SPECIFICATION FOR LCD MODULE

Model No. _ TM161BAAG

Prepared by:	**Date:**
Checked by :	**Date:**
Verified by :	**Date:**
Approved by:	**Date:**

TIANMA MICROELECTRONICS CO., LTD

REVISION RECORD

Date	Ref. Page	Revision No.	Revision Items	Check & Approval

1 Display Specifications

1.1 Display type: TN

1.2 Display color*: Black/White

1.3 Polarizer mode: Reflective/Positive

1.4 Viewing Angle: 6:00

1.5 Driving Duty: 1/16

* **Color tone is slightly changed by temperature and driving voltage.**

2 Mechanical Specifications

2.1 Outline Dimensions: Refer to outline drawing on page: 2

2.2 Display Format: 16 Characters X 1 Line

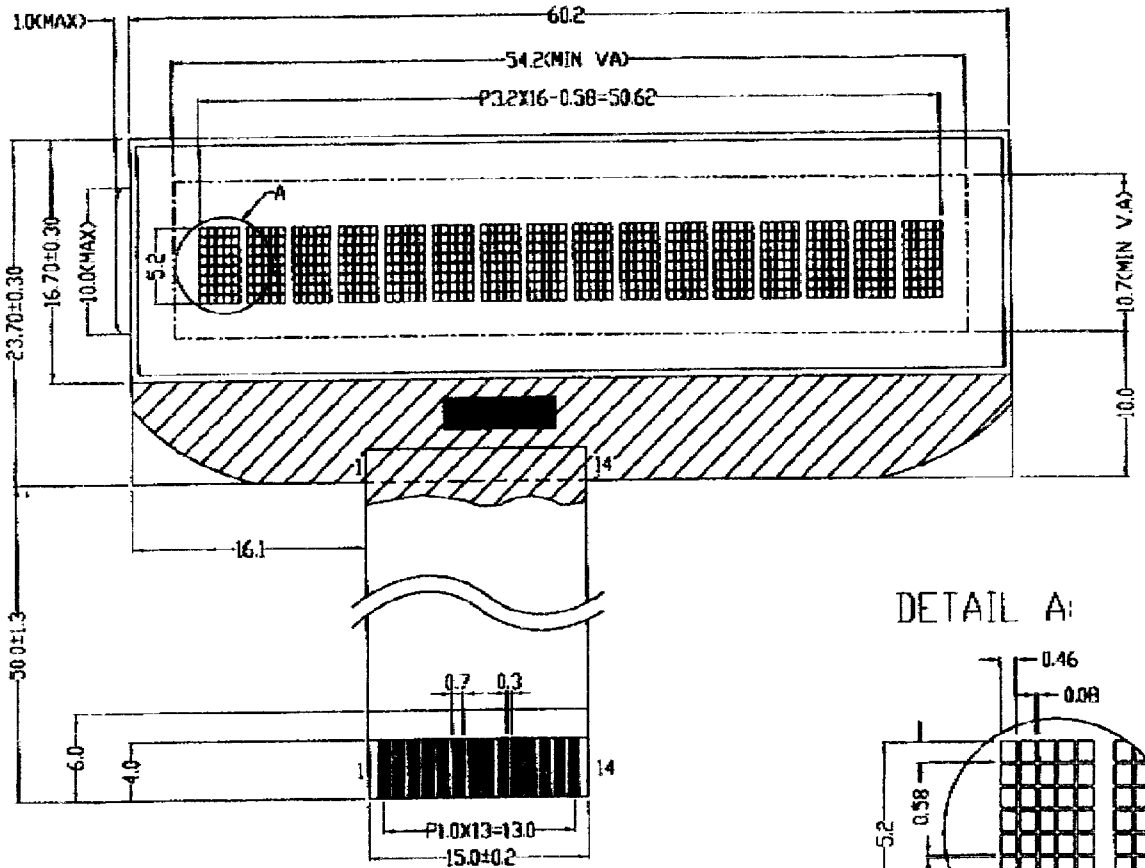
2.3 Display Fonts: 5 X 7 Dots+Cursor

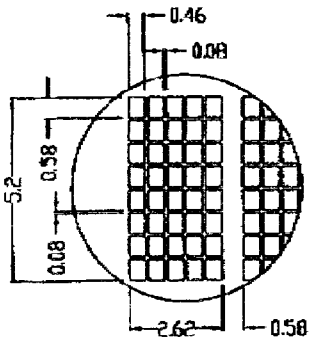
2.4 Character Size: 2.62 X 5.2 (mm)

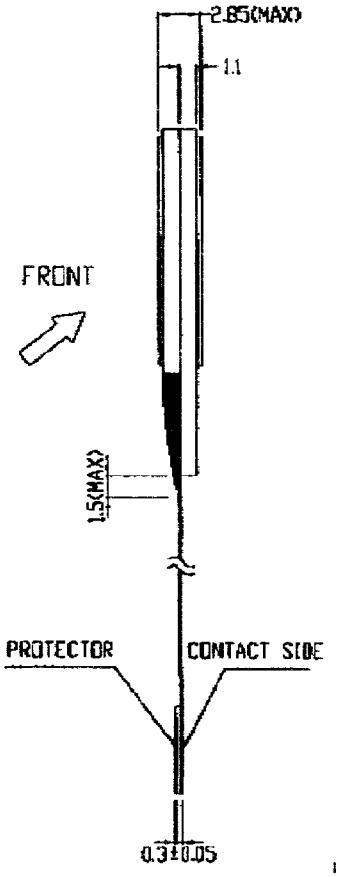
2.5 Dot Size: 0.46X0.58(mm)

2.6 Dot Pitch: 0.54X0.66 (mm)

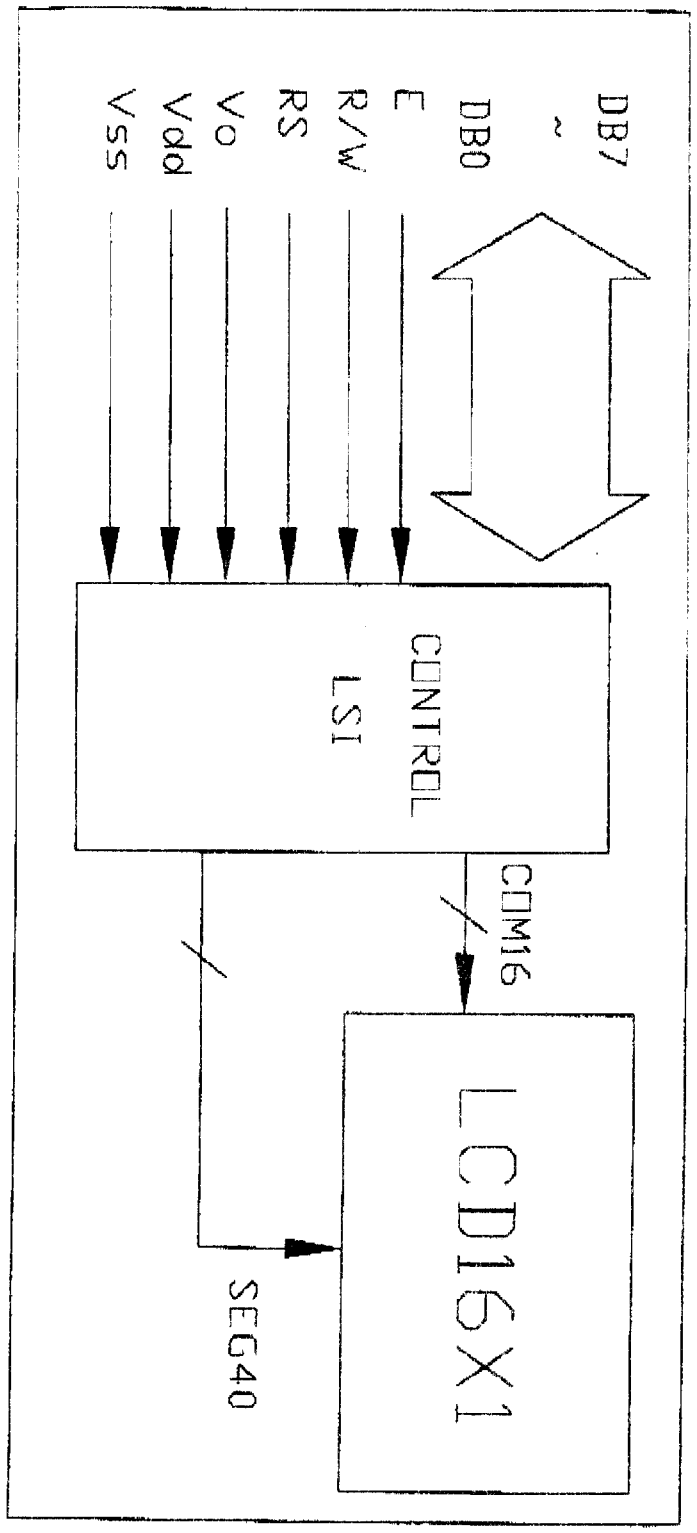
2.7 Weight: 8.5 g


1.0(MAX)
60.2
54.2(MIN VA)
P3.2X16-0.58=50.62
A
5.2
23.70±0.30
16.70±0.30
10.0(MAX)
10.7(MIN V.A)
10.0
1
14
16.1
50.0±1.3
0.7
0.3
6.0
4.0
P1.0X13=13.0
15.0±0.2


DETAIL A
0.46
0.08
0.58
5.2
0.08
2.62
0.58


2.85(MAX)
1.1
FRONT
1.5(MAX)
PROTECTOR
CONTACT SIDE
0.3±0.05

3 Circuit Block Diagram



4 Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit	Remark
Power Supply Voltage	V_{DD}– V_{SS}	4.5	5.5	V	
LCD Driving Voltage	V_{DD}–V_{EE}	-	5.5		
Operating Temperature Range	T_{OP}	0	+50	℃	No Condensation
Storage Temperature Range	T_{ST}	-20	+60		

5 Electrical Specifications and Instruction Code

5.1 Electrical characteristics

Item		Symbol	Min.	Typ.	Max.	Unit	Remark
Supply Voltage (Logic)		V_{DD}–V_{SS}	2.7	5.0	5.5	V	
Supply Voltage (LCD Drive)		V_{DD}–V_{EE}	-	4.7	-	V	
Input Signal Voltage	'H'Level	V_{IH}	0.7V_{DD}	-	V_{DD}+0.3	V	
	'L'Level	V_{IL}	-0.3	-	0.2 V_{DD}	V	
Supply current (Logic)		I_{DD}	-	-	3.0	mA	
Supply current (LCD Drive)		I_{EE}	-	-	1.0	mA	

5.2 Interface Signals

Pin No.	Symbol	Level	Description
1	DB7	H/L	Data bit7
2	DB6	H/L	Data bit6
3	DB5	H/L	Data bit5
4	DB4	H/L	Data bit4
5	DB3	H/L	Data bit3
6	DB2	H/L	Data bit2
7	DB1	H/L	Data bit1
8	DB0	H/L	Data bit0
9	E	H/L	Enable Input
10	R/W	H/L	Selects read or write
11	RS	H/L	Instruction/Data Selects registers
12	Vo	0.3V	Power supply voltage for LCD(-)
13	V_{dd}	5.0V	Power supply voltage for logic and LCD(+)
14	V_{SS}	0V	Ground

5.3 Interface Timing Chart:

AC Characteristics

(V_{DD} = 4.5 ~ 5.5V, Ta = -30 ~ + 85°C)

Mode	Characteristic	Symbol	Min	Typ	Max	Unit
Write Mode (Refer to Fig-3)	E Cycle Time	tc	500	-	-	ns
	E Rise / Fall Time	tr, tf	-	-	20	
	E Pulse Width (High, Low)	tw	230	-	-	
	R/W and RS Setup Time	tsu1	40	-	-	
	R/W and RS Hold Time	th1	10	-	-	
	Data Setup Time	tsu2	80	-	-	
	Data Hold Time	th2	10	-	-	
Read Mode (Refer to Fig-4)	E Cycle Time	tc	500	-	-	ns
	E Rise / Fall Time	tr, tf	-	-	20	
	E Pulse Width (High, Low)	tw	230	-	-	
	R/W and RS Setup Time	tsu	40	-	-	
	R/W and RS Hold Time	th	10	-	-	
	Data Output Delay Time	t_D	-	-	120	
	Data Hold Time	t_{DH}	20	-	-	

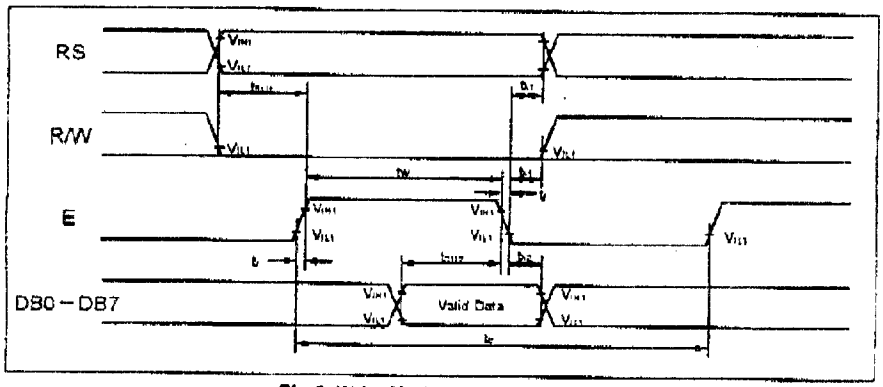


Fig-3. Write Mode Timing Diagram

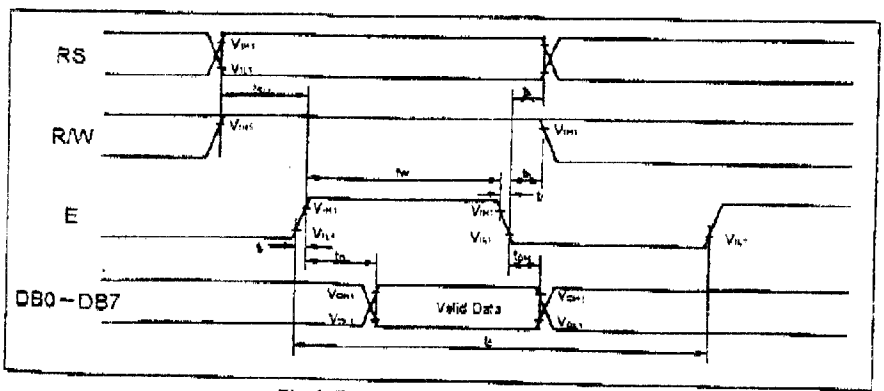


Fig-4. Read Mode Timing Diagram

5.4 Instruction Code

Instruction	Instruction Code										Description	Execution Time (fosc=270 kHz)
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Test Mode	0	0	0	0	0	0	0	0	0	0	Device test mode (When 4-bit interface mode) No operation (When 8-bit interface mode)	-
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM and set DDRAM address to "00H" from AC.	629μs
Return Home	0	0	0	0	0	0	0	0	1	*	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	629μs
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Assign cursor moving direction and enable the entire display shift.	37μs
Display ON/OFF Control	0	0	0	0	0	0	1	D	C	B	Allow display(D), cursor(C), and blinking of cursor position character on/off control bit(B)	37μs
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	*	*	Cursor and Display shift and their direction control without changing DDRAM data	37μs
Function Set	0	0	0	0	1	DL	A	*	M1	M0	Set interface data length(DL), DDRAM addressing mode (A) and COM/SEG output pattern(M0,M1)	37μs
Set CGRAM Address	0	0	0	1	*	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter	37μs
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter	37μs
Read Busy flag and Address	DDRAM	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether in internal operation or not can be known by reading BF. The contents of address counter can also be read	0μs
	CGRAM				*	*	AC4	AC3	AC2	AC1	AC0		
Write Data to RAM	DDRAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM)	43μs
	CGRAM			*	*	*	D4	D3	D2	D1	D0		
Read Data from RAM	DDRAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM).	43μs
	CGRAM			*	*	*	D4	D3	D2	D1	D0		

NOTE: the asterisk means "don't care".

I/D = 1	: Increment,	I/D = 0	: Decrement
S = 1	: Shift enable,	S = 0	: Shift disable
S/C = 1	: Display shift,	S/C = 0	: Move cursor
R/L = 1	: Shift right,	R/L = 0	: Shift left
DL = 1	: 8 bit interface,	DL = 0	: 4 bit interface
A = 0	: DDRAM addressing mode 0,	A = 1	: DDRAM addressing mode1
M0 = 0	: COM/SEG output pattern A,	M0 = 1	: COM/SEG output pattern B
M1 = 0	: 1 line 16 characters,	M1 = 1	: 2 line 8 characters
BF = 1	: System is in operation	BF = 0	: System is ready

6.Optical Characteristics

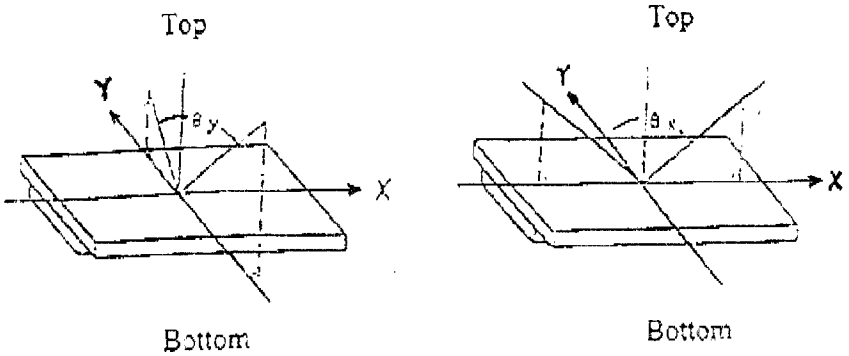
6.1 Optical Characteristics

Top=25℃

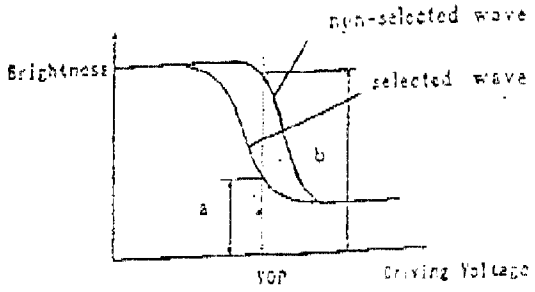
Item		Symbol	Condition		Min.	Typ.	Max.	Unit	Remark
Viewing Angle		θ_x	Cr>2	$\theta_y=0°$	-35	--	10	Deg	
		θ_y		$\theta_x=0°$	-30	--	30		
Contrast Ratio		Cr	$\theta_x=0°$ $\theta_y=0°$		3.0				
Response Time	Turn on	Ton	$\theta_x=0°$ $\theta_y=0°$				150	ms	
	Turn off	Toff					150		

6.2 Definition of optical characteristics

6.2.1 Definition of viewing Angle(see fig. as follow)



6.2.2 Definition of Contrast Ratio(see fig. as follow)

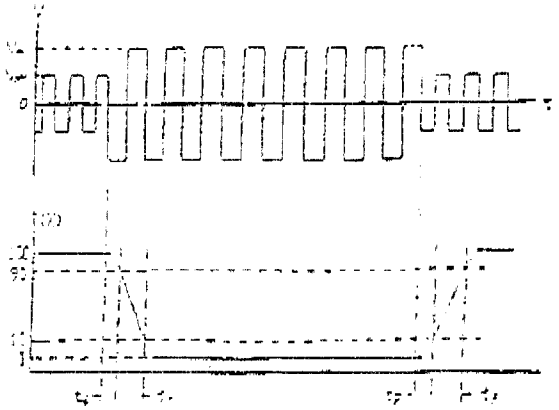


$$\text{Contrast Ratio} = b / a = \frac{\text{non-selected state brightness}}{\text{selected state brightness}}$$

Measuring Conditions:

1) Ambient Temperature: 25 ℃ ; 2) Frame frequency: 105.6Hz

6.2.3 Definition of Response time(see fig. as follow)



Turn-on time: $t_{on}=t_d+t_r$

Turn-off time: $t_{off}=t_d+t_f$

Measuring Condition:

1) Operating Voltage: 4.7V ; 2) Frame frequency: 105.6Hz

7. Reliability

7.1 Content of Reliablity Test (T_{OP}=25℃)

No.	Test Item	Content of Test	Test condition
1	High Temperature Storage	Endurance test applying the high storage temperature for a long time	60℃ 96H
2	Low Temperature Storage	Endurance test applying the low storage temperature for a long time	-20℃ 96H
3	High Temperature Operation	Endurance test applying the electric stress (voltage & current) and the thermal stress to the element for a long time	50℃ 96H
4	Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time	0℃ 96H
5	High Temperature /Humidity Storage	Endurance test applying the high temperature and high humidity storage for a long time	40℃ 90%RH 96H
6	Temperature Cycle	Endurance test applying the low and high temperature cycle -20℃←→25℃←→60℃←→-20℃ 30min 5min 30min 5min ←——————→ 1 cycle	-20℃/60℃ 10 cycles
7	Vibration Test (package state)	Endurance test applying the vibration during transportation	10Hz~150Hz, 50m/s^2, 40min
8	Shock Test (package state)	Endurance test applying the shock during transportation	Half-sinewave, 100m/s^2, 11ms
9	Atmospheric Pressure Test	Endurance test applying the atmospheric pressure during transportation by air	40kPa 16H

7.2 Failure Judgment Criterion

Criterion Item	Test Item No.									Failure Judgement Criterion
	1	2	3	4	5	6	7	8	9	
Basic Specification	0	0	0	0	0	0	0	0	0	Out of the basic Specification
Electrical specification	0	0	0	0	0					Out of the electrical specification
Mechanical Specification							0	0		Out of the mechanical specification
Optical Characteristic	0	0	0	0	0	0			0	Out of the optical specification
Remark	Basic specification = Optical specification + Mechanical specification									

8 Precautions for use of LCD Modules

8.1 Handling Precautions

8.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

8.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

8.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

8.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

8.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

—Isopropyl alcohol

— Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

— Water

—Ketone

—Aromatic solvents

8.1.6 Do not attempt to disassemble the LCD Module.

8.1.7 If the logic circuit power is off, do not apply the input signals.

8.1.8 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environwent.

a. Be sure to ground the body when handling the LCD Modules.

b. Tools required for assembly, such as soldering irons, must be properly ground.

c. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

d. The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

8.2 Storage precautions

8.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

8.2.2 The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

temperature : 0℃ ~ 40℃

relatively humidity: ≤80%

8.2.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.

8.3 The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.