InLight™ Systems Readers

Service Manual

For Models:

Manual Reader ZPA-500

Automatic Reader 200 Unit ZPA-710

Automatic Reader 500 Unit ZPA-700

Version 3 September 2006

Contents

1. Introduction

InLight Systems Readers provide readout for InLight Systems dosimeters, and each system includes a reader, an external PC, and dosimetry software. The InLight software resides on the external PC and provides control over the setup, analysis, and data recording enabling dosimeter read out and reader quality control. This service manual covers the InLight Systems manual reader, the 200 capacity automatic reader, and the 500 capacity automatic reader.

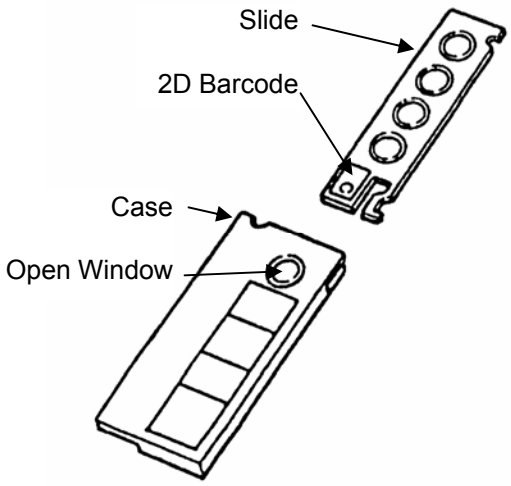
InLight Systems are automated dosimetry systems using Landauer's optically stimulated luminescence (OSL) technology. Dosimeters measure radiation exposure with aluminum oxide detectors (Al_2O_3:C) and OSL technology. The reader stimulates the detector with a light emitting diode (LED) array causing it to luminesce in proportion to the amount of radiation exposure and the intensity of stimulation light. The luminescence is detected and measured by the reader's photomultiplier tube using a high sensitivity photon counting system. A dose calculation algorithm is then applied to the measurement to determine exposure results.

2. Measuring

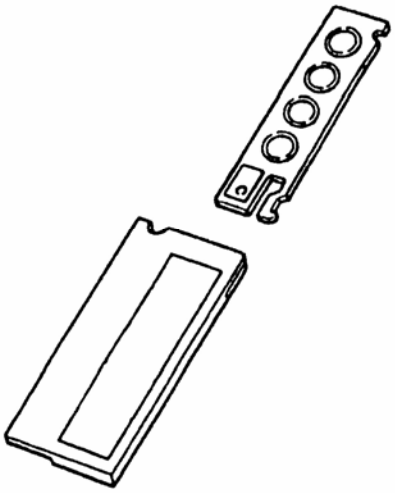
2.1 Structure of InLight Dosimeter

InLight dosimeters are built on an assembly of a case component with metal and plastic filters along with a four-positioned aluminum oxide detector slide component. Both the case and slide are uniquely bar coded with serial numbers for chain of custody and sensitivity identification.

The InLight dosimeter and the InLight calibration dosimeter are shown below. A maximum of four elements are located in the slide, and the slide is inserted in the case to shield from exposure by light. The case and slide bar codes are automatically read in the InLight reader.



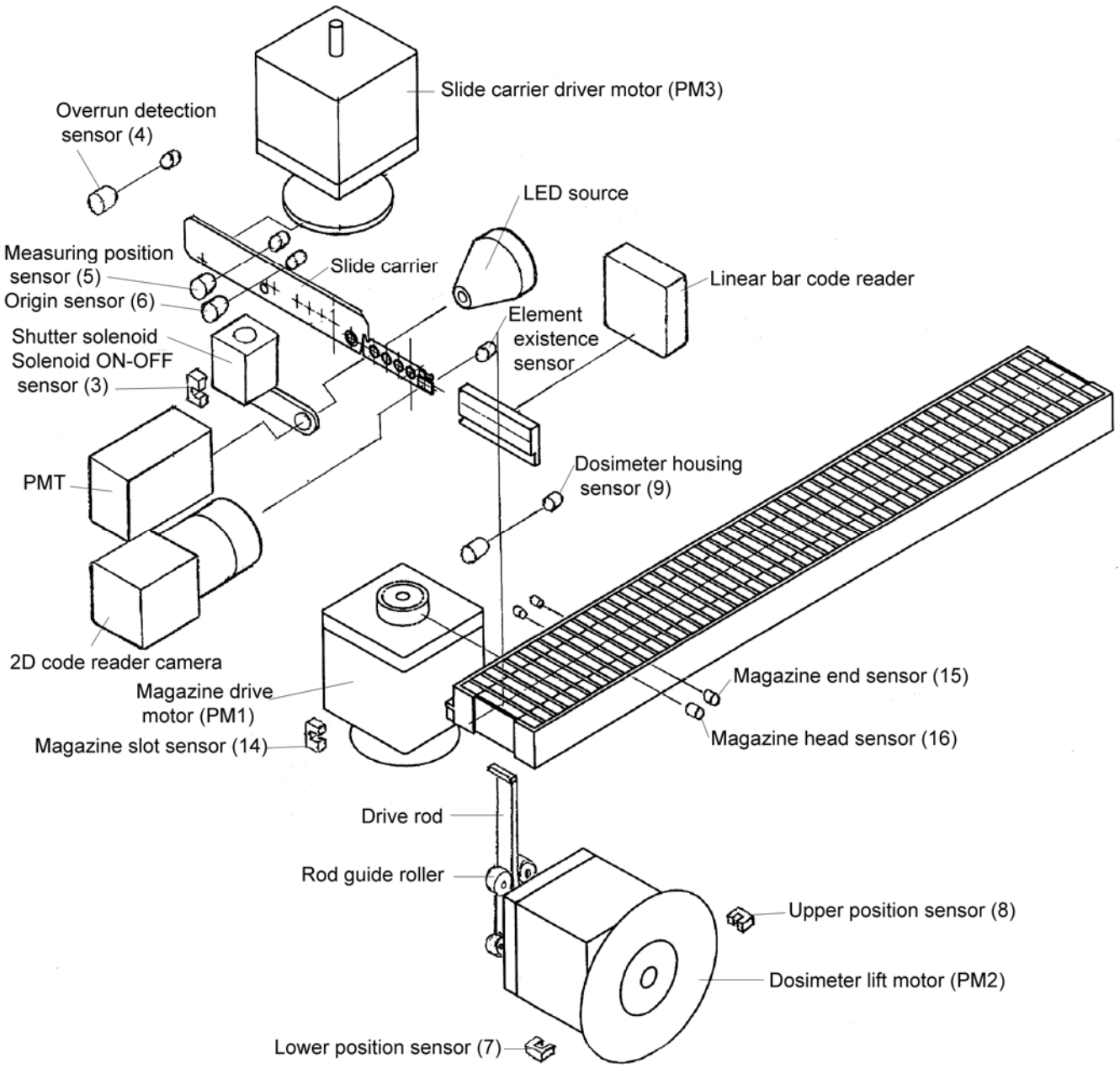
Window Type With Filters



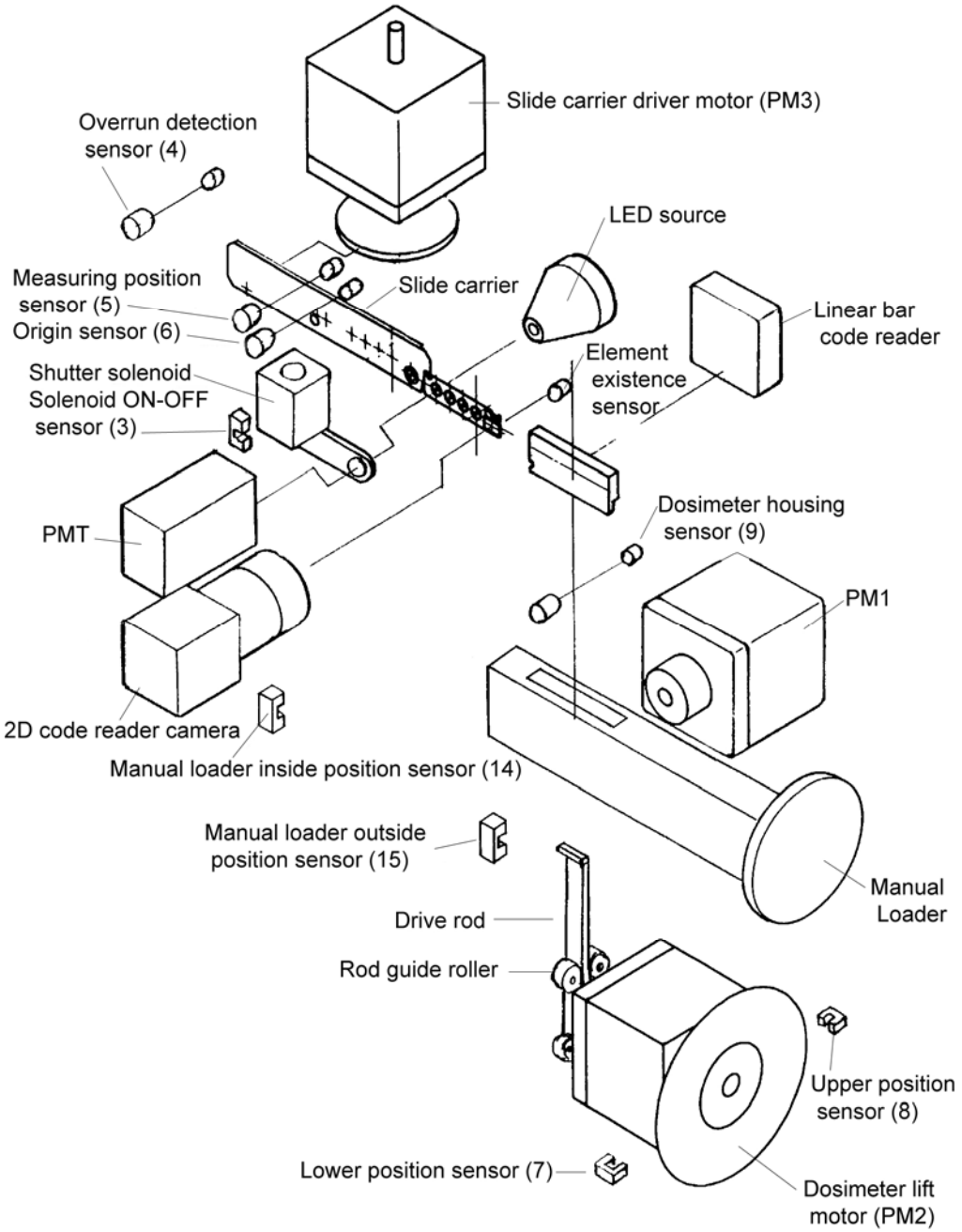
Calibration dosimeter

2.2 Structure of Measuring Block

Automatic Readers



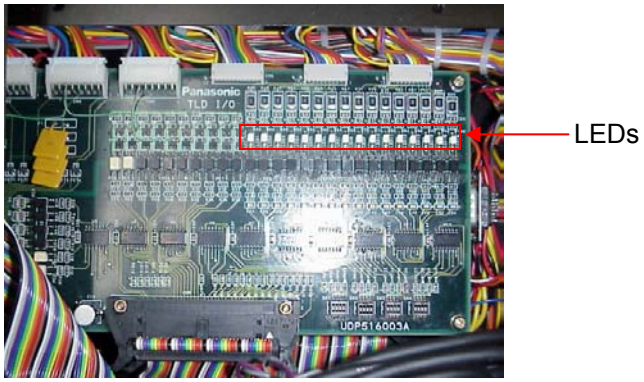
Manual Reader



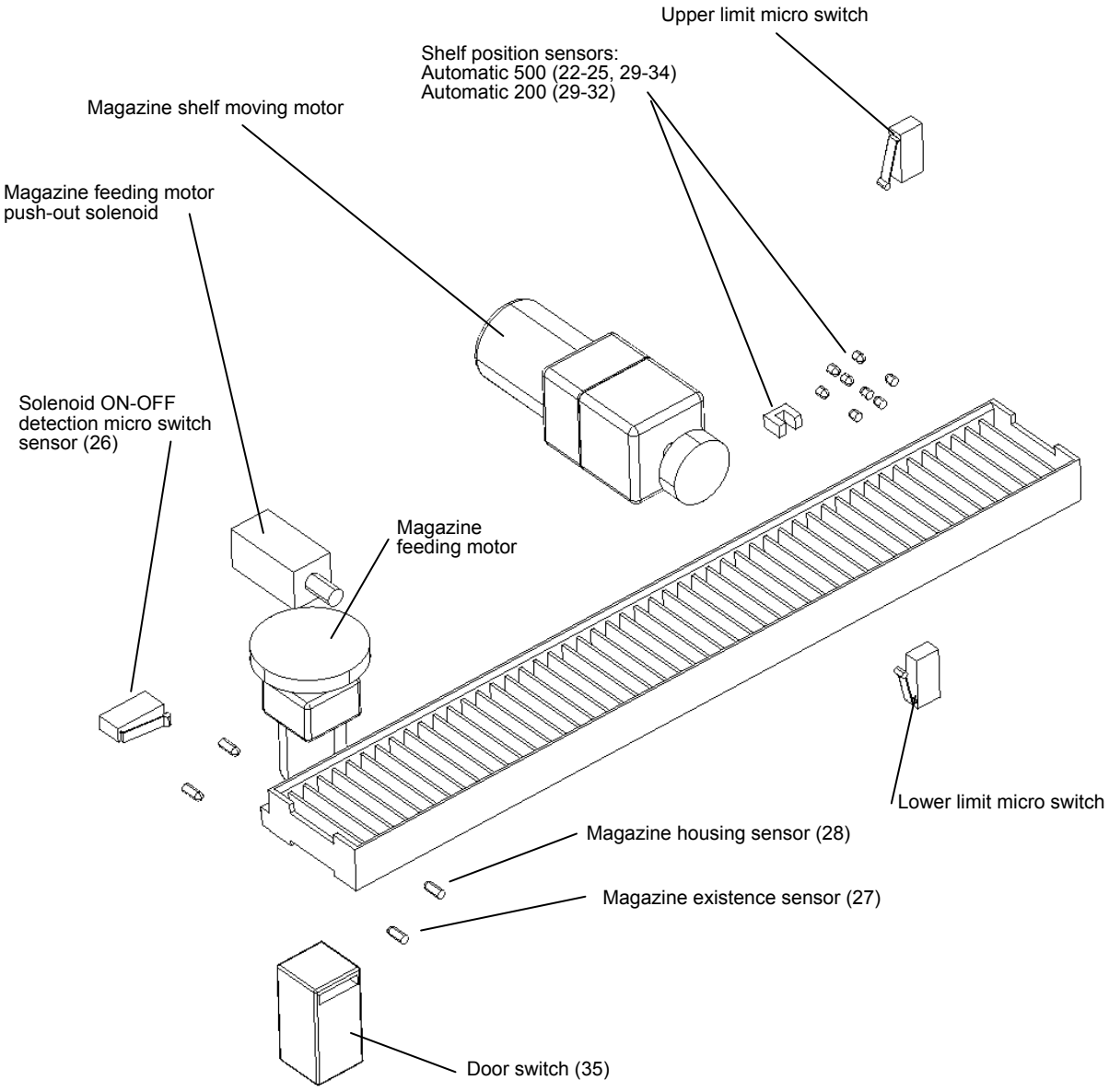
Measuring Block Sensor Descriptions

Sensor RSR No.	LED No.	Signal Name PC No.	Function	Description	LED Active State
1	1	116	2DCR_RDY	2D code reader is ready.	OFF
2	2	115	2DCR_ERR	2D code reader error.	OFF
3	3	114	Shutter solenoid on/off	When solenoid is energized, LED is off.	ON
4	4	113	Overrun position of carrier	When slide carrier overruns, this is off.	OFF
5	5	112	Measurement position of carrier	When measuring E1, E2, E3 or E4, this is on.	ON
6	6	111	Origin position of carrier	When slide carrier stops at the origin position, this is on.	ON
7	7	110	Lower position of dosimeter	When the dosimeter stops at the lower position, this is on.	ON
8	8	19	Upper position of dosimeter	When the dosimeter stops at the upper position, this is on.	ON
9	9	18	Existence of dosimeter	When checking for dosimeter, this is off if the dosimeter exists.	OFF
10	10	17			
11	11	16			
12	12	15			
13	13	14			
14	14	13	Manual Reader: inside position of manual loader	When the manual loader is pushed in, this is off.	OFF
		13	Automatic Reader: magazine slot position	When the dosimeter is in measuring position, this is on.	ON
15	15	12	Manual Reader: outside position of manual loader	When the manual loader is pushed out, this is off.	OFF
		12	Automatic Reader: magazine end	When the sensor detects end of magazine, this is on.	ON
16	16	11	Magazine head	When the sensor detects head of the magazine, this is off.	OFF

LED1-16:on PCB (UDP516003A)



2.3 Magazine Changer

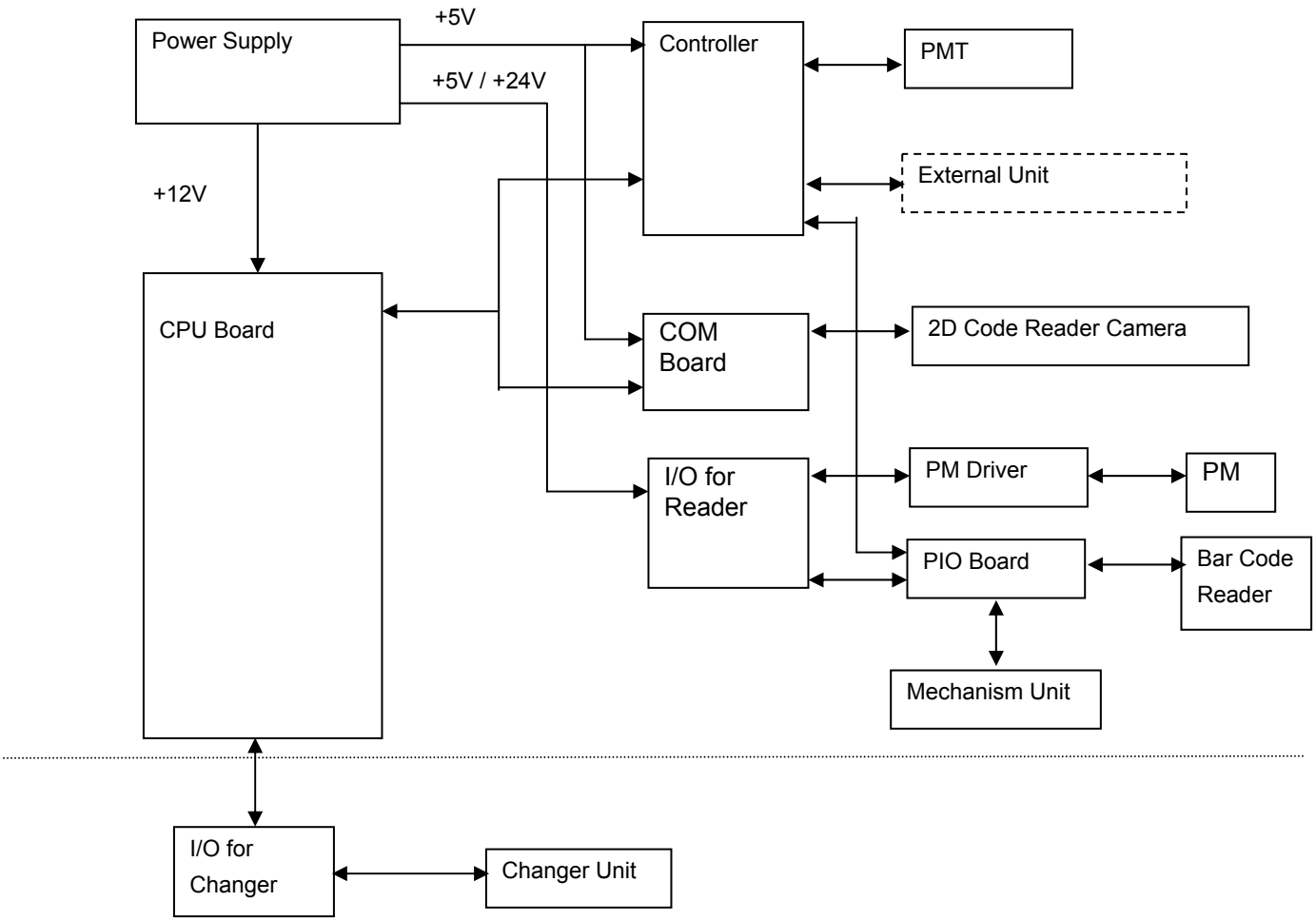


Magazine Changer Sensor Descriptions

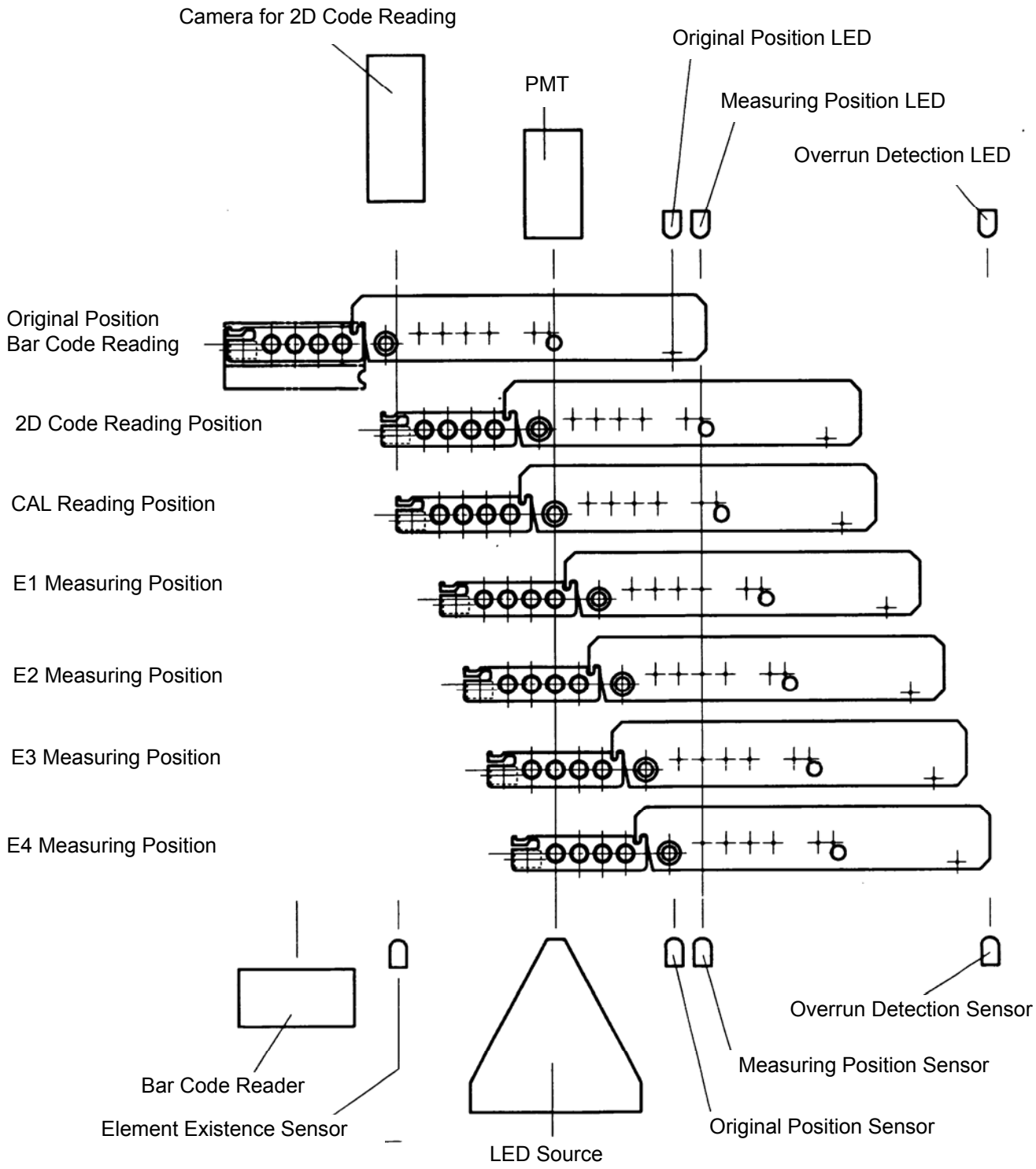
Sensor RSR No.	LED No.	Function	Description	LED Active State
21	1	Judgment of changer		
22	2	Automatic 500 No. 10 shelf position	When this shelf of the magazine is shifted to the position of the first step, this is on.	ON
23	3	Automatic 500 No. 9 shelf position		
24	4	Automatic 500 No. 8 shelf position		
25	5	Automatic 500 No. 7 shelf position		
26	6	Solenoid detection switch	When the magazine feeding motor is in original position, this on.	ON
27	7	Existence of magazine	When checking the magazine, if the magazine exists this is off.	OFF
28	8	Magazine housing sensor	When a magazine is in original position, this is on.	OFF
29	9	Automatic 200 No. 4 shelf position	When this shelf of the magazine is shifted to the position of the first step, this is on.	ON
		Automatic 500 No. 6 shelf position		
30	10	Automatic 200 No. 3 shelf position		
		Automatic 500 No. 5 shelf position		
31	11	Automatic 200 No. 2 shelf position		
		Automatic 500 No. 4 shelf position		
32	12	Automatic 200 No. 1 shelf position	When this shelf of the magazine is at the original position, this is on.	
		Automatic 500 No. 3 shelf position	When this shelf of the magazine is shifted to the position of the first step, this is on.	
33	13	Automatic 500 No. 2 shelf position	When this shelf of the magazine is shifted to the position of the first step, this is on.	
34	14	Automatic 500 No. 1 shelf position	When this shelf of the magazine is at the original position, this is on.	
35	15	Automatic 200 cover open	If cover of reader is open, this is on.	OFF
		Automatic 500 front door open	If the front door of the changer is open, this is off.	
36	16	Automatic 200 judgment of reader	If this LED is on, the reader is manual. If this LED is off, the reader is automatic.	OFF
		Automatic 500 judgment of reader		ON

LED1-16: on PCB (UDP516003A)

3. Reader Electrical Diagram



4. Operation of Slide Carrier and Element Position



5. Pulse Motor Drive and Response of Each Sensor

5.1 Measuring Block

Automatic Readers

Main Operation		Description	Sensor Response (LED) 0=OFF 1=ON															
Pulse Motor	Direction		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PM1	Forward magazine (clockwise)	Feed magazine by 1 slot	0	0	1	1	0	1	1	0	1	0	0	0	0	1	0	0
	Reverse magazine (counterclockwise)	Reverse magazine by 1 slot	0	0	1	1	0	1	1	0	1	0	0	0	0	1	1	1
PM2	Push up (clockwise)	Move dosimeter from the magazine slot to the measurement origin	0	0	1	1	0	1	0	1	1	0	0	0	0	1	0	0
	Down (counterclockwise)	Reverse dosimeter from the measurement origin to the magazine slot	0	0	1	1	0	1	1	0	1	0	0	0	0	1	0	0
PM3		Dosimeter measurement origin or Ref-element measuring position	0	0	1	1	0	1	0	1	1	0	0	0	0	1	0	0
	Pull out (clockwise)	2D code reading position (from dosimeter measurement origin)	0	0	1	1	0	0	0	1	1	0	0	0	0	1	0	0
	Same above	Ref-light measuring position (CAL)	0	0	1	1	1	0	0	1	1	0	0	0	0	1	0	0
	Same above	Element 1 measuring position	0	0	1	1	1	0	0	1	1	0	0	0	0	1	0	0
	Same above	Element 2 measuring position	0	0	1	1	1	0	0	1	1	0	0	0	0	1	0	0
	Same above	Element 3 measuring position	0	0	1	1	1	0	0	1	1	0	0	0	0	1	0	0
	Same above	Element 4 measuring position	0	0	1	1	1	0	0	1	1	0	0	0	0	1	0	0
	Reverse (counterclockwise)	Reverse to the dosimeter measurement origin position	0	0	1	1	0	1	0	1	1	0	0	0	0	1	0	0

Manual Reader

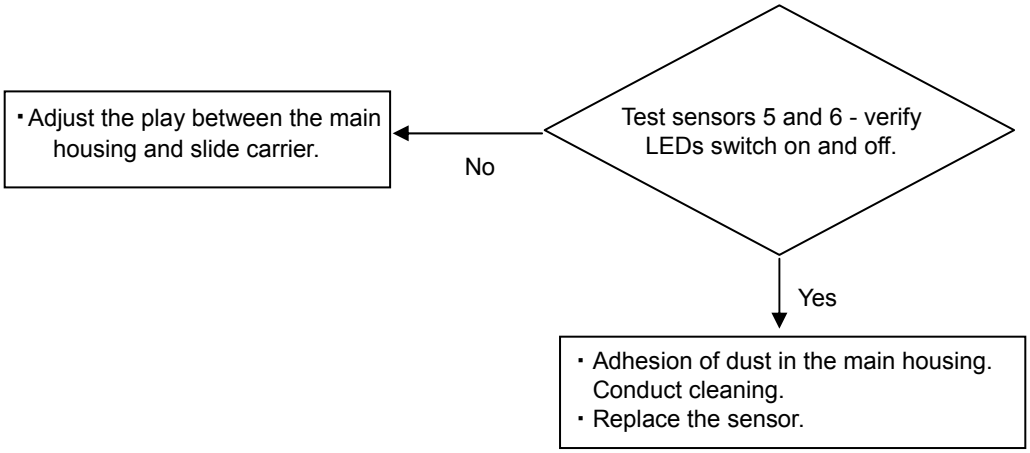
Main operation		Description	Sensor Response (LED) 0=OFF 1=ON															
Pulse Motor	Direction		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PM1	Load a dosimeter	Manually push the dosimeter loader into the machine	0	0	1	1	0	1	1	0	1	0	0	0	0	1	0	0
	Push out	Dosimeter loader moves out	0	0	1	1	0	1	1	0	1	0	0	0	0	0	1	0
PM2	Push up (clockwise)	Move dosimeter from the loader to the measurement origin	0	0	1	1	0	1	0	1	1	0	0	0	0	0	1	0
	Down (counterclockwise)	Reverse dosimeter from the measurement origin to the loader	0	0	1	1	0	1	1	0	1	0	0	0	0	0	1	0
PM3		Dosimeter measurement origin or Ref-element measuring position	0	0	1	1	0	1	0	1	1	0	0	0	0	0	1	0
	Pull out (counterclockwise)	2D code reading position (from dosimeter measurement origin)	0	0	1	1	0	0	0	1	1	0	0	0	0	0	1	0
	Same above	Ref-light measuring position (CAL)	0	0	1	1	1	0	0	1	1	0	0	0	0	0	1	0
	Same above	Element 1 measuring position	0	0	1	1	1	0	0	1	1	0	0	0	0	0	1	0
	Same above	Element 2 measuring position	0	0	1	1	1	0	0	1	1	0	0	0	0	0	1	0
	Same above	Element 3 measuring position	0	0	1	1	1	0	0	1	1	0	0	0	0	0	1	0
	Same above	Element 4 measuring position	0	0	1	1	1	0	0	1	1	0	0	0	0	0	1	0
	Reverse (clockwise)	Reverse to the dosimeter measurement origin position	0	0	1	1	0	1	0	1	1	0	0	0	0	0	1	0

5.2 Magazine Changer

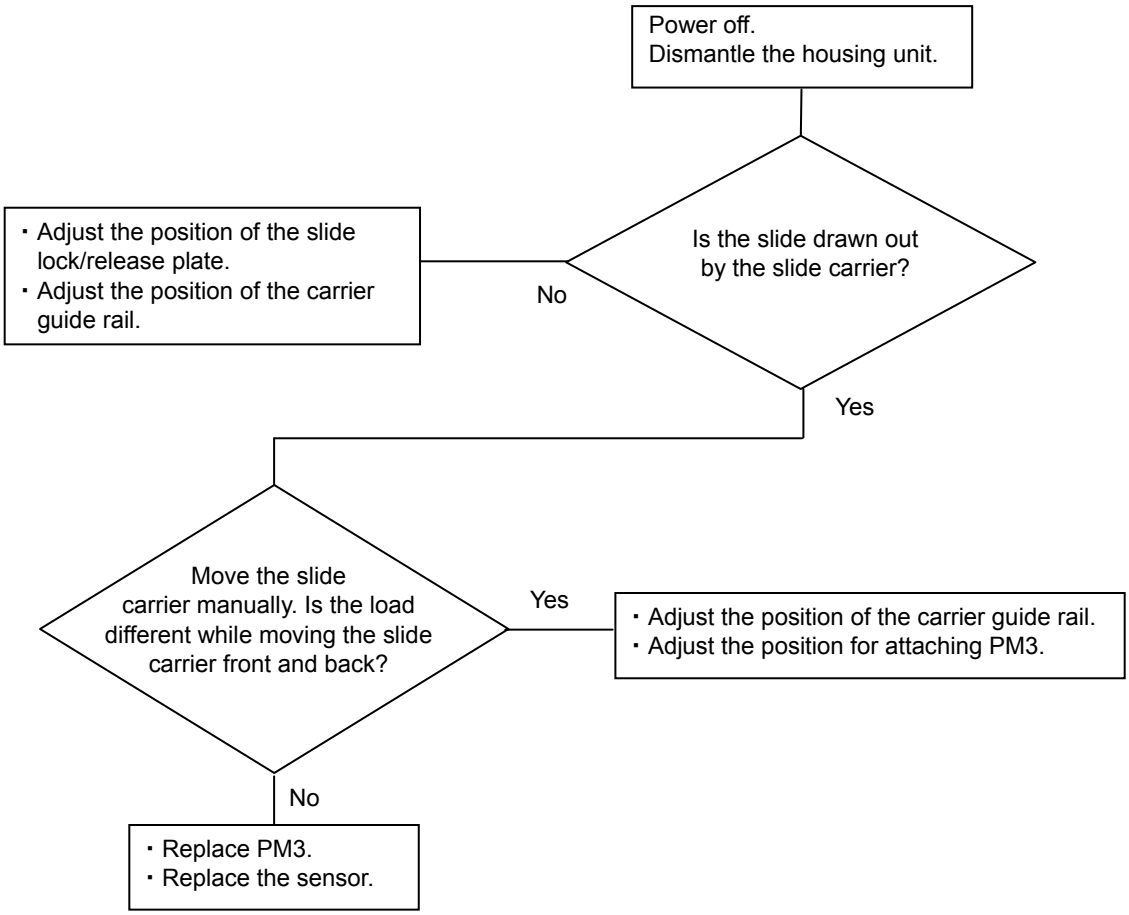
Main Operation		Description	Sensor Response (LED) 0=OFF 1=ON															
Motor or Solenoid	Direction		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
M1	Load (clockwise)	Feed the magazine into the reader	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
	Unload (counterclockwise)	Draw back the magazine from the reader	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
M2		Original position of magazine shelf	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
	Forward (up) (clockwise)	Second stage of the magazine shelf	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0
	Same above	Third stage of the magazine shelf	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
	Same above	Fourth stage of magazine shelf	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
	Reverse (down) (counterclockwise)	Original position of the magazine shelf	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
SOL	Excitation	Unloading position of magazine feeding motor unit	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
	Non-excitation	Loading position	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0

6. Error Message Handling

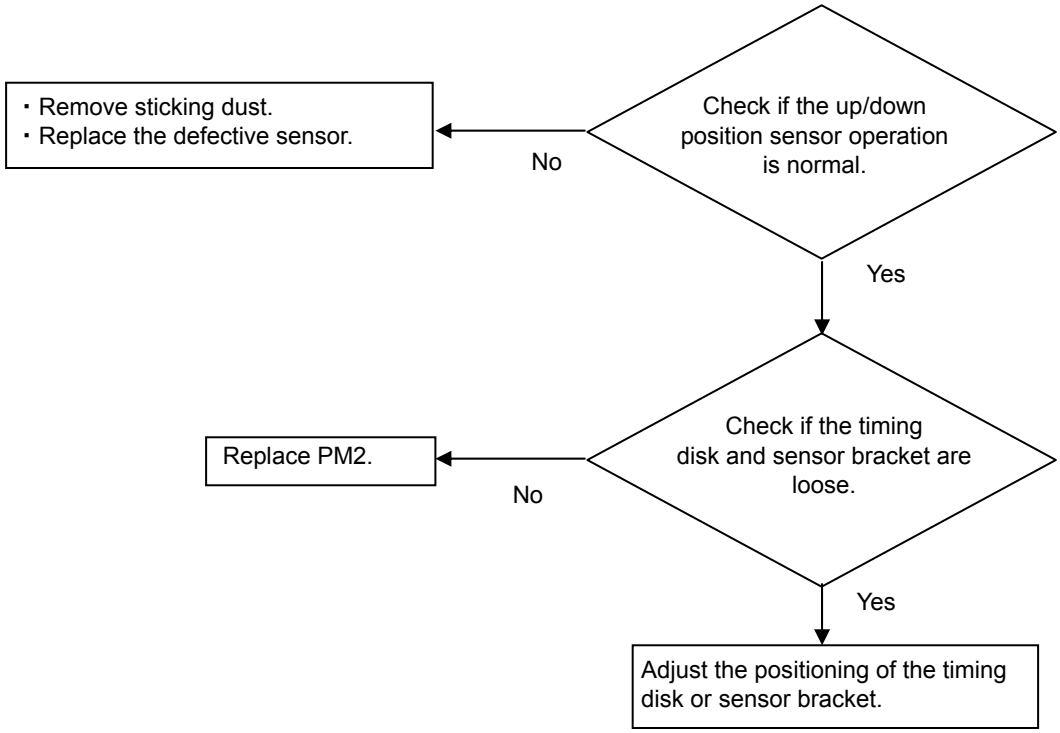
6.1 Measuring unit error while initializing the reader:



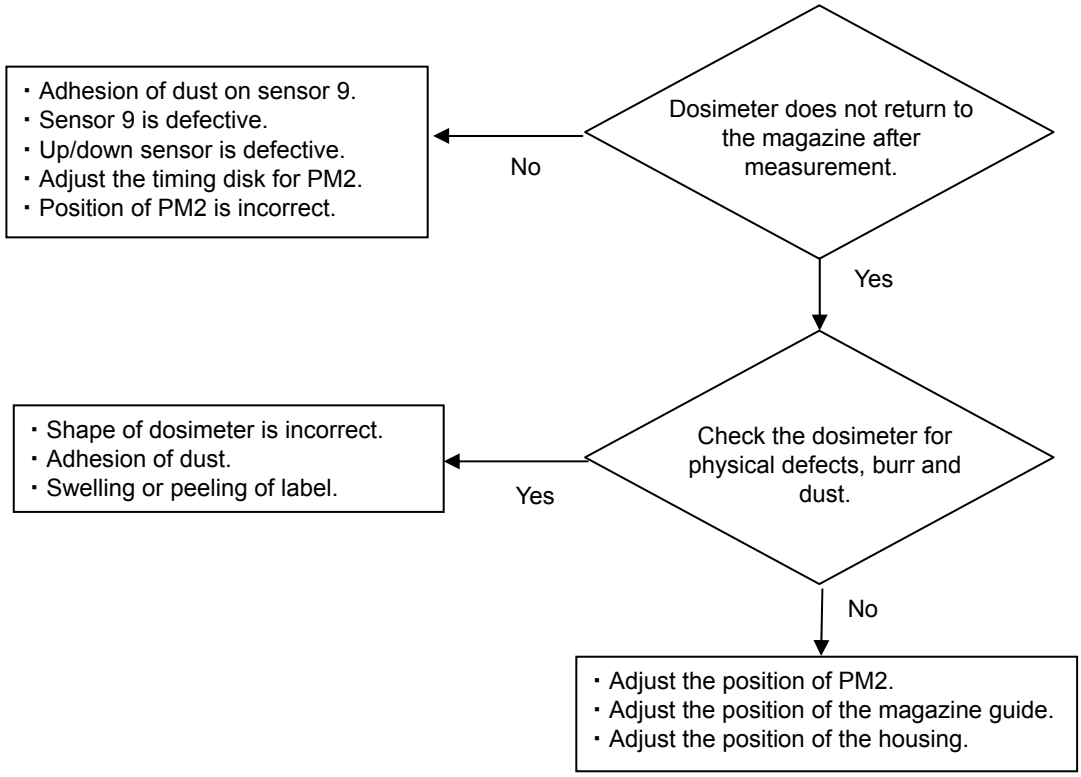
6.2 Measuring unit error while measuring:



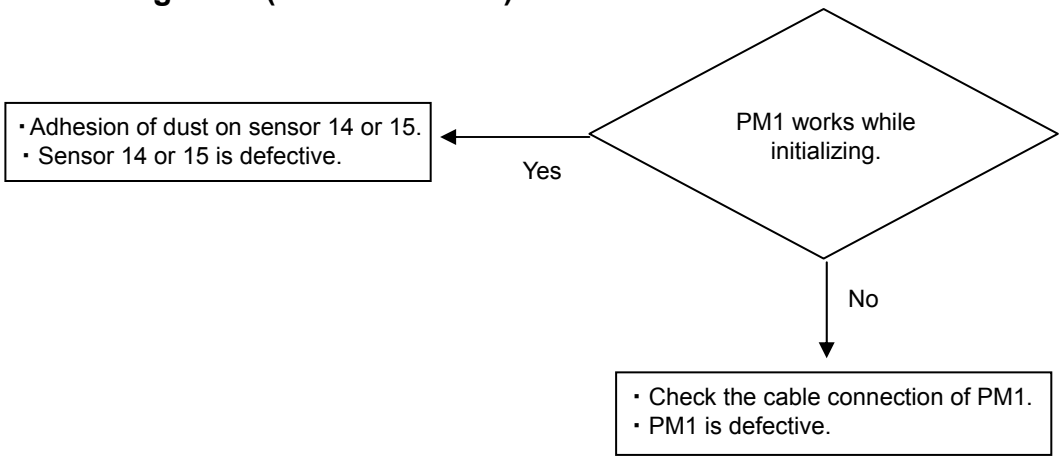
6.3 Dosimeter push up unit error while initializing the reader:



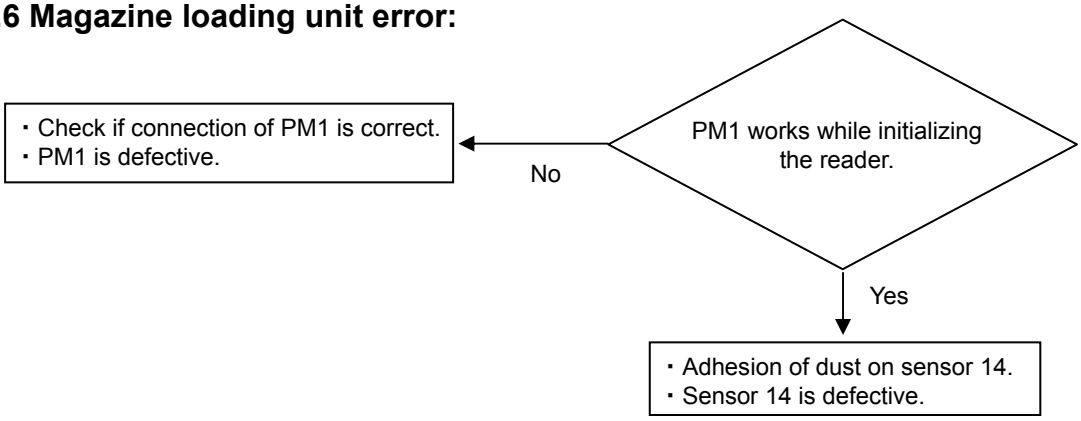
6.4 Dosimeter push up unit error while measuring:



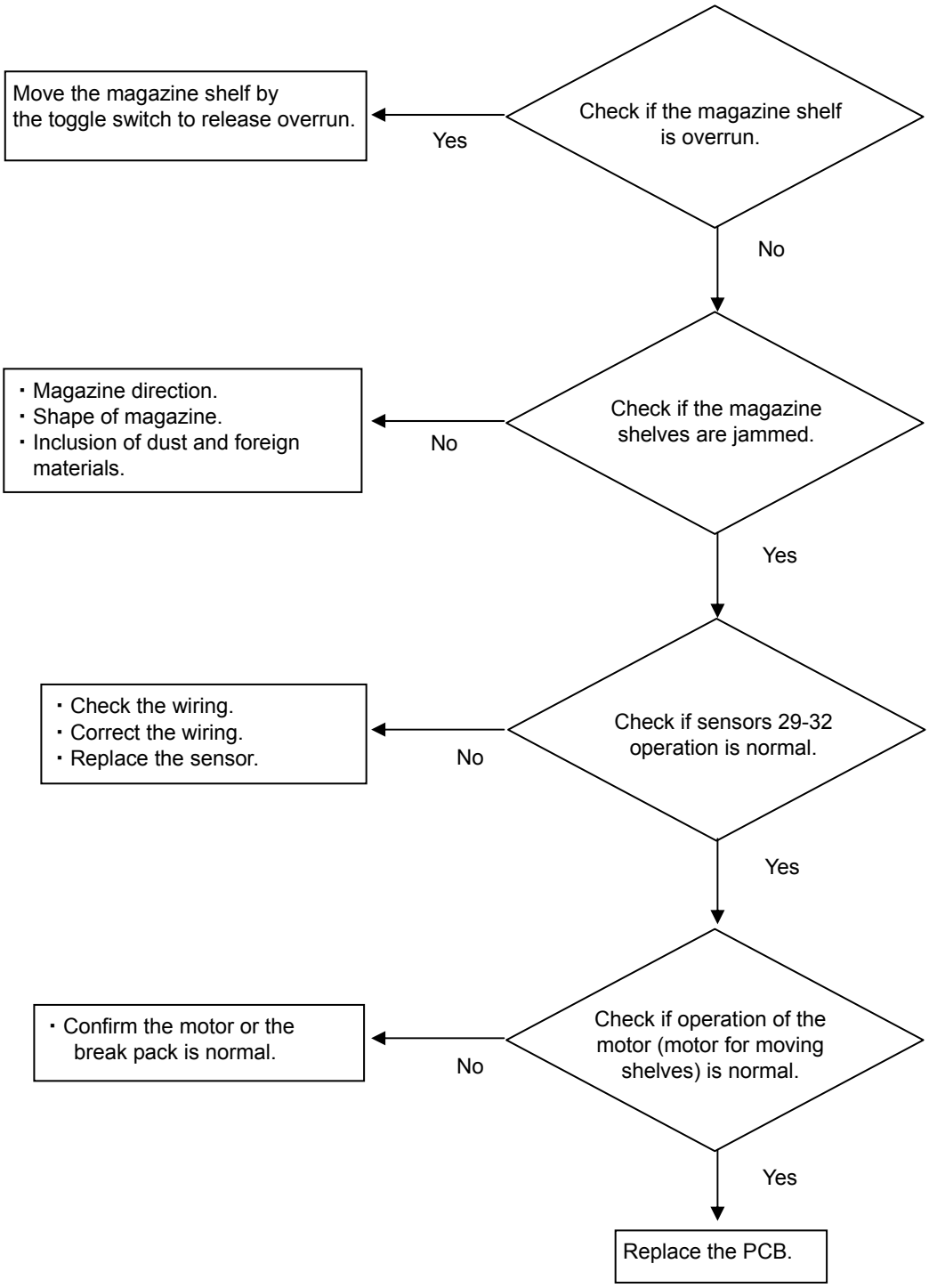
6.5 Unloading error (Manual Reader)



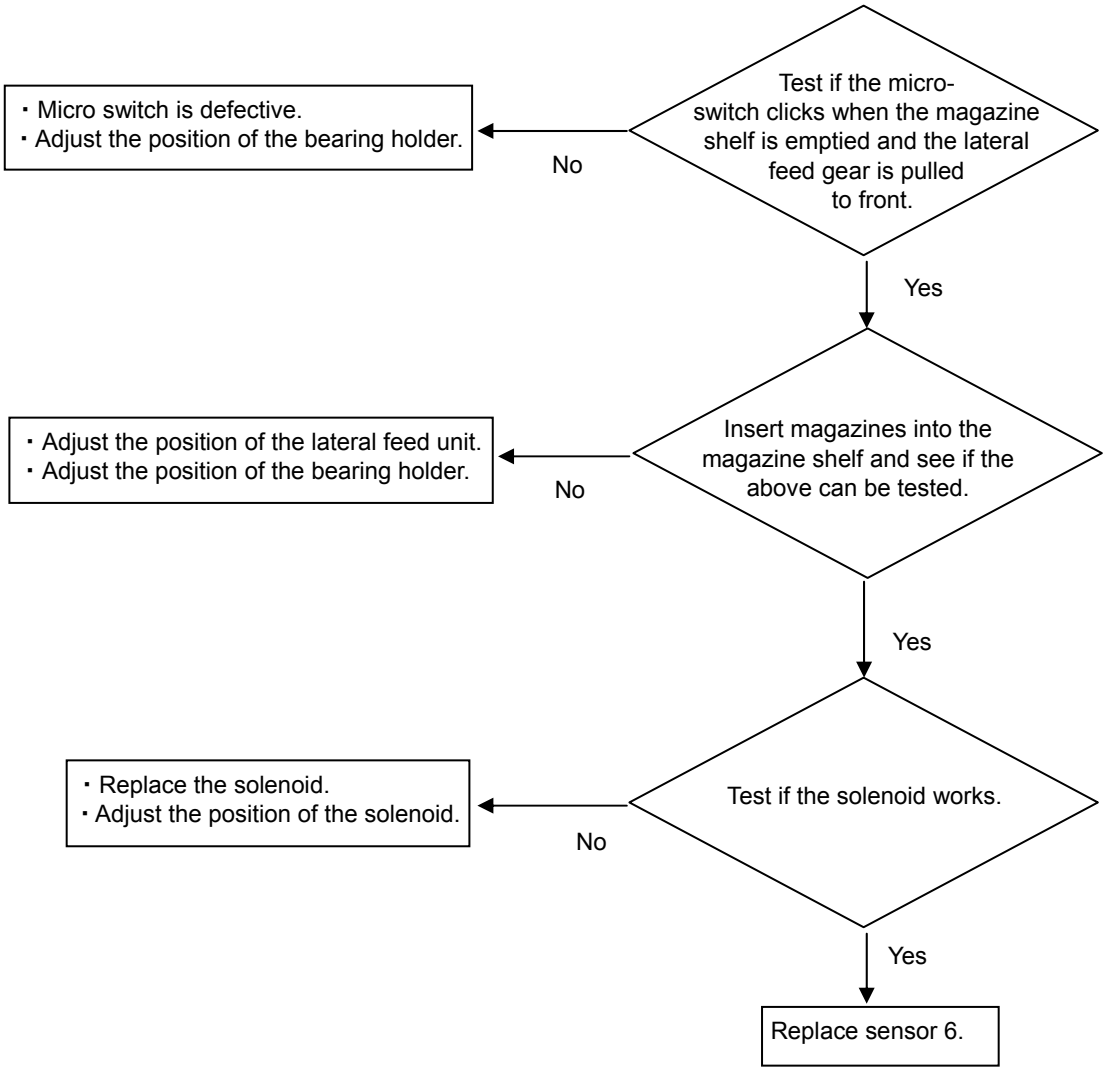
6.6 Magazine loading unit error:



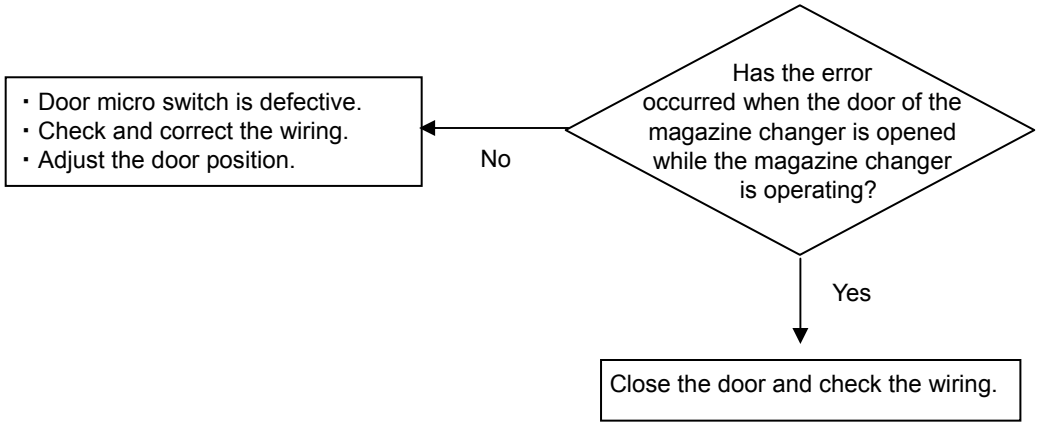
6.7 Changer unit error with magazine shelf failure:



6.8 Changer unit error with magazine not pushed into reader:



6.9 Cover open error:



7. Periodic Inspection Items and Check Sheet

Automatic Readers

	Inspection Contents		6 Month	Monthly	Weekly	Daily	Check
1	Power ON	・ Fan in the rear of the main unit starts operation (No abnormal sound allowed.)	○			○	
		・ Initial operation of the machine should be correctly made. (No error allowed.)	○			○	
2	Checking CAL Value	・ Value of Ref-light should be STD±10%. STD = the standard value of each reader	○			○	
3	Checking LED Value	・ Value of LED should be Weak : 800 counts ±30 % Strong : 10,000 counts ±30 %	○			○	
4	Cleaning of each unit	・ PMT filter (No dust and no dirt allowed)	○				
		・ CAL glass surface	○		○		
		・ Slide carrier	○		○		
		・ Inside the housing	○	○			
		・ Shutter	○		○		
5	Measurement	・ Checking measuring operation by PC				○	
		・ Checking reading operation of bar code reader by PC				○	
		・ Checking reading operation of 2D code reader by PC				○	
6	Equipment calibration and check	・ Zero-point check	○				
		・ Value of Ref-light should be STD±10%.	○				
		・ Checking calibration (value setting) (Using 10 elements with irradiation of about 200mR) Read value $\frac{\overline{X}}{A} \times 100 \leq 10\%$ Expected value A : Irradiating value	○				

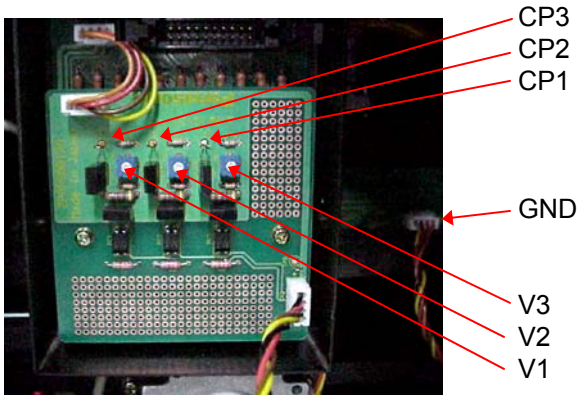
Manual Reader

	Inspection Contents		6 Month	Monthly	Weekly	Daily	Check
1	Power ON	・ Fan in the rear of the main unit starts operation. (No abnormal sound allowed.)	○			○	
		・ Initial setting of the main unit of the machine should be correctly made. (No error allowed.)	○			○	
2	Checking CAL value	・ Value of Ref-light should be standard±10%.	○			○	
3	Manual measurement	・ Manual measurement should be correctly made by selecting MANUAL on the PC screen.	○				
4	Cleaning of each unit	・ PMT filter	○				
		・ CAL glass surface	○		○		
		・ Card carrier	○		○		
		・ Inside the housing	○	○			
		・ Shutter	○		○		
		・ Input (ENTRY)	○				
		・ Output (DUMP)	○				
5	Equipment calibration and check	・ Zero-point check	○				
		・ CAL value: standard value±10%	○				
		・ Checking calibration (value setting) (Using 10 elements with irradiation of about 1R) Compare the read value of Strong LED and Weak LED. The ratio of S-LED/W-LED should be within±10%.	○				

8. Reader Internal Adjustments

8.1 Adjust LED Intensity and Calibration

1. Initial Setting
   (CP 3-GND)＝(CP2-GND)＝11.5V(Max.12V)
   (CP 1-GND)＝1.5V(Max.12V)
   Adjust the VRs V1, V2, V3 so that the initial setting is shown above.



2. To Adjust LED Voltage
   Irradiate 5R (137-Cs) on InLight element for adjustment, read 10 times continuously, and adjust V1, V2 and V3 so that the average of the count of S-LED (high luminous intensity) and W-LED (low luminous intensity) is in the following range.
   In case the count number is small, increase the voltage (V*), and in case the count number is large, decrease the voltage (V*).
   However, V1≒V2.
   In this event, the following standard should be satisfied.
   (a) S-LED: 50000±5000 counts
   (b) W-LED: 4000±500 counts
   (Record) V1, V2, V3, S-LED count average, W-LED count average.

3. Reference Measurement
   The following state shall occur in the reference measurement.
   (1) DARK
   The average of 10 times measurement results should be less than 20 count/sec.
   In case of NG, light leak is possible. Check, and if the result is still NG, replace the PMT.
   (Record) average value.
   (2) CAL
   The average of 10 times measurement results should be less than 500～3000 count/sec. and the variation factor should be 5% MAX.
   In case of NG, replace the PMT.
   (Record) average value, variation factor
   (3) LED Luminance Intensity Measurement
   The average of 10 times measurement results should satisfy the following standard for S-LED and W-LED.
   (a) S-LED ： 10000±3000 counts
   (b) W-LED : 800±240 counts
   In case the count number is small, increase the voltage (V*), and in case the count number is large, decrease the voltage (V*).
   However, V1≒V2.
   Check that the test standard “2. Adjusting LED Voltage” is satisfied.
   (Record) V1, V2, V3, S-LED count average, W-LED count average.

4. Linearity Check
   Prepare InLight element for adjustment without irradiation (annealed *1), and one each with 10mR, approximately 150mR, 1R, 10R, 100R and 500R irradiated (137-Cs).
   The average of 3 times measurement results should satisfy the following standard.
   (a) Average of 1R (standard), 10R, 100R and 500R should be within ±20% for W-LED.
   (b) Average of 1R (standard), approximately 150mR and 10mR should be within ±20% for S-LED.
   However, deduct the count number with no irradiation from the count number with 10mR.
   (Record) Average count with the respective radiation dosage.

*1 For annealing, leave elements under fluorescent light (about 40W) with ultraviolet removed for more than two hours.

8.2 Setting of 2D Code Reader

Setting 2D Code Reader Controller

Connect the keypad monitor and make setting.

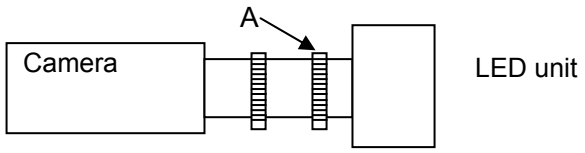
1. Press the center of the cursor key in the center and display [Setting] on the screen.
2. Press B key.
3. Select [Setting parameters] with the cursor key and press the center of the cursor key.
4. Change parameters as shown below.
   Select an item with the cursor key and press the center of the cursor key. When the up cursor or down cursor key is pressed, the setting will change. When the setting is displayed, press the center of the cursor key.
   A. Operator modes
      (1) Reading mode : <Trigger>
      (2) Number of retries : False
      (3) Double read protection
      (4) Read time-out time : None
      (5) Trig. Continuous:
      (6) On delay time
      (7) OFF delay time
      (8) OK output time
   B. Communication conditions
      (1) Comm. protocol : <None>
      (2) Comm. speed : 9600 bps
      (3) Data pit length : 8 bits
      (4) Parity : None
      (5) Stop bit : 1 bit
      (6) Response signal waiting time: 2S
      (7) Handshake : None
      (8) Data format : Header: ESC
      Terminator: CR
      Data number: None
      Sum check data: None
      Code Identification: False
      Final null(00x0)data: Not send
      Replay data at read- in error :False
      Error correction rate: False
      Position around 2D code : False
      Reading time: False
      Soft. trig. third character : 00
      Soft. trig. fourth character : FF
5. When setting parameters is completed, select [Exit] and press the center of the cursor key.
   Next, select [Camera parameters] and press the center of the cursor key.

6. Change camera condition as shown below.
   Select an item with the cursor key and press the center of the cursor key. When the up cursor or down cursor key is pressed, the setting will change. When the setting is displayed, press the center of the cursor key.
   (1) Camera type : <Double speed>
   (2) Synchronous type : <External sync.>
   (3) Camera mode : <Frame mode>
   (4) Shutter speed : 1/120s
7. When the setting of camera parameters is completed, select [Exit] and press the center of the cursor key. Next, select [Reading Code setting] and press the center of the cursor key.
8. Change Reading Code setting as shown below.
   Select an item with the cursor key and press the center of the cursor key. When the up cursor or down cursor key is pressed, the setting will change. When the setting is displayed, press the center of the cursor key.
   Priority1 : <Data Matrix>
   Priority2 : <NONE>
   Select the Priority1 and press the center of the cursor key and press again.

   Data Matrix Symbol colon : <Block>
   Mirror symbol : <false>
   Marking type : <Dot marking>
9. Select <Exit> and press the center of the cursor key.
10. Select <Exit> and press the center of the cursor key.
11. Select <Exit> and press the center of the cursor key.
12. Select <Exit> and press the center of the cursor key.
13. Select <OK> and press the center of the cursor key.
14. Press the center of the cursor key.
15. Press the center of the cursor key and confirm <Trigger> is displayed.

Adjusting the Contrast of Camera

1. Change the <Reading mode> from <Trigger> to <Continuous>.
2. Save the parameter and return to initial mode.
3. Confirm <Continuous> is displayed.
4. Start the measurement of the dosimeter.
5. Error occurs and the reader stops.
6. Turn the ‘A’ of the camera watching the monitor.



7. Confirm the two points changing from <NG> to <OK>.
8. Adjust the ‘A’ to the middle position between two points.
9. Change the <Reading mode> from <Trigger> to <Continuous>
10. Save the parameter and return to initial mode.
11. Confirm <Trigger> is displayed.