ES011-61	FLASH BUTTON	
12	SS203-01	JACK MOLD	
13	SS166-15	JACK SPRING	
14	SS027-66	BATTERY CASE	
15	SS029-09	BATTERY SEPARATOR	
16-1	SS038-74	CLICK MOLD	
16-2	SS038-74	CLICK MOLD	
17	SS222-93	BACK PLATE	
18	SS001-69	BATTERY LID UNIT	
19	SS056-90	FRONT PANEL	
20	SS056-91	FRESNEL PANEL	
21	SS228-35	ORNAMENT PLATE	
22	SS040-04	REFLECTION UMBRELLA COVER	
24	SS800-96	INSULATION SHEET	
25-1	SS164-35	SPRING	
25-2	SS164-35	SPRING	
26	SS024-93	SIDE RUBBER 1	
27	SS024-94	SIDE RUBBER 2	
28-1	SS022-16	PROTECTION PLATE	
28-2	SS022-16	PROTECTION PLATE	
28-3	SS022-16	PROTECTION PLATE	
29	SS025-13	ND FILTER (0.3)	
30	SS025-04	ND FILTER (0.4)	(Refer to Adjustment Procedures)
	SS025-12	ND FILTER (0.5)	(Refer to Adjustment Procedures)
	SS025-08	ND FILTER (0.6)	(Refer to Adjustment Procedures)
36	SS209-71S	BATTERY TERMINAL (+)	
37	SS209-72	BATTERY TERMINAL (-)	
38	SS014-13	REFLECTION UMBRELLA	
39	SS011-77	XE BUSHING	
41	SS013-57	BOUNCE SHAFT (A)	
42	SS013-58	BOUNCE SHAFT (B)	
43	SS128-84	SHOE UNIT	
44-1	SS166-16	LOCK SPRING	
44-2	SS166-16	LOCK SPRING	
45	SS804-11	SEAL	
49	SS306-89	C.B.A. (A)	(RTL)
50	SS306-90	C.B.A. (B)	(RTL)
60	SS228-41	SYNC PLATE	
62	SG900-29	CUSHION	
B1	SG012-70	SCREW	
B2	SG012-70	SCREW	
B3	SG022-83	SCREW	
B4	SG022-83	SCREW	
B5	SG022-83	SCREW	
B7	SG052-35	SCREW	
B8	SG052-35	SCREW	
B9	SG052-35	SCREW	
B10	SG052-35	SCREW	
B11	SG052-35	SCREW	
B12	SG052-35	SCREW	
B13	SG052-35	SCREW	
B14	SG052-35	SCREW	
B16	SG052-34	SCREW	
B17	SG052-34	SCREW	
B18	SG052-34	SCREW	
B19	SG052-34	SCREW	
B20	SG022-60	SCREW	
B21	SG022-60	SCREW	

11.1.2. PACKING PARTS & ACCESSORIES SECTION PARTS LIST

Ref. No.	Part No.	Part Name & Description	Remarks
101	SP500-63	POLY BAG	
102	SP500-33	POLY BAG	
103	SP500-33	POLY BAG	
104	SP603-67	INSTRUCTION BOOK	⚠ DMW-FL28PP
104	SP603-68	INSTRUCTION BOOK	⚠ DMW-FL28E
105	SP012-21	PACKING CASE	
106	SP400-35	PAD	
107	SS056-92	WIDE PANEL	

11.2. ELECTRICAL REPLACEMENT PARTS LIST

Note: 1. Be sure to make your orders of replacement parts according to this list.
2. IMPORTANT SAFETY NOTICE ; Components identified with the mark ⚠ have the special characteristics for safety. When replacing any of these components, use only the same type.
3. Unless otherwise specified,
All resistors are in OHMS , K=1,000 OHMS. All capacitors are in MICRO-FARADS(uf) , P=uuF.
4. The P.C.Board units marked width"▮"show below the main assembled parts.
5. The marking(RTL) indicates the retention time is limited for this item. After the discontinuation of this assembly in production, it will no longer be available.

Ref. No.	Part No.	Part Name & Description	Remarks
C1	SC100-07	E.CAPACITOR CH 10V 220U	
C3	SS505-78	E.CAPACITOR CH 330V 800U	
C4	SC201-22	C.CAPACITOR CH 250V0.047U	
C6	SC201-27	T.CAPACITOR CH 16V 2.2U	
C7	ECJ2XB1H473K	C.CAPACITOR CH 50V 0.047U	
C8	ECJ2XB1H823K	C.CAPACITOR CH 50V 0.082U	
C9	SC201-24	C.CAPACITOR CH 50V 0.15U	
C10	SC002-22	C.CAPACITOR CH 50V 220P	
C11	SC002-22	C.CAPACITOR CH 50V 220P	
C12	ECJ2VB1H223K	C.CAPACITOR CH 50V 0.022U	
C13	ECJ2VB1H103K	C.CAPACITOR CH 50V 0.01U	
C14	SC102-51	CAPACITOR CH 400V 0.047U	
C15	SC102-51	CAPACITOR CH 400V 0.047U	
C16	ECJ2XB1H473K	C.CAPACITOR CH 50V 0.047U	
C17	F3K1C1050001	T.CAPACITOR CH 16V 1U	
C18	SC201-27	T.CAPACITOR CH 16V 2.2U	
C19	F3K1C1050001	T.CAPACITOR CH 16V 1U	
C20	SC201-25	C.CAPACITOR CH 25V 3300P	
C21	ECJ2VB1H393K	C.CAPACITOR CH 50V 0.039U	
C22	F3K1A4750002	T.CAPACITOR CH 10V 4.7U	
C23	ECEA1CKS101	E.CAPACITOR 16V 100U	
C24	SC201-26	C.CAPACITOR CH 25V 0.01U	
C25	SC201-26	C.CAPACITOR CH 25V 0.01U	
CUT1	SC014-06	FUSE	
CUT2	SC014-12	FUSE	
D1	MA2J11100L	DIODE	
D2	SC105-24	DIODE	
D3	MA2J11100L	DIODE	
D4	SC105-25	DIODE	
D5	SC105-20	DIODE	
D6	RB501V-40	DIODE	
D7	MA2J11100L	DIODE	
D8	MA2J11100L	DIODE	
D9	MA2J11100L	DIODE	
D10	MA2J11100L	DIODE	
IC1	SS534-23	IC	
IC2	NJM2903V	IC	C0BBBA000032
IC3	NJM2904M	IC	C0ABBA000021
IC4	TC7W00F	IC	
IT1	SC013-53	IGBT	
LD1	SC125-09	LED	
LD2	SC125-10	LED	
PD1	SS512-34S	PHOTO DIODE	
PT1	SS512-18	PHOTO TRANSISTOR	
PT2	SS512-08	PHOTO TRANSISTOR	
Q1	SC013-01	TRANSISTOR	
Q2	SC013-01	TRANSISTOR	
Q3	SC013-49	TRANSISTOR	
Q4	SC013-51	TRANSISTOR	
Q5	SC013-51	TRANSISTOR	
Q6	SC013-52	TRANSISTOR	
Q7	SC013-51	TRANSISTOR	
Q8	SC013-39	TRANSISTOR	
Q9	SC013-39	TRANSISTOR	
Q10	SC013-39	TRANSISTOR	
Q11	SC013-51	TRANSISTOR	
R1	ERJ3GEYJ103V	M.RESISTOR CH 1/10W 10K	D0GB103JA002
R2	ERJ3GEYJ103V	M.RESISTOR CH 1/10W 10K	D0GB103JA002
R3	ERJ3GEYJ152V	M.RESISTOR CH 1/10W 1.5K	
R4	ERJ3GEYJ821	M.RESISTOR CH 1/10W 820	
R5	SC207-85	M.RESISTOR CH 1/4W 1.2M	
R6	SC207-85	M.RESISTOR CH 1/4W 1.2M	
R7	ERJ6GEYJ125	M.RESISTOR CH 1/10W 1.2M	
R8	ERJ6GEYJ125	M.RESISTOR CH 1/10W 1.2M	
R9	ERJ6GEYG222	M.RESISTOR CH 1/10W 2.2K	
R10	ERJ3GEYJ333	M.RESISTOR CH 1/10W 33K	
R11	ERJ3GEYJ683	M.RESISTOR CH 1/10W 68K	
R12	ERJ3GEYJ105V	M.RESISTOR CH 1/10W 1M	
R13	ERJ3GEYJ103V	M.RESISTOR CH 1/10W 10K	D0GB103JA002
R14	ERJ3GEYJ103V	M.RESISTOR CH 1/10W 10K	D0GB103JA002
R15	ERJ3GEYJ222	M.RESISTOR CH 1/10W 2.2K	
R16	ERJ3GEYJ332	M.RESISTOR CH 1/10W 3.3K	
R17	ERJ3GEYJ222	M.RESISTOR CH 1/10W 2.2K	
R18	ERJ6GEYJ474	M.RESISTOR CH 1/10W 470K	
R19	ERJ6GEYJ474	M.RESISTOR CH 1/10W 470K	
R20	ERDS2TJ333J	C.RESISTOR CH 1/4W 33K	
R21	ERJ6GEYG330	M.RESISTOR CH 1/8W 33	
R22	ERDS2FJ330	C.RESISTOR 1/4W 33	
R23	ERJ8GEYJ155	M.RESISTOR CH 1/4W 1.5M	
R25	ERJ3GEYJ102V	M.RESISTOR CH 1/10W 1K	
R26	ERJ3GEYJ561	M.RESISTOR CH 1/10W 560	
R27	ERJ3GEYJ472	M.RESISTOR CH 1/10W 4.7K	
R28	ERJ3GEYJ222	M.RESISTOR CH 1/10W 2.2K	
R29	ERJ3GEYJ184V	M.RESISTOR CH 1/10W 180K	
R30	ERJ3GEYJ102V	M.RESISTOR CH 1/10W 1K	
R31	ERJ3GEYJ273	M.RESISTOR CH 1/10W 27K	
R32	SC207-86	M.RESISTOR CH 1/10W 11.5K	
R33	SC207-87	M.RESISTOR CH 1/10W 24.3K	
R34	ERJ3GEYJ202	M.RESISTOR CH 1/10W 2K	
R35	ERJ3GEYJ103V	M.RESISTOR CH 1/10W 10K	D0GB103JA002
R36	ERJ6GEYJ474	M.RESISTOR CH 1/10W 470K	
R37	ERJ3GEYJ473V	M.RESISTOR CH 1/10W 47K	D0GB473JA002
R38	ERJ3GEYJ105V	M.RESISTOR CH 1/10W 1M	
R39	ERJ3GEYD153V	M.RESISTOR CH 1/10W 15K	D0HB153ZA002
R40	ERJ6GEYG103	M.RESISTOR CH 1/10W 10K	
R41	ERJ3GEYJ684	M.RESISTOR CH 1/10W 680K	D0GB684JA002
R42	ERJ3GEYJ223	M.RESISTOR CH 1/10W 22K	
R43	ERJ3GEYJ223	M.RESISTOR CH 1/10W 22K	
R44	ERJ3GEYJ102V	M.RESISTOR CH 1/10W 1K	
R45	ERJ3GEYJ103V	M.RESISTOR CH 1/10W 10K	D0GB103JA002
R46	ERJ3GEYJ103V	M.RESISTOR CH 1/10W 10K	D0GB103JA002
R48	ERJ3GEYJ103V	M.RESISTOR CH 1/10W 10K	D0GB103JA002
R49	ERJ3GEYJ684	M.RESISTOR CH 1/10W 680K	D0GB684JA002
R50	ERJ6GEYJ220	M.RESISTOR CH 1/10W 22	
R51	ERJ3GEYJ204	M.RESISTOR CH 1/10W 200K	
R53	ERJ6GEYG331	M.RESISTOR CH 1/10W 330	
R55	ERJ3GEYJ102V	M.RESISTOR CH 1/10W 1K	
R56	ERJ3GEYJ220	M.RESISTOR CH 1/10W 22	
R57	ERJ3GEYJ103V	M.RESISTOR CH 1/10W 10K	D0GB103JA002
RQ1	DTA143XU	DIGITAL TRANSISTOR	
RQ2	SC032-71	DIGITAL TRANSISTOR	
RQ3	DTC124XU	DIGITAL TRANSISTOR	
RQ4	SC032-79	DIGITAL TRANSISTOR	
RQ5	DTA114EUA106	DIGITAL TRANSISTOR	
RQ6	DTC124XU	DIGITAL TRANSISTOR	
RQ7	DTC124XU	DIGITAL TRANSISTOR	
RQ8	DTC114EU	DIGITAL TRANSISTOR	
SCR1	SC023-52	THYRISTOR	
SCR2	SC023-52	THYRISTOR	
T1	SS516-60	TRANSFORMER	
T2	SS508-60	TRIGGER COIL	
TH1	SC010-15	THERMISTOR	

Ref. No.	Part No.	Part Name & Description	Remarks
TH2	SC010-16	THERMISTOR	
VR1	SC065-78	VARIABLE RESISTOR	
VR2	SC065-79	VARIABLE RESISTOR	
VR3	SC065-80	VARIABLE RESISTOR	
XE1	SS501-50	XE TUBE	
ZD1	MA3270M	DIODE	MAZ32700M

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