

ELECTRICAL CONNECTOR FOR AN ELECTRONIC-MEMORY CARD OR SMART CARD

The present invention relates to an electrical connector for a contact-type smart card of rectangular general shape.

5 The invention relates more particularly to a connector of the type comprising a support made of insulating material which defines a housing open in its upper face, this housing being bounded laterally by two parallel longitudinal edges and transversely by at least one front bottom edge and
10 accommodating a front portion of a card which is inserted into the housing in a longitudinal direction parallel to its plane and which, on its lower main face, includes conducting contact pads which are arranged near the front transverse edge of the card and which engage with the contact ends of electrical-contact
15 elements arranged in the bottom of the housing of the support when the card is in its contact position in which its front transverse edge butts against the front transverse bottom edge of the housing, and of the type in which the electrical-contact elements are carried by the support.

20 Such an example of an electrical connector, sold by the company ITT, is described and illustrated in the French Patent Application FR-A-2,742,561.

 That document provides a connector for connecting a standardized card of the MICROSIM type which is a small card.
25 Thus, the greater longitudinal part forming the front portion of the card is accommodated in the housing of the connector support, that is to say the lower face of the card extends virtually over the entire area opposite the bottom of the housing formed in the insulating support, only a small rear longitudinal portion of the
30 card projecting out of the housing, especially in order to be able to make it easier to grip it.

Moreover, the connection ends of the contact elements extend in groups longitudinally to the front and respectively to the rear of the insulating support, and beyond the front and rear transverse faces of the latter, in order to engage with conducting tracks of a printed-circuit board which accommodates the connector.

Finally, that document also proposes the arrangement of a metal cover which is mounted so as to slide on the support and which holds the card in the housing of the insulating support by virtue of its main upper plate-shaped part which extends above the upper face of the card when the latter is in place in the housing.

The invention aims more particularly to provide a connector suitable for connecting another type of card, also standardized, which especially makes it possible to store a large amount of data in order thus to constitute a removable data medium which is generally of small size but of high storage capacity. Several embodiments of such a type of memory card, also called a "flash" card, the dimensions of which are becoming smaller and the storage capacity of which is becoming greater, are known.

This is especially the case with the so-called "MMC" (MultiMediaCard) card sold by the company SANDISK, the dimensions of whose body containing the integrated circuits and the positioning of its conducting contact pads are specifically defined by its manufacturer and by an association of users so as to have a standardized-type definition of such a card. This definition forms the subject, for example, of the publication MultiMediaCard System Specification Version 1.4 Official Release @ February 1998 MMCA.

This type of MMC card is generally similar in its shape and in its proportions to a MICROSIM card, especially in that it

includes polarizing means for correctly and unambiguously positioning it in a connector and/or in a read/write device, which consist of a cut corner formed at one of the corners of the card, which is generally rectangular in shape.

5 On the other hand, the contact pads on the MMC card consist of a series of adjacent conducting pads which are aligned transversely along the short front end transverse edge of the MMC card in which the polarizing cut corner is also formed.

 However, the overall dimensions of the MMC card, or of
10 other cards of the same type, are larger than those of a MICROSIM card and the design of a connector proposed in the above-mentioned French Patent Application is not perfectly suitable for this type of card insofar as it results in a very large overall size of the connector, this being a significant drawback
15 insofar as the surface area occupied by the insulating support of the connector on the upper face of a printed-circuit board on which it is mounted is large, this surface area then being, of course, no longer available for mounting other electronic components on the printed-circuit board.

20 The invention therefore aims to provide a novel design of electrical connector of the above-mentioned type which is suitable for connecting a smart card, especially a card of MMC type, and which remedies the above-mentioned drawbacks, especially those relating to the size of the connector.

25 To this end, the invention provides a connector characterized in that the electrical-contact elements have free connection ends which all extend longitudinally beyond a rear transverse face of the insulating support, beyond which face the main portion of the body of the card extends rearwards in a
30 cantilevered fashion.

 Thus, the overall dimensions of the connector are reduced and the surface area of the printed-circuit board which extends

beneath the main portion of the body of the card arranged so as to be cantilevered from the connector may carry other electronic components.

According to other characteristics of the invention :

5 - the length of the front portion of the card accommodated in the housing bounded longitudinally by the said front transverse bottom edge and by the said rear transverse face of the support is less than the transverse width of the card ;

10 - the length of the front portion of the card accommodated in the housing bounded longitudinally by the said front transverse bottom edge and by the said rear transverse face of the support is equal to approximately one third of the length of the card ;

15 - the insulating support is extended longitudinally rearwards, beyond the said rear transverse face, by two opposed lateral extensions in which the rear parts of the parallel longitudinal edges of the housing are formed for guiding the card laterally ;

20 - all the conducting pads on the card are aligned transversely, especially along the front end transverse edge of the card and the contact ends are aligned transversely apart from at least one of these ends which is offset longitudinally rearwards so that, when the card is inserted longitudinally from the rear to the front into its housing, the corresponding conducting pad on the card comes into contact with this offset
25 contact end before the other conducting pads on the card each come into contact with one of the transversely aligned contact ends ;

30 - it includes a metal cover for holding the card in the housing which extends above the upper face of the card and which is bounded longitudinally by two transverse edges, namely a front transverse edge and a rear transverse edge, located longitudinally approximately in line with the said front transverse

bottom edge of the housing and in line with the said rear transverse face of the insulating support, respectively, and the cover has tabs for fixing it, by soldering, to the upper face of a board which carries the connector, especially on conducting
5 tracks connected to the earth plane of a printed-circuit board ;

- the cover is made in the form of an upper plate which extends above the upper face of the card and the parallel lateral edges of which are extended by two flanges bent over downwards for mounting the cover on the insulating support ;

10 - the two mounting flanges form slideways allowing the cover to be mounted on the insulating support by sliding in the longitudinal direction ;

- the metal cover includes integrally formed retractable means for providing longitudinal retention of the card in its
15 housing, against the elastic return force which is applied to it by a spring for automatically ejecting the card, which means engage with at least one portion of the rear transverse edge of the card ;

- one of the said lateral extensions extends approximately the entire length of a first lateral edge of the card, the said
20 retention means engage with that part of the rear transverse edge of the card which is adjacent to the said first lateral edge and the ejection spring engages with a portion of the front transverse edge of the card adjacent to the second lateral edge of the card ;

25 - the automatic ejection spring is made in the form of a metal blade produced integrally with the metal cover ;

- the front transverse edge of the card has a corner cut at approximately 45° and intended to engage with a corresponding surface inclined at 45° formed at one of the ends of the front
30 transverse bottom edge of the housing in order to form polarizing means defining a correct position for the card in the housing of the connector ;

- it includes a switch for detecting the presence of the card in the contact position in the housing ;

- the switch is carried by the insulating support and includes an actuator for tripping it, with which a portion of the front transverse edge of the card engages ;

the actuator is placed close to the said inclined surface and the said portion of the front transverse edge of the card consists of the cut corner of the card ;

- the switch is of the type normally closed in the absence of a card and comprises an elastically deformable switch blade which is integrally produced with the metal cover and which extends vertically and longitudinally from the upper plate of the latter into the housing with its free end which, in the absence of a card, is in elastic bearing contact against a contact end of one of the contact elements of the connector in order to establish a switching circuit between the free connection end of this contact element and an electrical earth plane to which the metal cover is connected ;

- a switch tab of the cover extends horizontally below the lower face of the insulating support opposite the free contact end part of a contact element which is extended vertically downwards by a switch blade, especially in the form of a loop, in order to form a normally-open switching circuit which is closed upon insertion of the card which causes the contact end to bend elastically downwards in order to bring the loop into contact with a facing portion of the said switch tab of the cover ;

- the upper plate of the cover has as many test holes as there are contact ends with offset test holes opposite the offset ends.

The invention also provides a double connector for connecting two similar smart cards arranged so as to be parallel, one above the other, of the type comprising a lower connector,

which is made according to any one of the preceding claims and which accommodates a lower card, and an upper connector which lies on top of the lower connector and accommodates the upper card, the design of the upper connector being generally similar to that of the lower connector except for its contact elements, which extend, from the contact ends, longitudinally forwards with their free connection ends which extend longitudinally forwards beyond the front end transverse face of the insulating support of the lower connector and then vertically downwards, at least as far as level with the lower face of the insulating support of the lower connector.

According to other characteristics of the double connector :

- the two cards are aligned longitudinally when they each occupy their contact position ;

- it includes a single metal cover common to both connectors in order to hold them in the superposed position and for fixing the double connector by soldering ;

- the upper connector includes a switch of the normally-closed type and the lower connector includes a switch of the normally-open type, the two switches having a common point connected to an earth plane via the common cover.

Other characteristics and advantages of the invention will appear upon reading the detailed description which follows, for the comprehension of which reference will be made to the appended drawings in which :

- Figure 1 is a top and three-quarter rear perspective view which illustrates a connector according to the invention, shown in the position mounted on a printed-circuit board and in association with an MMC-type card in the approach position for the purpose of inserting it into the connector ;

- Figure 2 is a top view of the connector in Figure 1, in which the card is illustrated in the inserted connection position in the connector ;

- Figure 3 is a top view similar to that in Figure 2, in which the connector is illustrated without a card ;

- Figure 4 is a longitudinal sectional view on the line 4-4 in Figure 3 ;

- Figure 5 is a side view in the direction of the arrow F5 in Figure 3 ;

- Figure 6 is a longitudinal end view in the direction of the arrow F6 in Figure 3, with a detailed part illustrated in cross section on the line 6-6 in Figure 4 ;

- Figure 7 is a perspective view on a larger scale of the connector illustrated in Figure 1, including modifications making it easier to fit its metal cover ;

- Figure 8 is a top view which illustrates only the metal cover of the connector ;

- Figure 9 is a bottom view of the cover of the connector ;

- Figure 10 is an end view in the direction of the arrow F10 in Figure 8 ;

- Figure 11 is a top and three-quarter rear perspective view which illustrates a first variant of the connector according to the invention, comprising retractable means for retaining the card in the connection position in the connector opposing an ejection force applied to the card by an ejection spring, the card being shown in Figure 11 in this position in its housing in the connector ;

- Figure 12 is a view similar to that in Figure 11, in which the card is illustrated in a position in which it is partially ejected from the connector ;

- Figure 13 is a view similar to that in Figure 12, which shows the connector without a card ;

- Figure 14 is a view similar to that in Figure 13, which shows the connector without its metal cover ;

- Figure 15 is a top and three-quarter rear perspective view which illustrates a variant of the connector illustrated in Figure 12 which differs from it due to the design of the spring for automatically ejecting the card ;

- Figures 16 and 17 are views similar to those in Figures 3 and 6, which illustrate another variant of a connector according to the invention with regard to a first embodiment of a switch for detecting the presence of a card in the contact position ;

- Figures 18 to 20 are views similar to those in Figures 3, 4 and 6, which illustrate another variant of a connector according to the invention, comprising another embodiment of a switch for detecting the presence of a card in the contact position ;

- Figures 21 and 22 are views similar to those in Figures 18 and 20, which also illustrate another variant of a connector according to the invention comprising another embodiment of a switch for detecting the presence of a card in the contact position ;

- Figures 23A, 23B and 23C are three similar views, in longitudinal section on the line 23-23 in Figure 21, which illustrate three successive longitudinal insertion positions of the card in its housing ;

- Figure 24 is a view on a larger scale of the detail D24 in Figure 21, with partial cut-away of the corresponding portion of the cover of the connector ;

- Figure 25 is a top and three-quarter front perspective view which illustrates a double connector made according to the teachings of the invention with its two cards, namely the lower and upper cards, in the contact position, the connector being shown mounted on the upper face of a printed-circuit board ;

- Figure 26 is a view similar to that in Figure 25, in which the connector is illustrated in its metal cover ;

- Figure 27 is a view similar to that in Figure 26, in which the connector is illustrated without an upper card;

5 - Figure 28 is a view similar to that in Figure 27, in which the connector is illustrated without a lower card ;

- Figure 29 is a top and three-quarter front perspective view of the connector shown in Figure 28 ;

10 - Figures 30 to 33 are views similar to those in Figures 3 to 6, which relate to the double connector illustrated in Figure 25 but shown without any card ;

- Figure 34 is a top and three-quarter rear perspective view which shows the lower connector of the double connector in Figure 25 ;

15 - Figure 35 is a top and three-quarter rear perspective view which shows the upper connector of the double connector in Figure 25 ;

- Figure 36 is a three-quarter front perspective view of the upper connector in Figure 35 ;

20 - Figure 37 is a bottom and three-quarter rear perspective view of the upper connector in Figure 35 ;

- Figure 38 is a top and three-quarter rear perspective view of the cover of the double connector in Figure 25 ;

25 - Figure 39 is a top and three-quarter rear perspective view which illustrates a double connector according to the invention of the type illustrated in Figure 25, but having a modified cover incorporating a switch blade for detecting the presence of the upper card ;

30 - Figure 40 is a bottom and three-quarter rear perspective view illustrating the cover of the double connector illustrated in Figure 25 and showing a modification of its lower part in order to

form a switch for detecting the presence of the lower card in the connector ; and

- Figure 41 is a diagrammatic representation of the lower face of an MMC-type card.

5 In the description which follows, identical, similar or analogous components will be denoted by the same reference numbers.

Figure 1 shows an electrical connector 50 made according to the teachings of the invention, which connector is illustrated in the position mounted in and fixed to the upper face 52 of a board
10 P which carries the connector 50 and which is, for example, a printed-circuit board whose upper face 52 has conducting tracks, not shown in detail in the figures.

The connector 50 essentially consists of a generally plate-shaped insulating support 52 made of plastic and of a metal
15 cover or lid 54 which especially extends above the plane and horizontal upper face 56 of the insulating support 52 in which is formed a card housing 58 which is open vertically upwards opposite the upper plate-shaped main part 60 of the cover 54.

20 The housing 58 is bounded vertically downwards by a horizontal lower bottom wall 62 and it is open longitudinally rearwards in order to present a slot for the longitudinal insertion of the front portion of an electronic-memory card C which, for example, is an MMC-type card.

25 The card C, of known design, has a rectangular general shape bounded longitudinally by a front end transverse edge 66, by a rear end transverse edge 68 and by two parallel and opposed lateral edges 70 and 72.

The front corner corresponding to the intersection of the
30 edges 66 and 70 is a standardized 45° cut corner 64 for polarizing the position and orientation of the card C.

Moreover, the card C has a horizontal free upper face 74 and an opposed and parallel lower face 76 which is oriented downwards in the direction of the printed-circuit board and which has (see Figure 41), near its front end transverse edge 66, a series of seven conducting contact pads 77 and 77' which are all aligned transversely and which are adjacent to the front end transverse edge 66. According to one aspect of the invention, the contact pads 77 and 77' are oriented downwards in the direction of the printed-circuit board P.

The card C is thus able to be inserted, in the direction I indicated in Figure 1, from the rear to the front into the housing 58 until its front transverse edge 66 butts against a front transverse bottom edge 78 by which the housing 58 is bounded at the front.

The opposed lateral edges 70 and 72 of the card C are slidably guided in the housing 58 by parallel and opposed longitudinal edges 80 and 82 respectively (see Figure 14) by which the housing 58 is bounded transversely.

As may be seen in the figures, the housing 58 proper, in which the front portion of the card C is accommodated, is bounded transversely at the front by the front transverse bottom edge 78 and transversely at the rear by a rear end transverse face 84 of the insulating support 52.

Moreover, the insulating support 52 is bounded transversely at the front by a front transverse face 86.

In order to improve the lateral sliding guidance of the card C as it is being inserted into or extracted from the housing 58, the body of the insulating support 52 has two opposed longitudinal extensions 88 and 90 which extend longitudinally rearwards beyond the rear transverse face 84 in order to increase the length of the longitudinal guiding edges 80 and 82.

The extensions 88 and 90 also have horizontal parts 92 and 94 which extend the plane of the bottom 92 with an insertion chamfer 96.

In order to fulfil the function of polarizing the position and orientation of the card C, the corner of the housing 58 corresponding to the intersection of the front transverse bottom edge 78 with the longitudinal edge 80 has a vertical face 98 inclined at 45° which is complementary to the shape and to the size of the cut corner 64 as may be seen in Figure 2, when the card C is inserted into the correct position.

According to a known technique in the field of connectors for connecting printed-circuit boards, the insulating support 52 carries a series of electrical-contact elements 100 which are made in the form of elastically deformable blades, a free contact end 102 of which projects vertically above the plane of the bottom 62 in order to engage with the conducting pads on the lower face 76 of the card C.

In the example illustrated in the figures, there are seven elastic contact blades 100, this being equal to the number of contact blades 77 and 77', five of these blades 100 being aligned transversely near the front transverse bottom edge 78 of the housing 58 whereas the other two blades 100' are offset longitudinally rearwards so that their two contact ends 102' are offset longitudinally rearwards.

The purpose of this offset is to comply with a requirement pertaining to the standardization of the method of connection to the MMC card, which requires two special contact pads 77' to be connected to a power supply before the other pads are connected. For this purpose, the two contact ends 102' are offset longitudinally rearwards with respect to the contact ends 102 of the other five contact elements 100 and in the same way their

associated connection ends 104' are offset longitudinally rearwards with respect to the other five connection ends 104.

All the contact blades 100 and 100' are identical and each has a rear free connection end 104, 104' which terminates
5 approximately in line with the rear transverse face 84, each end 104, 104' being designed here in the form of a lead to be soldered onto the surface of the upper face 51 of the printed-circuit board P.

Because of the rearward longitudinal offset of two elastic
10 blades 100', the insulating support has a corresponding extension 106 which extends longitudinally rearwards slightly beyond the vertical plane corresponding to the rear transverse face 84.

The length of the aligned contact pads 77 and 77' is such
15 that it makes it possible to obtain a reliable electrical connection to all the pads when the card is in the butted contact position, despite the slight offset of the ends 102'.

As may be seen especially with regard to Figures 3 and 4, the total length L1 of the housing 58 which accommodates the
20 front portion of the card C is markedly less than the transverse width L2 of the housing 58 which itself is approximately equal to the transverse width of the card C.

Moreover, the transverse length L1 bounded by the front transverse bottom edge 78 and the rear transverse face 84 here
25 is substantially equal to about 1/3 of the total length L3 of the card C.

Thus, as may be seen more particularly in Figure 2, it is the approximately two thirds of the card C which extend
30 longitudinally rearwards out of the housing 58 so as to be cantilevered above the facing portion of the upper face 51 of the board P.

As may also be seen in Figures 3 and 4, the length of the upper plate 60 of the cover 54, bounded by its front transverse edge 108 and its rear transverse edge 110, is also approximately equal to the length L1 of the housing 58, that is to say its edges 108 and 110 extend approximately in line with the front transverse bottom edge 78 and with the rear transverse face 84 of the insulating support 52.

By virtue of this dimensioning of the cover 54, the connection ends 104 and 104' are completely clear (see Figure 2) and visible in order to facilitate the infrared soldering operations and to allow a visual inspection of the soldered joints as well as a possible subsequent repair, by manual intervention. Moreover, the lateral extensions 88 and 90 protect all the output leads 104 and 104' during manufacture and transportation of the connectors.

As may be seen especially in Figure 4, the free connection ends 104 and 104' lie substantially in the plane of the lower plane face 57 of the insulating support 52.

According to a general design known, for example, from the above-mentioned French patent application, the metal cover 54 has, in order to mount it on the insulating support 52, two parallel and opposed lateral flanges 120 and 122 which extend vertically downwards along corresponding portions 116 and 118 of the vertical external longitudinal faces of the insulating support 52 (see Figure 14, for example).

The flanges 120 and 122 are shaped so as to form slideways, that is to say they are extended horizontally beneath the insulating support 52 by inwardly-bent horizontal branches 124 and 126 which are accommodated in corresponding housings formed in the lower face 57 of the insulating support 52 so as not to extend beyond the plane of this face.

According to one characteristic of the invention, the cover 54 has, near its front transverse edge 108, two lower horizontal tabs 132 and 134 which extend from the flanges 120 and 122 in order to be accommodated in recesses 136 in the lower face 57 so that the tabs 132, 134 can be soldered, for example by reflow soldering, to the corresponding conducting tracks on the printed-circuit board P (these not being shown) which are preferably connected to the earth plane of the electrical circuit of the printed-circuit board so as to electrically connect the metal cover 54 to this earth plane.

Mechanically fastening, by soldering, the cover 54 by means of its soldering tabs allows the connector 50 to be mechanically held in place at its front part, without requiring the use of any additional piece or component. In addition, this fastening of the front part balances the fastening of the rear part, provided by the soldering of the output leads 104, 104'. The gap between the cover 54 and the insulating support 52 makes it possible to achieve automatic centring positioning when the connector is put into place in order to solder it with its front part having the soldering tabs which always come into contact.

In addition, the cover 54 compensates for the forces involved if a user attempts to lift the card C which then bears against the plate of the cover 54 which is soldered to the board P, no force being transferred to the support 52 or to the output leads 104 and 104'.

In the variant illustrated in Figures 12 to 14, the connector 50 includes a first embodiment of means for automatically ejecting the card C which has, according to a design known especially from French Patent Application No. 98/06852, to the content of which reference may be made in order to understand the embodiment details thereof, an ejection spring 140 which here is a helical compression spring mounted in a semi-

cylindrical housing 142 open to the top and formed in the bottom 62 of the housing 58 and partly in a rear longitudinal extension 144 of the insulating support which is arranged laterally in the extension of the rear longitudinal extension 90 in line with the lateral side 72 of the card C.

The automatic ejection means also include a retractable retention lip or tab 146 which, in the inserted position of the card illustrated in Figure 11 and against the force which is applied by the spring 140 to the front transverse edge 66 of the card C, provides longitudinal retention of the latter inside the housing 58.

If the retention tab 146 is retracted, as illustrated in Figure 12, the compressed spring 140 relaxes and causes total or partial ejection of the card C out of the housing 58.

In order to allow the arrangement of the retention tab 146, the rearward longitudinal extension 88 of the insulating support 52, which lies on the opposite side to the extensions 90 and 144 that are adjacent to the point of action of the spring 140 on the front transverse edge 66 of the card C, extends substantially over the entire length of the lateral edge 70 of the card C, as may be seen in Figure 11.

Thus, the action of the spring 140, which tends to make the card C pivot in a swinging motion in its plane about a vertical axis, is counteracted by the very long internal longitudinal guiding edge 80 which extends over the entire length of the rearwardly elongate longitudinal extension 88.

The variant illustrated in Figure 15 differs from the previous one only by the design of the ejection spring 140, which here is an elastically deformable blade made as one piece with the metal cover 54 by cutting and bending.

By virtue of this design, if it is compared with the previous one, the length of the insulating support 52 at the front is not extended beyond its front transverse face 86, that is to say there

is no excrescence of the type of that 144 which partly accommodates the coil spring 140.

In the variant shown in Figures 16 and 17, a connector 50 of the type illustrated in Figures 1 to 10 has been shown, that is to say without means for automatically ejecting the card C, but including a switch 150 for detecting the presence of a card C in the fully inserted position in the housing 58.

In this first example of the arrangement of a switch 150, the latter is of a known general design and is a component attached to the insulating support, comprising an actuator in the form of a pedal 152 for tripping it.

When the front transverse edge of the card C engages with the pedal 152, it causes the switch 150 to trip.

In order to ensure that the switching signal is tripped as late as possible during the insertion movement of the card C, the actuator in the form of a pedal 152 is advantageously arranged close to the 45° inclined vertical face 98 for polarizing the card, that is to say it is the cut corner 64 of the card which engages with the pedal 152 at the very end of the insertion travel of the card C.

The switch 150 has two output or connection leads 154 which extend longitudinally forwards in order to be connected to corresponding conducting tracks on the printed-circuit board P.

The switch for detecting the presence of the card C, the design of which is illustrated in Figures 18 to 20, is of another type, that is to say it consists essentially of an eighth contact blade or element 100" and of a switch blade 160 made integrally with the upper plate 60 of the cover 54.

As may be seen in Figures 18 to 20, the switch blade 160 extends longitudinally forwards and vertically downwards inside the housing 58 so as to present an inclined ramp profile 162 with which the front transverse edge of the card C, and more

particularly its cut corner 64, is able to engage insofar as the lower free end 166 of the switch blade 160 engages with the electrical contact 100", 102" which is located in line with the inclined polarizing face 98.

5 In its rest state illustrated in Figures 19 to 20, that is to say in the absence of a card C, the end 166 bears elastically against the contact end 102" of the contact element 100" which itself is slightly bent vertically downwards.

As soon as the card C acts via its cut corner 64
10 simultaneously on the switch blade 160 and on the contact end 102", the switching circuit opens, that is to say the blade 100" is no longer connected to the earth plane of the circuit via the switch blade 160 integrated into the metal cover 54.

As may be seen in Figure 18, in a top view, the switch
15 blade 160 has an S-shaped sharply-angled profile so as to use a contact 100" which is similar to the other contact elements 100 and is placed transversely with the same spacing, this solution also having the advantage of placing the point at which the switch trips close to the vertical inclined face 98 in order to act at
20 the last moment of the insertion travel of the card via the cut corner 64 of the latter.

This arrangement makes it possible to guarantee that, during insertion of the card C, the switch is only actuated at the end of insertion travel, that is to say after the contacts between
25 the contact ends 102 and 102' and the pads 77 and 77' have been established, the switch thus acting as a means of detecting the end of insertion travel of the card into the connector. This same sequence occurs in the reverse order when removing the card C from the connector 50.

30 Although the switch described above with reference to Figures 18 to 20 was of the type normally closed - in the absence of a card - the switch whose design is illustrated in Figures 21 to

24 is of the type normally open, that is to say, in the absence of a card, the switching circuit is broken.

The switch 150 illustrated in Figures 21 to 24 also makes use of a contact blade 100" which occupies the same position with respect to the other contacts as that mentioned above, but the free contact end 102" of which is shaped in the form of a loop, that is to say it is extended inside vertically downwards by a switch blade 170 which, when the switch is open, in the absence of the card C, is extended by its lower end 172 opposite the upper face 174 of a switch tab 175 of the metal cover 54 which, for this purpose extends transversely inwards beneath the switch blade 170.

The operating cycle for closing the switch 150 is illustrated in Figures 23A to 23C which show that the front transverse edge of the card C, i.e. more specifically the cut corner 164, acts on the end 102" of the blade 100" so as to bend it elastically downwards and to bring the lower end 172 of the loop which comprises the switch blade 170 into contact with the switch tab 175 which is connected to the earth plane of the printed circuit through the cover 54 which itself is connected to the earth plane by soldering.

The shape of the loop forming the switch blade 170 is such that a self-cleaning effect is produced during the closing cycle by the lower end 172 engaging with the upper face 174 of the tab 132.

In this design, if it is compared with the previous one illustrated in Figures 18 to 20, all the elastically deformable contact elements used as signal contacts or for producing the switch act everywhere only on the lower face 76 of the card C which bears vertically upwards against the facing internal face of the upper plate 60 of the cover 54.

As may be seen especially in Figure 2, the upper plate 60 of the cover 54 has a series of holes 61 and 61' which, since the contact ends 102 and 102' face upwards, make it possible to test the equipment after the components and connectors have been soldered, by connecting directly to the ends which are accessible in the absence of a card C. The forwardly offset test holes 61' are arranged in such a way that the region separating them from the rear transverse edge 110 allows the connector to be picked up, in pick-and-place technology, appreciably more in line with the centre of gravity of the connector.

The double connector 500 illustrated in Figures 25 to 40 will now be described, in which figures the same references have been used as previously for the two connectors, namely the lower connector 50i and the upper connector 50s by giving them the suffixes "i" and "s" respectively.

Thus, as may be seen in the figures, the double connector 500 essentially consists of the superposition on a lower connector 50i, which is everywhere identical to the single connector 50 described above, of an upper connector 50s whose design is similar but has certain modifications intended to allow its superposition and the electrical connection of the blade-shaped contact elements 100i and 100i'.

As may be seen in Figure 25 et seq., the upper connector 50s rests with its plane lower face 57s on the upper face 56i of the lower connector 50i.

In order to allow correct relative positioning of the upper connector 50s on the lower connector 50i, the upper face 56i of the latter has a hole 180i which accommodates a complementary stud 182s which extends vertically from the lower face 57s of the upper connector 50s. The means for the relative positioning of the two connectors are completed by two lateral tabs 184s and 186s which extend vertically downwards beneath the lower face

57s of the upper connector 50s in order to be accommodated in complementary notches 188i and 190i formed in the lateral faces 118i and 116i of the lower connector 50i. Thus, the position of the upper connector 50s with respect to the lower connector 50i is precisely defined, both longitudinally and transversely.

As may be seen in Figure 37, the lower face 57s of the upper connector 50s is plane and smooth in order to form the upper face of the lower housing 58i in which the lower card Ci is accommodated.

10 In order to fasten the two connectors together so as to form a unitary double connector 500 and subsequently to be fixed to the board P by soldering, the double connector 500 has a single common metal cover 54 whose design is generally identical to that of the cover 54 described above except for its lateral flanges 108 and 110 whose height is greater so as to extend vertically along the superposed lateral walls of the two connectors 50i and 50s.

As may be seen in Figure 26, the upper face 74s of the upper card Cs is more or less flush with the plane of the upper face 56s of the upper connector 50s and it is the internal face of the upper plate 60 of the cover 54 which extends above the upper card Cs in order to define the housing 58s in the upward vertical direction.

As may be seen in Figure 31, the relative positioning of the two connectors is such that the two cards are aligned longitudinally. For this purpose, the transverse bottom edges 78i and 78s are aligned longitudinally.

In order to allow electrical connection, the contact blades 100s and 100's of the upper connector generally extend longitudinally forwards in the insulating support 52s. From the free contact ends 102s and 102's they extend longitudinally forwards in the direction of the front transverse wall 86s of the

insulating support 52s and are then bent through a right angle so as to form tall vertical sections 192s and 192's which extend until they are level with the horizontal plane of the lower face 57i of the lower connector 50i in order for their free connection ends
5 104s and 104's to lie in the same plane as the connection ends 104i and 104'i of the lower connector 50i.

Because of the similar design of the two connectors of the double connector 500, and as may be seen especially in Figure 33, the free contact ends of the two connectors are aligned
10 vertically.

Referring to Figure 30 and comparing it with Figure 3, it may be seen that the longitudinal dimension of the double connector 500 is only slightly increased compared with a single connector 50 and that the transverse dimension is maintained.

15 As may be seen in Figures 39 and 40, it is possible to provide two switches for detecting the presence of each of the cards Ci and Cs in the double connector 500.

Advantageously, in order to avoid having to use two independent switches produced in the form of added
20 components, it is proposed to make the lower switch in the form of the normally-open-type switch described with reference to Figures 21 to 24 while the upper switch is made in the form of the normally-closed-type switch described previously with reference to Figures 18 to 20.

25 The cover 54 is then modified in the manner illustrated in Figures 39 and 40 in order to incorporate, on the one hand, the upper switch blade 160s and the extended tab 175i intended to engage with the lower switch blade (not shown in the figures).

Thus, it will be noted that the two switches have a
30 common point corresponding to the common earth to which the metal cover 54 is connected.

The design of the lower connector is such that it forms a standard component, except of course for the cover 54, in order to produce single connectors or lower connectors for superposed multiple connectors.

5 As may be seen in Figure 31, it is possible to use tall components under the front part of the upper connector 50s which projects transversely forwards, between the rear transverse wall 86i of the lower connector and the connection leads 104s and 104s', the "wasted" area on the printed-circuit
10 board thus being reduced to the minimum.

If it is desired to make it easier to grip each card, the upper connector may be offset further forwards.

By way of a variant that is not shown, it is of course possible to superpose a third connector, offsetting it slightly
15 forwards with respect to the connector immediately below.

CLAIMS

1. Electrical connector (50) for a contact-type smart card (C) of rectangular general shape, of the type comprising a support (52) made of insulating material which defines a housing (58) open in its upper face (56), this housing being bounded laterally by two parallel longitudinal edges (80, 82) and transversely by at least one front bottom edge (78) and accommodating a front portion of a card (C) which is inserted longitudinally (l) from the front forwards into the housing (58) in a direction parallel to the general plane of the card and which, on its lower main face (76) includes conducting pads which are arranged near the front transverse edge (66) of the card and which engage with the contact ends (102, 102') of electrical-contact elements (100, 100') arranged in the bottom (62) of the housing of the support (52) when the card is in its contact position in which its front transverse edge (64, 66) butts against the front transverse bottom edge (78) of the housing, and of the type in which the electrical-contact elements are carried by the support, characterized in that the electrical-contact elements have free connection ends (104, 104') which all extend longitudinally beyond a rear transverse face (84) of the support (52), beyond which face the main portion of the body of the card (C) extends rearwards in a cantilevered fashion.

2. Connector according to the preceding claim, characterized in that the length of the front portion of the card (C) accommodated in the housing (58) bounded longitudinally (L1) by the said front transverse bottom edge (78) and by the said rear transverse face (84) of the support is less than the transverse width (L2) of the card (C).

3. Connector according to the preceding claim, characterized in that the length of the front portion of the card

(C) accommodated in the housing (58) bounded longitudinally (L1) by the said front transverse bottom edge (78) and by the said rear transverse face (84) of the support (52) is equal to approximately one third of the length (L3) of the card (C).

5 4. Connector according to any one of the preceding claims, characterized in that the insulating support (52) is extended longitudinally rearwards, beyond the said rear transverse face (84), by two opposed lateral extensions (88, 90) in which the rear parts of the parallel longitudinal edges (80, 82)
10 of the housing (58) are formed for guiding the card (C, 70, 72) laterally.

 5. Connector according to any one of the preceding claims, characterized in that all the conducting pads on the card (C) are aligned transversely, especially along the front end
15 transverse edge (66) of the card (C) and in that the contact ends (102) are aligned transversely apart from at least one (102') of these ends which is offset longitudinally rearwards so that, when the card (C) is inserted longitudinally from the rear to the front into its housing (58), the corresponding conducting pad on the
20 card comes into contact with this offset contact end (102') before the other conducting pads on the card each come into contact with one of the transversely aligned contact ends (102).

 6. Connector according to any one of the preceding claims, characterized in that it includes a metal cover (54) for
25 holding the card (C) in the housing (58) which extends above the upper face (74) of the card and which is bounded longitudinally by two transverse edges, namely a front transverse edge (108) and a rear transverse edge (110), located longitudinally approximately in line with the said front transverse bottom edge
30 (78) of the housing (58) and in line with the said rear transverse face (84) of the insulating support (52), respectively, and in that the cover (54) has tabs (132, 134) for fixing it, by soldering, to



the upper face (51) of a board (P) which carries the connector (50), especially on conducting tracks connected to the earth plane of a printed-circuit board.

7. Connector according to the preceding claim,
5 characterized in that the cover (54) is made in the form of an upper plate (60) which extends above the upper face (74) of the card (C) and the parallel lateral edges of which are extended by two flanges (120, 122) bent over downwards for mounting the cover (54) on the insulating support (52).

10 8. Connector according to the preceding claim, characterized in that the two mounting flanges (120, 122) form slideways allowing the cover (54) to be mounted on the insulating support by sliding in the longitudinal direction (I).

9. Connector according to any one of Claims 4 to 8,
15 characterized in that the metal cover (54) includes integrally formed retractable means (146) for providing longitudinal retention of the card (C) in its housing (58), against the elastic return force which is applied to it by a spring (140) for automatically ejecting the card (C), which means engage with at
20 least one portion of the rear transverse edge of the card (C).

10. Connector according to the preceding claim, taken in combination with Claim 4, characterized in that one (88) of the said lateral extensions (88, 90) extends approximately the entire length of a first lateral edge (70) of the card (C), in that the said
25 retention means (146) engage with that part of the rear transverse edge (68) of the card (C) which is adjacent to the said first lateral edge (70) and in that the ejection spring (140) engages with a portion of the front transverse edge (66) of the card adjacent to the second lateral edge (72) of the card.

30 11. Connector according to either of Claims 9 and 10, characterized in that the automatic ejection spring (140) is made



in the form of a metal blade produced integrally with the metal cover (54).

12. Connector according to any one of the preceding claims, characterized in that the front transverse edge (66) of the
5 card has a corner (64) cut at approximately 45° and intended to engage with a corresponding surface (98) inclined at 45° formed at one of the ends of the front transverse bottom edge (78) of the housing (58) in order to form polarizing means defining a correct position for the card (C) in the housing (58) of the connector
10 (50).

13. Connector according to any one of the preceding claims, characterized in that it includes a switch (150) for detecting the presence of the card (C) in the contact position in the housing (58).

14. Connector according to the preceding claim, characterized in that the switch (150) is carried by the insulating support (52) and includes an actuator (152) for tripping it, with which a portion (64) of the front transverse edge (66) of the card (C) engages.

15. Connector according to the preceding claim taken in combination with Claim 12, characterized in that the actuator (152) is placed close to the said inclined surface (98) and in that the said portion of the front transverse edge (66) of the card consists of the cut corner (64) of the card.

16. Connector according to Claim 13 taken in combination with Claim 7, characterized in that the switch is of the type normally closed in the absence of a card and comprises an elastically deformable switch blade (160) which is integrally produced with the metal cover (54) and which extends vertically
and longitudinally from the upper plate (60) of the latter into the housing (58) with its free end (166) which, in the absence of a card (C), is in elastic bearing contact against a contact end



(102") of one of the contact elements (100") of the connector (50) in order to establish a switching circuit between the free connection end (104") of this contact element and an electrical earth plane to which the metal cover (54) is connected.

5 17. Connector according to Claim 13 taken in combination with Claim 6, characterized in that a switch tab (175) of the cover (54) extends horizontally below the lower face (57) of the insulating support (52) opposite the free contact end part of a contact element (100") which is extended vertically downwards
10 by a switch blade (170), especially in the form of a loop, in order to form a normally-open switching circuit which is closed upon insertion of the card (C) which causes the contact end (102", 170) to bend elastically downwards in order to bring the loop into contact with a facing portion (134) of the said switch tab (175) of
15 the cover.

 18. Double connector for connecting two similar smart cards (Ci, Cs) arranged so as to be parallel, one above the other, of the type comprising a lower connector (50i), which is made according to any one of the preceding claims and which
20 accommodates a lower card (Ci), and an upper connector (50s) which lies on top of the lower connector (50i) and accommodates the upper card (Cs), the design of the upper connector (50s) being generally similar to that of the lower connector (50i) except for the orientation of its contact elements (100s, 100's) which
25 extend, from the contact ends (102s, 102's), longitudinally forwards with their free connection ends (104s, 104's) which extend longitudinally forwards beyond the front end transverse face (86i) of the insulating support (52i) of the lower connector (50i) and then vertically downwards, at least as far as level with
30 the lower face (57i) of the insulating support (52i) of the lower connector (50i).



19. Connector according to the preceding claim, characterized in that the two cards (Ci, Cs) are aligned longitudinally when they each occupy their contact position.

20. Connector according to the preceding claim, characterized in that it includes a single metal cover (54) common to both connectors (50i, 50s) in order to hold them in the superposed position and for fastening the double connector (500) by soldering.

21. Connector according to the preceding claim, taken in combination with Claims 16 and 17, characterized in that the upper connector (50s) includes a switch of the normally-closed type and in that the lower connector (50i) includes a switch of the normally-open type, the two switches having a common point connected to an earth plane via the common cover (54).

22. Connector according to Claim 6 taken in combination with Claim 5, characterized in that the upper plate (22) of the cover (54) has as many test holes (61, 61') as there are contact ends (102, 102'), with test holes (61') offset with respect to the offset ends (102').

