



Pages 1 to 17

**CAPACITORS, FIXED, CHIPS,  
CERAMIC DIELECTRIC, TYPE II,  
BASED ON TYPE 2220  
ESCC Detail Specification No. 3009/011**

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<p>104 159</p>	<p>Specification upissued to incorporate technical and editorial changes per DCRs.</p>



**TABLE OF CONTENTS**

	<u>Page</u>
<b>1. <u>GENERAL</u></b>	<b>5</b>
1.1 Scope	5
1.2 Range of Components	5
1.3 Maximum Ratings	5
1.4 Parameter Derating Information	5
1.5 Physical Dimensions	5
1.6 Functional Diagram	5
<b>2. <u>APPLICABLE DOCUMENTS</u></b>	<b>8</b>
<b>3. <u>TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS</u></b>	<b>8</b>
<b>4. <u>REQUIREMENTS</u></b>	<b>8</b>
4.1 General	8
4.2 Deviations from Generic Specification	8
4.2.1 Deviations from Special In-process Controls	8
4.2.2 Deviations from Final Production Tests	8
4.2.3 Deviations from Burn-in and Electrical Measurements	8
4.2.4 Deviations from Qualification Tests	8
4.2.5 Deviations from Lot Acceptance Tests	8
4.3 Mechanical Requirements	8
4.3.1 Dimension Check	8
4.3.2 Weight	9
4.3.3 Adhesion	9
4.4 Materials and Finishes	9
4.4.1 Terminations	9
4.5 Marking	9
4.5.1 General	9
4.5.2 The ESCC Component Number	9
4.5.3 Electrical Characteristics and Ratings	10
4.5.4 Traceability Information	11
4.6 Electrical Measurements	11
4.6.1 Electrical Measurements at Room Temperature	11
4.6.2 Electrical Measurements at High and Low Temperatures	11
4.6.3 Circuits for Electrical Measurements	11
4.7 Burn-in Tests	11
4.7.1 Parameter Drift Values	11
4.7.2 Conditions for Burn-in	11
4.7.3 Electrical Circuit for Burn-in	11
4.8 Environmental and Endurance Tests	14
4.8.1 Measurements and Inspections on Completion of Environmental Tests	14
4.8.2 Measurements and Inspections at Intermediate Points during Endurance Tests	14
4.8.3 Measurements and Inspections on Completion of Endurance Tests	14
4.8.4 Conditions for Operating Life Test	14
4.8.5 Electrical Circuit for Operating Life Test	14



**TABLES**

	<u>Page</u>
1(a) Range of Components	6
1(b) Maximum Ratings	7
2 Electrical Measurements at Room Temperature	12
3 Electrical Measurements at High and Low Temperatures	12
4 Parameter Drift Values	13
5 Conditions for Burn-in and Operating Life Tests	13
6 Measurements and Inspections on Completion of Environmental Tests and at Intermediate Points and on Completion of Endurance Testing	15

**FIGURES**

1 Parameter Derating Information	7
2 Physical Dimensions	7
3 Functional Diagram	7
4 Test Circuits	13
5 Electrical Circuit for Burn-in and Operating Life Tests	13

**APPENDICES (Applicable to specific Manufacturers only)**

'A' Agreed Deviations for Vitramon Ltd. (UK)	17
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1. **GENERAL**

1.1 **SCOPE**

This specification details the ratings, physical and electrical characteristics, test and inspection data for Capacitors, Fixed, Chips, Ceramic Dielectric, Type II, based on Type 2220. It shall be read in conjunction with ESCC Generic Specification No. 3009, the requirements of which are supplemented herein.

1.2 **RANGE OF COMPONENTS**

The range of capacitors covered by this specification is given in Table 1(a).

1.3 **MAXIMUM RATINGS**

The maximum ratings, which shall not be exceeded at any time during use or storage, applicable to the capacitors specified herein, are as scheduled in Table 1(b).

1.4 **PARAMETER DERATING INFORMATION (FIGURE 1)**

Not applicable.

1.5 **PHYSICAL DIMENSIONS**

The physical dimensions of the capacitors specified herein are shown in Figure 2.

1.6 **FUNCTIONAL DIAGRAM**

The functional diagram for the capacitors specified herein is shown in Figure 3.



**TABLE 1(a) - RANGE OF COMPONENTS**

CAPACITANCE RANGE (pF)	TOLERANCE ( $\pm$ ) (%)	VALUES SERIES	RATED VOLTAGE ( $U_R$ ) (V)
6800 to 22000	5.0	E 24	400
6800 to 22000	10	E 12	400
6800 to 22000	20	E 6	400
6800 to 100000	5.0	E 24	200
6800 to 100000	10	E 12	200
6800 to 100000	20	E 6	200
4700 to 1000000	5.0	E 24	100
4700 to 1000000	10	E 12	100
4700 to 1000000	20	E 6	100
100000 to 1500000	5.0	E 24	50
100000 to 1500000	10	E 12	50
100000 to 1500000	20	E 6	50
100000 to 1500000	5.0	E 24	25
100000 to 1500000	10	E 12	25
100000 to 1500000	20	E 6	25

**NOTES**

1. 7 variants are specified in Para. 4.4.1, Figure 2 and Table 3.

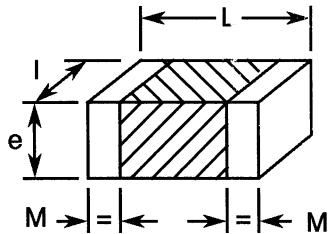
**TABLE 1(b) - MAXIMUM RATINGS**

No.	CHARACTERISTICS	SYMBOL	LIMITS		UNIT	REMARKS
			MIN.	MAX.		
1	Rated Voltage	$U_R$	See Table 1(a)		V	-
2	Operating Temperature Range	$T_{amb}$	-55	+125	°C	Without derating
3	Storage Temperature Range	$T_{stg}$	-55	+125	°C	-
4	Maximum Soldering Temperature	$T_{sol}$	-	+260	°C	Soldering time: t: < 10 sec.

**FIGURE 1 - PARAMETER DERATING INFORMATION**

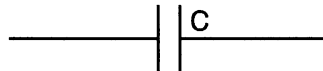
Not applicable.

**FIGURE 2 - PHYSICAL DIMENSIONS**




SYMBOL	DIMENSIONS (mm)					
	VARIANTS 01, 03, 06		VARIANTS 02, 04, 05		VARIANT 07	
	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.
L	5.2	6.2	5.2	6.7	5.2	6.2
I	4.5	5.5	4.05	6.0	4.5	5.5
e	-	2.3	-	2.3	-	1.8
M	0.2	0.75	0.2	0.75	0.2	0.75

**FIGURE 3 - FUNCTIONAL DIAGRAM**





	<p style="text-align: center;">ESCC Detail Specification No. 3009/011</p>		<p>PAGE 8 ISSUE 2</p>
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## 2. APPLICABLE DOCUMENTS

The following documents form part of this specification and shall be read in conjunction with it:-

- (a) ESCC Generic Specification No. 3009 for Capacitors, Fixed, Chips, Ceramic Dielectric, Types I and II.

## 3. TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS

For the purpose of this specification, the terms, definitions, abbreviations, symbols and units specified in ESCC Basic Specification No. 21300 shall apply. In addition, the following symbols are used:-

TCC = Temperature Characteristic.  
V<sub>T</sub> = Test Voltage.

## 4. REQUIREMENTS

### 4.1 GENERAL

The complete requirements for procurement of the capacitors specified herein shall be as stated in this specification and ESCC Generic Specification No. 3009 for Capacitors, Fixed, Chips, Ceramic Dielectric, Types I and II. Deviations from the Generic Specification, applicable to this specification only, are listed in Para. 4.2.

Deviations from the applicable Generic Specification and this Detail Specification, formally agreed with specific Manufacturers on the basis that the alternative requirements are equivalent to the ESCC requirements and do not affect the components' reliability, are listed in the appendices attached to this specification.

### 4.2 DEVIATIONS FROM GENERIC SPECIFICATION

#### 4.2.1 Deviations from Special In-process Controls

None.

#### 4.2.2 Deviations from Final Production Tests (Chart II)

None.

#### 4.2.3 Deviations from Burn-in and Electrical Measurements (Chart III)

None.

#### 4.2.4 Deviations from Qualification Tests (Chart IV)

None.

#### 4.2.5 Deviations from Lot Acceptance Tests (Chart V)

None.

### 4.3 MECHANICAL REQUIREMENTS

#### 4.3.1 Dimension Check

The dimensions of the capacitors specified herein shall be verified in accordance with the requirements set out in Para. 9.3 of ESCC Generic Specification No. 3009 and shall conform to those shown in Figure 2 of this specification.

4.3.2 Weight

The maximum weight of the capacitors specified herein shall be 0.3 grammes.

4.3.3 Adhesion

The requirements for adhesion are specified in Para. 9.5 of ESCC Generic Specification No. 3009.

4.4 MATERIALS AND FINISHES

The materials and finishes shall be as specified herein. Where a definite material is not specified, a material which will enable the capacitors specified herein to meet the performance requirements of this specification shall be used. Acceptance or approval of any constituent material does not guarantee acceptance of the finished product.

4.4.1 Terminations

- Variant 01: The capacitors shall be terminated with AgPd pads.
- Variant 02: The capacitors shall be terminated with AgPd with solder coating, 62 Sn, 36 Pb, 2.0 Ag %, + 188°C.
- Variant 03: The capacitors shall be terminated with AgPdPt pads.
- Variant 04: The capacitors shall be terminated with AgPdPt with solder coating, 62 Sn, 36 Pb, 2.0 Ag %, + 188°C.
- Variant 05: The capacitors shall be terminated with Ag, Ni barrier with solder coating, 62 Sn, 36Pb, 2.0 Ag %, + 188°C.
- Variants 06 and 07: The capacitors shall be terminated with Ag, Ni barrier with coating tin-lead, near eutectic, minimum 10% lead.

All the above Variants are suitable for reflow soldering.

**N.B.**

Variants 06 and 07 have the preferred termination finish for the specified chip size (see Figure 2).

4.5 MARKING

4.5.1 General

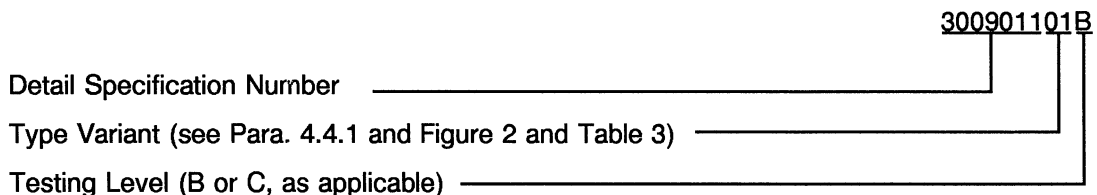
The marking of all components delivered to this specification shall be in accordance with the requirements of ESCC Basic Specification No. 21700 and the following paragraphs.

These components being too small to accommodate the marking as specified hereafter, the marking information in full shall accompany each component in its primary package. Such marking shall comprise:-

- (a) The ESCC Component Number.
- (b) Characteristics and Ratings.
- (c) Traceability Information.

4.5.2 The ESCC Component Number

Each component shall bear the ESCC Component Number which shall be constituted and marked as follows:

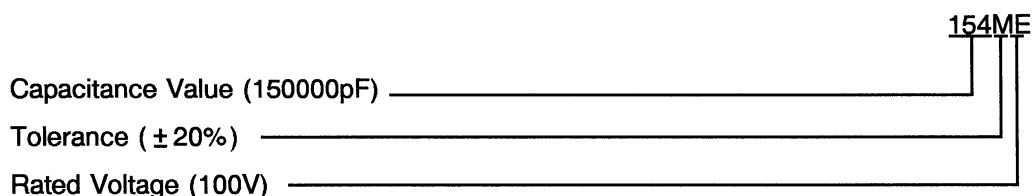


#### 4.5.3 Electrical Characteristics and Ratings

The electrical characteristics and ratings to be marked in the following order of precedence are:-

- (a) Capacitance Value.
- (b) Tolerance.
- (c) Rated Voltage.

The information shall be constituted and marked as follows:-



##### 4.5.3.1 Capacitance Values

The capacitance values shall be expressed by means of the following codes. The unit quantity for marking shall be picofarads (pF).

CAPACITANCE VALUE	CODE
XX10 <sup>2</sup>	XX2
XX10 <sup>3</sup>	XX3
XX10 <sup>4</sup>	XX4
XX10 <sup>5</sup>	XX5

##### 4.5.3.2 Tolerances

The tolerances on capacitance values shall be indicated by the code letters specified hereafter.

TOLERANCE (%)	CODE LETTER
± 5.0	J
± 10	K
± 20	M

##### 4.5.3.3 Rated Voltage

The rated voltages shall be indicated by the code letters specified hereafter.

RATED VOLTAGE (U <sub>R</sub> ) (V)	CODE LETTER
25	A
50	C
100	E
200	G
400	K

#### 4.5.4 Traceability Information

Traceability information shall be marked in accordance with the requirements of ESCC Basic Specification No. 21700.

- (a) Manufacturing Date Code.
- (b) Manufacturer's Name.

#### 4.6 ELECTRICAL MEASUREMENTS

##### 4.6.1 Electrical Measurements at Room Temperature

The parameters to be measured at room temperature are scheduled in Table 2. Unless otherwise specified, the measurements shall be performed at  $T_{amb} = +22 \pm 3$  °C.

##### 4.6.2 Electrical Measurements at High and Low Temperatures

The parameters to be measured at high and low temperatures are scheduled in Table 3.

##### 4.6.3 Circuits for Electrical Measurements

A circuit for use in performing the electrical measurements listed in Table 2 of this specification is shown in ESCC Generic Specification No. 3009.

#### 4.7 BURN-IN TESTS

##### 4.7.1 Parameter Drift Values

The parameter drift values applicable to burn-in are specified in Table 4 of this specification. Unless otherwise stated, measurements shall be performed at  $T_{amb} = +22 \pm 3$  °C. The parameter drift values ( $\Delta$ ) applicable to the scheduled parameters shall not be exceeded. In addition to these drift value requirements for a given parameter, the appropriate limit value specified in Table 2 shall not be exceeded.

##### 4.7.2 Conditions for Burn-in

The requirements for burn-in are specified in Section 7 of ESCC Generic Specification No. 3009. The conditions for burn-in shall be as specified in Table 5 of this specification.

On completion of burn-in, a recovery period of  $24 \pm 2$  hours is necessary before performance of the end-measurements.

##### 4.7.3 Electrical Circuit for Burn-in (Figure 5)

Not applicable.

**TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE**

No.	CHARACTERISTICS	SYMBOL	ESCC 3009 TEST CONDITIONS	LIMITS		UNIT
				MIN.	MAX.	
1	Capacitance	C	Para. 9.4.1.1	-5.0 -10 -20	+5.0 +10 +20	% (1)
2	Tangent of Loss Angle	$T_{g\delta}$	Para. 9.4.1.2	-	250	$10^{-4}$
3	Insulation Resistance	$R_i$	Para. 9.4.1.3	100 (2)	-	$G\Omega$
4	Voltage Proof	VP	Para. 9.4.1.4	$2.5U_R$	-	V

**NOTES**

- The capacitance limits before burn-in are -5.0 and +20%.
- For C equal to, or less than, 10 000pF.  
For C greater than 10 000pF,  $R_i \times C = 1\ 000$  seconds minimum.

**TABLE 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES**

No.	CHARACTERISTICS	SYMBOL	ESCC 3009 TEST CONDITIONS	LIMITS		UNIT	REMARKS
				MIN.	MAX.		
3	Insulation Resistance at $+125 \pm 3^\circ C$	$R_i$	Para. 9.4.1.3	10 000	-	$M\Omega$	Notes 1, 2 and 4
5(i)	Temperature Characteristic $\frac{\Delta C}{C} = f(T)$	TCC	Para. 9.12 $V_T = 0$ (for Variants 01 to 07) $V_T = U_R$ (for Variants 01 to 06)	-20 -30	+20 +20	%	5 parts for each capacitance value. Notes 2, 5 and 6
5(ii)	Temperature Characteristic $\frac{\Delta C}{C} = f(T)$	TCC	Para. 9.12 $V_T = 0$ (for Variants 01 to 07) $V_T = U_R$ (for Variants 01 to 06)	-20 -30	+20 +20	%	5 parts for each dielectric lot. Notes 3, 5 and 6

**NOTES**

- Single sample; Inspection Level S3; AQL = 2.5%.
- Applicable to Level 'B' only.
- Applicable to Level 'C' only.
- For C equal to, or less than, 10 000pF.  
For C greater than 10 000pF,  $R_i \times C = 100$  seconds minimum.
- If 1 failure out of 5 parts, then test 100%.  
1.0% rejects maximum allowed in case of 100% testing.
- Variant 07 is X7R dielectric. Delta C/C at  $U_R$  is typically -60% for this dielectric type.

**TABLE 4 - PARAMETER DRIFT VALUES**

No.	CHARACTERISTICS	SYMBOL	SPEC. AND/OR TEST METHOD	TEST CONDITIONS	CHANGE LIMITS ( $\Delta$ )	UNIT
1	Capacitance Change	$\frac{\Delta C}{C}$	ESCC Gen. Spec. 3009	Para's. 9.4.2 and 9.4.1.1	$\pm 15$	%

**FIGURE 4 - TEST CIRCUITS**

Not applicable.

**TABLE 5 - CONDITIONS FOR BURN-IN AND OPERATING LIFE TESTS**

No.	CHARACTERISTIC	SYMBOL	CONDITION	UNIT
1	Ambient Temperature	$T_{amb}$	+ 125	°C
2	Test Voltage	$V_T$	2.0U <sub>R</sub>	V

**FIGURE 5 - ELECTRICAL CIRCUIT FOR BURN-IN AND OPERATING LIFE TESTS**

Not applicable.

4.8 ENVIRONMENTAL AND ENDURANCE TESTS (CHARTS IV AND V OF ESCC GENERIC SPECIFICATION No 3009)

4.8.1 Measurements and Inspections on Completion of Environmental Tests

The parameters to be measured and inspections to be performed on completion of environmental tests are scheduled in Table 6. Unless otherwise stated, the measurements shall be performed at  $T_{amb} = +22 \pm 3^{\circ}\text{C}$ .

4.8.2 Measurements and Inspections at Intermediate Points during Endurance Tests

The parameters to be measured and inspections to be performed at intermediate points during endurance tests are scheduled in Table 6. Unless otherwise stated, the measurements shall be performed at  $T_{amb} = +22 \pm 3^{\circ}\text{C}$ .

4.8.3 Measurements and Inspections on Completion of Endurance Tests

The parameters to be measured and inspections to be performed on completion of endurance tests are scheduled in Table 6. Unless otherwise stated, the measurements shall be performed at  $T_{amb} = +22 \pm 3^{\circ}\text{C}$ .

4.8.4 Conditions for Operating Life Test (Part of Endurance Testing)

The requirements for operating life testing are specified in Section 9 of ESCC Generic Specification No. 3009. The conditions for operating life testing shall be as specified in Table 5 for the Burn-in test.

4.8.5 Electrical Circuit for Operating Life Test (Figure 5)

Not applicable.

**TABLE 6 - MEASUREMENTS AND INSPECTIONS ON COMPLETION OF ENVIRONMENTAL TESTS AND AT INTERMEDIATE POINTS AND ON COMPLETION OF ENDURANCE TESTING**

NO.	ESCC GENERIC SPECIFICATION NO. 3009		MEASUREMENTS AND INSPECTIONS		SYMBOL	LIMITS		UNIT
	ENVIRONMENTAL AND ENDURANCE TESTS (1)	TEST METHOD AND CONDITIONS	IDENTIFICATION	CONDITIONS		MIN.	MAX.	
01	Mounting	Para. 9.15	<b>Final Examination</b> Terminals <b>Final Measurements</b> Capacitance Tangent of Loss Angle Insulation Resistance	Good Tinning  Table 2 Item 1 Table 2 Item 2 Table 2 Item 3	- C $T_{g\delta}$ $R_f$	- - Record Values Table 2 Item 2 Table 2 Item 3	- - pF 10 <sup>-4</sup> GΩ	
02	Adhesion	Para. 9.5	<b>Final Examination</b> Visual Examination Capacitance	Damage or loosening Table 2 Item 1	- C	- - Table 2 Item 1	- - pF	
03	Solderability	Para. 9.6	<b>Final Examination</b> Visual Examination	Para. 9.6	-	- -	- -	
04	Rapid Change of Temperature	Para. 9.7	<b>Initial Measurements</b> Capacitance <b>Final Measurements</b>  Visual Examination Capacitance Change  Tangent of Loss Angle	Table 2 Item 1 Recovery period 24 ± 2 hours No damage Table 2 Item 1  Table 2 Item 2	C  - $\frac{\Delta C}{C}$ C $T_{g\delta}$	Item 01 Value  - -10 +10  - (2)	pF  - %  10 <sup>-4</sup>	
05	Climatic Test Sequence	Para. 9.8	<b>Initial Measurements</b> Capacitance <b>Final Measurements</b>  Visual Inspection Capacitance Change  Tangent of Loss Angle Insulation Resistance	Table 2 Item 1 Recovery Period 1 -24 hrs Para. 9.8.7 Table 2 Item 1  Table 2 Item 2 Table 2 Item 3	C  - $\frac{\Delta C}{C}$ C $T_{g\delta}$ $R_f$	Item 01 Value  - -10 +10  - (2) 3.0(3)	pF  - %  10 <sup>-4</sup> GΩ	
06	Damp Heat Steady State	Para. 9.9	<b>Initial Measurements</b> Capacitance <b>Final Measurements</b>  Visual Examination Capacitance Change  Tangent of Loss Angle Insulation Resistance	Table 2 Item 1 Recovery Period 6 - 24 hrs No damage Table 2 Item 1  Table 2 Item 2 Table 2 Item 3	C  - $\frac{\Delta C}{C}$ C $T_{g\delta}$ $R_f$	Item 01 Value  - -10 +10  - (2) 3.0(3)	pF  - %  10 <sup>-4</sup> GΩ	

**NOTES**

1. The tests in this table refer to either Chart IV or V and shall be used as applicable.
2. Twice the values specified in Table 2 of this specification.
3. Or 30 seconds for C > 10 000pF.
4. Or 100 seconds for C > 10 000pF.




**TABLE 6 - MEASUREMENTS AND INSPECTIONS ON COMPLETION OF ENVIRONMENTAL TESTS AND AT INTERMEDIATE POINTS AND ON COMPLETION OF ENDURANCE TESTING (CONT'D)**

NO.	ESCC GENERIC SPECIFICATION NO. 3009		MEASUREMENTS AND INSPECTIONS		SYMBOL	LIMITS		UNIT
	ENVIRONMENTAL AND ENDURANCE TESTS (1)	TEST METHOD AND CONDITIONS	IDENTIFICATION	CONDITIONS		MIN.	MAX.	
07	Operating Life	Para. 9.10	<b>Initial Measurements</b>	Table 2 Item 1 Recovery period 24 ± 2 hours	C	Item 01	Value	pF
			Capacitance					
			<b>Intermediate Measurements</b>	Table 2 Item 1	$\frac{\Delta C}{C}$	- 15	+ 15	%
			Capacitance Change					
			<b>Final Measurements</b>	Table 2 Item 3 Recovery period 24 ± 2 hours	R <sub>i</sub>	10 (4)	-	GΩ
			Insulation Resistance					
			Capacitance Change	Table 2 Item 1	$\frac{\Delta C}{C}$	- 15	+ 15	%
Tangent of Loss Angle	Table 2 Item 2	T <sub>gδ</sub>	-	(2)	10 <sup>-4</sup>			
Insulation Resistance	Table 2 Item 3	R <sub>i</sub>	10 (4)	-	GΩ			
Voltage Proof	Table 2 Item 4	VP	Table 2 Item 4		V			
Visual Examination	No damage	-	-	-	-			
08	Temperature Characteristic	Para. 9.12	Capacitance Changes	Table 3 Item 5(i) or 5(ii)	TCC	Table 3 Item 5(i) or 5(ii)		%

**NOTES**

1. The tests in this table refer to either Chart IV or V and shall be used as applicable.
2. Twice the values specified in Table 2 of this specification.
3. Or 30 seconds for C > 10 000pF.
4. Or 100 seconds for C > 10 000pF.

	<p>ESCC Detail Specification No. 3009/011</p>	<p>PAGE 17 ISSUE 2</p>
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**APPENDIX 'A'**

Page 1 of 1

AGREED DEVIATIONS FOR VITRAMON LTD. (UK)

ITEMS AFFECTED	DESCRIPTION OF DEVIATIONS
Para. 4.2.1	Microsectioning may be performed using Vitramon document QCN-020 (Issue as per P.I.D.).