

ELECTRICAL CONNECTOR

TECHNICAL FIELD

The present invention relates to an electrical connector, in particular, an electrical connector for use in a testing device.

5 BACKGROUND

In medical testing and diagnosis, there is a need to measure the concentration of substances, particularly in the presence of other substances. For example, the measurement of glucose in body fluids such as blood, is crucial to the effective treatment of diabetes.

10 Typical methods used for measuring the concentration of analytes include optical methods and electrochemical methods. Optical methods generally involve reflectance or absorbance spectroscopy to observe the spectrum shift in a reagent. Such shifts are caused by a chemical reaction that produces a colour change indicative of the concentration of the analyte.

15 Electrochemical methods generally involve amperometric or coulometric responses indicative of the concentration of the analyte. In the case of a blood glucose test meter, a blood sample is typically placed onto or into a disposable test strip which is then inserted into the test meter. For an electrochemical test meter, electrical signals are transferred between the test meter and the test strip
20 and vice versa.

Test system designers desire to minimise the size of the sample test strip required for accurate measurement in order to improve the user experience. The resulting test meter and test strip miniaturisation have resulted in the use of thin film test strip patterns comprised of noble metals deposited on plastic substrates,
25 such as by plating and subsequent laser ablation, to form the electrodes and

associated connector contact pads of the test strip. U.S. Patent Publication No. 2006/0052682A1 teaches one such testing system.

With medical and technological advancement, there is a desire to increase the number of contact pads on the test strip so that more information may be
5 extracted from the test substance for diagnosis to aid the treatment of the patient. However, in order not to affect the user experience, it is desired that the size of the test meter and the test strip remain small even though the number of contact pads on the test strip is to increase.

SUMMARY

10 It would be desirable to provide an electrical connector for use in a testing device configured to operate in conjunction with a test strip with increased contact pads. It would also be desirable to provide a test system operable with test strips with increased contact pads.

In accordance with one embodiment of the present invention, there is
15 provided an electrical connector for use in a testing device configured to measure an analyte of interest in a fluid applied to a test strip having at least two sets of contact pads for connecting with the electrical connector electrically, the electrical connector comprising a housing having a strip insertion end, a terminal insertion end and a plurality of terminal passageways extending from the strip
20 insertion end to the terminal insertion end; a strip insertion slot at the strip insertion end extending to the terminal passageways and configured to allow the test strip to be inserted when in use; and a first set and a second set of connector terminals wherein each connector terminal comprises an engagement portion, a secured portion wherein the connector terminal is secured to the terminal
25 passageway by a plurality of securing devices, a terminal contact portion and a flexible portion spanning from the secured portion to the terminal contact portion; and wherein the terminal contact portion of the first set of connector

terminals and the terminal contact portion of the second set of connector terminals define a plane substantially parallel to the strip insertion slot.

In accordance with another embodiment of the present invention, there is provided a testing system comprising an electrical connector comprising a housing having a strip insertion end, a terminal insertion end and a plurality of terminal passageways extending from the strip insertion end to the terminal insertion end; a strip insertion slot at the strip insertion end extending to the terminal passageways and configured to allow a test strip to be inserted when in use; a first set and a second set of connector terminals wherein each connector terminal comprises an engagement portion, a secured portion wherein the connector terminal is secured to the terminal passageway by a plurality of securing devices, a terminal contact portion and a flexible portion spanning from the secured portion to the terminal contact portion; and wherein the terminal contact portion of the first set of connector terminals and the terminal contact portion of the second set of connector terminals define a plane substantially parallel to the strip insertion slot; the test strip configured for insertion into the electrical connector, the test strip having at least two sets of contact pads thereon; and an electronic circuit coupled to the electrical connector adapted to produce a plurality of output signals based on electrical responses through the contact pads of the test strip inserted into the electrical connector.

The invention further includes any alternative combination of parts or features mentioned herein or shown in the accompanying drawings. Known equivalents of these parts or features which are not expressly set out are nevertheless deemed to be included.

25 BRIEF DESCRIPTION OF THE DRAWINGS

An exemplary form of the present invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a perspective view of a testing system as disclosed in U.S. Patent Publication No. 2006/0052682A1;

Figure 2 is a perspective view of a testing system in accordance to the present invention;

5 **Figure 3** is an exploded, perspective view of an electrical connector in accordance with the present invention;

Figure 4 is a rear view of a housing of the electrical connector in Figure 3;

10 **Figure 5** is a bottom view of the electrical connector in Figure 3 with connector terminals inserted in the housing;

Figure 6A is a perspective view of two sets of connector terminals in accordance with the present invention;

Figure 6B is a top view of the two sets of connector terminals in Figure 6A;

15 **Figure 7** is a side view of a pair of connector terminals from the two sets of connector terminals in Figure 6A;

Figure 8A shows a cross-sectional side view of the electrical connector in Figure 3; and

20 **Figure 8B** shows a cross-sectional side view of the connector in Figure 3 with a test strip inserted in the electrical connector.

While the above-identified drawing figures set forth several embodiments of the invention, other embodiments are also contemplated, as noted in the discussion. In all cases, this disclosure presents the invention by way of representation and not limitation. It should be understood that numerous other

modifications and embodiments can be devised by those skilled in the art, which fall within the scope and spirit of the principles of the invention. The figures may not be drawn to scale. Like reference numbers have been used throughout the figures to denote like parts.

5 DETAILED DESCRIPTION

Figure 1 is a perspective view of a testing system as disclosed in U.S. Patent Publication No. 2006/0052682A1. The testing system **20** includes a testing meter **30** having a distal end **34**. A disposable test strip **40** is inserted in a direction I through a slot **32** at the distal end **34**. The test strip **40** includes at least
10 one contact pad **42** near its end **44**. The contact pads **42** are connected via conductors **46** to electrodes (not shown) near the end of strip **40** opposite to the end **44** (i.e., near the end in the direction indicated by extraction directional arrow E). In the event that more contact pads **42** are needed, there will be a need to widen the width of the test strip **40**. Correspondingly, the physical dimensions of
15 the testing meter **30** that is used with the test strip **40** will be increased. It will be desirable to increase the number of contact pads **42** on the test strip **40** without increasing the size of the testing meter **30**.

Figure 2 is a perspective view of a testing system in accordance to the present invention. The testing system **2** comprises an electrical connector **10**
20 comprising a housing **12** having a strip insertion end **100** and a terminal insertion end **200**; a strip insertion slot **110** at the strip insertion end **100** configured to allow a test strip **50** to be inserted when in use; the test strip **50** having at least two sets of contact pads **60** thereon; and an electronic circuit **90** coupled to the electrical connector **10** adapted to produce a plurality of output signals based on
25 electrical responses through the contact pads **60** of the test strip **50** inserted into the electrical connector **10**.

In one embodiment, the contact pads **60** are arranged in a first set **61** and a second set **62** wherein the first set **61** of contact pads is arranged in one row and the second set **62** of contact pads is arranged in another row. Preferably, the electrical connector **10** and the electronic circuit **90** are housed within a testing device **14** with a device insertion slot **16** aligned to the strip insertion slot **110** at the strip insertion end **100** of the electrical connector **10**.

Figure 3 is an exploded, perspective view of an electrical connector in accordance with the present invention, Figure 4 is a rear view of a housing of the electrical connector and Figure 5 is a bottom view of the electrical connector with connector terminals inserted in the housing. The electrical connector **10** may be used in the abovementioned testing device **14** which is configured to measure an analyte of interest such as glucose in a fluid such as blood applied to the test strip **50** having at least two sets of contact pads **60** thereon.

The electrical connector **10** comprises a housing **12** having a strip insertion end **100**, a terminal insertion end **200** and a plurality of terminal passageways **300** extending from the strip insertion end **100** to the terminal insertion end **200**; a strip insertion slot **110** (as shown in Figure 8A) at the strip insertion end **100** extending to the terminal passageways **300** and configured to allow the test strip **50** to be inserted when in use; and at least two sets of connector terminals **400**. The connector terminals **400** are inserted into the terminal passageways **300** from the terminal insertion end **200** of the housing **12**.

The electrical connector **10** may include a plurality of connector mounting devices, including but not limited to, solder tabs **500** and mounting posts **510**. The solder tabs **500** serve to secure the electrical connector **10** to the electronic circuit **90** while the mounting posts **510** aids the accurate mounting of the electrical connector **10** to the electronic circuit **90**.

Referring to Figures 3, 6A and 6B, each connector terminal **400** comprises an engagement portion **430**, a secured portion **435** wherein the connector terminal **400** is secured to the terminal passageway **300** by a plurality of securing devices **440** such as barbs, a terminal contact portion **445** and a flexible portion **450** spanning from the secured portion **435** to the terminal contact portion **445**. The terminal contact portion **445** of each connector terminal **400** connects electrically with each contact pad **60** on the test strip **50** when the test strip **50** is inserted into the testing device **14** when in use. Thus, the positions of the terminal contact portions **445** in the electrical connector **10** are dependent on the positions of the corresponding contact pads **60** on the test strip **50** which the connector terminals **400** are to establish electrical connection.

When there is a need to increase the number of contact pads **60** on the test strip **50**, the number of the connector terminals **400** in the electrical connector **10** is likely to be increased accordingly. If the contact pads **60** and the connector terminals **400** are arranged in a single row on the test strip **50** and in the electrical connector **10** respectively, the increase in the number of contact pads **60** will likely cause the width of test strip **50** and the physical dimensions of the electrical connector **10** to change. By arranging the contact pads **60** on the test strip **50** and the connector terminals **400** in the electrical connector **10** in a plurality of rows, it is possible to accommodate the increase in the contact pads **60** without increasing substantially the width of the test strip **50** and the physical dimensions of the electrical connector **10**.

In one embodiment, the connector terminals **400** are arranged in a first set **410** of connector terminals and a second set **420** of connector terminals wherein the first set **410** of connector terminals is arranged in one row and each connector terminal **410** comprises an engagement portion **4301**, a secured portion **4351**, a terminal contact portion **4451** and a flexible portion **4501** while the second set **420** of connector terminals is arranged in another row and each connector terminal **420** comprises an engagement portion **4302**, a secured portion **4352**, a

terminal contact portion **4452** and a flexible portion **4502**. Preferably, all the contact pads **60** are placed on a same face of the test strip **50** so that the first set **410** of connector terminals and the second set **420** of connector terminals may be installed on a side of the terminal passageways **300** adjacent to the face of the incoming test strip **50** wherein the contact pads **60** are placed. This connector terminal arrangement will minimise the need to increase the height of the electrical connector **10** when the number of contact pads **60** on the test strip **50** increase.

Depending on the number of contact pads **60** in each set on the test strip **50**, the number of connector terminals in the first set **410** may either be the same or different from the number of connector terminals in the second set **420**. Since the position of each terminal contact portion **445** in the electrical connector **10** is dependent on the position of the corresponding contact pad **60** on the test strip **50**, the adjacent terminal contact portions **4451**, **4452** of the first set **410** and the second set **420** of connector terminals may be spaced apart by varying distance.

In order to minimise any substantial increase in the footprint (i.e. amount of real estate occupied by the electrical connector on the electronic circuit) of the electrical connector **10** within the testing device **14** as a result of an increase in the number of connector terminals **400**, it is preferable to arrange the engagement portions **4301**, **4302** of the first **410** and the second set **420** of connector terminals such that the engagement portions **4301**, **4302** of the first set **410** and the second set **420** of connector terminals are substantially equidistant from the terminal insertion end **200** of the connector housing **12**.

The engagement portions **430** may be solder tails configured for surface mounting onto the electronic circuit **90**, for press-fits or for through hole, all of which are within the scope and spirit of the invention. Also, the engagement portions **4301**, **4302** of the first set **410** and the second set **420** of connector terminals are preferably spaced apart by a substantially constant distance. This

will make easier the manufacturing of the electrical connector **10** and the mounting of the electrical connector **10** on the electronic circuit **90**.

As mentioned earlier, the positions of the individual terminal contact portions **445** in the electrical connector **10** are dependent on the positions of the corresponding contact pads **60** on the test strip **50**. Depending on the layout design of the contact pads **60** on the test strip **50**, a plurality of contact pads in the second set **62** may be aligned behind a plurality of contact pads in the first set **61**. Accordingly, a plurality of connector terminals in the first set **410** will then be aligned behind a plurality of connector terminals in the second set **420**.

Referring to Figure 7, in one embodiment, the flexible portion **4501** of the first set **410** of connector terminals is shorter than the flexible portion **4502** of the second set **420** of connector terminals. Referring to Figure 8A, in another embodiment, the terminal contact portion **4451** of the first set **410** of connector terminals and the terminal contact portion **4452** of the second set **420** of connector terminals define a plane **P** substantially parallel to the strip insertion slot **110**.

When using the testing device **14**, a test strip **50** is inserted into the strip insertion slot **110** as illustrated in Figure 2. As the test strip **50** is inserted, the leading end of the test strip **50** first comes into contact with the terminal contact portion **4452** of the second set **420** of connector terminals and then into contact with the terminal contact portion **4451** of the first set **410** of connector terminals as the test strip **50** is further inserted. Each connector terminal **400** is deflected downwards in a direction **D** away from the plane **P** as the test strip **50** comes into contact with the connector terminal **400**. The test strip insertion stops when the leading end of the test strip **50** meets a test strip insertion limiting wall **120**.

By having the connector terminals **400** arranged in a first set **410** and a second set **420** and with each set occupying a different row, the insertion force

generated by the test strip **50** will be relatively low because the two rows of connector terminals **400** are engaged at different times. In addition, by having the flexible portion **4501** of the first set **410** shorter than the flexible portion **4502** of the second set **420**, the downward force exerted by the test strip **50** at the terminal contact portion **4451** on the flexible portion **4501** is relatively the same as the downward force exerted by the test strip **50** at the terminal contact portion **4452** on the flexible portion **4502**. These two factors are important in minimising the stress on the connector terminals **400** and prolonging the useful life of the electrical connector **10**. Also, the electrical connectivity for the testing system **2** can be maintained when the downward forces experienced at both sets of connector terminals **400** are relatively the same.

In one embodiment, the flexible portion **4501** of the first set **410** of connector terminals is bent at the section where the secured portion **4351** meets the flexible portion **4501**. In doing so, the amount of downward deflection of the connector terminal for the first set **410** is less than the amount of downward deflection of connector terminal for the second set **420**, thus reducing the likelihood of having the first set **410** of connector terminals coming into contact with the second set **420** of connector terminals as the two sets of connector terminals deflects downwards in the direction **D** away from the plane **P**. This will then prevent an electrical shorting of the connector terminals **400** when the test strip **50** is inserted into the testing device **14**. Figure 8B shows the terminal contact portions **4451**, **4452** of the first set **410** and the second set **420** of connector terminals connecting electrically with the two rows of contact pads **60** (not shown) on the test strip **50** when the test strip **50** is inserted into the electrical connector **10**.

The foregoing description of the preferred embodiment of the invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed, since many modifications or variations thereof are possible in light of the above

teaching. All such modifications and variations are within the scope of the invention. The embodiments described herein were chosen and described in order to best explain the principles of the invention and its practical application, thereby to enable others skilled in the art to use the invention in various

5 embodiments and with various modifications as are suited to the particular use contemplated thereof. It is intended that the scope of the invention be defined by the claims appended hereto, when interpreted in accordance with the full breadth to which they are legally and equitably entitled.

CLAIMS

1. An electrical connector for use in a testing device configured to measure an analyte of interest in a fluid applied to a test strip having at least two sets of contact pads for connecting with the electrical connector electrically, the electrical

5 connector comprising:

a housing having a strip insertion end, a terminal insertion end and a plurality of terminal passageways extending from the strip insertion end to the terminal insertion end;

10 a strip insertion slot at the strip insertion end extending to the terminal passageways and configured to allow the test strip to be inserted when in use; and

a first set and a second set of connector terminals wherein each connector terminal comprises an engagement portion, a secured portion wherein the connector terminal is secured to the terminal passageway by a plurality of securing devices, a terminal contact portion and a flexible portion spanning from the secured portion to the terminal contact portion; and

15 wherein the terminal contact portion of the first set of connector terminals and the terminal contact portion of the second set of connector terminals define a plane substantially parallel to the strip insertion slot.

2. The electrical connector as claimed in claim 1 wherein the securing device is a barb.

3. The electrical connector as claimed in claims 1 and 2 wherein the flexible portion of the first set of connector terminals is shorter than the flexible portion of the second set of connector terminals.

4. The electrical connector as claimed in any of the preceding claims wherein the number of connector terminals in the first set is different from the number of connector terminals in the second set.

5. The electrical connector as claimed in any of the preceding claims wherein adjacent terminal contact portions are spaced apart by varying distance, and adjacent engagement portions are spaced apart by a substantially constant distance.

6. The electrical connector as claimed in any of the preceding claims wherein
5 the engagement portions of the first set and the second set of the connector terminals are substantially equidistant from the terminal insertion end of the housing.

7. The electrical connector as claimed in any preceding claims wherein the first set and the second set of connector terminals are inserted into the terminal
10 passageways from the terminal insertion end of the housing.

8. A testing system comprising:

an electrical connector comprising a housing having a strip insertion end, a terminal insertion end and a plurality of terminal passageways extending from the strip insertion end to the terminal insertion end; a strip insertion slot at the strip
15 insertion end extending to the terminal passageways and configured to allow a test strip to be inserted when in use; a first set and a second set of connector terminals wherein each connector terminal comprises an engagement portion, a secured portion wherein the connector terminal is secured to the terminal passageway by a plurality of securing devices, a terminal contact portion and a flexible portion
20 spanning from the secured portion to the terminal contact portion; and wherein the terminal contact portion of the first set of connector terminals and the terminal contact portion of the second set of connector terminals define a plane substantially parallel to the strip insertion slot;

the test strip configured for insertion into the connector, the test strip having
25 at least two sets of contact pads thereon; and

an electronic circuit coupled to the electrical connector adapted to produce a plurality of output signals based on electrical responses through the contact pads of the test strip inserted into the electrical connector.