
Product Specifications

Type	:	MS Lithium Rechargeable Battery
Model	:	MS412FE FL26E

This is a "Standard Spec sheet " which is a general documentation for your evaluation.

Before we will start to supply this part to you, we would like you to ask us the formal version of this spec sheet.

We will issue the formal specification sheet for you. (Basically the contents is the same as this one.)

We would like you to put your signature on it to state your approval of the specification, and send it back to us.

It will be a kind of contract between you and us.

Seller: **Seiko Instruments Inc .**

Network Components Business Unit
Micro-Energy Division

Sales Dep.

;

History of Revision

No.	Described by	Details of Change	Checked by	Issue Date
01	QA Sec.. R. Ito	Initial Release for Standard Specifications No. STDE-B-MS0412E-6ATFL26E-0014-1	QA Sec.. H. Ishikawa	Dec. 01, 2007

Manufacturer information

Company name: Seiko Instruments Inc .

Network Components Business Unit

Micro-Energy Division

Address: 45-1, Aza-Matsubara, Kami-ayashi, Aoba-ku, Sendai-shi, Miyagi,
Japan, postal code: 989-3124

Quality Assurance Department

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Appendix

Leakage Criteria
 Construction of Battery
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1. Application

This specification applies to the coin-type MS Lithium Rechargeable Battery, which is manufactured and supplied by Seiko Instruments Inc. to the specified customer in cover page.

2. Model

Model described in cover

3. Chemical System and Structure

Refer to the document "The construction of battery" attached.

4. Nominal Specifications

		Model
No.	Characteristics	MS412FE
4-1	Range of temperature in which it can be operated	from -20°C to 60°C
4-2	Recommended range of preservation temperature and humidity	from 10°C to 30°C 60%RH or less
4-3	Nominal voltage	3V
4-4	Charging voltage	from 2.8V to 3.3V
4-5	Recommended Charging voltage	3.1V
4-6	Maximum Charging Current (mA) At 3V in the battery voltage. At 0V in the battery voltage.	0.15 2
4-7	Nominal capacity(mAh): after charging from 3.1V to 2.0V	1.0
4-8	Remaining Capacity(mAh): At delivery	0.8
4-9	Standard Discharge Current (mAh)	0.01
4-10	Nominal dimensions Diameter(mm) Height(mm)	4.8 1.2
4-11	Standard mass(g)	0.07
4-12	Applicable Safety Standard	UL1642 (File MH15628)

The "Perchlorate Contamination Prevention Act" in California does not apply to this product."

5. Characteristics

* "Initial" means within one month after deliver.

* Attached "Leakage Criteria" is used for the judgment of leakage.

5-1. Electric characteristics

No.	Characteristics	Model	Test Methods	Measuring Methods
		MS412FE		
1	Open Circuit Voltage(V) at delivery		-	6-4
	maximum	3.3		
	minimum	2.5		
2	Open Circuit Voltage(V) after charge		-	6-2 -1) 6-4
	maximum	3.1		
	Minimum	2.8		
3	Initial Capacity(mAh)		-	6-2
	24°C	0.8 or more		
	-20°C	0.3 or more		
	60°C	0.8 or more		
4	Initial Internal impedance(ohm)		-	6-3
	24°C	400 or less		
	-20°C	2500 or less		
	60°C	400 or less		

5-2. Mechanical characteristics

No.	Characteristics	Model	Test Methods	Measuring Methods
		MS412FE		
1	Tab Pulling Strength(N): With the terminal		-	6-8
	-	Refer to Battery Drawing with tabs attached		
2	External Appearance		-	6-9
	Initial	No leakage There must not be foreign body adhesion (over level S2). There is no significant deformation, stain, stricken mark, rust and burr.		
	After Tests	There is no significant leakage (over level C1), deformation, stain, stricken mark, rust and burr.		
3	Free fall	Satisfy initial capacity and internal impedance. There is no significant leakage, deformation, stain, stricken mark, rust and burr, which effect battery performance.	7-9	6-2 6-3 6-9
4	Vibration	Satisfy initial capacity and internal impedance. There is no significant leakage, deformation, stain, stricken mark, rust and burr, which effect battery performance.	7-10	6-2 6-3 6-9

5-3. Reliability

No.	Characteristics	Model	Test Methods	Measuring Methods
		MS412FE		
1	High Temperature Storage Characteristics		7-3	6-2
	Min. Capacity(mAh)	0.6		
3	Low Temperature Storage Characteristics		7-4	6-2
	Min. Capacity(mAh)	0.7		
3	Float Charge Characteristics		7-5	6-2 6-3
	Min. Capacity(mAh)	0.6		
	Max. Internal impedance (ohm)	1200		
4	Over Discharge Characteristics		7-6	6-2
	Min. Capacity(mAh)	0.6		
5	Charge / Discharge Cycle Characteristics (Cycles)			6-2
	20% D.O.D.	500 cycles or more	7-7-1	
	100% D.O.D.	100 cycles or more	7-7-2	
6	Leakage Resistance	level S3 (*1) or less (There is no significant leakage which effect battery performance.)	7-8	6-9

5-4. Table of Parameter for Test and Measuring

No.	Characteristics	Model(Type)	Test Methods	Measuring Methods
		MS412FE		
1	Capacity		-	6-2
	Vc(V)	3.1		
	Rp(kohm)	4.7		
	Tc(hrs)	96		
	Rd(kohm)	330		
	Voff(V)	2.0		
2	Float Charge Characteristics		7-5	
	Vc(V)	3.1		
	Rp(kohm)	4.7		
3	Over Discharge Characteristics		7-6	
	Rs(kohm)	33		
4	Charge / Discharge Cycle(20% D.O.D)		7-7-1	
	Vc(V)	3.1		
	Rp(kohm)	4.7		
	Tcs(hrs)	10		
	Rds(kohm)	100		
	Tds(hours)	6		
5	Charge / Discharge Cycle(100% D.O.D)		7-7-2	
	Vc(V)	3.1		
	Rp(kohm)	4.7		
	Tcd(hrs)	48		
	Rdd(kohm)	100		
	Tdd(hours)	30		

6. Measuring Methods

6-1. General Conditions

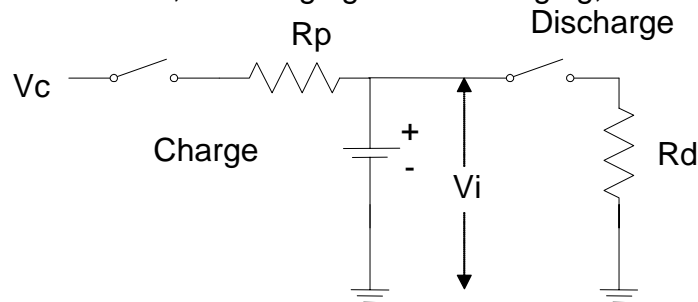
The measuring conditions are temperature of 24+/-2 °C, humidity of 65+/-20%Rh and within one month after delivering, if not specified.

6-2. Capacity

- 1) Charging: Apply specified voltage (V_c) through the protective resistance (R_p) for specified time (T_c).
- 2) Discharging: Discharging with load resistance (R_d) until the cell voltage reaches the cut off voltage (V_{off}), the cell voltage (V_i) and time (T_i) should be measured at intervals within one hour.
- 3) Calculation: The capacity value is calculated by the expression below.

$$Capacity = \sum_i \left(\frac{(V_i + V_{i+1})}{2} \times \frac{1}{R_d} \times (T_{i+1} - T_i) \right)$$

- 4) General Circuit: The circuit, for charging and discharging, is shown as follows.



6-3. Internal Impedance

Measure by alternating current method using frequency of 1KHz.

6-4. Voltage

Use a direct current voltage meter, which has input impedance of 10Mohm or more and accuracy of +/-0.2% or less.

6-5. Current

Use an ammeter with accuracy of +/-0.2% or less.

6-6. Resistance

Resistance, which includes resistance of all external circuits, requires accuracy of 2.0% or less.

6-7. Size measurement

Use the size measurement instruments with accuracy of 0.01mm or 0.001mm if necessary.

6-8. Terminal pull strength: The direction of the pull is vertical.

Use a digital force gauge, which has accuracy of +/-1.0% or less.

6-9. Appearance

- | | |
|-------------|--|
| After Test | : Microscope, which has magnification of 10 times. |
| At delivery | : Naked eye |

7. Test Methods

7-1. General conditions

If not specified, the test conditions are temperature of 24 ± 2 °C, humidity of $65\pm 20\%$ Rh and the test should be started within one month after delivering.

7-2. Temperature Characteristics Test

Measure electrical characteristics after exposing battery to each temperature atmosphere for 2 hours.

Temperature: -20 ± 2 °C, $+24\pm 2$ °C, $+60\pm 2$ °C

7-3. High Temperature Storage

After Charging at voltage of V_c through protective resistance of R_p for T_c hours, store battery at temperature 60 ± 2 °C for 20days.

7-4. Low Temperature Storage

After Charging at voltage of V_c through protective resistance of R_p for T_c hours, store battery at temperature of -40 ± 2 °C for 96 hours.

7-5. Float Charge Characteristics Test

Charge battery at voltage of V_c through protective resistance of R_p at temperature of 60 ± 2 °C for 20days.

7-6. Over Discharge Characteristics Test

Discharge battery by discharge resistance of R_s for 30 days.

7-7. Charge / Discharge Cycle Characteristics Test

7-7-1. Shallow Discharge cycle characteristics (20% Depth of discharge)

Charge : Apply specified voltage (V_c) through protective resistance (R_p) for specified period (T_c).

Discharge : With load resistance (R_d) for specified period (T_d).

Life : Let the time of putting on measurement of 6-2 and becoming 50% of a initial capacity standard value be a life..

7-7-2. Deep Discharge cycle characteristics (100% Depth of discharge)

Charge : Apply specified voltage (V_c) through protective resistance (R_p) for specified period (T_{cd}).

Discharge : With load resistance (R_{dd}), for specified time (T_{dd}) or until the cell voltage reaches 2.0V.

Life : Let the time of putting on measurement of 6-2 and becoming 50% of a initiale capacity standard value be a life..

7-8. Leakage Resistance (Thermal Shock Test: Air to Air)

Hold battery at -10 ± 2 °C for 1 hour then hold it at 60 ± 2 °C for 1 hour.

Repeat 100 cycles between above conditions. (Chamber) Not humidity controlled.

7-9. Free Fall Test

Drop the battery ten times in an arbitrary direction on the board of the oak of 3cm in thickness from the height of 75cm. The tabs of battery should be cut before test.

7-10. Vibration Test

Vibrate the battery in the direction of 3(x, y, z) for 30 minutes by 1000 cycles per minute with an amplitude of 2mm. The tabs of battery should be cut before test.

8. Mounting Conditions

8-1. Battery with tabs

1) For soldering iron

Use the conditions as follows

	Model
	MS412FE
Temperature	260°C or less
Soldering time	Within five seconds

Within above conditions, do not heat battery over 85°C.

Do not solder directly to the battery.

2) Dip soldering

Not applicable

3) Reflow soldering

Not applicable

8-2. Battery without tabs

Use the spring terminal, which meets the specification as follows.

Surface treatment: Nickel plating or Gold plating

Contact force: 0.5N or more

Note contact failure with the terminal because the ink of the insulation thing adheres on the battery side.

9. Indications (Markings)

9-1. Dies

Following items are indicated on battery.

Below items can be omitted except item (2).

(1) Model code

(2) Cathode polarity(+)

(3) Manufacturer's name or monogram

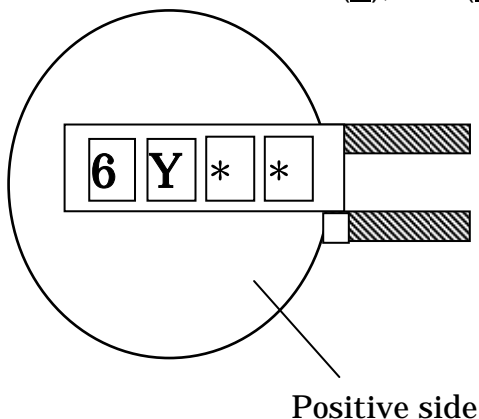
(4) Country of origin

9-2. Date of Manufacturing

Date of Manufacturing is marked on the side of battery (if possible) and label of each packages as.

(Example) 51...manufactured in January 2005
6Y...manufactured in November 2006
70...manufactured in October 2007

Abbreviation of month: Jan.(1), Feb.(2).... Sep.(9), Oct.(0), Nov.(Y), Dec.(Z)



Date of manufacturing is positioned at random.

**is our own number, might be omitted.

Method of marking of manufacturing date is laser type.

10. Inspection (Outgoing and Incoming)

10-1. Lot composition

Lot must be composed within the same manufacturing conditions.

10-2. Outgoing Inspection

Seiko Instruments Inc. shall do outgoing inspection before shipping. The inspection items are as below table. The inspection results shall be submitted by the customer request.

No	Characteristics	Inspection levels	frequency
1	Open circuit voltage	n=6, c=0	per lot
2	Internal impedance	n=6, c=0	per lot
3	Discharge capacity	n=6, c=0	per month
4	Leakage resistance	n=10, c=0	per lot

10-3. Incoming Inspection

The customer should do incoming inspection within 30 days from receiving day.

If defective products are find out at incoming inspection, the customer immediately should notify to Seiko Instruments Inc. in writing with the defective products for replacement request. When there was no contact from you within 30 days, we shall judge that those were accepted.

11. Package Specifications

Examples of the tray for wrapping, wrapping specification, and packing specification are shown in the following as our standard.

11-1. The tray for wrapping

Refer to "Drawing of tray".

11-2. Wrapping and packing

Refer to "Packing specifications (Domestic)" and "Packing specifications (overseas)".

12. In case of quality trouble

The warranties set forth herein are the only warranties on the products.

The liabilities of Seiko Instruments Inc. in connection with the products under these specifications are expressly limited to the replacement of defective products.

13. Operation of this Specification

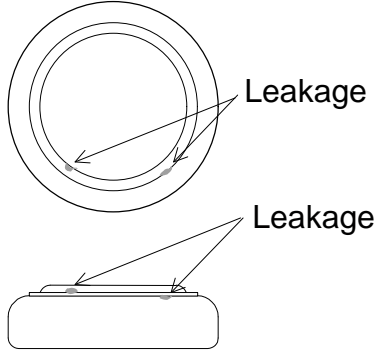
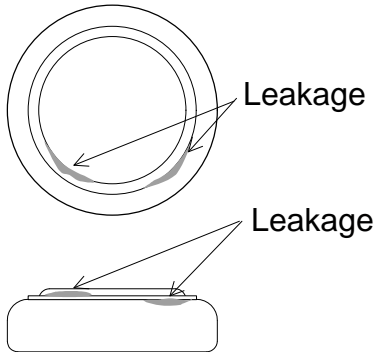
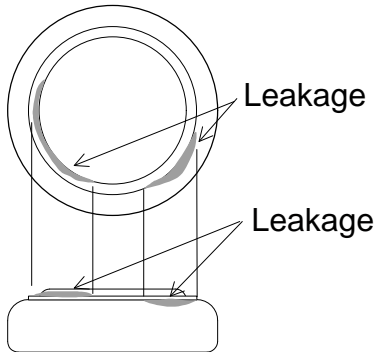
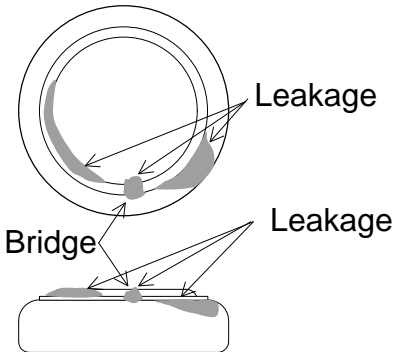
13-1. Agreement

Before these specifications being revised, the agreement, of the customer, seller and manufacturer, is required.

13-2. Negotiation

If some accident not specified on these specifications occurs, the customer, seller and manufacturer must negotiate in order to solve the problem faithfully.

Leakage Criteria

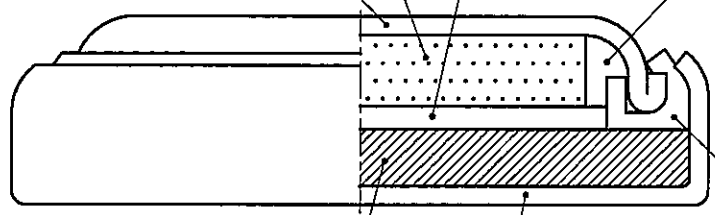
Grade	Criteria	
	Diagram	Definition
S1		<p>The leakage can not be seen by naked eyes, but can be seen by microscope, which have magnification of 10 to 15.</p>
S2		<p>The leakage can be seen by naked eyes. The area of leakage is within half of the round and reaching to neither the flat area of the negative can nor the straight area of the positive can. The leakage is not bridged between the negative can and the positive can.</p>
S3		<p>The area of leakage is from half to all of the round and reaching to neither the flat area of the negative can nor the straight area of the positive can. The leakage is not bridged between the negative can and the positive can.</p>
C1		<p>The area of leakage is reaching to either the flat area of the negative can or the straight area of the positive can. The leakage is bridged between the negative can and the positive can.</p>

②負極 Negative electrode
 (リチウムシリコン複合酸化物
 Lithium-Silicon composite oxide)

③セパレータ Separator

①負極缶 Negative electrode can
 (ニッケルメッキ付ステンレス鋼
 Nickel plated stainless steel)

⑥電解液 Electrolyte
 (有機電解液 Organic electrolyte)



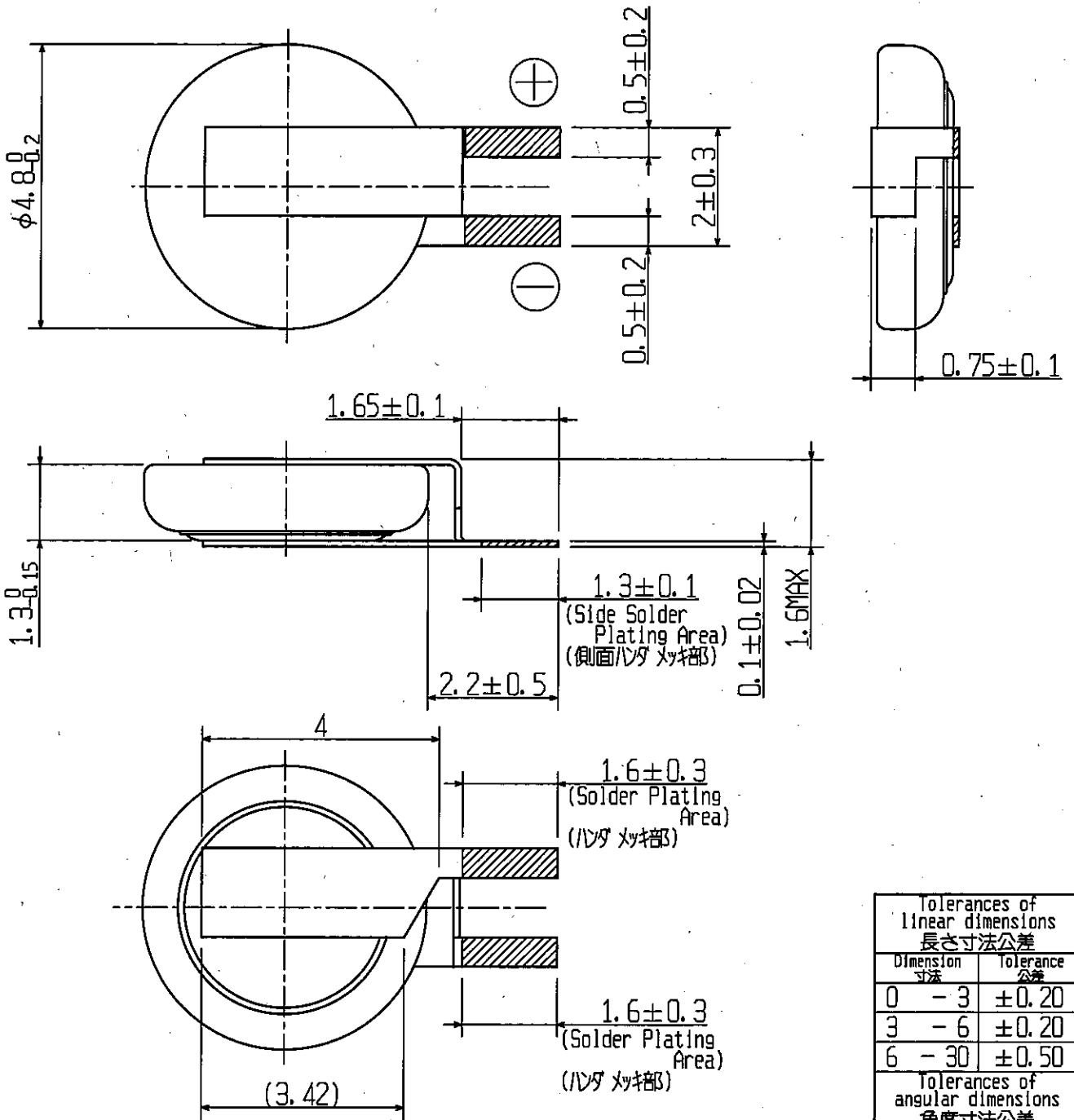
⑤正極 Positive electrode
 (リチウムマンガン複合酸化物
 Lithium-Manganese composite oxide)

④ガスケット Gasket
 (ポリプロピレン Polypropylene)

⑦正極缶 Positive electrode can
 (ニッケルメッキ付ステンレス鋼
 Nickel plated stainless steel)

				File No.	30460000-MSF00-4
				Material	
				Process	
E02B-013	07. Mar. '02	名称、図番変更		Date	05. Jan. '01
	20. Dec. '01	物質名見直し		Name	Construction of battery 電池構成図
	23. Oct. '01	図番変更		Cal. No.	MS***F, MS***S
History	Date	Reason		Drw. No.	3046 MSF00
Approved	Checked	Drawn	Scale		
			Unit	1=1mm	
赤坂	冨塚	尾形	Rev.	4	

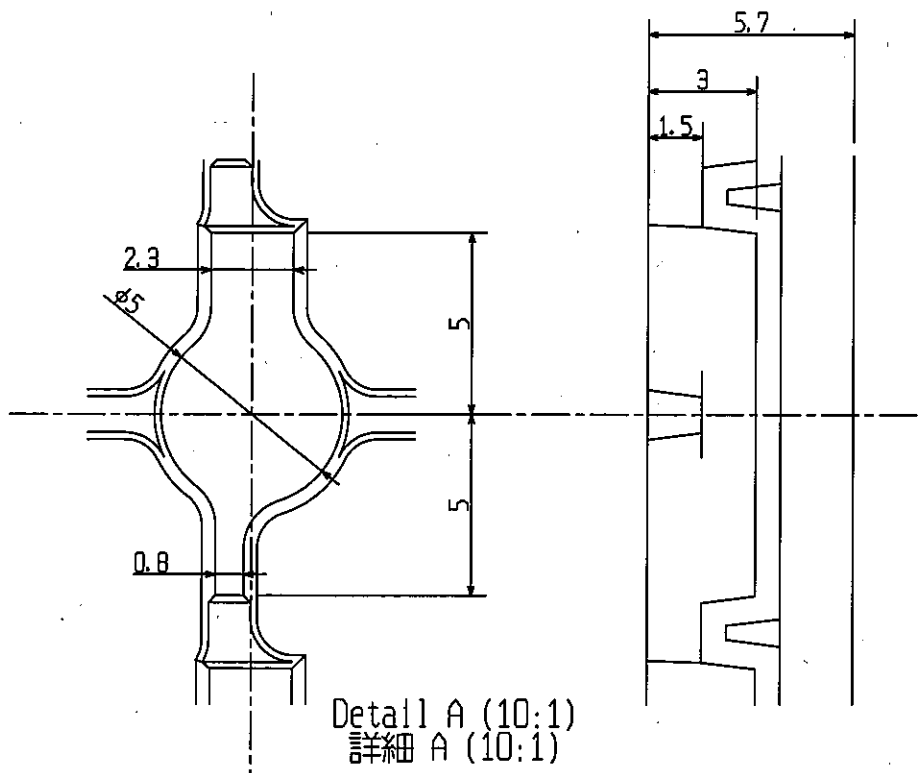
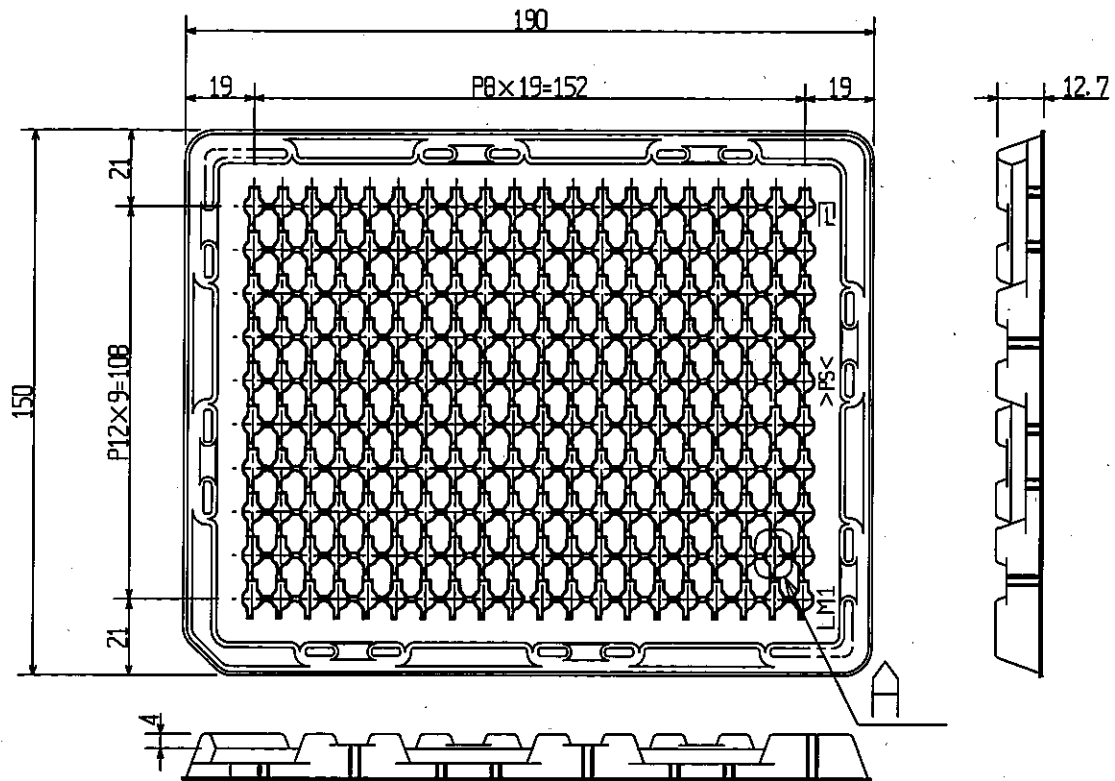
(NOTES) 1. TAB pulling strength : Over 9.8N(1.0kgf)
 (注) 1. 端子引張強度 : 9.8N(1.0kgf) 以上



Tolerances of linear dimensions 長さ寸法公差		
Dimension 寸法		Tolerance 公差
0 - 3		± 0.20
3 - 6		± 0.20
6 - 30		± 0.50
Tolerances of angular dimensions 角度寸法公差		
$\pm 2^\circ$		

					File No. 文件番号	3046E460-FL26E-1	
					Material 材料	TAB: SUS304-NI·P H/2	
					Process 処理	: Solder plating ハンダメッキ $2 \sim 4 \mu\text{m}$ (Sn 100%)	
					Date 日付	Jan. 11. '07	
E07A-003	Jan. 11. '07	設定			Name 名称	Battery drawing with tabs 端子付電池図面	
History 履歴	Date 日付	Reason 理由			Cal. No. 製品番号	MS412FE FL26E	
Approved 承認	Checked 検査	Drawn 製図	Scale 尺度	10:1	Drw. No. 図面番号	E46 FL26E	
富塚	鈴木	三浦	Unit 単位	1=1mm			
					Rev. 改訂	1	

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Tolerances of linear dimensions 長さ寸法公差	
Dimension 寸法	Tolerance 公差
$L \leq 10$	± 0.50
$10 < L < 60$	± 0.80
$60 < L < 100$	± 1.00
$100 \leq L$	± 1.50
Tolerances of angular dimensions 角度寸法公差	
$\pm 2^\circ$	

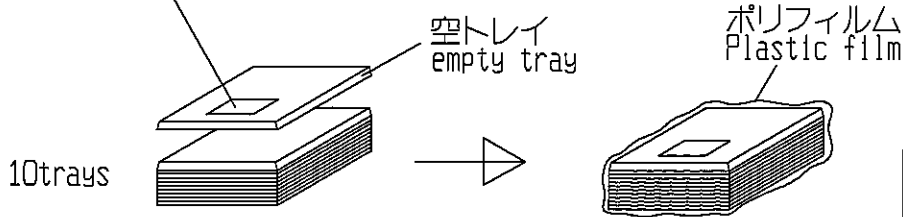
				File No. 文件番号	31760000-LM010A1
				Material 材料	Polystyren ポリスチレン
				Process 処理	
				Date 日付	Oct. 22. '06
E07A-001	Jan. 09. '07	設定		Name 名称	Drawing of tray N/A 図
History 履歴		Date 日付		Reason 理由	
Approved 承認	Checked 検査	Drawn 製図	Scale 尺度	1:2	Cal. No. 製品番号
冨塚	尾形	央戸	Unit 単位	1=1mm	LM1 tray
			Rev. 改訂	1	LM1 N/A
					Drw. No. 図面番号

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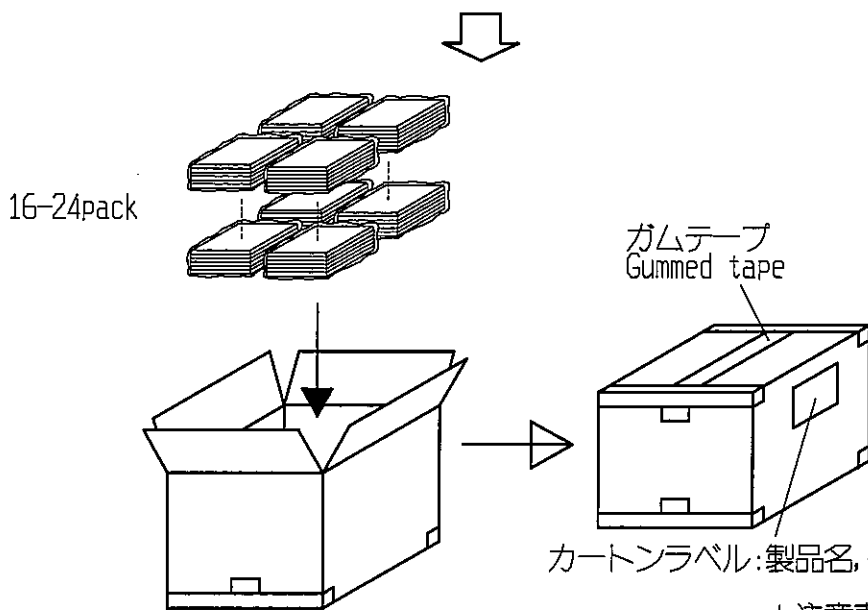
100or200pcs.

100又は200個入り トレイ
100 or 200pcs. in a tray

ラベル: 製品名, ロットNo., 数量, 備考
Label: Model, lot number, quantity, remarks



10トレイ ポリパック
10 trays in plastic film pack



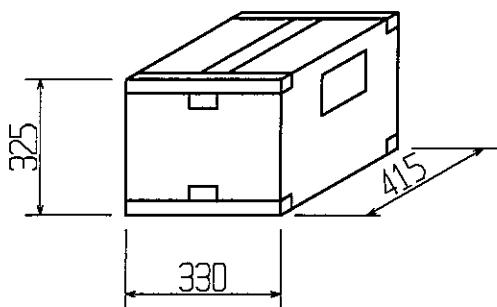
最大48000個入りカートン
Max 48000pcs. in carton

カートンラベル: 製品名, 納入数量, 納入月日, 注番

! 注意表示^{*}(リチウム二次電池在中)等
Carton label: Model, quantity, delivery date,
purchase order number.

! CAUTION^{*}(Lithium rechargeable
Batteries inside)etc.

* 空・海上輸送時のみ
* At the airlift and the ship transportation



梱包外観
Package appearance

上記、梱包形態は標準的なもので、納入時の数量により異なります。
The above packaging specifications are standard.
These specifications vary with the quantity to be supplied.

			File No. 文件番号	31760055-48000-3
E03B-024	4. Aug. '03	カートンラベル注意表示内容変更	Date 日付	24. Jul. '01
E03B-014	24. Apr. '03	カートンラベル注意表示追記変更、図番変更	Name 名称	梱包仕様(国内向け) Package specifications(Domestic)
History履歴	Date 日付	Reason 理由	Cal. No. 製品番号	55-48000pcs
Approved 承認	Checked 検査	Drawn 製図	Scale 尺度	3176 0055
山田	冨塚	尾形	Unit 単位 1=1mm	
			Rev. 改訂 3	Draw. No. 図面番号

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100又は200個入り トレイ
100 or 200 pcs. in a tray

ラベル: 製品名, ロットNo., 数量, 備考
Label: Model, lot number, quantity, remarks

10trays

空トレイ
empty tray

ポリフィルム
Plastic film

10トレイ ポリパック
10 trays in plastic film pack

10-20pack

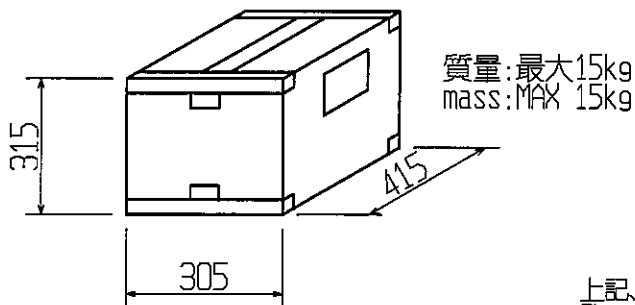
内箱
Inner carton

ガムテープ
Tape

最大20000個入りカートン
Max 20000 pcs. in carton

カートンラベル: 行き先, 原産国, カートンNo.
! 注意表示(リチウム二次電池在中)等
Carton label: Destination, country of origin,
carton number.
! CAUTION(Lithium rechargeable
Batteries inside)etc.

外箱
Outer carton



梱包外観
Package appearance

上記、梱包形態は標準的なもので、納入時の数量により異なります。
The above packaging specifications are standard.
These specifications vary with the quantity to be supplied.

				File No. 文件番号	317600A2-20000-3
E03B-024	4. Aug. '03	カートンラベル注意表示内容変更		Date 日付	05. Feb. '01
E03B-014	24. Apr. '03	カートンラベル注意表示追記、図番変更		Name 名称	梱包仕様(海外向け) Package specifications(overseas)
History 履歴	Date 日付	Reason 理由			
Approved 承認	Checked 検査	Drawn 製図	Scale 尺度	Cal. No. 製品番号	A2-20000pcs
山田	富塚	尾形	Unit 単位	1=1mm	Drw. No. 図面番号
			Rev. 改訂	3	

Seiko Instruments Inc.

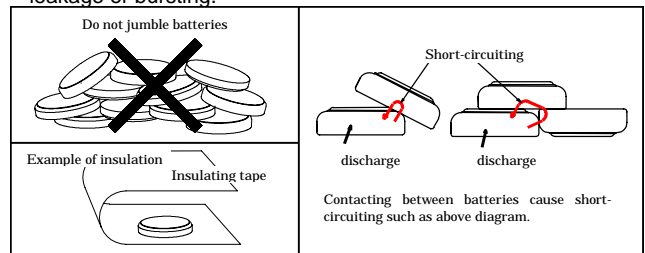
Precautions for Your Safety

SII Lithium rechargeable batteries (ML, MS, HB, TS) contain flammable organic solvents. For your safety, please follow following prohibitions.

WARNING!

1. Do not charge by high current or high voltage.
Doing so may generate gas inside the battery, resulting swelling, catching fire, and heat generation or bursting.
2. Do not heat, disassemble nor dispose of in fire
Doing so damages the insulation materials and may cause catching fire, heat generation, leakage or bursting.
3. Do not solder directly to the battery
If soldering is performed directly to the battery, the battery is heated up, consequently cause leakage, explosion or fire due to overheating from internal short-circuiting.
4. Do not short.
If the (+) and (-) come into contact with metal materials, short-circuiting occurs. As a result, catching fire, heat generation, leakage or bursting.
5. Keep batteries out of children's reach.
If leaked liquid is ingested or a battery is swallowed, consult a physician immediately.
6. Do not reverse placement of (+) and (-)
If the (+) and (-) side of the battery is reverse inserted, it may cause a short-circuiting or over discharge of the battery on some equipment and it may induce overheating, explosion or fire.

7. Do not discharge by force
If the battery is discharged by direct connection to an external power supply etc., voltage of the battery will decline lower than 0 volts (electrical reversal) and will cause the battery case to expand, overheat, leak, explode or burn.
8. In case of leakage or a strange-smell; keep away from fire to prevent ignition of any leaked electrolyte.
9. In case of disposal, insulate between (+) and (-) of battery by an insulating
Jumbling batteries or with other metal materials cause short-circuiting. As a result, catching fire, heat generation, leakage or bursting.



CAUTION!

1. If leaked liquids gets in the eyes, wash them with clean water and consult a physician immediately.
2. Do not use new and used batteries together. Do not use different types of batteries together.
It may cause catching fire, heat generation, leakage or bursting.
3. If you connect two or more batteries in series or parallel, please consult us in advance.
It may cause bursting or catching fire due to unbalanced load or voltage.
4. Do not use nor leave the batteries in direct sunlight

nor in high-temperature areas.

It may cause catching fire, heat generation, leakage or bursting.

5. Do not apply strong pressure to the batteries nor handle roughly.
It may cause catching fire, heat generation, leakage or bursting.
6. Avoid contact with water.
It may cause heat generation.
7. Keep batteries away from direct sunlight, high temperature and humidity.
It may cause heat generation.

For prevention the performance of battery

1. Pay attention to mat or sheet for ESD
Battery with tabs or battery on PCB may short circuit on the mat for ESD. As a result the voltage of cell drops down.
2. Pay attention to soldering by tips
Do not touch the battery by solder chips, in case of soldering another components after equipping battery.
In basically, keep any high temperature process away from battery.

3. Pay attention to material of jig for pick and place
Use nonconductive material of jig for pick and place of batteries, for short-circuit protect. If short circuit of battery is occurred, the voltage of battery drops down quickly but raise gradually.
4. Pay attention to washing and drying
Some detergent or high temperature drying cause deteriorates of battery. If wash batteries, consult us.

International Transportation and Disposal

International Air / Marine / Ground Transportation

Regarding the transport of Lithium battery and Lithium-ion battery, organizations like IATA, ICAO, IMO, DOT have determined transport regulations, based on the United Nations Regulations.

The SII Lithium rechargeable batteries can be transported being not subject to the provisions of dangerous goods, if they meet the following requirements.

- (a) **<Lithium content>**The Lithium content is not more than 1g.
- (b) **<Safety Certification>**Each battery is of a type proved to meet the requirements of each test in the UN Manual of Tests and Criteria, Part 3, sub-section 38.3.
- (c) **<Strong packaging>**Batteries are separated so as to prevent short circuits and are packed in strong packaging.
- (d) **<Caution Label>**Each package must be marked indicating that it contains lithium batteries and that special procedures should be followed in the event that the package is damaged.
- (e) **<Not Restricted Declaration>**Each shipment must be accompanied with a document indicating that the packages contain lithium batteries and that special procedures should be

followed in the event that a package is damaged.

(f) **<Package Drop Test>**Each packages is capable of withstanding a 1.2 m drop test in any orientation without damage to batteries contained.

(g) **<Weight Limit>**Except in the case of packed with equipment, packages may not exceed 30 kg gross mass.

(h) **<Transport to U.S.A>**When you transport to U.S.A., emergency contact information must be indicated on the required documents.

For further information, please consult with us.

Disposal

Recent environmental protection concerns have increased globally and waste and recycling are regulated in the world. The current regulations differ in each country, state and local municipality. Please consult local regulations and authorities for recommended disposal of batteries. If you are in question of application or safety of our batteries, please consult your local authorities.