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**Secure Elements;
Additional UICC form factors and environmental conditions;
Physical and logical characteristics
(Release 18)**

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650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
Association à but non lucratif enregistrée à la
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Contents

Intellectual Property Rights	5
Foreword.....	5
Modal verbs terminology.....	6
1 Scope	7
2 References	7
2.1 Normative references	7
2.2 Informative references.....	8
3 Definition of terms, symbols and abbreviations.....	8
3.1 Terms.....	8
3.2 Symbols.....	8
3.3 Abbreviations	8
4 Overview	8
5 Definition of Environmental Classes.....	9
5.1 Environmental condition classification system	9
5.1.0 Environmental property indicators	9
5.1.1 Storage of environmental properties	9
5.1.2 E _{ENV-CLASSES}	9
5.2 Operational and Storage Temperature (TX).....	10
5.2.0 Overview	10
5.2.1 Temperature (TS) -25 °C to +85 °C.....	10
5.2.2 Temperature (TA) -40 °C to +85 °C.....	10
5.2.3 Temperature (TB) -40 °C to +105 °C	10
5.2.4 Temperature (TC) -40 °C to +125 °C	10
5.3 Moisture/Reflow conditions (MX).....	10
5.3.0 Overview	10
5.3.1 Moisture/Reflow conditions (MA)	10
5.4 Humidity (HX)	11
5.4.0 Overview	11
5.4.1 Humidity (class HA) - High humidity	11
5.5 Corrosion (CX).....	11
5.5.0 Overview	11
5.5.1 Corrosion (CA to CD) - Salt atmosphere.....	11
5.6 Vibration (VX)	11
5.6.0 Overview	11
5.6.1 Vibration (VA) - Automotive vibration	11
5.7 Void.....	12
5.8 Shock (SX)	12
5.8.0 Overview	12
5.8.1 Shock (SA) - Automotive shock	12
5.9 Data Retention Time (RX)	12
5.9.0 Overview	12
5.9.1 Data Retention Time (RA) - 10 years	12
5.9.2 Data Retention Time (RB) - 12 years	12
5.9.3 Data Retention Time (RC) - 15 years	12
5.10 Minimum Updates (UX)	12
5.10.0 Overview	12
5.10.1 Minimum Updates (UA) - 100 000.....	12
5.10.2 Minimum Updates (UB) - 500 000.....	13
5.10.3 Minimum Updates (UC) - 1 000 000.....	13
6 MFF characteristics	13
6.0 Basic requirements	13
6.1 Void.....	13
6.2 Specific MFF physical characteristics.....	13

6.2.0	Introduction.....	13
6.2.1	MFF1	14
6.2.1.0	Dimensions.....	14
6.2.1.1	Orientation mark for the bottom of the package	15
6.2.1.2	Orientation mark for top of package	15
6.2.2	MFF2	16
6.2.2.1	Dimensions.....	16
6.2.2.2	Orientation mark for the bottom of the package	17
6.2.2.3	Orientation mark for top of package	17
6.2.3	Additional packages for the UICC.....	17
6.2.3.1	Dimensions.....	17
6.2.3.1.1	MFF3 Dimensions	17
6.2.3.1.2	MFF4 Dimensions	18
6.2.3.2	Contact and pin assignment	18
6.2.3.3	Orientation mark for the bottom of the package	19
6.2.3.4	Orientation mark for top of package	19
7	Electrical and Logical specifications.....	19
7.0	Requirements.....	19
7.1	Voltage Class support.....	19
8	Device Pairing Mechanism	19
8.0	Introduction	19
8.1	Secure Channel Pairing	19
8.2	CAT application pairing.....	20
Annex A (informative): PCB layout for the MFF.....		21
Annex B (informative): Change history		23
History		24

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1 Scope

The present document details the technical specifications for additional form factors and extended environmental conditions for the UICC.

Specifically, the present document specifies:

- Physical, logical and electrical specifications for additional form factors of the UICC.
- Extension of the environmental class specifications as originally defined in ETSI TS 102 221 [1]. These may optionally be applied to all specified UICC form factors (including the form factors defined in ETSI TS 102 221 [1]).
- Device pairing mechanisms that allow the UICC to verify the terminal with which it is operating.

2 References

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The following referenced documents are necessary for the application of the present document.

- [1] [ETSI TS 102 221](#): "Smart Cards; UICC-Terminal interface; Physical and logical characteristics".
- [2] Void.
- [3] [ETSI TS 102 613](#): "Smart Cards; UICC - Contactless Front-end (CLF) Interface; Physical and data link layer characteristics".
- [4] [ETSI TS 102 600](#): "Smart Cards; UICC-Terminal interface; Characteristics of the USB interface".
- [5] [ETSI TS 102 484](#): "Smart Cards; Secure channel between a UICC and an end-point terminal".
- [6] [ETSI TS 102 223](#): "Smart Cards; Card Application Toolkit (CAT)".
- [7] [IPC/JEDEC J-STD-020D.1](#): "Moisture/Reflow Sensitivity Classification for Non-hermetic Solid State Surface Mount Devices".
- [8] [JEDEC JESD22-A104D](#): "Temperature Cycling".
- [9] [JEDEC JESD22-B103B.01](#): "Vibration, Variable Frequency".
- [10] [JEDEC JESD22-B104C](#): "Mechanical Shock".
- [11] [JEDEC JESD22-A107B](#): "Salt Atmosphere".
- [12] [JEDEC MO-229F](#): "Registration - Thermally Enhanced Plastic Very Thin, Very Very Thin, and Ultra Thin Fine Pitch Small Outline No Lead Package Family. H(V, W, U)F-PSON".

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The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI TR 102 216: "Smart Cards; Vocabulary for Secure Element Technologies specifications".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI TR 102 216 [i.1] and the following apply:

MFF: form factor for a UICC which is soldered or not intended to be easily removable

NOTE: Starting from Rel-18 of the present specification, the MFF form factors are defined as form factors for non-removable UICCs. Previous versions of ETSI TS 102 671 associated the MFF form factors with UICCs intended for Machine to Machine (M2M) applications with extended environmental conditions. This is no longer the case.

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI TR 102 216 [i.1] and the following apply:

ASCII	American Standard Code for Information Interchange
ESN	Electronic Serial Number
IMEI	International Mobile Equipment Identity
IMEISV	International Mobile Equipment Identity and Software Version
MEID	Mobile Equipment IDentifier
PCB	Printed Circuit Board
SMS	Short Message Service

4 Overview

The present document details:

- Optional extended environmental specifications of the UICC.
- The definition of the environmental classes for the UICC.
- The physical characteristics of soldered or not intended to be easily removable UICC.
- Optional extended electrical specifications of the UICC.

- The logical characteristics of the UICC supporting the present document.
- The definition of device pairing mechanisms between the UICC and the terminal.

5 Definition of Environmental Classes

5.1 Environmental condition classification system

5.1.0 Environmental property indicators

The following classification system allows the easy identification of the extended environmental performance of the UICC.

A UICC supporting extended environmental performance as specified in the present document shall be classified with a string representing its environmental performance. This string has two characters for each environmental property and is separated from each condition by a "-" (e.g. TA-HA-...-RA). The first letter defines the environmental property as detailed in table 5.1 and the second letter is the level of support for this property as defined in each clause.

If a UICC does not meet any level specified in the present document for a particular environmental property then this property shall not be present in the string representing its environmental performance. There is no defined order for the environmental properties.

Table 5.1: Description of the environmental property indicators

Environmental property letter	Description of environmental property	Property details in clause
T	Operational and storage temperature	5.2
M	Moisture/Reflow conditions	5.3
H	Humidity	5.4
C	Corrosion	5.5
V	Vibration	5.6
S	Shock	5.8
R	Data Retention time	5.9
U	Minimum Updates	5.10

5.1.1 Storage of environmental properties

The environmental properties of UICCs shall be stored in an Elementary File under the Master File according to the classification system defined in clause 5.1.0.

5.1.2 EF_{ENV-CLASSES}

EF_{ENV-CLASSES} is a transparent file under the MF and is under the responsibility of the issuer. It provides information about the UICC capabilities to external entities.

Table 5.1a: EF_{ENV-CLASSES} at MF-level

Identifier: '2F07'	Structure: Transparent	Mandatory
SFI: Optional		
File size: X bytes	Update activity: low	
Access Conditions:		
READ	ALW	
UPDATE	ADM	
DEACTIVATE	ADM	
ACTIVATE	ADM	
Bytes	Description	M/O
1 to X	Environmental property classes	M
		Length
		X bytes

The EF stores the environmental property classes supported by the UICC as defined for the classification system in clauses 5.1 to 5.10. The coding shall be as for an alpha identifier using SMS default 7-bit coding with bit 8 set to 0 (see ETSI TS 102 223 [6]), e.g. "TA-HA" = '54412D4841'.

5.2 Operational and Storage Temperature (TX)

5.2.0 Overview

The TX property defines the UICC performance for operational and storage temperature.

Support of a given temperature range for a UICC operation implies that the UICC shall withstand the following conditions:

- 500 temperature cycles within the full supported range.
- 2 cycles per hour.

Testing temperature cycling shall be in accordance with JESD22-A104 [8].

5.2.1 Temperature (TS) -25 °C to +85 °C

UICCs indicating TS as their temperature property shall conform to the storage and operational temperature specifications detailed in ETSI TS 102 221 [1] for the standard temperature range.

5.2.2 Temperature (TA) -40 °C to +85 °C

UICCs indicating TA as their temperature property shall conform to the storage and operational temperature specifications detailed in ETSI TS 102 221 [1] for class A specific UICC environmental conditions.

5.2.3 Temperature (TB) -40 °C to +105 °C

UICCs indicating TB as their temperature property shall conform to the storage and operational temperature specifications detailed in ETSI TS 102 221 [1] for class B specific UICC environmental conditions.

5.2.4 Temperature (TC) -40 °C to +125 °C

UICCs indicating TC as their temperature property shall conform to the storage and operational temperature specifications detailed in ETSI TS 102 221 [1] for class C specific UICC environmental conditions.

5.3 Moisture/Reflow conditions (MX)

5.3.0 Overview

The MX property defines the UICC performance for moisture/reflow conditions that may be experienced during the manufacturing of the M2M communication module.

5.3.1 Moisture/Reflow conditions (MA)

UICCs indicating MA shall support at least the following moisture/reflow conditions according to IPC/JEDEC J-STD-020D [7]:

- Classification Temperature (T_c) of 260 °C supporting Pb-Free process.
- Moisture Sensitivity Level 3.
- Pb-Free Assembly reflow profile class.

5.4 Humidity (HX)

5.4.0 Overview

The HX property defines the UICC performance in humid conditions.

5.4.1 Humidity (class HA) - High humidity

UICCs indicating HA as their humidity property shall support the high humidity condition as specified in ETSI TS 102 221 [1] specific UICC environmental conditions.

5.5 Corrosion (CX)

5.5.0 Overview

The CX property defines the UICC performance in corrosive conditions.

5.5.1 Corrosion (CA to CD) - Salt atmosphere

UICCs indicating CA, CB, CC or CD shall be able to pass the salt atmosphere test according to JESD22-A107 [11].

JESD22-A107 [11] applies for removable UICCs only. Non-removable UICCs shall indicate CN.

The following test condition (referring to the duration of exposure to the salt atmosphere) apply.

Table 5.2

Environmental property indicators	Test condition as specified in JESD22-A107 [11]
CA	A
CB	B
CC	C
CD	D

5.6 Vibration (VX)

5.6.0 Overview

The VX property defines the UICC performance in vibrating conditions.

5.6.1 Vibration (VA) - Automotive vibration

UICCs indicating VA as their vibration property shall be able to pass the variable frequency vibration tests according to JESD22-B103 [9] with test levels as defined in service condition 1 for the swept sine test; optional random vibration tests as defined in JESD22-B103 [9] are not applicable for the VA vibration property.

JESD22-B103 [9] applies for cavity packages only. Non-cavity (e.g. moulded) UICCs shall indicate VN.

5.7 Void

5.8 Shock (SX)

5.8.0 Overview

The SX property defines the UICC susceptibility to shock.

5.8.1 Shock (SA) - Automotive shock

UICCs indicating SA as their shock property shall be able to pass the mechanical shock tests according to JESD22-B104 [10] with test levels as defined in service condition B.

JESD22-B104 [10] applies for cavity packages only. Non-cavity (e.g. moulded) UICCs shall indicate SN.

5.9 Data Retention Time (RX)

5.9.0 Overview

The RX property defines the UICC's ability to retain data over time.

5.9.1 Data Retention Time (RA) - 10 years

UICCs indicating RA as their data retention time property shall be able to fully operate with no loss of stored information over a 10 year period from the time of manufacture. Loss of information due to multiple erase/write cycles is excluded from this property.

5.9.2 Data Retention Time (RB) - 12 years

UICCs indicating RB as their data retention time property shall be able to fully operate with no loss of stored information over a 12 year period from the time of manufacture. Loss of information due to multiple erase/write cycles is excluded from this property.

5.9.3 Data Retention Time (RC) - 15 years

UICCs indicating RC as their data retention time property shall be able to fully operate with no loss of stored information over a 15 year period from the time of manufacture. Loss of information due to multiple erase/write cycles is excluded from this property.

5.10 Minimum Updates (UX)

5.10.0 Overview

The UX property defines the UICC's expected minimum number of UPDATE commands (as specified in ETSI TS 102 221 [1]) supported for specified files, which are indicated as "high" in the "update activity" field.

5.10.1 Minimum Updates (UA) - 100 000

UICCs indicating UA as their minimum number of UPDATE commands property shall be able to update the specified file(s), 100 000 times without failure. Loss of information due to time factors is excluded from this property.

5.10.2 Minimum Updates (UB) - 500 000

UICCs indicating UB as their minimum number of update commands property shall be able to update the specified file(s), 500 000 times without failure. Loss of information due to time factors is excluded from this property.

5.10.3 Minimum Updates (UC) - 1 000 000

UICCs indicating UC as their minimum number of update commands property shall be able to update the specified file(s), 1 000 000 times without failure. Loss of information due to time factors is excluded from this property.

6 MFF characteristics

6.0 Basic requirements

Unless otherwise specified in the present specification the UICC shall conform to the physical characteristics of the UICC as defined in ETSI TS 102 221 [1].

6.1 Void

6.2 Specific MFF physical characteristics

6.2.0 Introduction

This clause defines the specific physical characteristics for the MFF.

Two form factors are defined and called hereafter MFF1 and MFF2:

- MFF1 is well adapted for socketing.
- MFF2 offers the possibility to have a large heatsink in the middle.

NOTE: The MFF1 central contacts also allow heatsink dissipation.

6.2.1 MFF1

6.2.1.0 Dimensions

The MFF1 shall have the following dimensions outlined in figure 6.1 and a thickness of 0,50 mm to 0,65 mm.

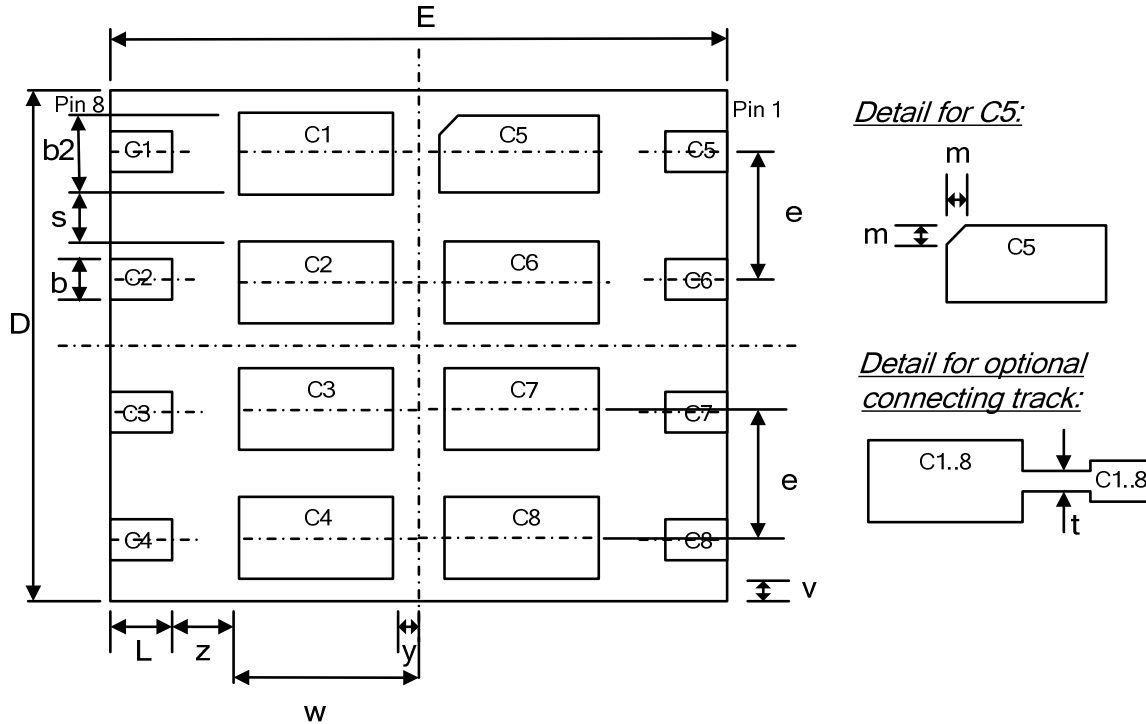


Figure 6.1: MFF1 bottom view

The inner tips of the outer contacting pads may be rectangular or rounded.

Table 6.1: Package pin to UICC contact mapping

Package pin	UICC contact	Package pin	UICC contact
1	C5	8	C1
2	C6	7	C2
3	C7	6	C3
4	C8	5	C4

In the case where the MFF1 does not support the functionality as defined in ETSI TS 102 600 [4] then contacts C4 and C8 shall not be bonded.

In the case where the MFF1 does not support the functionality as defined in ETSI TS 102 613 [3] then contact C6 shall not be bonded.

Table 6.2: Dimensions of the MFF1

Parameter	Description	Dimensions (mm)
E	The package body dimension in the horizontal direction.	6,00 ± 0,10
D	The package body dimension in the vertical direction.	5,00 ± 0,10
L	The length of the outer contacting pad as measured from the edge of the package.	0,60 ± 0,15
s	The vertical distance from the bottom of the inner contacting pad to the top of the next inner contacting pad.	min 0,20
w	The horizontal distance from the centre of the package to the furthest side of the inner contacting pad.	min 1,75
z	The horizontal distance from the nearest sides of the outer and the inner contacting pad.	min 0,20
t	the width of the connecting track that may connect corresponding inner and outer contacting pads on the surface of the MFF1.	max 0,20
y	The horizontal distance from the centre of the package to the nearest side of the inner contacting pad.	0,20 ± 0,10
v	The vertical distance between the side of the package and the nearest side of the nearest inner contacting pad.	min 0,10
b	The width of the outer metallised outer contacting pads (including lead finish) exposed at the bottom surface of the package.	0,40 ± 0,10
b2	The width of the inner metallised contacting pads (including lead finish) exposed at the bottom surface of the package. The inner contacting pads may be elongated in the vertical direction without staying centred with the horizontal axis of the corresponding outer contacting pad as long as the gap between contacts is greater than s and the gap from the inner contacting pad to the edge of the package is greater than v and a minimum width of 0,7 mm stays centred with the horizontal axis of the corresponding outer contacting pad.	min 0,70
e	The centreline-to-centreline spacing of the inner and outer contacting pads.	1,27 for tolerances see parameters bbb and ddd
bbb	The tolerance that controls the position of the contact pattern with respect to the horizontal package centreline. The centre of the tolerance zone for each contact is defined by basic dimension e as related to the horizontal package centreline.	0,10
ddd	The tolerance that controls the position of the contacts to each other. The centres of the profile zones are defined by basic dimension e.	0,05
m	Horizontal and vertical size of orientation mark.	0,25 ± 0,05

As outlined in figure 6.1, each MFF1 contact (C1 to C8) shall comprise the following contact areas:

- one small outer contacting pad aligned with the edge of the package; plus
- one larger inner contacting pad.

The inner and outer pads belonging to the same contact shall be electrically connected in the MFF1. This connection may be on the surface as long as the connecting track's width t is compliant with what is indicated for this parameter in table 6.2.

6.2.1.1 Orientation mark for the bottom of the package

An orientation mark shall be visible on the inner C5 contacting pad.

6.2.1.2 Orientation mark for top of package

The top of the package shall have an orientation mark located in the same corner as contact C5.

6.2.2 MFF2

6.2.2.1 Dimensions

Figure 6.2 defines various dimensions of the package layout seen from the bottom side.

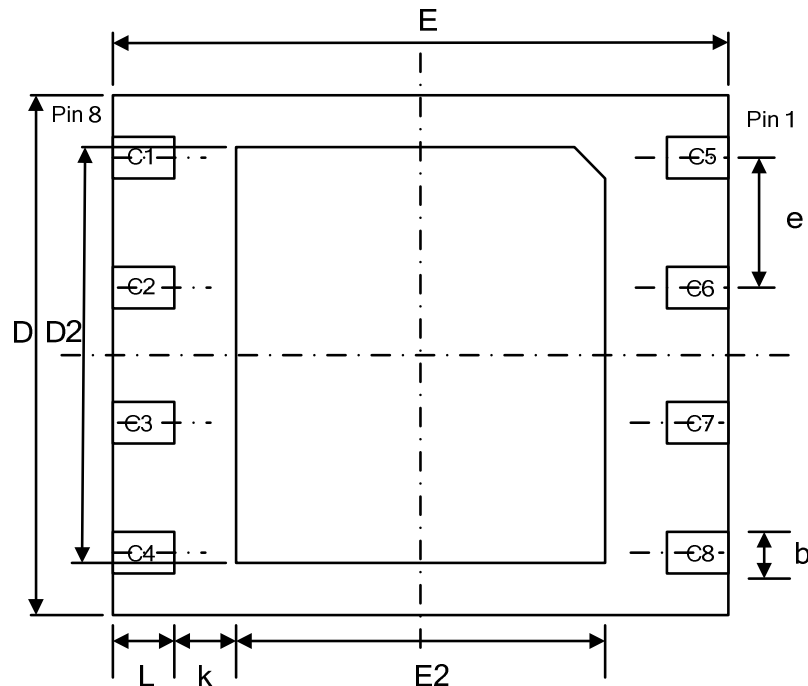


Figure 6.2: MFF2 bottom view

The inner contact tips may be rectangular or rounded.

Package pin to UICC contact mapping is defined in table 6.1.

In the case where the MFF2 does not support the functionality as defined in ETSI TS 102 600 [4] then contacts C4 and C8 shall not be bonded.

In the case where the MFF2 does not support the functionality as defined in ETSI TS 102 613 [3] then contact C6 shall not be bonded.

Table 6.3: Dimensions of the MFF2

Parameter	Description	Dimensions (mm)
E	The package body dimension in the horizontal direction.	$6,00 \pm 0,15$
D	The package body dimension in the vertical direction.	$5,00 \pm 0,15$
L	The length of the contact as measured from the edge of the package.	$0,60 \pm 0,15$
b	The width of the metallised contacts (including lead finish) exposed at the bottom surface of the package.	$0,40 \pm 0,10$
E2	The horizontal dimension of the exposed metal heat feature (exposed die pad).	min 3,30
D2	The vertical dimension of the exposed metal heat feature (exposed die pad).	min 3,90
k	The gap between any contact and the heat feature.	min 0,20
e	The centreline-to-centreline spacing of the contacts.	1,27 for tolerances see parameters bbb and ddd
bbb	The tolerance that controls the position of the contact pattern with respect to the horizontal package centreline. The centre of the tolerance zone for each contact is defined by basic dimension e as related to the horizontal package centreline.	0,10
ddd	The tolerance that controls the position of the contacts to each other. The centres of the profile zones are defined by basic dimension e.	0,05

6.2.2.2 Orientation mark for the bottom of the package

An orientation mark, located in the same corner as contact C5, shall be visible on the heat feature. This orientation mark may be a different shape than the one shown in figure 6.2.

6.2.2.3 Orientation mark for top of package

The top of the package shall have an orientation mark located in the same corner as contact C5.

6.2.3 Additional packages for the UICC

6.2.3.1 Dimensions

6.2.3.1.1 MFF3 Dimensions

The MFF3 shall be a 10-pin package in accordance with JEDEC MO-229F [12].

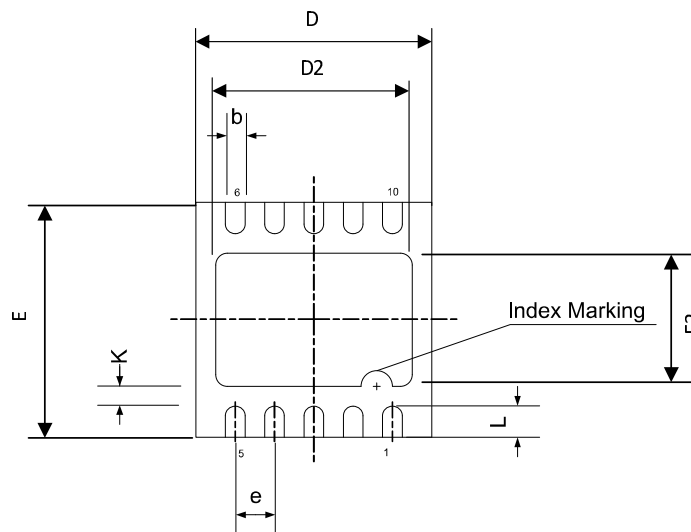


Figure 6.3: MFF3 bottom view

Table 6.4: Dimensions of the MFF3

Parameter	Description	Dimensions (mm)
A	Thickness	U, V or W as defined in JEDEC MO-229F [12]
E	The package body dimension in the horizontal direction.	$3,00 \pm 0,15$
D	The package body dimension in the vertical direction.	$3,00 \pm 0,15$
L	The length of the contact as measured from the edge of the package.	$0,20 - 0,65$
b	The width of the metallised contacts (including lead finish) exposed at the bottom surface of the package.	$0,18 - 0,30$
D2	Heat sink length	1,20 min
E2	Heat sink width	0,10 min
K	The gap between any contact and the heat feature.	0,20 min
e	The centreline-to-centreline spacing of the contacts.	0,50 for tolerances see parameters bbb and ddd as defined in JEDEC MO-229F [12]

Other dimensions shall be compliant with the definitions in JEDEC MO-229F [12].

6.2.3.1.2 MFF4 Dimensions

The MFF4 shall be an 8-pin package in accordance with JEDEC MO-229F [12].

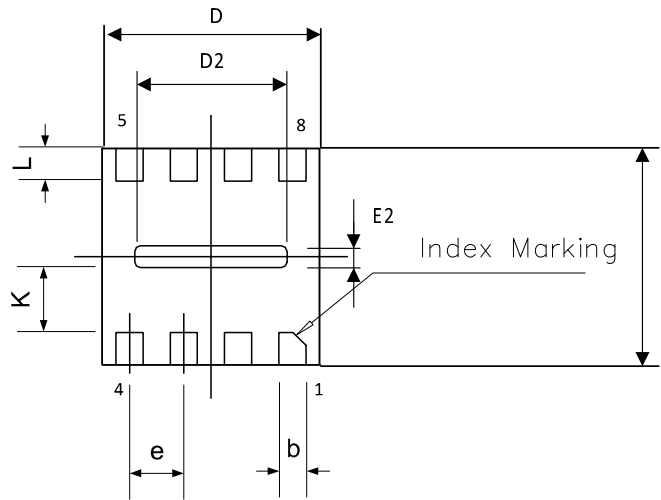


Figure 6.4: MFF4 bottom view

Table 6.5: Dimensions of the MFF4

Parameter	Description	Dimensions (mm)
A	Thickness	U, V or W as defined in JEDEC MO-229F [12]
E	The package body dimension in the horizontal direction.	2,00 ± 0,15
D	The package body dimension in the vertical direction.	2,00 ± 0,15
L	The length of the contact as measured from the edge of the package.	0,20 - 0,45
b	The width of the metallised contacts (including lead finish) exposed at the bottom surface of the package.	0,18 - 0,30
D2	Heat sink length	1,00 min
E2	Heat sink width	0,10 min
K	The gap between any contact and the heat feature.	0,20 min
e	The centreline-to-centreline spacing of the contacts.	0,50 for tolerances see parameters bbb and ddd as defined in JEDEC MO-229F [12]

Other dimensions shall be compliant with the definitions in JEDEC MO-229F [12].

6.2.3.2 Contact and pin assignment

Table 6.6: Package contact and pin assignment

UICC Contact	UICC Signal	MFF3 Pin assignment	MFF4 Pin assignment	UICC Contact	UICC signal	MFF3 Pin assignment	MFF4 Pin assignment
C1	VCC	10	8	C5	GND	1	1
C2	ISO RST	9	7	C6	SWP / SPI INT	2	2
C3	ISO CLK	8	6	C7	ISO I/O	3	3
C4	I3C SCL / SPI MISO	7	5	C8	I3C SDA / SPI CLK	4	4
	SPI MOSI	6	NA		SPI NSS	5	NA

In case that signals are sharing the same contact pin, the corresponding interface configuration shall be static.

NOTE 1: The use of the SPI interface for the UICC is For Further Study.

NOTE 2: The definition of I3C support for the UICC is For Further Study.

6.2.3.3 Orientation mark for the bottom of the package

An orientation mark may be present on the bottom of the package to locate the terminal#1 index area as defined in JEDEC MO-229F [12].

NOTE: This orientation mark may be a different shape than the one used for illustration in figures 6.3 and 6.4.

6.2.3.4 Orientation mark for top of package

An orientation mark may be present on the top of the package to locate the terminal#1 index area as defined in JEDEC MO-229F [12].

7 Electrical and Logical specifications

7.0 Requirements

For a UICC using one of the form factors defined in the present document, the following applies:

- Unless otherwise specified in the present specification the UICC shall conform to the electrical specifications as defined in ETSI TS 102 221 [1].
- The use of all contacts shall be as defined in ETSI TS 102 221 [1], ETSI TS 102 600 [4] and ETSI TS 102 613 [3] except stated differently in the related form factor section.
- Unless otherwise specified in the present specification the UICC shall conform to the logical characteristics as defined in ETSI TS 102 221 [1].

7.1 Voltage Class support

The terminal supporting the present document shall not power the UICC using Voltage Class A.

8 Device Pairing Mechanism

8.0 Introduction

The following mechanisms for device pairing may be supported:

- Secure Channel pairing.
- CAT application pairing.

For each of the above pairing techniques, the UICC shall decide the level of access that the terminal may have followed the operation of the pairing mechanism.

8.1 Secure Channel Pairing

The UICC and terminal may securely pair and communicate by setting up a platform to platform APDU secure channel as described in ETSI TS 102 484 [5].

Where the securing of information is not required, a reduced secure channel procedure may be followed:

- The support for secure channel and the requirement for a platform to platform secure channel shall be set in the ATR.
- There shall be an entry in the endpoints retrieved from the UICC with the terminal application identifiers set to the ASCII encoded string "M2M pairing". If an entry for a platform to platform APDU secure channel exists then this shall take precedence.
- The platform to platform APDU secure channel setup process shall be completed and then terminated by the terminal immediately without any secure data being sent.

8.2 CAT application pairing

The UICC may use CAT (as specified in ETSI TS 102 223 [6]) to retrieve the terminal identity (e.g. IMEI, IMEISV, ESN, MEID, etc.) and to restrict access to UICC files and services as required.

Annex A (informative): PCB layout for the MFF

This annex details a PCB layout that is able to connect any MFF and various MFF sockets to the PCB.

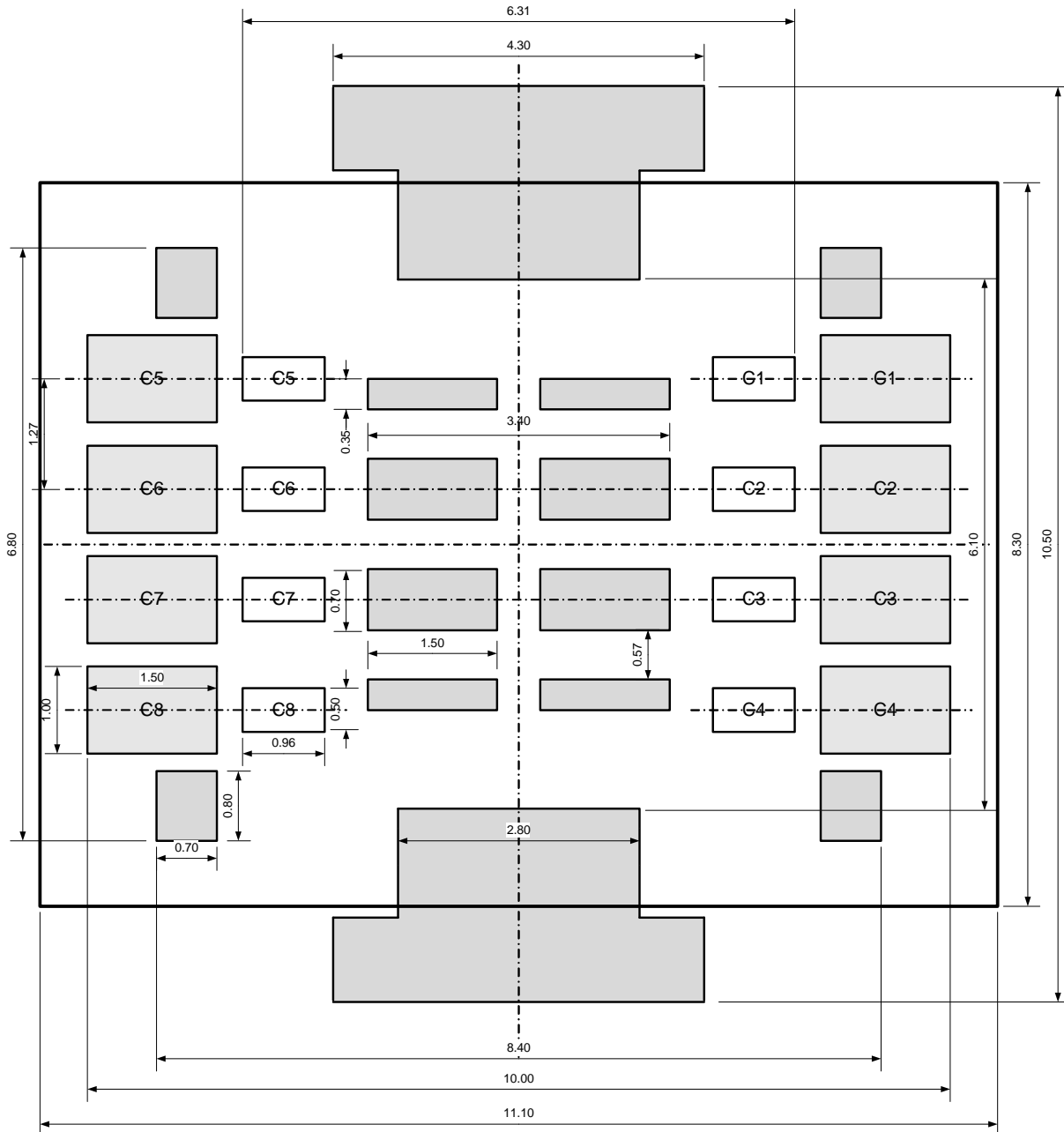


Figure A.1: PCB layout

The inner C1 to C8 pads are the electrical connection points for MFF1 or MFF2.

The outer C1 to C8 pads are the electrical connection points for MFF sockets.

The grey pads in the central area between the C1 to C8 pads are not electrically connected (i.e. they are insulated) and may serve as anchors to reinforce the mechanical attachment of an MFF to the board.

Other grey pads beyond the C1 to C8 area may serve as anchors for MFF sockets.

The rectangular box of 10,50 mm by 11,10 mm in figure A.1 is the recommended clearance zone to accommodate a wide range of MFF sockets. A minimum clearance area of 8,05 mm by 9,00 mm centered at the middle of the contact areas is a minimum to accommodate an MFF socket.

Annex B (informative): Change history

The table below indicates all changes that have been incorporated into the present document since it was placed under change control.

Change history								
Date	Meeting	Plenary Doc	CR	Rev	Cat	Subject/Comment	Old	New
						Creation of the specification		9.0.0
07/2010	SCP #45	SCP(10)0187	001	-	F	Correction of automotive vibration and automotive shock clauses	9.0.0	9.1.0
10/2013	SCP #61	SCP(13)000238r1	002	1	F	Deletion of Fretting Corrosion environmental condition	9.1.0	9.2.0
-	-	-	-	-	-	To comply with ETSI drafting rules: - renumbering of table 5.5.1 to table 5.2 - removal of hanging paragraphs through addition of missing section headers	9.1.0	9.2.0
05/2018	SCP#62	SCP(14)000034r1	003	1	B	Addition of a possibility to store and retrieve M2M UICC environmental classes	9.2.0	12.0.0
07/2018						Editorial update in clause 5.2: value '2Fxx' changed to '2F07' in table 5.1a	12.0.0	12.0.1
10/2022						Automatic update to next Release	12.0.1	13.0.0
10/2022						Automatic update to next Release	13.0.0	14.0.0
10/2022						Automatic update to next Release	14.0.0	15.0.0
10/2022						Automatic update to next Release	15.0.0	16.0.0
10/2022						Automatic update to next Release	16.0.0	17.0.0
10/2022	SET#107	SET(22)000199	004		B	Clarification on Environmental Property Indicators for M2M UICCs	17.0.0	18.0.0
07/2024	SET#113	SET(24)000092r1	005	1	C	Change title and scope	18.0.0	18.1.0
07/2024	SET#113	SET(24)000093r1	006		B	Introduction of new embedded form factors	18.0.0	18.1.0

History

Document history		
V18.0.0	November 2022	Publication
V18.1.0	September 2024	Publication