Development of the ECLIPSE 2001 model with touch panel

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Abstract

With advancements from CDs to DVDs, the addition of hard disks and large capacity databases, and increased CPU and graphic processing, car navigation systems are becoming ever higher in performance with a multitude of features. On the other hand, as multiple features and performance have increased, so have complaints from users regarding user-friendliness, and demand for products that are easier to use is on the rise. Since we introduced the first AVN audio and navigation, one piece 2DIN product to the market in 1997, we have pursued performance, enlarging the screen, switching to DVD, introducing the famous 3 deck (DVD/CD/MD), etc., and were evaluated highly by the market. In the 5th year, ease of use and safety was focused upon, resulting in a combination touch panel and screen switches, raising user friendliness dramatically. The balance of high performance, multiple features, and safety, is the main characteristic of this product, and in this document, some of the technology used in achieving this goal will be introduced

1 Forward

Car navigation systems have become one of the most demanded items in vehicle products. Our own AVN (a product with Navigation, Audio, and monitor screen fit into a 2 DIN size in the console) has been gathering attention in recent years.

This is believed to be due to:

①The "Multi in ONE" concept is clear, in which audio, visual, and navigation features are put together in a 2 DIN space.

②It can be controlled from one location on the console.

③Everything is installed in the console, so there is no extra space necessary, matching the interior perfectly, and is less likely to be stolen.

When introducing multiple features and high performance in a limited 2 DIN space, high levels of miniaturization technologies are required.

Here is the transition of the hardware installation at our company of AVN through the last 5 years (Fig. 1).

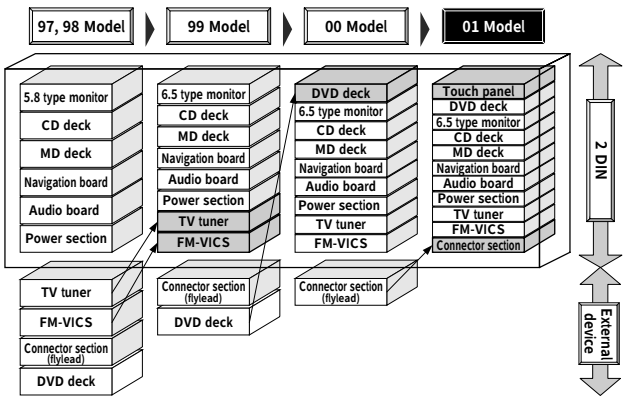

Fig.1 Transition of AVN miniaturization

As you can see in this transition, improvements in miniaturization technology at our company have been remarkably high, and by continuing to develop these strongpoints, our brand image, reliability, and expectations have been set in the market.

2 Outline of the Product

ECLIPSE 01 MODEL, [AVN5501D]

[Common parts]

- Dimensions : 2DIN (W178, H100, D165mm
- Weight: Approx. 3.6kg
- Included playback features : DVD/CD/MD
- Operation method: On the unit (touch panel and front face switches), remote control

[Audio/Visual]

- Radio (AM/FM/FM simulcast)
- TV (1-62 channel, VTR input
- CD(CD-TEXT compatible)
- MD

[Navigation]

- DVD Navigation (DISC: ONE SIDE 2 LAYER 8.5GB)
- FM-VICS (ROAD TRAFFIC INFORMATION FM RECEIVER)

[Sound Quality]

- DSP/Graphic EQ/Position Selector
- 35w (4 ch amplifier

[System Upgrades]

- CD Changer
- MD Changer
- 3 Media VICS (Road Traffic Information Beacon Receiver)
- ETC (Highway toll road automatic payment system)
- Back Eye Camera (rear view camera)
- Mascot Robot

3 Technical Development Item

Regarding AVN development, the 2000 model was introduced in issue No. 36. It described the development of a thin DVD deck that made a 3 deck system possible, a front face tilt feature, and cooling methods. In this issue, the new touch panel front face configuration and design, ease of installation and cost efficiency by utilizing a built in fly lead connector, and noise prevention are described.

4 Introduction of a Touch Panel

4.1 Aim of the Touch Panel

As mentioned before, in the car audio/video and navigation market, there is an enormous complication of features. Though customers usually purchase systems with the most features and the biggest database, there are a lot of complaints about not being able to operate the unit very well, or that it is not easy to use.

Especially in the navigation menu, there are a lot of layers in its operation. In order to get to a feature that you want to operate, you must choose an item from a list of selections (switches on the screen) with an 8 direction joystick or the like. The joystick is used to move the cursor selection to switch a menu, then the same is done at the next menu, and so on, to get to the desired selection.

Users are now getting used to clicking on the screen buttons with a mouse click on a PC, but in a car, there are restrictions to using a mouse. Therefore, in considering ease of use and safety, we have utilized a touch panel. Touch panel allows pressing of the screen switch by hand, and in this product where the screen is near by and operations are grouped in a single location, outstanding controllability is gained.

Also, numbers, size, design, and location of switches can be set freely for each screen in consideration of the frequency of use. This makes it possible to improve safety and ease of use required in a vehicular device.

4.2 Screen design

The screen of an AVN, in addition to the [Display] feature for TV screens and other entertainment, holds more weight as a [Control] unit. This now means that screen designs must take into account usability, where the user will be able to operate the unit intuitively. To make a product easy and safe to use, design improvements will be required (such as making icons of button designs).

For example, in the operation of the equalizer which has a tendency to be complicated, drawing the imaged equalizing curve on the screen now allows one touch adjustment (Fig. 2).

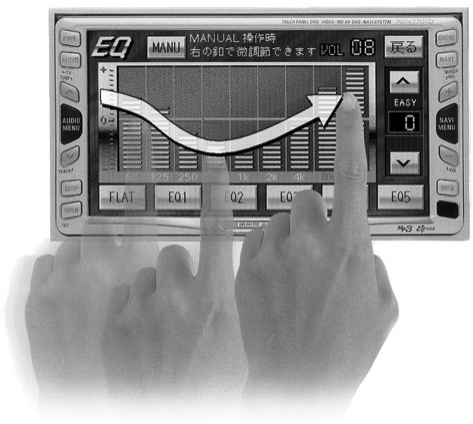

Fig.2 Equalizing control screen

Furthermore, the equalizing screen was made so that the desired frequency bar can be raised or lowered directly by finger.

Also, in position selection (adjustment of acoustic image position according to passenger seat positions), the vehicle interior design is directly touched on the screen to make the setting (Fig. 3).

Fader/balance adjustment normally involved selecting and adjusting front/back and left/right, and the figures were often shown in numbers, making it difficult to understand.

This product shows the interior design by illustration, and enables the selection of the desired position, making easier, visible, intuitive operation possible.

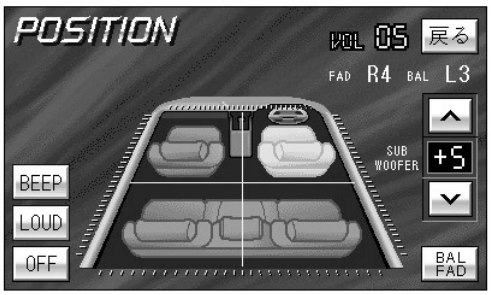

Fig.3 Position adjustment screen

Also, not only audio operations, but navigation operations are made easier. For Japanese character input (Fig. 4), instead of the normal "find the place to push", "move the curser", "verify the position", "confirm" steps required of the user, the touch screen shortens the steps to "find the place to push", then "push (confirm)".

Fig.4 Japanese input screen

In order to make the screen operation more intuitive, there were some screens in which the number of screen operations were increased as a result. By making the audio menu screen independent, it is now possible to see what audio can currently be used (10 sources maximum), and it is possible to hear the desired audio source with one touch (Fig. 5).

This added one extra process, but it connects more smoothly to the later menu screens, and ease of use was improved.

To conclude, this product was developed with a screen design in mind with which the user can operate the unit intuitively.

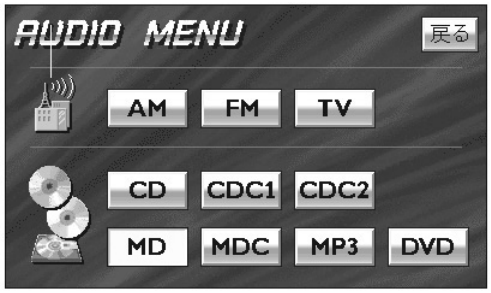

Fig.5 Audio menu screen

4.3 Configuration and Operation Principles

The pressure sensitive (resistance film type) touch panel is made of 2 sheets of clear resistance layers. The resistance layer is ITO (indium tin oxide) vapor coated onto glass or film.

Coordinates are detected through the upper layer coming into contact with the bottom layer by pushing the upper layer with fingers or a pen. Each layer has 2 poles, for a total of 4 poles (Fig. 6).

Operational principles involve applying voltage between the upper electrical poles, producing a potential gradient between the electric poles. The resistance value of the resistance membrane is equal, so the potential gradient will basically be in a straight line. From the lower pole (Y axis), voltage is detected, and with anA/D converter, it is changed to a digital value, allowing calculation of the X axis.

To find the Y axis, voltage is applied between the lower poles, and voltage is detected from the upper poles (X axis), and the Y axis is calculated. The coordinate is found from the calculations of the X and Y axis (Fig. 7).

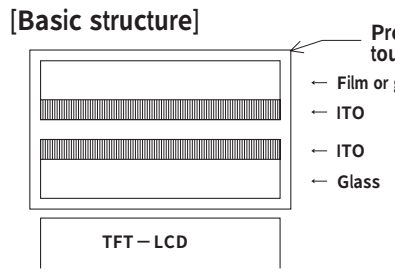

Fig.6 Parts of a Touch Panel

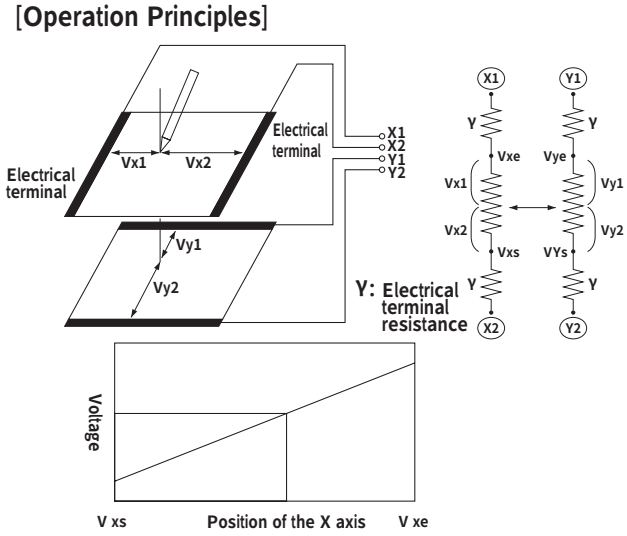

Fig.7 Touch panel operation principles

4.4 Performance

The most important factor in the performance of a touch panel is the positional accuracy. If buttons next to the one pressed are reacting, it will not pass as a product.

Reasons for misalignment include deviations in the resistance membrane of the touch panel, deviations in the circuit, misalignment during installation of the touch panel, misalignment of the picture, misalignment during calibration in the manufacturing process, and parts deviations from aging.

Because of the product format of the AVN, deviations in the touch panel, deviations in the circuit, misalignment during assembly, and misalignment of the drawings are collected as one in the product, and they can be absorbed in the calibration.

Therefore, the most important factor is human error during calibration in the manufacturing process.

To resolve this problem, a 16 point correction process was used for the calibration (Fig. 8).

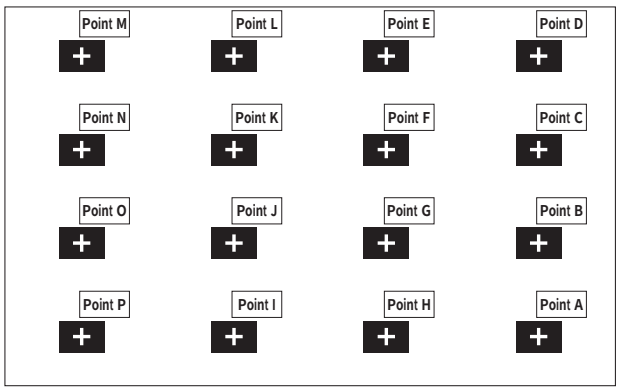

Fig.8 16 Touch panel Correction points

Though accuracy will increase when there are more correction points, the correction time will increase greatly and is not suited for mass production. Considering balance, it was determined that 16 points will be corrected.

When performing correction in the manufacturing process, human error can affect precision greatly. Position accuracy was greatly improved by utilizing

mechanical automatic correction using image recognition.

In regards to the problem with changes over time, an automatic correction feature was added to continually monitor the resistance of the resistance membrane on the touch panel and the internal resistance of the terminal through a microcomputer. If a change occurs in resistance, a correction is applied according to the amount of change.

By doing this, deviation of position accuracy has been kept to less than 1mm.

4.5 Product Configuration

A touch panel was placed between the front panel and the liquid crystal of the previous model. To be exact, a touch panel was attached to the liquid crystal surface using double sided tape (Fig. 9). During installation, the position accuracy is maintained using a manufacturing jig.

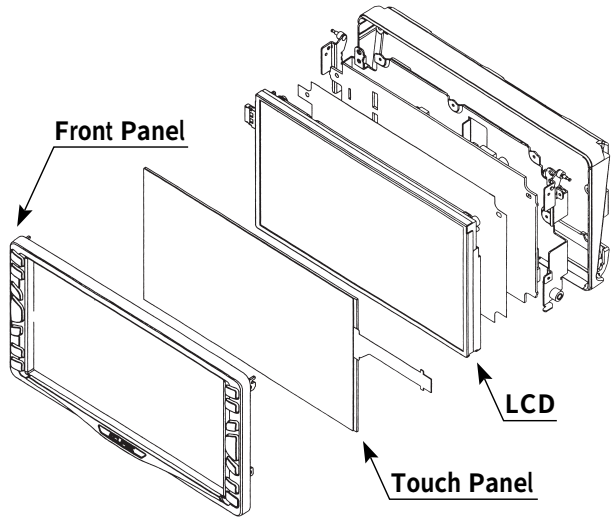

Fig.9 Touch panel attachment diagram

5 Front face switch

5.1 Design specifications

In AVN, the addition of features and performance improvements have been continuing through the years. With the increasing size of the screen in the limited 2 DIN space, there is very little space left for buttons. A very difficult situation arises here, in that there is a continuing demand for even more features, and considerable thought was given to create a design in which a user will feel intuitively that it is easy to use.

First, the layout was made to be uniform on both sides, and buttons uniform on top and bottom, making a basic layout in 4 sections. The buttons for audio were placed on the left side, while the navigation buttons and the frequently used volume control was placed on the right side.

For top and bottom, the more important and frequently used features were placed on the top, and the lesser ones on the bottom, grouping the layout to consider improvement of usage.

The audio and navigation menu buttons were made to stand out from the other buttons, configuring it so that they are bigger than the other buttons. These buttons were then separated into top and bottom button groups, to make it easier for beginning users to find menu positions.

Our AVN uses a 6.5 inch type size screen, and for the 172mm (W)×92mm (H) display panel, a 144.5mm (W)×78.1mm (H) screen opening is required (Fig. 10).

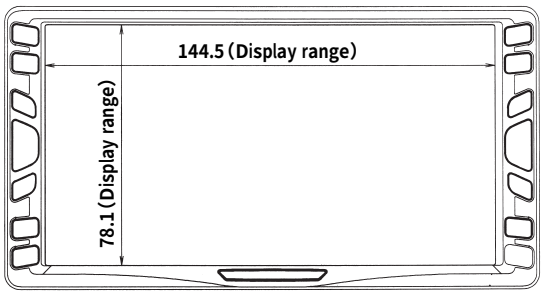

Fig.10 Display panel measurement diagram

The remaining frame shaped panel surface area requires a design with good looks, visibility, and controllability. In this model, efforts were made to acquire as much button surface area as possible in the design (Fig. 11).

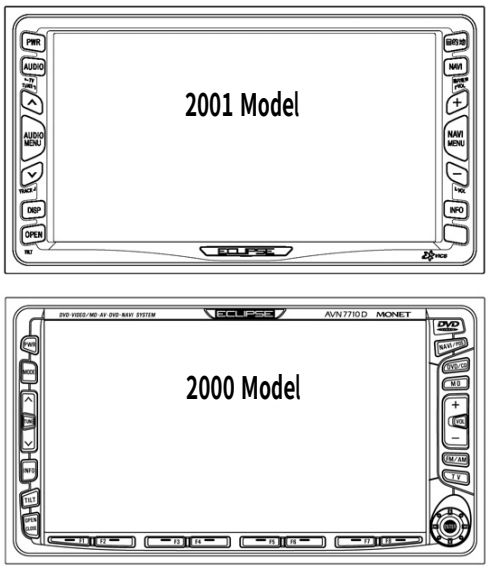

Fig.11 Display panel design diagram

Also to accentuate the design, the buttons are made with clear acrylic plastic, and letters were printed on the back surfaces of the buttons (Fig. 12).

Fig.12 Acrylic button exterior view

5.2 Challenges

5.2.1 Enlarging the buttons

Currently, most buttons are made in a configuration where several buttons are linked in a hinge shape, to reduce the cost of the part and the die, and this has been the case in our design until now. This hinge also the button to return after being pressed (Fig. 13).

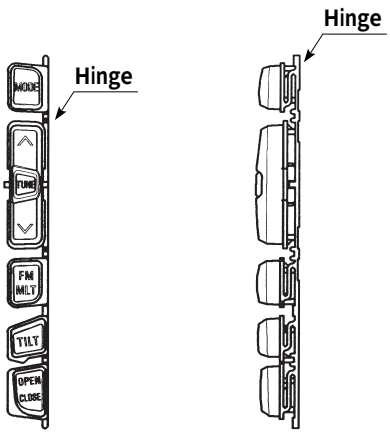

Fig.13 Linked button exterior view

In this current model, because the buttons are made large in an area where the display panel space is very small, there is no space for a conventional hinge, and it is not possible to link the buttons together. Therefore, it also became necessary to make the buttons return by another means.

5.2.2 Clear Acrylic Buttons

When making buttons out of clear acrylic plastic, it is possible to link the buttons as mentioned above by making the acrylic section and a hinge section in order, using a conventional two-color mold.

However the problem in doing this is that printing is required on the back surface of the acrylic button. When performing a 2 color mold, because the acrylic section and the hinge sections are molded simultaneously, there is no room for a printing process. Therefore, in order to have both linked buttons and rear surface printing, acrylic buttons with rear surface printing must be adhered somehow to a separately molded hinge.

5.3 Rubber one piece button

In this model, in order to solve the problem mentioned above, a silicone rubber one piece button was utilized.

This button uses a silicon rubber base, and a preformed acrylic button is adhered to it.

By doing this, the silicon rubber base covers the hinge function of the conventional hinge, and several buttons can be linked together. In addition, the return strength for the button is acquired (Fig. 14).

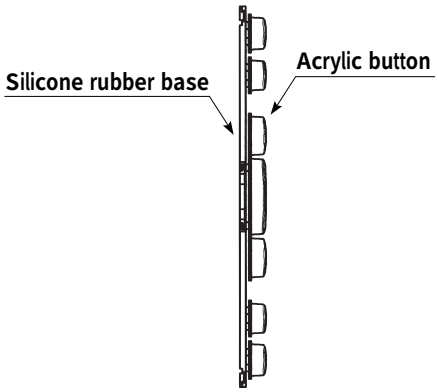

Fig.14 Silicon rubber 1 piece button exterior view

In recent years, this method is used often in cellular phone buttons.

Conventionally, silicon rubber was considered impossible to adhere to another material, but through the development of cellular phones in recent years, a new technique was developed, and this method was raised for consideration.

The actual adhesion method is confidential and will not be described in this article.

- Adhesive strength: pulling strength + 9.8N (1kg・f)
- Temperature: -40℃ to + 85℃

Not only is the adhesion method difficult, but positioning several buttons on a silicon base is also difficult. However this has been cleared at the manufacturer with positioning jigs.

6 Changing to a fixed type connector

6.1 Flylead type connector

In the current year 2000 model, the biggest objective was to combine the DVD, CD, and MD decks, so the external connector was partly changed to a flylead type instead of the conventional board mounted type. This time, the connectors were changed to a fixed type.

The aim is to increase the number of possible vehicles for installation, reduce installation time, and improve cost efficiency (Fig. 15).

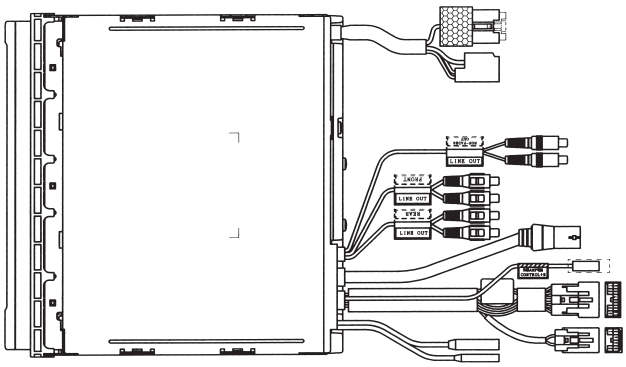

Fig.15 Flylead type connector

6.2 Problems

When the connectors are the flylead type, during installation the cord becomes a bundle requiring space on the back side of the product. Depending on the vehicle, it may not be possible to mount due to a lack of space in the interior panel, or it may be very difficult to route the wiring cords. Also, it is more expensive than the fixed type connector.

6.3 Changing to the fixed connector

6.3.1 Internal configuration

①Tilt gear unit position

The display tilt gear unit was moved from the right side of the current model to the bottom of the unit (Fig. 16). By doing this, space was gained on the right side of the product.

②Regulator position

The regulator in the back of the unit was moved to the right side of the product, where the tilt gear unit was (Fig. 17).

By doing this, space was gained on the back side of the product.

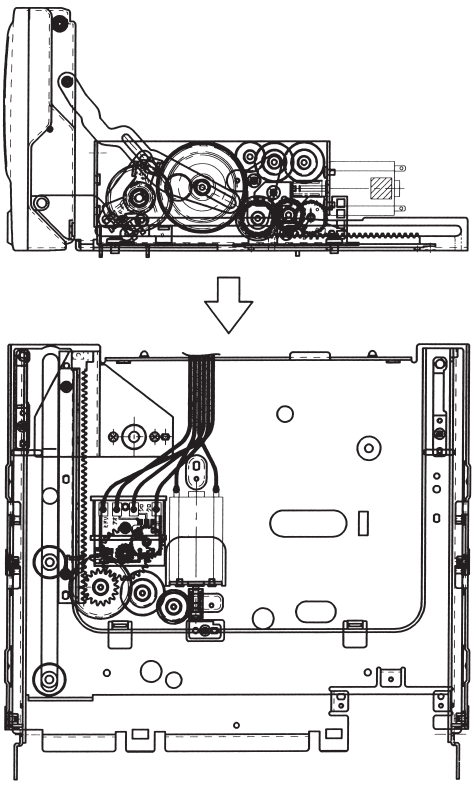

Fig.16 Gear unit layout

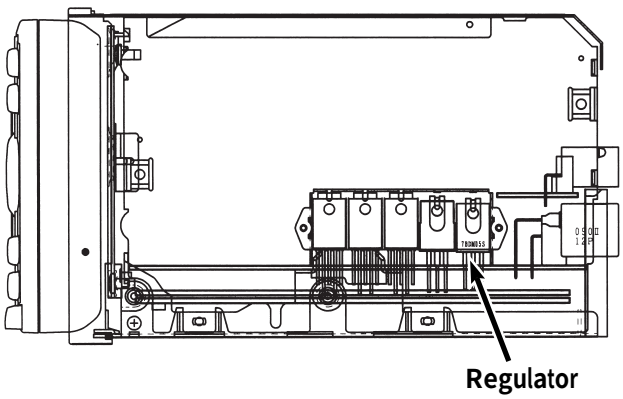

Fig.17 Regulator placement diagram

6-3-2 Fixed connector placement

With the changes made above, it became possible to use a fixed type external connector (Fig. 18).

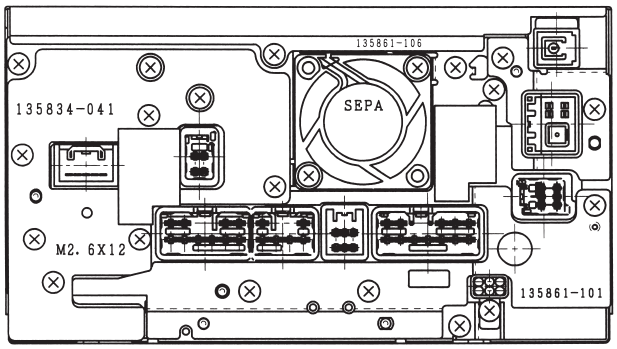

Fig.18 Fixed connector

7 Conclusion

This concludes the development objectives and points of design on the 2001 model Eclipse AVN with touch panel.

This model has been popular since its introduction, and is continuing to sell well.

Though it is not described in this article, we believe that the application of a film antenna and optional rear eye camera, the improvements in ease of installation, and considerations to safety were regarded highly, in addition to the touch panel, other features, and the efforts to improve user friendliness.

We will continue to pursue the "All-in-one" concept in the future, aiming to develop truly "user-friendly" and "welcomed" products.

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