COAXIAL, DOUBLE SHIELD COAXIAL,

SHIELDED AND JACKETED COAXIAL CABLES

FLEXIBLE, 50 Ω, MINIATURE, PTFE DIELECTRIC,

BASED ON TYPE 50 CIS

ESCC Detail Specification No. 3902/001

ISSUE 1

October 2002

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Pages 1 to 19

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space components
coordination group

Issue/Rev.	Date	Approved by	
		SCCG Chairman	ESA Director General or his Deputy
Issue 4	April 1998		
Revision 'A'	May 2000		

DOCUMENTATION CHANGE NOTICE

Rev. Letter	Rev. Date	Reference	CHANGE Item	Approved DCR No.
		This Issue supersedes Issue 3 and incorporates all changes agreed in the following DCRs:-		
		Cover page	: Title amended	221449
		DCN		None
		Para. 1.1	: Text amended	221449
		Para. 2	: Item (c) added	23885
		Table 1(a)	: "Figure" column added	23885
			: Variants 02 and 03 added	221449
			: Note 3 added	221449
		Table 1(b)	: Nos. 5 and 6, Variant information added	221449
		Figure 1(d)	: Figure added	221449
		Figure 2	: Existing Figure deleted and Figures 2(a) to 2(c) added	221449
		Para. 4.2.2	: Deviation (a) added	221449/ 23885
		Para. 4.3.1	: In the Table, lower 2 sections amended and a new section added	221449
		Para. 4.3.3	: (b), Title amended	221449
			: (c), New (c) added	221449
		Para. 4.4.3	: Title amended	221449
		Para. 4.4.3.1	: In the text, "outer conductor" replaced by "shields"	221449
		Para. 4.4.3.2	: In the text, "outer conductor" replaced by "shields"	221449
		Para. 4.4.4	: Existing paragraph deleted and new paragraph added	221449
		Para. 4.4.5	: New paragraph added	221449
		Para. 4.4.6	: New paragraph added	221449
		Para. 4.4.7	: New paragraph added	221449
		Para. 4.5.2	: "(see Table 1(a))" added to "Type Variant"	23885
		Para. 4.8.3	: Maximum shrinkage amended	221449
		Para. 4.8.4	: Mandrel Diameter amended	221449
		Para. 4.8.12	: New paragraph added	221449
		Table 2	: No. 3, Characteristic amended	221449
			: Nos. 10 and 11, Tests added	221449/ 23885
			: No. 12 added	221449
'A'	May '00	P1. Cover page		None
		P2. DCN		None
		P6. Table 1(a)	: Outer Jacket column heading amended	221554
		P19. Table 2	: No. 12, in Characteristics "03" amended to "02"	221554

TABLE OF CONTENTS

APPENDICES (Applicable to specific Manufacturers only)
None.

1. GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, test and inspection data for Coaxial, Double Shield Coaxial, Shielded and Jacketed Coaxial Cables, Radio Frequency, Flexible, 50Ω, Miniature, PTFE Dielectric, based on Type 50 CIS. It shall be read in conjunction with ESA/SCC Generic Specification No. 3902, the requirements of which are supplemented herein.

1.2 COMPONENT TYPE VARIANTS

Variants of the basic types of coaxial cables specified herein, which are also covered by this specification, are listed in Table 1(a).

1.3 MAXIMUM RATINGS

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

1.4 PARAMETER DERATING INFORMATION

The parameter derating information, applicable to the coaxial cables specified herein, is scheduled in Figure 1(a).

1.5 PHYSICAL CHARACTERISTICS

The physical characteristics of the coaxial cables specified herein are shown in Figure 2 and their dimensions in Table 1(a).

1.6 FUNCTIONAL DIAGRAM

Not applicable.

2. APPLICABLE DOCUMENTS

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

(a) ESA/SCC Generic Specification No. 3902, Cables, Coaxial, Radio Frequency, Flexible.

(b) IEC Standard No. 1196-1, Radio Frequency Cables, General, Definitions, Requirements and Test Methods.

(c) MIL-W-81381, Wire, Electric, Polyimide Insulated, Copper or Copper Alloy VSMF.

3. TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS

For the purpose of this specification, the terms, definitions, abbreviations, symbols and units specified in ESA/SCC Basic Specification No. 21300 and ESA/SCC Generic Specification No. 3902 shall apply.

TABLE 1(a) - TYPE VARIANTS

VARIANT	STRANDING No. of Strands ×Ø	INNER CONDUCTOR CHARACTERISTICS			DIELECTRIC CORE Ø	1st SHIELD Strand Ø	1st INNER Sheath Max. Ø	2nd INNER Sheath Ø	Outer SHIELD Strand Ø	Outer JACKET Max. Ø	Max. WEIGHT (kg/km)	FIGURE
		MAX. Ø (mm)	NOM. SECT. (mm^2)	MAX. OHMIC. RESIST. (Ω/km)								
01	7×0.175	0.56	0.17	122	1.52 ± 0.03	-	-	-	0.07	2.05	9.5	2(a)
02	7×0.175	0.56	0.17	122	1.52 ± 0.03	0.07	-	-	0.07	2.70	20	2(b)
03	7×0.175	0.56	0.17	122	1.52 ± 0.03	0.07	2.05	2.25 ± 0.05	0.10	3.30	24	2(c)

NOTES

1. For Attenuation characteristics, see Figure 1(b).
2. For Return Loss characteristics, see Figure 1(c).
3. For Transfer Impedance characteristics, see Figure 1(d).

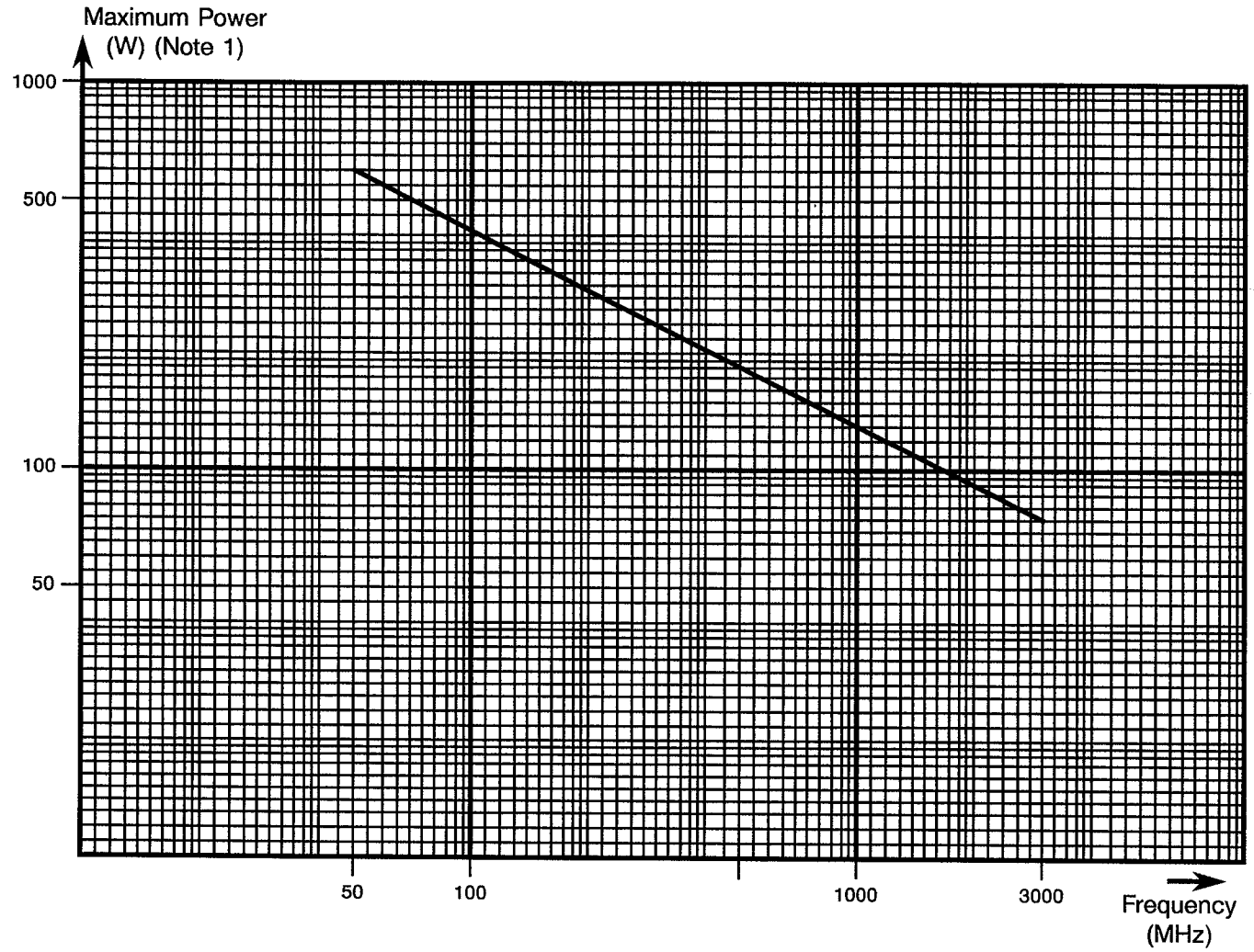
TABLE 1(b) - MAXIMUM RATINGS

No.	CHARACTERISTICS	SYMBOL	MAXIMUM RATINGS	UNIT	REMARKS
1	Continuous Working Voltage	V_P	900	Vrms	
2	Operating Frequency	f_M	3.0	GHz	
3	Power Rating	P_R	See Figure 1(a)	W	Note 1
4	Maximum Current	I	2.5	A	
5	Operating Temperature Range Variant 01 Variant 02 Variant 03	T_{op}	 −100 to +200 −80 to +200 −80 to +200	°C	T_{amb} Note 1
6	Storage Temperature Range Variant 01 Variant 02 Variant 03	T_{stg}	 −100 to +200 −80 to +200 −80 to +200	°C	

NOTES

1. Precautions must be taken to ensure that the aggregate temperature of the cables (ambient plus rise due to power dissipation in the cables) does not exceed the maximum operating temperature.

FIGURE 1(a) - POWER RATING



NOTES

1. At +25°C, sea level.

FIGURE 1(b) - MAXIMUM ATTENUATION

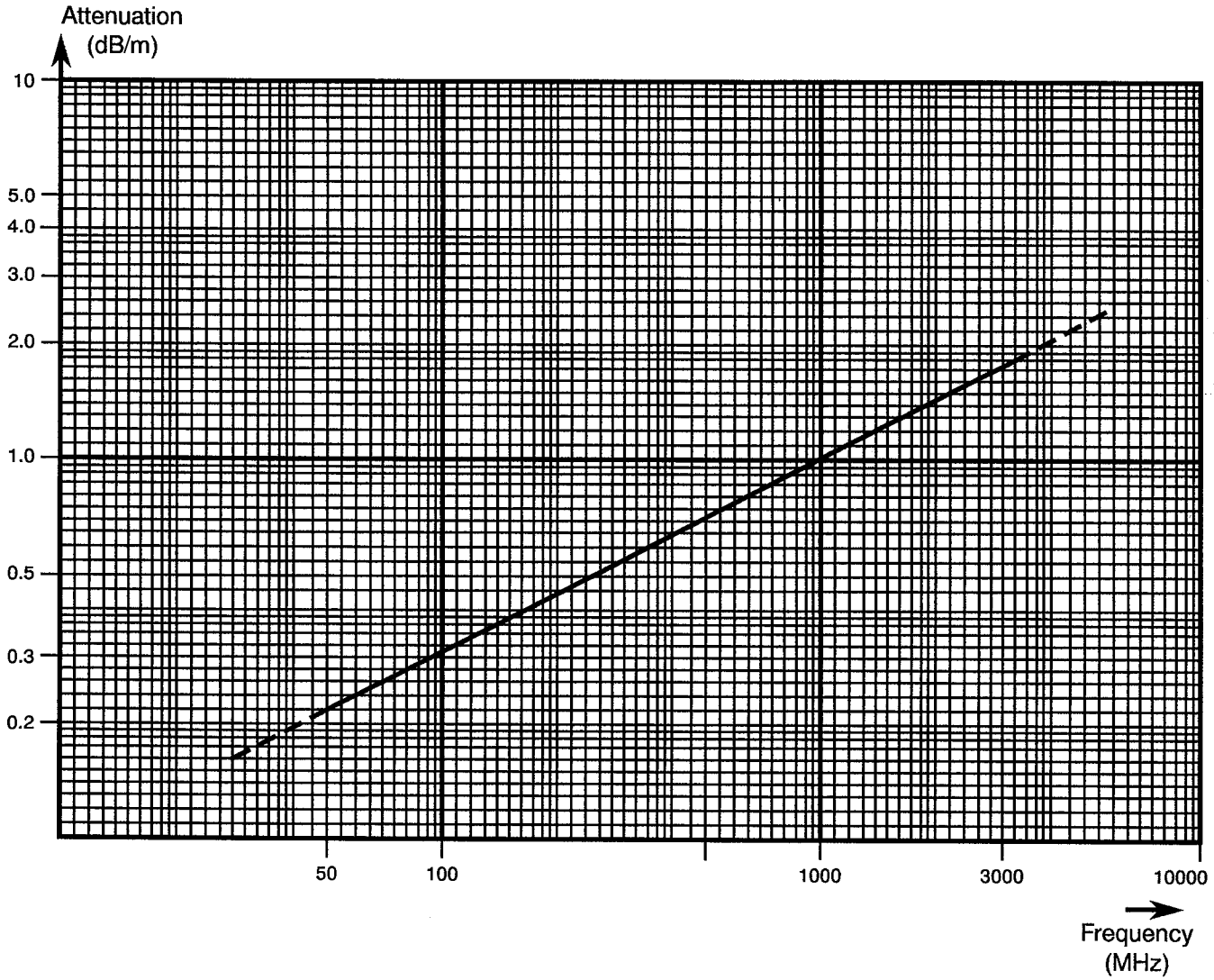


FIGURE 1(c) - MINIMUM STRUCTURAL RETURN LOSS

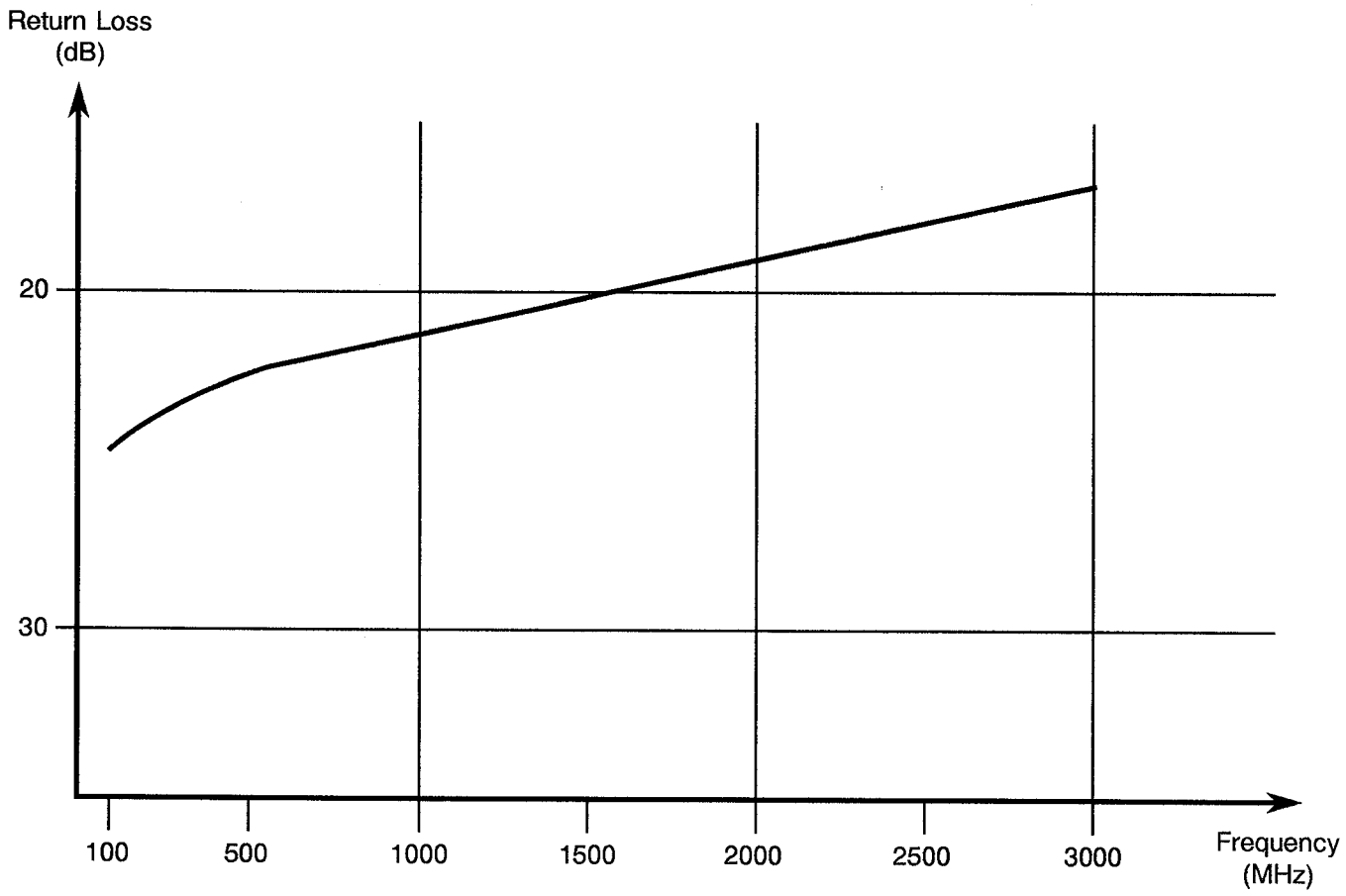


FIGURE 1(d) - TRANSFER IMPEDANCE

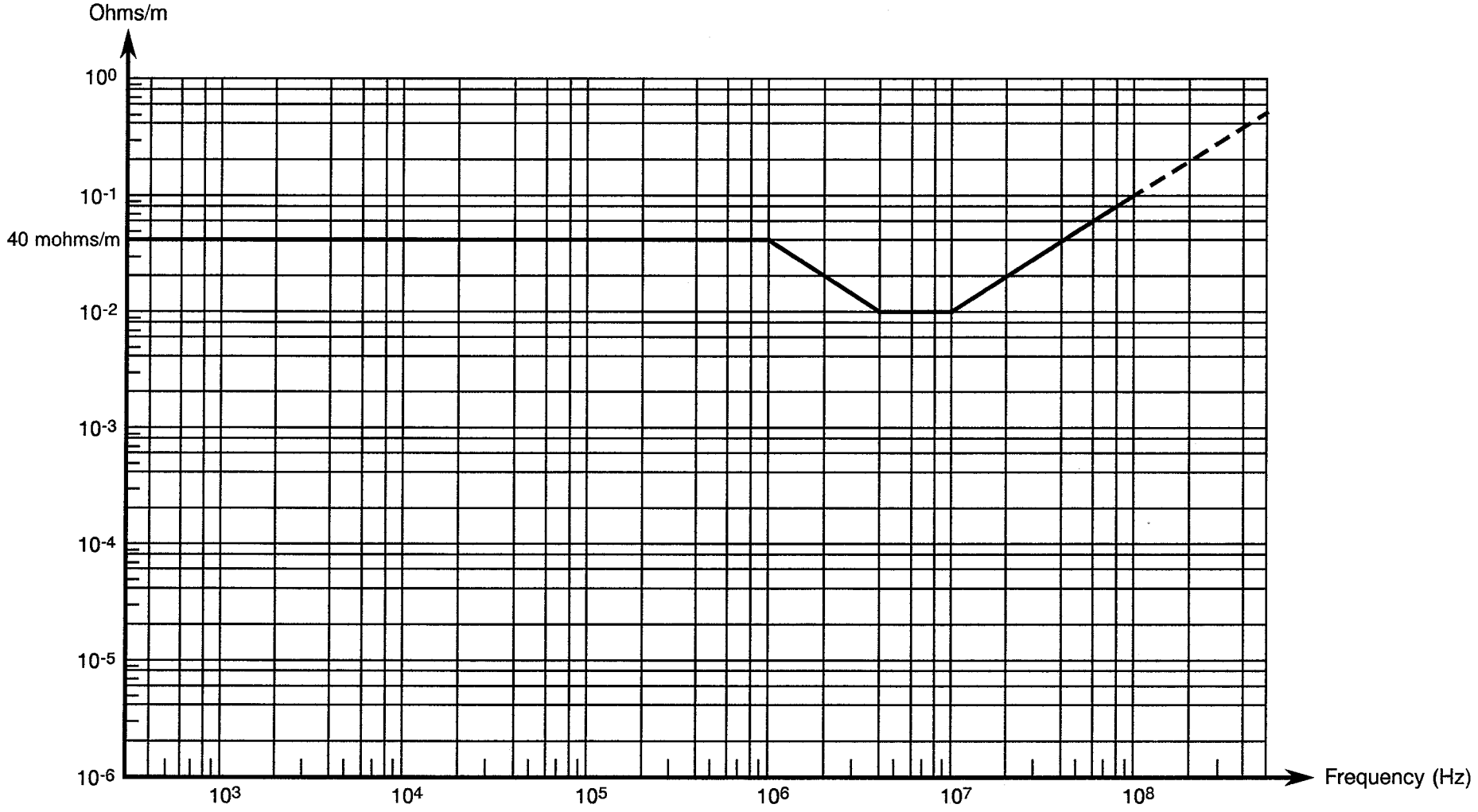


FIGURE 2 - PHYSICAL CHARACTERISTICS

FIGURE 2(a) - COAXIAL CABLE VARIANT 01

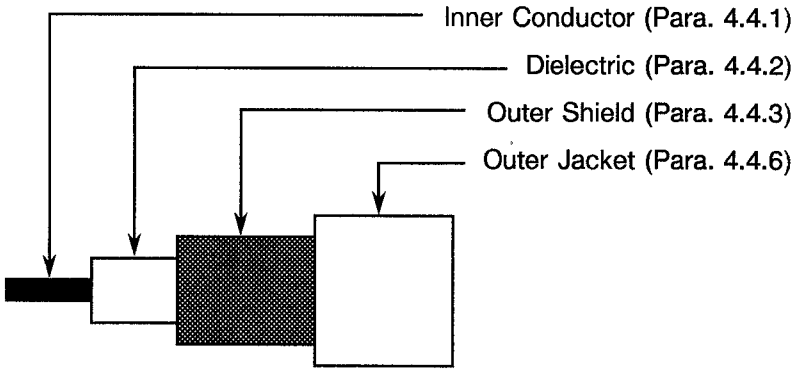


FIGURE 2(b) - DOUBLE SHIELD COAXIAL CABLE VARIANT 02

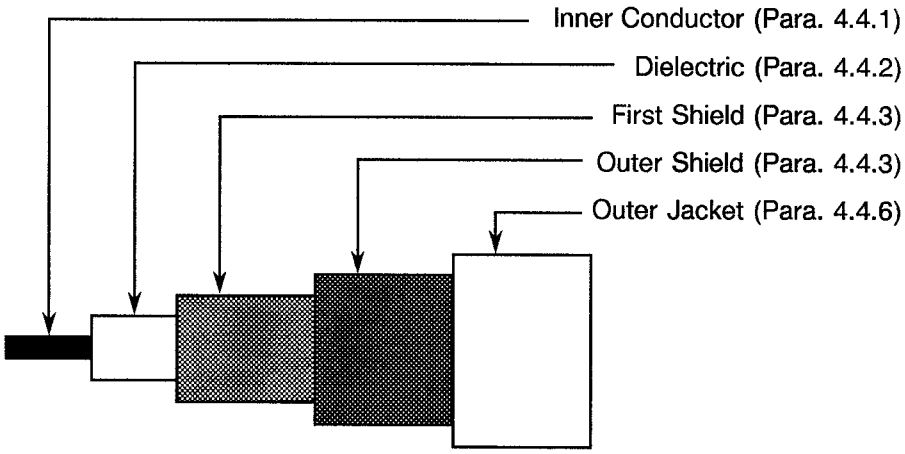
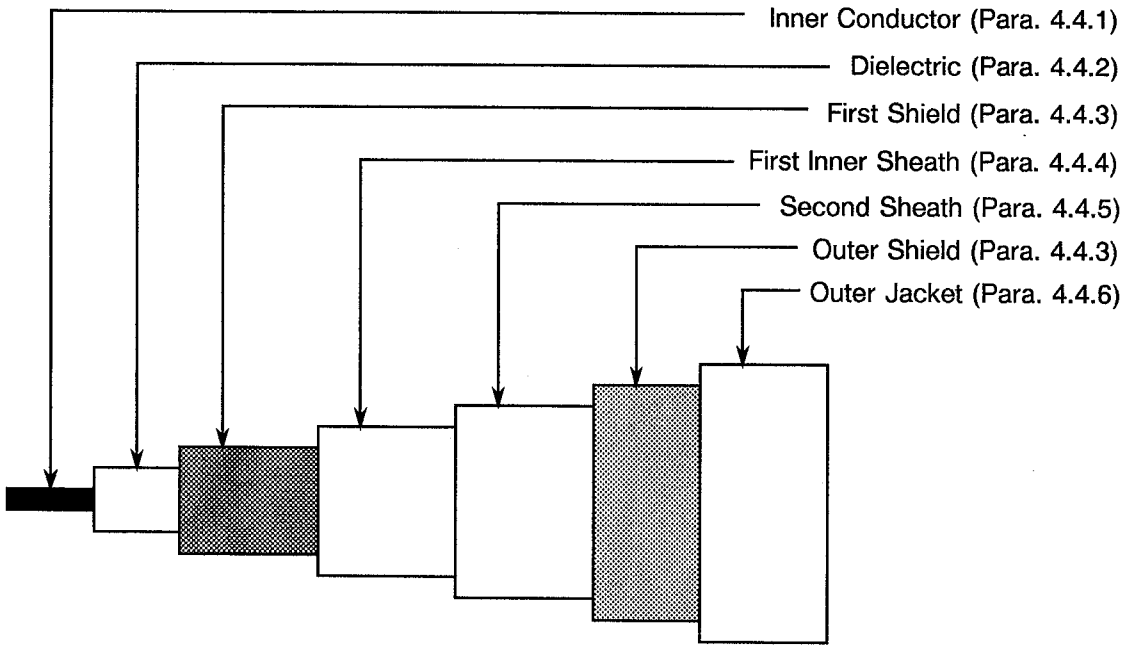


FIGURE 2(c) - SHIELDED AND JACKETED COAXIAL CABLE VARIANT 03



4. REQUIREMENTS

4.1 GENERAL

The complete requirements for procurement of the finished coaxial cables specified herein are stated in this specification and ESA/SCC Generic Specification No. 3902. 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 ESA/SCC 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)

(a) Para. 9.11, Attenuation: Shall be verified at f = 500MHz only.

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

Not applicable.

4.2.4 Deviations from Qualification Tests (Chart IV)

(a) Para. 9.21, Resistance to Fluids: To be modified in accordance with Para. 4.8.7 of this specification.

4.2.5 Deviations from Lot Acceptance Tests (Chart V)

None.

4.3 MECHANICAL REQUIREMENTS

4.3.1 Dimension Check

The dimensions of the coaxial cables specified herein shall be checked; they shall conform to those shown in Figure 2, Table 1(a) and Para. 4.4 of this specification (see below for the list of parameters to be checked).

LIST OF PARAMETERS TO BE CHECKED

PARAMETER	TABLE 1(a)	FIGURE 2	PARA 4.4
INNER CONDUCTOR			
Nature			X
Outer diameter	X		
Number of strands	X		
Strand diameter	X		
Length of lay			X
Silver thickness			X
DIELECTRIC CORE			
Nature		X	X
Thickness			X
Concentricity			X
Outer diameter	X		
INNER AND OUTER SHIELD			
Number of strands			X
Strand diameter	X		
Nature		X	X
Silver thickness			X
Shielding lay			X
Shield coverage			X
POLYIMIDE JACKET			
Composition		X	X
Overlapping			X
Outer diameter	X		
EXTRUDED PFA JACKETS			
Thickness			X
Concentricity			X
Outer diameter	X		

4.3.2 Weight

The maximum weight of the coaxial cables specified herein shall be as specified in Table 1(a).

4.3.3 Stripping Capability

(a) Adhesion of Inner Conductor

The result of the test performed as specified in Para. 9.13 of ESA/SCC Generic Specification No. 3902 shall be within the following limits:-

Minimum value: 9.0N.

Maximum value: 35N.

(b) Polymide Jacket Stripping (Variants 01 and 02)

Easy manual stripping of the jacket shall be verified by means of the following procedure:

- Using a thermal stripper, make an annular incision in the jacket at 40mm from the end of the sample to be stripped.
- Cause a clean, annular break of the jacket by alternate bendings.
- Strip off the jacket by hand. If necessary, use an abrasive cloth (grade 600).

(c) PFA Jackets Stripping Capability (Variant 03)

The adhesion between the outer PFA jacket and the screen and between the inner PFA sheath and the polyimide sheath will be determined as per Specification No. MIL-C17-F, Para. 4.8.1.4 with the following deviations: measured length = 20mm.

The results of the tests will be within the following limits.

	SECOND INNER SHEATH	OUTER JACKET
MIN.	7.0N	10N
MAX.	30N	50N

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 coaxial cables 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 Inner Conductor

4.4.1.1 Material Characteristics

All strands used in the manufacture of the inner conductor shall be silver-coated, high strength copper alloy. The silver thickness of silver shall be 4.0 microns minimum.

The tensile characteristics shall be not less than 6% in elongation at break and a 40kg/mm^2 tensile strength.

For determination of the conductor resistance at +20°C as mentioned in Para. 9.5 of ESA/SCC Generic Specification No. 3902, the 'α' coefficient for copper alloy is 0.0035.

4.4.1.2 Stranding

The inner-conductor shall be constructed of concentrically laid strands so as to produce a smooth and uniform conductor of circular cross-section and free from any high strands or other surface irregularities.

The length of lay of each layer shall not be less than 8, nor more than 16, times the maximum conductor diameter specified in Table 1(a).

4.4.2 Dielectric Core

4.4.2.1 Material

Insulating material shall be virgin polytetrafluorethylene with only those additives that are necessary for processing.

4.4.2.2 Construction

The insulation shall have a uniform cross-section throughout the length of the cable and the conductor shall be evenly centred in the dielectric.

At any cross-section along the length of the coaxial cable, the minimum thickness of the insulation shall not be less than 43% of the difference between measured diameter over the insulation and diameter measured over the conductor, or not less than 76% of the maximum thickness at that cross-section.

Nominal dielectric thickness = 0.5mm.

4.4.3 Shields

4.4.3.1 Material Characteristics

All strands used in the manufacture of the shields shall be silver-coated, soft or annealed, oxygen-free, high conductivity copper. The silver thickness shall be 2.0 microns minimum. Any strand shall show a 10% minimum elongation.

4.4.3.2 Construction

The shields shall be closely woven around the strands and provide not less than 85% coverage, 'K' being calculated by the following formula:-

$K = (2F - F^2) \times 100.$

where

K = percent coverage.

$F = \frac{N.d.P}{\sin a}$.

N = number of strands per carrier.
d = diameter of strands (mm).
P = picks per mm.
a = angle of shield with cable axis in degrees.

$\text{tg } a = \frac{2\pi (D + d2) P}{C}$.

D = effective diameter of cable under shield (mm).
D = $(\pi + n)\ b/\pi$.
n = number of basic wires.
b = basic wire diameter.
C = number of carriers.

4.4.4 First Inner Sheath

4.4.4.1 Material

Any insulating material shall be virgin polyimide with only those additives that are necessary for processing and pigmentation.

4.4.4.2 Construction

The sheath shall consist of 1 wrapped ribbon, the overlapping of which shall be equal to, or more than 51%. The ribbon (30µm of thickness) shall conform to 0.1/1.0/0.1 type in accordance with MIL-W-81381. The sheath shall have a uniform cross section throughout the length of the cable. The nominal wall thickness shall be 0.05mm.

4.4.5 Second Inner Sheath

4.4.5.1 Material

Sheath material shall be virgin perfluroalkoxy (PFA) with only those additives that are necessary for processing and pigmentation.

4.4.5.2 Construction

The sheath shall have a uniform cross-section throughout the length of the cable. At any cross-section along the length of the cable, the minimum wall thickness shall not be less than 70% of the maximum thickness at that cross-section.

4.4.6 Outer Jacket

4.4.6.1 Material

Variant 01: Any insulating material shall be virgin polyimide with only those additives that are necessary for processing and pigmentation.

Variants 02 and 03: Jacket material shall be virgin perfluroalkoxy (PFA) with only those additives that are necessary for processing and pigmentation.

4.4.6.2 Construction

Variant 01: The jacket shall consist of 1 wrapped ribbon, the overlapping of which shall be equal to, or more than 51%. The ribbon (30µm of thickness) shall conform to 0.1/1.0/0.1 type in accordance with MIL-W-81381. The jacket shall have a uniform cross section throughout the length of the cable. The nominal wall thickness shall be 0.05mm.

Variants 02 and 03: The jacket shall have a uniform cross-section throughout the length of the cable. At any cross-section along the length of the cable, the minimum wall thickness shall not be less than 70% of the maximum thickness at that cross-section.

4.4.7 Colour Coding

The dielectric and the inner sheath materials shall have the natural colour of its material.

The colour of the outer jacket shall be as follows:

- Variant 01: Natural colour.
- Variant 02: Green.
- Variant 03: White.

4.5 MARKING

4.5.1 General

The marking of all spools of finished coaxial cables delivered to this specification shall be in accordance with the requirements of ESA/SCC Basic Specification No. 21700. Each spool shall be marked in respect of:-

(a) The SCC Component Number.

(b) Characteristics.

(c) Traceability Information.

(d) Additional Marking.

4.5.2 The SCC Component Number

Each spool shall bear the SCC Component Number which shall be constituted and marked as follows:-

390200101B

Detail Specification Number

Type Variant (see Table 1(a))

Testing Level

4.5.3 Characteristics

The characteristics shall show the length(s) of finished coaxial cable wound on each spool and shall be marked as follows:-

100m

Length in metres (see Note)

Symbol for metres

NOTE

Whenever the length is less than 100 metres, insert a zero in the first block (example: 075m). If more than one length of finished coaxial cable is wound on a spool, the characteristics of each length shall be marked as above.

4.5.4 Traceability Information

Each spool shall be marked in respect of traceability information in accordance with the requirements of ESA/SCC Basic Specification No. 21700.

4.5.5 Additional Marking

Each spool shall bear the cable Manufacturer's Quality Control Inspector's stamp.

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

Not applicable.

4.6.3 Circuits for Electrical Measurements (Figure 4)

Not applicable.

4.7 BURN-IN TESTS

Not applicable.

4.8 ENVIRONMENTAL AND ENDURANCE TESTS (CHARTS IV AND V OF ESA/SCC GENERIC SPECIFICATION No. 3902)

4.8.1 Mechanical Properties of Conductors

See Paras. 4.4.1.1 and 4.4.3.1 of this specification.

4.8.2 Alternate Bending Resistance

Weight applied : 500g.
Minimum number of cycles : 1000.

4.8.3 Accelerated Ageing Stability

Ageing temperature	:	+230 ± 5 °C for samples 1 and 2.
	:	+200 ± 5 °C for sample 3.
Maximum shrinkage or protrusion value	:	
- Dielectric	:	1.0mm.
- Inner and outer PFA jacket	:	1.5mm.
Maximum capacitance change	:	4.0%.
Maximum attenuation change	:	8.0%.
Structural Return Loss	:	Shall stay under the specified limit (see Figure 1(c)).

4.8.4 Cold Bend Test

Chamber temperature	:	−80 ± 2 °C.
Mandrel diameter	:	20mm − Variant 01.
	:	30mm − Variants 02 and 03.

4.8.5 Solderability

No particular conditions are applicable.

4.8.6 Corona Extinction Voltage

Minimum extinction voltage: 1200V.

4.8.7 Resistance to Fluids

Tests (e) and (f) shall be deleted.

4.8.8 Flammability Resistance

No particular conditions are applicable.

4.8.9 Radiation Resistance

No particular conditions are applicable.

4.8.10 Outgassing

No particular conditions are applicable.

4.8.11 Long-term Ageing Test

Long-term ageing temperature: +200°C.

4.8.12 Transfer Impedance

This test shall be performed in accordance with IEC 1196-1, Para. 12.2, triaxial method.

TABLE 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE

No.	CHARACTERISTICS	SYMBOL	ESA/SCC 3902 TEST METHOD AND CONDITIONS	LIMITS	UNIT
1	Insulation Flaws (Dielectric Core)	-	Para 5.3.1 50Hz	5.0	kVrms
2	Inner Conductor Resistance	R	Para. 9.5	Table 1(a)	Ω/km
3	Dielectric Strength of Polyimide Jacket	V_P	Para. 9.6	1.5	kVrms
4	Voltage Test (Dielectric Core)	V_T	Para. 9.7	2.0	kVrms
5	Insulation Resistance	Ri	Para. 9.8	5 000	MΩkm
6	Capacitance	C	Para. 9.9	95 ± 4	pF/m
7	Characteristic Impedance	Z	Para. 9.10	50 ± 2	Ω
8	Attenuation	IL	Para. 9.11	Figure 1(b)	dB/m
9	Structural Return Loss	SRL	Para. 9.12	Figure 1(c)	dB
10	Dielectric Strength of PFA Outer Jacket (Variants 02 and 03)	V	Para. 9.6	1.75	kVrms
11	Voltage Test Between Shields (Variant 03)	V	Para. 9.7	1.0	kVrms
12	Transfer Impedance (Variant 02)	Z_T	Para. 4.8.12 of this spec.	Figure 1(d)	Ω/m