



SAMXON BRAND ALUMINUM ELECTROLYTIC CAPACITORS

# PRODUCT SPECIFICATION

## 規格書

CUSTOMER :

(客戶) : 志盛翔

DATE :

(日期) : 2023-10-19

CATEGORY (品名) : ALUMINUM ELECTROLYTIC CAPACITORS

DESCRIPTION (型号) : RT 450V47 $\mu$ F( $\phi$ 16X20)

VERSION (版本) : 01

Customer P/N :

SUPPLIER :

### SUPPLIER

PREPARED  
(拟定)

CHECKED  
(审核)

梁文文

付婷婷

### CUSTOMER

APPROVAL  
(批准)

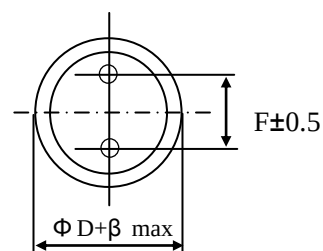
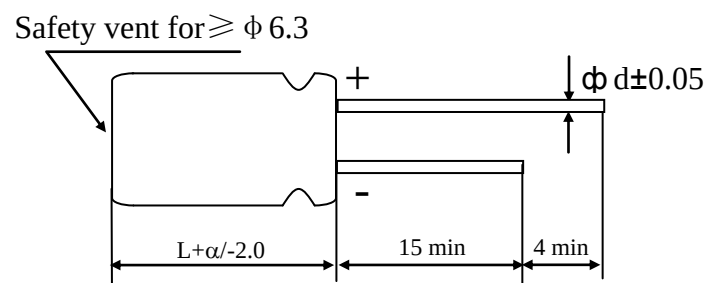
SIGNATURE  
(签名)



|                                        |                                                         |        |
|----------------------------------------|---------------------------------------------------------|--------|
| MAN YUE ELECTRONICS<br>COMPANY LIMITED | ELECTROLYTIC<br>CAPACITOR<br>SPECIFICATION<br>RT SERIES | SAMXON |
|                                        |                                                         |        |

**Table 1 Product Dimensions and Characteristics**

Unit: mm



|          |                                                           |
|----------|-----------------------------------------------------------|
| $\alpha$ | $L < 20 : \alpha = 1.5; L \geq 20 : \alpha = 2.0$         |
| $\beta$  | $\phi D < 20 : \beta = 0.5; \phi D \geq 20 : \beta = 1.0$ |

\* If it is flat rubber, there is no bulge from the flat rubber surface.

Table 1:

| N<br>o. | SAMXON<br>Part No.  | WV<br>(Vdc) | Cap.<br>( $\mu$ F) | Cap<br>tolerance | Temp.<br>range( $^{\circ}$ C) | $\tan \delta$<br>(120Hz,<br>20 $^{\circ}$ C) | Leakage<br>Current<br>( $\mu$ A,2min) | Max Ripple<br>Current at<br>105 $^{\circ}$ C<br>100KHz<br>(mA rms) | ESR<br>at 25 $^{\circ}$ C<br>100kHz<br>( $\Omega$ ) | Load<br>lifetime<br>(Hrs) | Dimension<br>(mm) |     |          | Sleeve |
|---------|---------------------|-------------|--------------------|------------------|-------------------------------|----------------------------------------------|---------------------------------------|--------------------------------------------------------------------|-----------------------------------------------------|---------------------------|-------------------|-----|----------|--------|
|         |                     |             |                    |                  |                               |                                              |                                       |                                                                    |                                                     |                           | D×L               | F   | $\phi d$ |        |
| 1       | ERT476M2WK20RR**A1R | 450         | 47                 | -20%~+20%        | -25~105                       | 0.20                                         | 448                                   | 1019                                                               | 1.5                                                 | 5000                      | 16X20             | 7.5 | 0.8      | PET    |

开阀电压  $\geq 610V$

|         |    |  |      |   |
|---------|----|--|------|---|
| Version | 01 |  | Page | 2 |
|---------|----|--|------|---|

| C O N T E N T S |                                                                                     | Sheet |
|-----------------|-------------------------------------------------------------------------------------|-------|
| 1.              | Application                                                                         | 4     |
| 2.              | Part Number System                                                                  | 4     |
| 3.              | Construction                                                                        | 5     |
| 4.              | Characteristics                                                                     | 5~10  |
| 4.1             | Rated voltage & Surge voltage                                                       |       |
| 4.2             | Capacitance (Tolerance)                                                             |       |
| 4.3             | Leakage current                                                                     |       |
| 4.4             | tan $\delta$                                                                        |       |
| 4.5             | Terminal strength                                                                   |       |
| 4.6             | Temperature characteristic                                                          |       |
| 4.7             | Load life test                                                                      |       |
| 4.8             | Shelf life test                                                                     |       |
| 4.9             | Surge test                                                                          |       |
| 4.10            | Vibration                                                                           |       |
| 4.11            | Solderability test                                                                  |       |
| 4.12            | Resistance to solder heat                                                           |       |
| 4.13            | Change of temperature                                                               |       |
| 4.14            | Damp heat test                                                                      |       |
| 4.15            | Vent test                                                                           |       |
| 4.16            | Maximum permissible (ripple current)                                                |       |
| 5.              | List of “Environment-related Substances to be Controlled (‘Controlled Substances’)” | 11    |
|                 | Attachment: Application Guidelines                                                  | 12~15 |

## 1. Application

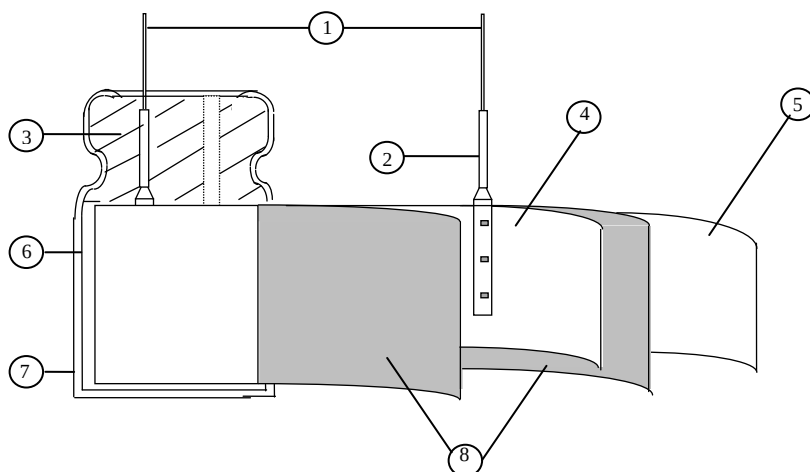
This specification applies to polar Aluminum electrolytic capacitor (foil type) used in electronic equipment. Designed capacitor's quality meets IEC60384.

## 2. Part Number System

| 1 2 3  |          |      | 4 5 6                                                                     |      |              | 7         | 8 9         |      | 10 11 12    |                 |                                                                                      | 13 14 |             | 15 16               |    | 17              |      |
|--------|----------|------|---------------------------------------------------------------------------|------|--------------|-----------|-------------|------|-------------|-----------------|--------------------------------------------------------------------------------------|-------|-------------|---------------------|----|-----------------|------|
| E G S  |          |      | 1 0 5                                                                     |      |              | M         | 1 H         |      | D 1 1       |                 |                                                                                      | T C   |             | S A                 |    | P               |      |
| SERIES |          |      | CAPACITANCE                                                               |      |              | TOLERANCE | VOLTAGE     |      | CASE SIZE   |                 |                                                                                      | TYPE  |             | SAMXON PRODUCT LINE |    | SLEEVE MATERIAL |      |
| Series | Cap (uF) | Code | Tol. (%)                                                                  | Code | Vol. (W.V.)  | Code      | Case Size   |      | Feature     | Code            | SAMXON Product Line                                                                  |       |             |                     |    |                 |      |
| EKF    | 0.1      | 104  | ±5                                                                        | J    | 2            | 0D        | Diameter(±) | Code | Radial bulk | RR              | For Internal use only<br>(The product lines we have H,A,B,C,D,E,M or 0,1,2,3,4,5,9). |       |             |                     |    |                 |      |
| EKS    |          |      |                                                                           |      | 0.22         | 224       | ±10         | K    | 2.5         | 0E              | 3                                                                                    | B     | Ammo Taping | 2.0mm Pitch         | TT | Sleeve Material | Code |
| EGS    |          |      |                                                                           |      |              |           |             |      | 3.5         | 1               | PET                                                                                  | P     |             |                     |    |                 |      |
| EKM    | 4        | C    | If this sleeve material is PVC, there will be blank in seventeenth digit. |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EKG    | 5        | D    |                                                                           |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| ECM    | 6.3      | E    |                                                                           |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGF    | 8        | F    |                                                                           |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| ESF    | 0.33     | 334  |                                                                           | ±15  | L            | 8         | 0K          | 10   | G           | Lead Cut & Form | CB-Type                                                                              | CB    |             |                     |    |                 |      |
| EGT    |          |      | 10                                                                        |      |              | 1A        | 2.5mm Pitch | TU   |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGH    |          |      | 12.5                                                                      |      |              | 1B        |             |      | 3.5mm Pitch |                 |                                                                                      |       | TV          |                     |    |                 |      |
| EGI    | 16       | 1C   | 5.0mm Pitch                                                               | TC   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGJ    | 20       | 1D   |                                                                           |      | CE-Type      | CE        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGK    | 25       | 1E   |                                                                           |      |              |           |             |      |             | HE-Type         | HE                                                                                   |       |             |                     |    |                 |      |
| EGL    | 30       | 1I   |                                                                           |      |              |           | KD-Type     | KD   |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGM    | 32       | 13   |                                                                           |      |              |           |             |      | FD-Type     |                 |                                                                                      | FD    |             |                     |    |                 |      |
| EGN    | 35       | 1V   | EH-Type                                                                   | EH   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGO    | 40       | 1G   |                                                                           |      | PCB Terminal | Snap-In   |             |      |             |                 |                                                                                      |       | SW          |                     |    |                 |      |
| EGP    | 42       | 1M   |                                                                           |      |              |           |             |      |             | 5X              |                                                                                      |       |             |                     |    |                 |      |
| EGQ    | 50       | 1H   |                                                                           |      |              |           | SZ          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGR    | 57       | 1L   |                                                                           |      |              |           |             | Lug  | SG          |                 |                                                                                      |       |             |                     |    |                 |      |
| EGS    | 63       | 1J   | Screw                                                                     | O5   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGT    | 71       | 15   |                                                                           |      | O6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGU    | 75       | 1T   |                                                                           |      |              | T5        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGV    | 80       | 1K   |                                                                           |      |              |           | T6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGW    | 85       | 1R   |                                                                           |      |              |           |             | D5   |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGX    | 90       | 19   | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGY    | 100      | 2A   |                                                                           | D5   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGZ    | 120      | 2O   |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGA    | 125      | 2B   |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGB    | 150      | 2Z   |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGC    | 160      | 2C   | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGD    | 180      | 2P   |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGE    | 200      | 2D   |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGF    | 215      | 22   |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGG    | 220      | 2N   |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGH    | 230      | 23   | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGI    | 250      | 2E   |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGJ    | 275      | 2T   |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGK    | 300      | 2I   |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGL    | 310      | 2R   |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGM    | 315      | 2F   | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGN    | 330      | 2U   |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGO    | 350      | 2V   |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGP    | 360      | 2X   |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGQ    | 375      | 2Q   |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGR    | 385      | 2Y   | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGS    | 400      | 2G   |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGT    | 420      | 2M   |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGU    | 450      | 2W   |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGV    | 500      | 2H   |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGW    | 550      | 25   | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGX    | 600      | 26   |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGY    | 630      | 2J   |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGZ    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGA    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGB    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGC    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGD    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGE    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGF    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGG    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGH    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGI    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGJ    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGK    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGL    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGM    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGN    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGO    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGP    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGQ    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGR    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGS    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGT    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGU    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGV    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGW    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGX    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGY    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGZ    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGA    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGB    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGC    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGD    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGE    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGF    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGG    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGH    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGI    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGJ    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGK    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGL    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGM    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGN    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGO    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGP    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGQ    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGR    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGS    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGT    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGU    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGV    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGW    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGX    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGY    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGZ    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGA    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGB    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGC    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGD    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGE    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGF    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGG    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGH    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGI    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGJ    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGK    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGL    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGM    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGN    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGO    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGP    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGQ    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGR    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGS    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGT    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGU    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGV    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGW    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGX    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGY    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGZ    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGA    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGB    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGC    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGD    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGE    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGF    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGG    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGH    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGI    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGJ    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGK    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGL    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGM    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGN    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGO    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGP    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGQ    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGR    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGS    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGT    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGU    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGV    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGW    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGX    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGY    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGZ    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGA    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGB    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGC    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGD    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGE    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGF    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGG    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGH    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGI    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGJ    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGK    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGL    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGM    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGN    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGO    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGP    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGQ    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGR    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGS    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGT    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGU    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGV    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGW    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGX    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGY    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGZ    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGA    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGB    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGC    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGD    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGE    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGF    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGG    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGH    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGI    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGJ    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGK    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGL    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGM    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGN    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGO    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGP    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGQ    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGR    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGS    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGT    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGU    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGV    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGW    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGX    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGY    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGZ    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGA    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGB    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGC    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGD    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGE    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGF    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGG    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGH    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGI    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGJ    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGK    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGL    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGM    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGN    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGO    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGP    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGQ    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGR    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGS    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGT    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGU    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGV    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGW    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGX    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGY    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGZ    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGA    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGB    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGC    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGD    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGE    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGF    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGG    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGH    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGI    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGJ    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGK    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGL    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGM    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGN    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGO    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGP    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGQ    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGR    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGS    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGT    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGU    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGV    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGW    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGX    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGY    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGZ    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGA    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGB    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGC    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGD    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGE    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGF    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGG    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGH    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGI    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGJ    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGK    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGL    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGM    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGN    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGO    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGP    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGQ    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGR    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGS    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGT    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGU    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGV    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGW    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGX    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGY    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGZ    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGA    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGB    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGC    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGD    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGE    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGF    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGG    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGH    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGI    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGJ    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGK    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGL    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGM    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGN    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGO    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGP    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGQ    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGR    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGS    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGT    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGU    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGV    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGW    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGX    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGY    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGZ    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGA    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGB    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGC    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGD    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGE    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGF    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGG    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGH    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGI    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGJ    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGK    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGL    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGM    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGN    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGO    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGP    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGQ    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGR    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGS    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGT    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGU    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGV    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGW    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGX    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGY    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGZ    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGA    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGB    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGC    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGD    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGE    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGF    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGG    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGH    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGI    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGJ    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGK    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGL    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGM    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGN    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGO    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGP    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGQ    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGR    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGS    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGT    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGU    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGV    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGW    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGX    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGY    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGZ    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGA    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGB    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGC    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGD    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGE    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGF    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGG    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGH    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGI    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGJ    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGK    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGL    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGM    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGN    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGO    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGP    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGQ    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGR    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGS    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGT    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGU    |          |      |                                                                           | D6   |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGV    |          |      |                                                                           |      | D6           |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGW    |          |      |                                                                           |      |              | D6        |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGX    |          |      |                                                                           |      |              |           | D6          |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGY    |          |      | D6                                                                        |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |
| EGZ    |          |      |                                                                           |      |              |           |             |      |             |                 |                                                                                      |       |             |                     |    |                 |      |

### 3. Construction

Single ended type to be produced to fix the terminals to anode and cathode foil, and wind together with paper, and then wound element to be impregnated with electrolyte will be enclosed in an aluminum case. Finally sealed up tightly with end seal rubber, then finished by putting on the vinyl sleeve.



| No | Component        | Material                                     |
|----|------------------|----------------------------------------------|
| 1  | Lead line        | Tinned CP wire (Pb Free)                     |
| 2  | Terminal         | Aluminum wire                                |
| 3  | Sealing Material | Rubber                                       |
| 4  | Al-Foil (+)      | Formed aluminum foil                         |
| 5  | Al-Foil (-)      | Etched aluminum foil or formed aluminum foil |
| 6  | Case             | Aluminum case                                |
| 7  | Sleeve           | PET                                          |
| 8  | Separator        | Electrolyte paper                            |

### 4. Characteristics

#### Standard atmospheric conditions

Unless otherwise specified, the standard range of atmospheric conditions for making measurements and tests are as follows:

|                     |                   |
|---------------------|-------------------|
| Ambient temperature | : 15°C to 35°C    |
| Relative humidity   | : 45% to 85%      |
| Air Pressure        | : 86kPa to 106kPa |

If there is any doubt about the results, measurement shall be made within the following conditions:

|                     |                   |
|---------------------|-------------------|
| Ambient temperature | : 20°C ± 2°C      |
| Relative humidity   | : 60% to 70%      |
| Air Pressure        | : 86kPa to 106kPa |

#### Operating temperature range

The ambient temperature range at which the capacitor can be operated continuously at rated voltage  
See table 1 temperature range.

As to the detailed information, please refer to table 2.

|                                        |                                                         |        |
|----------------------------------------|---------------------------------------------------------|--------|
| MAN YUE ELECTRONICS<br>COMPANY LIMITED | ELECTROLYTIC<br>CAPACITOR<br>SPECIFICATION<br>RT SERIES | SAMXON |
|                                        |                                                         |        |

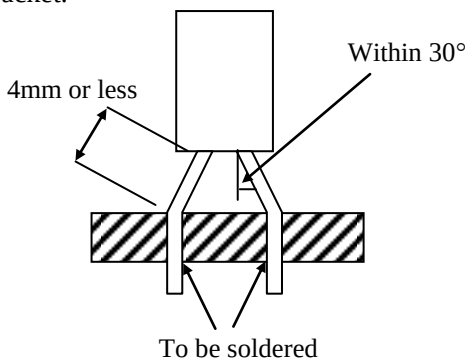
Table 2

| ITEM                  |                                 | PERFORMANCE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |  |  |  |  |  |  |                       |                       |                       |                |          |            |                     |          |          |           |     |     |     |     |     |     |     |     |
|-----------------------|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|--|-----------------------|-----------------------|-----------------------|----------------|----------|------------|---------------------|----------|----------|-----------|-----|-----|-----|-----|-----|-----|-----|-----|
| 4.1                   | Rated voltage (WV)              | <table><tr><td>WV (V.DC)</td><td>160</td><td>200</td><td>220</td><td>250</td><td>350</td><td>400</td><td>420</td><td>450</td></tr><tr><td>SV (V.DC)</td><td>200</td><td>250</td><td>270</td><td>300</td><td>400</td><td>450</td><td>470</td><td>500</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |  |  |  |  |  |  | WV (V.DC)             | 160                   | 200                   | 220            | 250      | 350        | 400                 | 420      | 450      | SV (V.DC) | 200 | 250 | 270 | 300 | 400 | 450 | 470 | 500 |
|                       | WV (V.DC)                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |  |  |  |  |  |  | 160                   | 200                   | 220                   | 250            | 350      | 400        | 420                 | 450      |          |           |     |     |     |     |     |     |     |     |
|                       | SV (V.DC)                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |  |  |  |  |  |  | 200                   | 250                   | 270                   | 300            | 400      | 450        | 470                 | 500      |          |           |     |     |     |     |     |     |     |     |
| Surge voltage (SV)    |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |  |  |  |  |  |  |                       |                       |                       |                |          |            |                     |          |          |           |     |     |     |     |     |     |     |     |
| 4.2                   | Nominal capacitance (Tolerance) | <p>&lt;Condition&gt;<br/>Measuring Frequency : 120Hz ± 12Hz<br/>Measuring Voltage : Not more than 0.5Vrms<br/>Measuring Temperature : 20 ± 2℃</p> <p>&lt;Criteria&gt;<br/>Shall be within the specified capacitance tolerance.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |  |  |  |  |  |  |                       |                       |                       |                |          |            |                     |          |          |           |     |     |     |     |     |     |     |     |
| 4.3                   | Leakage current                 | <p>&lt;Condition&gt;<br/>Connecting the capacitor with a protective resistor (1k Ω ± 10 Ω) in series for 2 minutes, and then, measure Leakage Current.</p> <p>&lt;Criteria&gt;<br/>Refer to Table 1</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |  |  |  |  |  |  |                       |                       |                       |                |          |            |                     |          |          |           |     |     |     |     |     |     |     |     |
| 4.4                   | tan δ                           | <p>&lt;Condition&gt;<br/>See 4.2, Norm Capacitance, for measuring frequency, voltage and temperature.</p> <p>&lt;Criteria&gt;<br/>Refer to Table 1</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |  |  |  |  |  |  |                       |                       |                       |                |          |            |                     |          |          |           |     |     |     |     |     |     |     |     |
| 4.5                   | Terminal strength               | <p>&lt;Condition&gt;<br/>Tensile Strength of Terminals<br/>Fixed the capacitor, applied force to the terminal in lead out direction for 10 ± 1 seconds.<br/>Bending Strength of Terminals.<br/>Fixed the capacitor, applied force to bent the terminal (1~4 mm from the rubber) for 90° within 2~3 seconds, and then bent it for 90° to its original position within 2~3 seconds.</p> <table><tr><td>Diameter of lead wire</td><td>Tensile force N (kgf)</td><td>Bending force N (kgf)</td></tr><tr><td>0.5mm and less</td><td>5 (0.51)</td><td>2.5 (0.25)</td></tr><tr><td>Over 0.5mm to 0.8mm</td><td>10 (1.0)</td><td>5 (0.51)</td></tr></table> <p>&lt;Criteria&gt;<br/>No noticeable changes shall be found, no breakage or looseness at the terminal.</p> |  |  |  |  |  |  |  | Diameter of lead wire | Tensile force N (kgf) | Bending force N (kgf) | 0.5mm and less | 5 (0.51) | 2.5 (0.25) | Over 0.5mm to 0.8mm | 10 (1.0) | 5 (0.51) |           |     |     |     |     |     |     |     |     |
| Diameter of lead wire | Tensile force N (kgf)           | Bending force N (kgf)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |  |  |  |  |  |  |                       |                       |                       |                |          |            |                     |          |          |           |     |     |     |     |     |     |     |     |
| 0.5mm and less        | 5 (0.51)                        | 2.5 (0.25)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |  |  |  |  |  |  |                       |                       |                       |                |          |            |                     |          |          |           |     |     |     |     |     |     |     |     |
| Over 0.5mm to 0.8mm   | 10 (1.0)                        | 5 (0.51)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |  |  |  |  |  |  |                       |                       |                       |                |          |            |                     |          |          |           |     |     |     |     |     |     |     |     |

| 4.6                 | Temperature characteristics                | <p><b>&lt;Condition&gt;</b></p> <table><tr><th>STEP</th><th>Testing Temperature(°C)</th><th>Time</th></tr><tr><td>1</td><td>20±2</td><td>Time to reach thermal equilibrium</td></tr><tr><td>2</td><td>-40(-25) ±3</td><td>Time to reach thermal equilibrium</td></tr><tr><td>3</td><td>20±2</td><td>Time to reach thermal equilibrium</td></tr><tr><td>4</td><td>105±2</td><td>Time to reach thermal equilibrium</td></tr><tr><td>5</td><td>20±2</td><td>Time to reach thermal equilibrium</td></tr></table> <p><b>&lt;Criteria&gt;</b></p> <p>a. In step 4, <math>\tan \delta</math> shall be within the limit of Item 4.4The leakage current measured shall not more than 8 times of its specified value.</p> <p>b. In step 5, <math>\tan \delta</math> shall be within the limit of Item 4.4The leakage current shall not more than the specified value.</p> <p>c. In step 2, At-40°C (-25°C), impedance (z) ratio shall not exceed the value of the following table.</p> <table><tr><th>Working Voltage (V)</th><td>160</td><td>200</td><td>250</td><td>350</td><td>400</td><td>450</td></tr><tr><th>Z-25°C/Z+20°C</th><td>3</td><td>3</td><td>3</td><td>5</td><td>5</td><td>6</td></tr></table> <p>For capacitance value &gt; 1000 μ F, Add 0.5 per another 1000 μ F for Z-25/Z+20°C,<br/>Add 1.0 per another 1000 μ F for Z-40°C/Z+20°C.</p> <p>Capacitance, <math>\tan \delta</math> , and impedance shall be measured at 120Hz.</p> | STEP            | Testing Temperature(°C)         | Time               | 1                             | 20±2          | Time to reach thermal equilibrium          | 2          | -40(-25) ±3                               | Time to reach thermal equilibrium | 3 | 20±2 | Time to reach thermal equilibrium | 4 | 105±2 | Time to reach thermal equilibrium | 5 | 20±2 | Time to reach thermal equilibrium | Working Voltage (V) | 160 | 200 | 250 | 350 | 400 | 450 | Z-25°C/Z+20°C | 3 | 3 | 3 | 5 | 5 | 6 |
|---------------------|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------------------------------|--------------------|-------------------------------|---------------|--------------------------------------------|------------|-------------------------------------------|-----------------------------------|---|------|-----------------------------------|---|-------|-----------------------------------|---|------|-----------------------------------|---------------------|-----|-----|-----|-----|-----|-----|---------------|---|---|---|---|---|---|
| STEP                | Testing Temperature(°C)                    | Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                 |                                 |                    |                               |               |                                            |            |                                           |                                   |   |      |                                   |   |       |                                   |   |      |                                   |                     |     |     |     |     |     |     |               |   |   |   |   |   |   |
| 1                   | 20±2                                       | Time to reach thermal equilibrium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |                                 |                    |                               |               |                                            |            |                                           |                                   |   |      |                                   |   |       |                                   |   |      |                                   |                     |     |     |     |     |     |     |               |   |   |   |   |   |   |
| 2                   | -40(-25) ±3                                | Time to reach thermal equilibrium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |                                 |                    |                               |               |                                            |            |                                           |                                   |   |      |                                   |   |       |                                   |   |      |                                   |                     |     |     |     |     |     |     |               |   |   |   |   |   |   |
| 3                   | 20±2                                       | Time to reach thermal equilibrium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |                                 |                    |                               |               |                                            |            |                                           |                                   |   |      |                                   |   |       |                                   |   |      |                                   |                     |     |     |     |     |     |     |               |   |   |   |   |   |   |
| 4                   | 105±2                                      | Time to reach thermal equilibrium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |                                 |                    |                               |               |                                            |            |                                           |                                   |   |      |                                   |   |       |                                   |   |      |                                   |                     |     |     |     |     |     |     |               |   |   |   |   |   |   |
| 5                   | 20±2                                       | Time to reach thermal equilibrium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |                                 |                    |                               |               |                                            |            |                                           |                                   |   |      |                                   |   |       |                                   |   |      |                                   |                     |     |     |     |     |     |     |               |   |   |   |   |   |   |
| Working Voltage (V) | 160                                        | 200                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 250             | 350                             | 400                | 450                           |               |                                            |            |                                           |                                   |   |      |                                   |   |       |                                   |   |      |                                   |                     |     |     |     |     |     |     |               |   |   |   |   |   |   |
| Z-25°C/Z+20°C       | 3                                          | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 3               | 5                               | 5                  | 6                             |               |                                            |            |                                           |                                   |   |      |                                   |   |       |                                   |   |      |                                   |                     |     |     |     |     |     |     |               |   |   |   |   |   |   |
| 4.7                 | Load life test                             | <p><b>&lt;Condition&gt;</b></p> <p>According to IEC60384-4No.4.13 methods, The capacitor is stored at a temperature of 105 °C ±2 with DC bias voltage plus the rated ripple current for Table 1 load life time hours. (The sum of DC and ripple peak voltage shall not exceed the rated working voltage) Then the product should be tested after 16 hours recovering time at atmospheric conditions. The result should meet the following table:</p> <p><b>&lt;Criteria&gt;</b></p> <p>The characteristic shall meet the following requirements.</p> <table><tr><td>Leakage current</td><td>Value in 4.3 shall be satisfied</td></tr><tr><td>Capacitance Change</td><td>Within ±20% of initial value.</td></tr><tr><td><math>\tan \delta</math></td><td>Not more than 200% of the specified value.</td></tr><tr><td>Appearance</td><td>There shall be no leakage of electrolyte.</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Leakage current | Value in 4.3 shall be satisfied | Capacitance Change | Within ±20% of initial value. | $\tan \delta$ | Not more than 200% of the specified value. | Appearance | There shall be no leakage of electrolyte. |                                   |   |      |                                   |   |       |                                   |   |      |                                   |                     |     |     |     |     |     |     |               |   |   |   |   |   |   |
| Leakage current     | Value in 4.3 shall be satisfied            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                 |                    |                               |               |                                            |            |                                           |                                   |   |      |                                   |   |       |                                   |   |      |                                   |                     |     |     |     |     |     |     |               |   |   |   |   |   |   |
| Capacitance Change  | Within ±20% of initial value.              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                 |                    |                               |               |                                            |            |                                           |                                   |   |      |                                   |   |       |                                   |   |      |                                   |                     |     |     |     |     |     |     |               |   |   |   |   |   |   |
| $\tan \delta$       | Not more than 200% of the specified value. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                 |                    |                               |               |                                            |            |                                           |                                   |   |      |                                   |   |       |                                   |   |      |                                   |                     |     |     |     |     |     |     |               |   |   |   |   |   |   |
| Appearance          | There shall be no leakage of electrolyte.  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                 |                    |                               |               |                                            |            |                                           |                                   |   |      |                                   |   |       |                                   |   |      |                                   |                     |     |     |     |     |     |     |               |   |   |   |   |   |   |
| 4.8                 | Shelf life test                            | <p><b>&lt;Condition&gt;</b></p> <p>The capacitors are then stored with no voltage applied at a temperature of 105±2°C for 1000+48/0 hours. Following this period the capacitors shall be removed from the test chamber and be allowed to stabilized at room temperature for 4~8 hours. Next they shall be connected to a series limiting resistor(1k±100 Ω ) with D.C. rated voltage applied for 30min. After which the capacitors shall be discharged, and then, tested the characteristics.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |                                 |                    |                               |               |                                            |            |                                           |                                   |   |      |                                   |   |       |                                   |   |      |                                   |                     |     |     |     |     |     |     |               |   |   |   |   |   |   |



|                                        |                                                         |        |
|----------------------------------------|---------------------------------------------------------|--------|
| MAN YUE ELECTRONICS<br>COMPANY LIMITED | ELECTROLYTIC<br>CAPACITOR<br>SPECIFICATION<br>RT SERIES | SAMXON |
|                                        |                                                         |        |

|                    |                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |                                                                                               |                    |                                                                                                                        |               |                                           |            |                                           |
|--------------------|------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-----------------------------------------------------------------------------------------------|--------------------|------------------------------------------------------------------------------------------------------------------------|---------------|-------------------------------------------|------------|-------------------------------------------|
| 4.8                | Shelf<br>life<br>test                                                                                                  | <p><b>&lt;Criteria&gt;</b><br/>The characteristic shall meet the following requirements.</p> <table><tr><td>Leakage current</td><td>Value in 4.3 shall be satisfied</td></tr><tr><td>Capacitance Change</td><td>Within <math>\pm 20\%</math> of initial value.</td></tr><tr><td><math>\tan \delta</math></td><td>Not more than 200%of the specified value.</td></tr><tr><td>Appearance</td><td>There shall be no leakage of electrolyte.</td></tr></table> <p>Remark: If the capacitors are stored more than 1 year, the leakage current may increase. Please apply voltage through about 1 k<math>\Omega</math> resistor, if necessary.</p>                                                                                                                                                                                                                                                                                                               | Leakage current    | Value in 4.3 shall be satisfied                                                               | Capacitance Change | Within $\pm 20\%$ of initial value.                                                                                    | $\tan \delta$ | Not more than 200%of the specified value. | Appearance | There shall be no leakage of electrolyte. |
| Leakage current    | Value in 4.3 shall be satisfied                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |                                                                                               |                    |                                                                                                                        |               |                                           |            |                                           |
| Capacitance Change | Within $\pm 20\%$ of initial value.                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |                                                                                               |                    |                                                                                                                        |               |                                           |            |                                           |
| $\tan \delta$      | Not more than 200%of the specified value.                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |                                                                                               |                    |                                                                                                                        |               |                                           |            |                                           |
| Appearance         | There shall be no leakage of electrolyte.                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |                                                                                               |                    |                                                                                                                        |               |                                           |            |                                           |
| 4.9                | Surge<br>test                                                                                                          | <p><b>&lt;Condition&gt;</b><br/>Applied a surge voltage to the capacitor connected with a <math>(100 \pm 50)/C_R</math> (k<math>\Omega</math>) resistor.<br/>The capacitor shall be submitted to 1000 cycles, each consisting of charge of 30 <math>\pm 5</math>s, followed discharge of 5 min 30s.<br/>The test temperature shall be 15~35°C.<br/><math>C_R</math> :Nominal Capacitance ( <math>\mu</math> F)</p> <p><b>&lt;Criteria&gt;</b></p> <table><tr><td>Leakage current</td><td>Not more than the specified value.</td></tr><tr><td>Capacitance Change</td><td>Within <math>\pm 15\%</math> of initial value.</td></tr><tr><td><math>\tan \delta</math></td><td>Not more than the specified value.</td></tr><tr><td>Appearance</td><td>There shall be no leakage of electrolyte.</td></tr></table> <p>Attention:<br/>This test simulates over voltage at abnormal situation only. It is not applicable to such over voltage as often applied.</p> | Leakage current    | Not more than the specified value.                                                            | Capacitance Change | Within $\pm 15\%$ of initial value.                                                                                    | $\tan \delta$ | Not more than the specified value.        | Appearance | There shall be no leakage of electrolyte. |
| Leakage current    | Not more than the specified value.                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |                                                                                               |                    |                                                                                                                        |               |                                           |            |                                           |
| Capacitance Change | Within $\pm 15\%$ of initial value.                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |                                                                                               |                    |                                                                                                                        |               |                                           |            |                                           |
| $\tan \delta$      | Not more than the specified value.                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |                                                                                               |                    |                                                                                                                        |               |                                           |            |                                           |
| Appearance         | There shall be no leakage of electrolyte.                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |                                                                                               |                    |                                                                                                                        |               |                                           |            |                                           |
| 4.10               | Vibration<br>test                                                                                                      | <p><b>&lt;Condition&gt;</b><br/>The following conditions shall be applied for 2 hours in each 3 mutually perpendicular directions.<br/>Vibration frequency range : 10Hz ~ 55Hz<br/>Peak to peak amplitude : 1.5mm<br/>Sweep rate : 10Hz ~ 55Hz ~ 10Hz in about 1 minute<br/>Mounting method:<br/>The capacitor with diameter greater than 12.5mm or longer than 25mm must be fixed in place with a bracket.</p> <div></div> <p><b>&lt;Criteria&gt;</b><br/>After the test, the following items shall be tested:</p> <table><tr><td>Inner construction</td><td>No intermittent contacts, open or short circuiting. No damage of tab terminals or electrodes.</td></tr><tr><td>Appearance</td><td>No mechanical damage in terminal. No leakage of electrolyte or swelling of the case.<br/>The markings shall be legible.</td></tr></table>                              | Inner construction | No intermittent contacts, open or short circuiting. No damage of tab terminals or electrodes. | Appearance         | No mechanical damage in terminal. No leakage of electrolyte or swelling of the case.<br>The markings shall be legible. |               |                                           |            |                                           |
| Inner construction | No intermittent contacts, open or short circuiting. No damage of tab terminals or electrodes.                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |                                                                                               |                    |                                                                                                                        |               |                                           |            |                                           |
| Appearance         | No mechanical damage in terminal. No leakage of electrolyte or swelling of the case.<br>The markings shall be legible. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                    |                                                                                               |                    |                                                                                                                        |               |                                           |            |                                           |

|                                        |                                                         |        |
|----------------------------------------|---------------------------------------------------------|--------|
| MAN YUE ELECTRONICS<br>COMPANY LIMITED | ELECTROLYTIC<br>CAPACITOR<br>SPECIFICATION<br>RT SERIES | SAMXON |
|                                        |                                                         |        |

| 4.11                                     | Solderability test                             | <p><b>&lt;Condition&gt;</b><br/>The capacitor shall be tested under the following conditions: Sn-Cu solder<br/>Soldering temperature : 250±3°C<br/>Dipping depth : 2mm<br/>Dipping speed : 25±2.5mm/s<br/>Dipping time : 3±0.5s</p> <p><b>&lt;Criteria&gt;</b></p> <table><tr><td>Coating quality</td><td>A minimum of 95% of the surface being immersed</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Coating quality | A minimum of 95% of the surface being immersed |                    |                               |                                          |                                            |                                    |                                           |                                   |  |                 |                                    |       |                                    |            |                                           |
|------------------------------------------|------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------------------------------------------------|--------------------|-------------------------------|------------------------------------------|--------------------------------------------|------------------------------------|-------------------------------------------|-----------------------------------|--|-----------------|------------------------------------|-------|------------------------------------|------------|-------------------------------------------|
| Coating quality                          | A minimum of 95% of the surface being immersed |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                                |                    |                               |                                          |                                            |                                    |                                           |                                   |  |                 |                                    |       |                                    |            |                                           |
| 4.12                                     | Resistance to solder heat test                 | <p><b>&lt;Condition&gt;</b><br/>Terminals of the capacitor shall be immersed into solder bath at 260±5°C for 10±1 seconds or 400±10°C for 3<sup>+1</sup><sub>-0</sub> seconds to 1.5~2.0mm from the body of capacitor .<br/>Then the capacitor shall be left under the normal temperature and normal humidity for 1~2 hours before measurement.</p> <p><b>&lt;Criteria&gt;</b></p> <table><tr><td>Leakage current</td><td>Not more than the specified value.</td></tr><tr><td>Capacitance Change</td><td>Within ±10% of initial value.</td></tr><tr><td>tan δ</td><td>Not ore than the specified value.</td></tr><tr><td>Appearance</td><td>There shall be no leakage of electrolyte.</td></tr></table>                                                                                                                                     | Leakage current | Not more than the specified value.             | Capacitance Change | Within ±10% of initial value. | tan δ                                    | Not ore than the specified value.          | Appearance                         | There shall be no leakage of electrolyte. |                                   |  |                 |                                    |       |                                    |            |                                           |
| Leakage current                          | Not more than the specified value.             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                                |                    |                               |                                          |                                            |                                    |                                           |                                   |  |                 |                                    |       |                                    |            |                                           |
| Capacitance Change                       | Within ±10% of initial value.                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                                |                    |                               |                                          |                                            |                                    |                                           |                                   |  |                 |                                    |       |                                    |            |                                           |
| tan δ                                    | Not ore than the specified value.              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                                |                    |                               |                                          |                                            |                                    |                                           |                                   |  |                 |                                    |       |                                    |            |                                           |
| Appearance                               | There shall be no leakage of electrolyte.      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                                |                    |                               |                                          |                                            |                                    |                                           |                                   |  |                 |                                    |       |                                    |            |                                           |
| 4.13                                     | Change of temperature test                     | <p><b>&lt;Condition&gt;</b><br/>Temperature Cycle: According to IEC60384-4No.4.7 methods, capacitor shall be placed in an oven, the condition according as below:</p> <table><tr><th>Temperature</th><th>Time</th></tr><tr><td>(1)+20°C</td><td>≤ 3 Minutes</td></tr><tr><td>(2)Rated low temperature (-40°C) (-25°C)</td><td>30±2 Minutes</td></tr><tr><td>(3)Rated high temperature (+105°C)</td><td>30±2 Minut s</td></tr><tr><td colspan="2">(1) to (3)=1 cycle, total 5 cycle</td></tr></table> <p><b>&lt;Criteria&gt;</b><br/>The characteristic shall meet the following requirement</p> <table><tr><td>Leakage current</td><td>Not more than the specified value.</td></tr><tr><td>tan δ</td><td>Not more than the specified value.</td></tr><tr><td>Appearance</td><td>There shall be no leakage of electrolyte.</td></tr></table> | Temperature     | Time                                           | (1)+20°C           | ≤ 3 Minutes                   | (2)Rated low temperature (-40°C) (-25°C) | 30±2 Minutes                               | (3)Rated high temperature (+105°C) | 30±2 Minut s                              | (1) to (3)=1 cycle, total 5 cycle |  | Leakage current | Not more than the specified value. | tan δ | Not more than the specified value. | Appearance | There shall be no leakage of electrolyte. |
| Temperature                              | Time                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                                |                    |                               |                                          |                                            |                                    |                                           |                                   |  |                 |                                    |       |                                    |            |                                           |
| (1)+20°C                                 | ≤ 3 Minutes                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                                |                    |                               |                                          |                                            |                                    |                                           |                                   |  |                 |                                    |       |                                    |            |                                           |
| (2)Rated low temperature (-40°C) (-25°C) | 30±2 Minutes                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                                |                    |                               |                                          |                                            |                                    |                                           |                                   |  |                 |                                    |       |                                    |            |                                           |
| (3)Rated high temperature (+105°C)       | 30±2 Minut s                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                                |                    |                               |                                          |                                            |                                    |                                           |                                   |  |                 |                                    |       |                                    |            |                                           |
| (1) to (3)=1 cycle, total 5 cycle        |                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                                |                    |                               |                                          |                                            |                                    |                                           |                                   |  |                 |                                    |       |                                    |            |                                           |
| Leakage current                          | Not more than the specified value.             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                                |                    |                               |                                          |                                            |                                    |                                           |                                   |  |                 |                                    |       |                                    |            |                                           |
| tan δ                                    | Not more than the specified value.             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                                |                    |                               |                                          |                                            |                                    |                                           |                                   |  |                 |                                    |       |                                    |            |                                           |
| Appearance                               | There shall be no leakage of electrolyte.      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                                |                    |                               |                                          |                                            |                                    |                                           |                                   |  |                 |                                    |       |                                    |            |                                           |
| 4.14                                     | Damp heat test                                 | <p><b>&lt;Condition&gt;</b><br/>Humidity Test:<br/>According to IEC60384-4No.4.12 methods, capacitor shall be exposed for 500±8 hours in an atmosphere of 90~95%R H .at 40±2°C, the characteristic change shall meet the following requirement.</p> <p><b>&lt;Criteria&gt;</b></p> <table><tr><td>Leakage current</td><td>Not more than the specified value.</td></tr><tr><td>Capacitance Change</td><td>Within ±20% of initial value.</td></tr><tr><td>tan δ</td><td>Not more than 120% of the specified value.</td></tr><tr><td>Appearance</td><td>There shall be no leakage of electrolyte.</td></tr></table>                                                                                                                                                                                                                            | Leakage current | Not more than the specified value.             | Capacitance Change | Within ±20% of initial value. | tan δ                                    | Not more than 120% of the specified value. | Appearance                         | There shall be no leakage of electrolyte. |                                   |  |                 |                                    |       |                                    |            |                                           |
| Leakage current                          | Not more than the specified value.             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                                |                    |                               |                                          |                                            |                                    |                                           |                                   |  |                 |                                    |       |                                    |            |                                           |
| Capacitance Change                       | Within ±20% of initial value.                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                                |                    |                               |                                          |                                            |                                    |                                           |                                   |  |                 |                                    |       |                                    |            |                                           |
| tan δ                                    | Not more than 120% of the specified value.     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                                |                    |                               |                                          |                                            |                                    |                                           |                                   |  |                 |                                    |       |                                    |            |                                           |
| Appearance                               | There shall be no leakage of electrolyte.      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                 |                                                |                    |                               |                                          |                                            |                                    |                                           |                                   |  |                 |                                    |       |                                    |            |                                           |

|                                        |                                                         |               |
|----------------------------------------|---------------------------------------------------------|---------------|
| MAN YUE ELECTRONICS<br>COMPANY LIMITED | ELECTROLYTIC<br>CAPACITOR<br>SPECIFICATION<br>RT SERIES | <b>SAMXON</b> |
|                                        |                                                         |               |

| 4.15                          | Vent test                            | <p><b>&lt;Condition&gt;</b><br/>The following test only apply to those products with vent products at diameter ≥Ø6.3 with vent.<br/>D.C. test<br/>The capacitor is connected with its polarity reversed to a DC power source. Then a current selected from below table is applied.</p> <p><b>&lt;Table 3&gt;</b></p> <table><tr><th>Diameter (mm)</th><th>DC Current (A)</th></tr><tr><td>22.4 or less</td><td>1</td></tr><tr><td>Over 22.4</td><td>10</td></tr></table> <p><b>&lt;Criteria&gt;</b><br/>The vent shall operate with no dangerous conditions such as flames or dispersion of pieces of the capacitor and/or case.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Diameter (mm)            | DC Current (A) | 22.4 or less | 1   | Over 22.4 | 10          |  |  |  |  |       |      |      |      |      |         |      |      |      |      |      |      |      |      |      |                               |        |      |      |      |       |                         |  |  |  |  |  |                    |      |      |      |      |      |                      |  |  |  |  |  |
|-------------------------------|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|----------------|--------------|-----|-----------|-------------|--|--|--|--|-------|------|------|------|------|---------|------|------|------|------|------|------|------|------|------|-------------------------------|--------|------|------|------|-------|-------------------------|--|--|--|--|--|--------------------|------|------|------|------|------|----------------------|--|--|--|--|--|
| Diameter (mm)                 | DC Current (A)                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                          |                |              |     |           |             |  |  |  |  |       |      |      |      |      |         |      |      |      |      |      |      |      |      |      |                               |        |      |      |      |       |                         |  |  |  |  |  |                    |      |      |      |      |      |                      |  |  |  |  |  |
| 22.4 or less                  | 1                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                          |                |              |     |           |             |  |  |  |  |       |      |      |      |      |         |      |      |      |      |      |      |      |      |      |                               |        |      |      |      |       |                         |  |  |  |  |  |                    |      |      |      |      |      |                      |  |  |  |  |  |
| Over 22.4                     | 10                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                          |                |              |     |           |             |  |  |  |  |       |      |      |      |      |         |      |      |      |      |      |      |      |      |      |                               |        |      |      |      |       |                         |  |  |  |  |  |                    |      |      |      |      |      |                      |  |  |  |  |  |
| 4.16                          | Maximum permissible (ripple current) | <p><b>&lt;Condition&gt;</b><br/>The maximum permissible ripple current is the maximum A.C current at 120Hz and can be applied at maximum operating temperature<br/>Table-1<br/>The combined value of D.C voltage and the peak A.C voltage shall not exceed the rated voltage and shall not reverse voltage.</p> <p>Frequency Multipliers:</p> <table><tr><th>Coefficient \ Freq. (Hz)</th><th>120</th><th>1k</th><th>10k</th><th>100k</th></tr><tr><th>Cap. ( µ F)</th><td></td><td></td><td></td><td></td></tr><tr><td>1~5.6</td><td>0.20</td><td>0.40</td><td>0.80</td><td>1.00</td></tr><tr><td>6.8~180</td><td>0.40</td><td>0.75</td><td>0.90</td><td>1.00</td></tr><tr><td>220~</td><td>0.50</td><td>0.85</td><td>0.94</td><td>1.00</td></tr></table> <p>Temperature Coefficient:</p> <table><tr><th>Capacitor ambient temperature</th><th>≤ 65°C</th><th>75°C</th><th>85°C</th><th>95°C</th><th>105°C</th></tr><tr><td>Temperature coefficient</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Actural rms ripple</td><td>1.73</td><td>1.73</td><td>1.73</td><td>1.41</td><td>1.00</td></tr><tr><td>Rated rms max.ripple</td><td></td><td></td><td></td><td></td><td></td></tr></table> | Coefficient \ Freq. (Hz) | 120            | 1k           | 10k | 100k      | Cap. ( µ F) |  |  |  |  | 1~5.6 | 0.20 | 0.40 | 0.80 | 1.00 | 6.8~180 | 0.40 | 0.75 | 0.90 | 1.00 | 220~ | 0.50 | 0.85 | 0.94 | 1.00 | Capacitor ambient temperature | ≤ 65°C | 75°C | 85°C | 95°C | 105°C | Temperature coefficient |  |  |  |  |  | Actural rms ripple | 1.73 | 1.73 | 1.73 | 1.41 | 1.00 | Rated rms max.ripple |  |  |  |  |  |
| Coefficient \ Freq. (Hz)      | 120                                  | 1k                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 10k                      | 100k           |              |     |           |             |  |  |  |  |       |      |      |      |      |         |      |      |      |      |      |      |      |      |      |                               |        |      |      |      |       |                         |  |  |  |  |  |                    |      |      |      |      |      |                      |  |  |  |  |  |
| Cap. ( µ F)                   |                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                          |                |              |     |           |             |  |  |  |  |       |      |      |      |      |         |      |      |      |      |      |      |      |      |      |                               |        |      |      |      |       |                         |  |  |  |  |  |                    |      |      |      |      |      |                      |  |  |  |  |  |
| 1~5.6                         | 0.20                                 | 0.40                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.80                     | 1.00           |              |     |           |             |  |  |  |  |       |      |      |      |      |         |      |      |      |      |      |      |      |      |      |                               |        |      |      |      |       |                         |  |  |  |  |  |                    |      |      |      |      |      |                      |  |  |  |  |  |
| 6.8~180                       | 0.40                                 | 0.75                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.90                     | 1.00           |              |     |           |             |  |  |  |  |       |      |      |      |      |         |      |      |      |      |      |      |      |      |      |                               |        |      |      |      |       |                         |  |  |  |  |  |                    |      |      |      |      |      |                      |  |  |  |  |  |
| 220~                          | 0.50                                 | 0.85                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.94                     | 1.00           |              |     |           |             |  |  |  |  |       |      |      |      |      |         |      |      |      |      |      |      |      |      |      |                               |        |      |      |      |       |                         |  |  |  |  |  |                    |      |      |      |      |      |                      |  |  |  |  |  |
| Capacitor ambient temperature | ≤ 65°C                               | 75°C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 85°C                     | 95°C           | 105°C        |     |           |             |  |  |  |  |       |      |      |      |      |         |      |      |      |      |      |      |      |      |      |                               |        |      |      |      |       |                         |  |  |  |  |  |                    |      |      |      |      |      |                      |  |  |  |  |  |
| Temperature coefficient       |                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                          |                |              |     |           |             |  |  |  |  |       |      |      |      |      |         |      |      |      |      |      |      |      |      |      |                               |        |      |      |      |       |                         |  |  |  |  |  |                    |      |      |      |      |      |                      |  |  |  |  |  |
| Actural rms ripple            | 1.73                                 | 1.73                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.73                     | 1.41           | 1.00         |     |           |             |  |  |  |  |       |      |      |      |      |         |      |      |      |      |      |      |      |      |      |                               |        |      |      |      |       |                         |  |  |  |  |  |                    |      |      |      |      |      |                      |  |  |  |  |  |
| Rated rms max.ripple          |                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                          |                |              |     |           |             |  |  |  |  |       |      |      |      |      |         |      |      |      |      |      |      |      |      |      |                               |        |      |      |      |       |                         |  |  |  |  |  |                    |      |      |      |      |      |                      |  |  |  |  |  |

|                                        |                                                         |        |
|----------------------------------------|---------------------------------------------------------|--------|
| MAN YUE ELECTRONICS<br>COMPANY LIMITED | ELECTROLYTIC<br>CAPACITOR<br>SPECIFICATION<br>RT SERIES | SAMXON |
|                                        |                                                         |        |

5. It refers to the latest document of “Environment-related Substances standard”(WI-HSPM-QA-072).

| Substances                                                   |                                                                                    |
|--------------------------------------------------------------|------------------------------------------------------------------------------------|
| Heavy metals                                                 | Cadmium and cadmium compounds                                                      |
|                                                              | Lead and lead compounds                                                            |
|                                                              | Mercury and mercury compounds                                                      |
|                                                              | Hexavalent chromium compounds                                                      |
| Chlorinated organic compounds                                | Polychlorinated biphenyls (PCB)                                                    |
|                                                              | Polychlorinated naphthalenes (PCN)                                                 |
|                                                              | Polychlorinated terphenyls (PCT)                                                   |
|                                                              | Short-chain chlorinated paraffins (SCCP)                                           |
|                                                              | Other chlorinated organic compounds                                                |
| Brominated organic compounds                                 | Polybrominated biphenyls (PBB)                                                     |
|                                                              | Polybrominated diphenylethers (PBDE) (including decabromodiphenyl ether [DecaBDE]) |
|                                                              | Other brominated organic compounds                                                 |
| Tributyltin compounds (TBT)                                  |                                                                                    |
| Triphenyltin compounds (TPT)                                 |                                                                                    |
| Asbestos                                                     |                                                                                    |
| Specific azo compounds                                       |                                                                                    |
| Formaldehyde                                                 |                                                                                    |
| Beryllium oxide                                              |                                                                                    |
| Beryllium copper                                             |                                                                                    |
| Specific phthalates (DEHP, DBP, BBP, DINP, DIDP, DNOP, DNHP) |                                                                                    |
| Hydrofluorocarbon (HFC), Perfluorocarbon (PFC)               |                                                                                    |
| Perfluorooctane sulfonates (PFOS)                            |                                                                                    |
| Specific Benzotriazole                                       |                                                                                    |

|                                        |                                                         |        |
|----------------------------------------|---------------------------------------------------------|--------|
| MAN YUE ELECTRONICS<br>COMPANY LIMITED | ELECTROLYTIC<br>CAPACITOR<br>SPECIFICATION<br>RT SERIES | SAMXON |
|                                        |                                                         |        |

#### Attachment: Application Guidelines

##### 1.Circuit Design

##### 1.1 Operating Temperature and Frequency

Electrolytic capacitor electrical parameters are normally specified at 20°C temperature and 120Hz frequency. These parameters vary with changes in temperature and frequency. Circuit designers should take these changes into consideration.

##### (1) Effects of operating temperature on electrical parameters

- At higher temperatures, leakage current and capacitance increase while equivalent series resistance (ESR) decreases.
- At lower temperatures, leakage current and capacitance decrease while equivalent series resistance (ESR) increases.

##### (2) Effects of frequency on electrical parameters

- At higher frequencies capacitance and impedance decrease while  $\tan\delta$  increases.
- At lower frequencies, ripple current generated heat will rise due to an increase in equivalent series resistance (ESR).

##### 1.2 Operating Temperature and Life Expectancy

See the file: Life calculation of aluminum electrolytic capacitor

##### 1.3 Common Application Conditions to Avoid

The following misapplication load conditions will cause rapid deterioration to capacitor electrical parameters. In addition, rapid heating and gas generation within the capacitor can occur causing the pressure relief vent to operate and resultant leakage of electrolyte. Under Leaking electrolyte is combustible and electrically conductive.

##### (1) Reverse Voltage

DC capacitors have polarity. Verify correct polarity before insertion. For circuits with changing or uncertain polarity, use DC bipolar capacitors. DC bipolar capacitors are not suitable for use in AC circuits.

##### (2) Charge / Discharge Applications

Standard capacitors are not suitable for use in repeating charge / discharge applications. For charge / discharge applications consult us and advise actual conditions.

##### (3) Over voltage

Do not apply voltages exceeding the maximum specified rated voltage. Voltages up to the surge voltage rating are acceptable for short periods of time. Ensure that the sum of the DC voltage and the superimposed AC ripple voltage does not exceed the rated voltage.

##### (4) Ripple Current

Do not apply ripple currents exceeding the maximum specified value. For high ripple current applications, use a capacitor designed for high ripple currents or contact us with your requirements. Ensure that allowable ripple currents superimposed on low DC bias voltages do not cause reverse voltage conditions.

##### (5) Pulse Current

The pulse current cannot exceed 10 times the rated ripple current at 120Hz.

##### 1.4 Using Two or More Capacitors in Series or Parallel

##### (1) Capacitors Connected in Parallel

The circuit resistance can closely approximate the series resistance of the capacitor causing an imbalance of ripple current loads within the capacitors. Careful design of wiring methods can minimize the possibility of excessive ripple currents applied to a capacitor.

##### (2) Capacitors Connected in Series

Normal DC leakage current differences among capacitors can cause voltage imbalances. The use of voltage divider shunt resistors with consideration to leakage current can prevent capacitor voltage imbalances.

##### 1.5 Capacitor Mounting Considerations

##### (1) Double Sided Circuit Boards

Avoid wiring pattern runs, which pass between the mounted capacitor and the circuit board.

When dipping into a solder bath, excess solder may collect under the capacitor by capillary action and short circuit the anode and cathode terminals.

##### (2) Circuit Board Hole Positioning

The vinyl sleeve of the capacitor can be damaged if solder passes through a lead hole for subsequently processed parts. Special care when locating hole positions in proximity to capacitors is recommended.

##### (3) Circuit Board Hole Spacing

The circuit board holes spacing should match the capacitor lead wire spacing within the specified tolerances. Incorrect spacing can cause excessive lead wire stress during the insertion process. This may result in premature capacitor failure due to short or open circuit, increased leakage current, or electrolyte leakage.

##### (4) Clearance for Case Mounted Pressure Relief vents

Capacitors with case mounted pressure relief vents require sufficient clearance to allow for proper vent operation. The minimum clearances are dependent on capacitor diameters as proper vent operation. The minimum clearances are dependent on capacitor diameters as follows.

$\phi 6.3 \sim \phi 16\text{mm}$ : 2mm minimum,  $\phi 18 \sim \phi 35\text{mm}$ : 3mm minimum,  $\phi 40\text{mm}$  or greater: 5mm minimum.

##### (5) Clearance for Seal Mounted Pressure Relief Vents

A hole in the circuit board directly under the seal vent location is required to allow proper release of pressure.

|         |    |  |      |    |
|---------|----|--|------|----|
| Version | 01 |  | Page | 12 |
|---------|----|--|------|----|

|                                        |                                                         |        |
|----------------------------------------|---------------------------------------------------------|--------|
| MAN YUE ELECTRONICS<br>COMPANY LIMITED | ELECTROLYTIC<br>CAPACITOR<br>SPECIFICATION<br>RT SERIES | SAMXON |
|                                        |                                                         |        |

(6) Wiring Near the Pressure Relief Vent

Avoid locating high voltage or high current wiring or circuit board paths above the pressure relief vent. Flammable, high temperature gas exceeding 100°C may be released which could dissolve the wire insulation and ignite.

(7) Circuit Board patterns Under the Capacitor

Avoid circuit board runs under the capacitor as electrolyte leakage could cause an electrical short.

(8) Screw Terminal Capacitor Mounting

Do not orient the capacitor with the screw terminal side of the capacitor facing downwards.

Tighten the terminal and mounting bracket screws within the torque range specified in the specification.

1.6 Electrical Isolation of the Capacitor

Completely isolate the capacitor as follows.

- (1) Between the cathode and the case (except for axially leaded B types) and between the anode terminal and other circuit paths
- (2) Between the extra mounting terminals (on T types) and the anode terminal, cathode terminal, and other circuit paths.

1.7 The Product endurance should take the sample as the standard.

1.8 If conduct the load or shelf life test, must be collect date code within 6 months products of sampling.

1.9 Capacitor Sleeve

The vinyl sleeve or laminate coating is intended for marking and identification purposes and is not meant to electrically insulate the capacitor.

The sleeve may split or crack if immersed into solvents such as toluene or xylene, and then exposed to high temperatures.

CAUTION!

Always consider safety when designing equipment and circuits. Plan for worst case failure modes such as short circuits and open circuits which could occur during use.

- (1) Provide protection circuits and protection devices to allow safe failure modes.
- (2) Design redundant or secondary circuits where possible to assure continued operation in case of main circuit failure.

**2.Capacitor Handling Techniques**

2.1 Considerations Before Using

- (1) Capacitors have a finite life. Do not reuse or recycle capacitors from used equipment.
- (2) Transient recovery voltage may be generated in the capacitor due to dielectric absorption. If required, this voltage can be discharged with a resistor with a value of about 1kΩ.
- (3) Capacitors stored for long periods of time may exhibit an increase in leakage current. This can be corrected by gradually applying rated voltage in series with a resistor of approximately 1kΩ.
- (4) If capacitors are dropped, they can be damaged mechanically or electrically. Avoid using dropped capacitors.
- (5) Dented or crushed capacitors should not be used. The seal integrity can be compromised and loss of electrolyte / shortened life can result.

2.2 Capacitor Insertion

- (1) Verify the correct capacitance and rated voltage of the capacitor.
- (2) Verify the correct polarity of the capacitor before inserting.
- (3) Verify the correct hole spacing before insertion (land pattern size on chip type) to avoid stress on the terminals.
- (4) Ensure that the auto insertion equipment lead clinching operation does not stress the capacitor leads where they enter the seal of the capacitor.

For chip type capacitors, excessive mounting pressure can cause high leakage current, short circuit, or disconnection.

2.3 Manual Soldering

- (1) Observe temperature and time soldering specifications or do not exceed temperatures of 400 °C for 3 seconds or less.
- (2) If lead wires must be formed to meet terminal board hole spacing, avoid stress on the lead wire where it enters the capacitor seal.
- (3) If a soldered capacitor must be removed and reinserted, avoid excessive stress to the capacitor leads.
- (4) Avoid touching the tip of the soldering iron to the capacitor, to prevent melting of the vinyl sleeve.

2.4 Flow Soldering

- (1) Do not immerse the capacitor body into the solder bath as excessive internal pressure could result.
- (2) Observe proper soldering conditions (temperature, time, etc.) Do not exceed the specified limits.
- (3) Do not allow other parts or components to touch the capacitor during soldering.

2.5 Other Soldering Considerations

Rapid temperature rises during the preheat operation and resin bonding operation can cause cracking of the capacitor vinyl sleeve. For heat curing, do not exceed 150°C for a maximum time of 2 minutes.

|         |    |  |      |    |
|---------|----|--|------|----|
| Version | 01 |  | Page | 13 |
|---------|----|--|------|----|

|                                        |                                                         |        |
|----------------------------------------|---------------------------------------------------------|--------|
| MAN YUE ELECTRONICS<br>COMPANY LIMITED | ELECTROLYTIC<br>CAPACITOR<br>SPECIFICATION<br>RT SERIES | SAMXON |
|                                        |                                                         |        |

## 2.6 Capacitor Handling after Solder

- (1). Avoid movement of the capacitor after soldering to prevent excessive stress on the lead wires where they enter the seal.
- (2). Do not use capacitor as a handle when moving the circuit board assembly.
- (3). Avoid striking the capacitor after assembly to prevent failure due to excessive shock.

## 2.7 Circuit Board Cleaning

- (1) Circuit boards can be immersed or ultrasonically cleaned using suitable cleaning solvents for up to 5 minutes and up to 60°C maximum temperatures. The boards should be thoroughly rinsed and dried. The use of ozone depleting cleaning agents is not recommended in the interest of protecting the environment.
- (2) Avoid using the following solvent groups unless specifically allowed for in the specification;
  - Halogenated cleaning solvents: except for solvent resistant capacitor types, halogenated solvents can permeate the seal and cause internal capacitor corrosion and failure. For solvent resistant capacitors, carefully follow the temperature and time requirements of the specification. 1-1-1 trichloroethane should never be used on any aluminum electrolytic capacitor.
  - Alkali solvents : could attack and dissolve the aluminum case.
  - Petroleum based solvents: deterioration of the rubber seal could result.
  - Xylene : deterioration of the rubber seal could result.
  - Acetone : removal of the ink markings on the vinyl sleeve could result.
- (3) A thorough drying after cleaning is required to remove residual cleaning solvents which may be trapped between the capacitor and the circuit board. Avoid drying temperatures, which exceed the maximum rated temperature of the capacitor.
- (4) Monitor the contamination levels of the cleaning solvents during use by electrical conductivity, pH, specific gravity, or water content. Chlorine levels can rise with contamination and adversely affect the performance of the capacitor. Please consult us for additional information about acceptable cleaning solvents or cleaning methods.

## 2.8 Mounting Adhesives and Coating Agents

When using mounting adhesives or coating agents to control humidity, avoid using materials containing halogenated solvents. Also, avoid the use of chloroprene based polymers. After applying adhesives or coatings, dry thoroughly to prevent residual solvents from being trapped between the capacitor and the circuit board.

## 3. Precautions for using capacitors

### 3.1 Environmental Conditions

Capacitors should not be stored or used in the following environments.

- (1) Temperature exposure above the maximum rated or below the minimum rated temperature of the capacitor.
- (2) Direct contact with water, salt water, or oil.
- (3) High humidity conditions where water could condense on the capacitor.
- (4) Exposure to toxic gases such as hydrogen sulfide, sulfuric acid, nitric acid chlorine, or ammonia.
- (5) Exposure to ozone, radiation, or ultraviolet rays.
- (6) Vibration and shock conditions exceeding specified requirements.

### 3.2 Electrical Precautions

- (1) Avoid touching the terminals of the capacitor as possible electric shock could result. The exposed aluminum case is not insulated and could also cause electric shock if touched.
- (2) Avoid short circuit the area between the capacitor terminals with conductive materials including liquids such as acids or alkaline solutions.

## 4. Emergency Procedures

- (1) If the pressure relief vent of the capacitor operates, immediately turn off the equipment and disconnect from the power source. This will minimize additional damage caused by the vaporizing electrolyte.
- (2) Avoid contact with the escaping electrolyte gas which can exceed 100°C temperatures.
  - If electrolyte or gas enters the eye, immediately flush the eyes with large amounts of water.
  - If electrolyte or gas is ingested by mouth, gargle with water.
  - If electrolyte contacts the skin, wash with soap and water.

## 5. Long Term Storage

Leakage current of a capacitor increases with long storage times. The aluminum oxide film deteriorates as a function of temperature and time. If used without reconditioning, an abnormally high current will be required to restore the oxide film. This current surge could cause the circuit or the capacitor to fail. After one year, a capacitor should be reconditioned by applying rated voltage in series with a 1000Ω, current limiting resistor for a time period of 30 minutes. If the expired date of products date code is over eighteen months, the products should be return to confirmation.

### 5.1 Environmental Conditions

|         |    |  |      |    |
|---------|----|--|------|----|
| Version | 01 |  | Page | 14 |
|---------|----|--|------|----|

|                                        |                                                         |        |
|----------------------------------------|---------------------------------------------------------|--------|
| MAN YUE ELECTRONICS<br>COMPANY LIMITED | ELECTROLYTIC<br>CAPACITOR<br>SPECIFICATION<br>RT SERIES | SAMXON |
|                                        |                                                         |        |

- The capacitor shall be not use in the following condition:
- (1) Temperature exposure above the maximum rated or below the minimum rated temperature of the capacitor.
  - (2) Direct contact with water, salt water, or oil.
  - (3) High humidity conditions where water could condense on the capacitor.
  - (4) Exposure to toxic gases such as hydrogen sulfide, sulfuric acid, nitric acid, chlorine, or ammonia.
  - (5) Exposure to ozone, radiation, or ultraviolet rays.
  - (6) Vibration and shock conditions exceeding specified requirements.

**6. Capacitor Disposal**

When disposing of capacitors, use one of the following methods.  
 Incinerate after crushing the capacitor or puncturing the can wall (to prevent explosion due to internal pressure rise).  
 Capacitors should be incinerated at high temperatures to prevent the release of toxic gases such as chlorine from the polyvinyl chloride sleeve, etc.  
 Dispose of as solid waste.  
 NOTE: Local laws may have specific disposal requirements, which must be followed.