

Design of Instrument Cluster and Control Switches for 2018 Gold Wing

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ABSTRACT

The Gold Wing was developed as a large luxury touring motorcycle. The styling design of the instrument cluster and control switches is therefore important in creating an enjoyable experience for the rider through their appearance and operation. In its first full model change in 17 years, the Gold Wing was updated with numerous advanced technologies. That brought significantly increased information displayed and rider controls. The design goal was set as an integrated human-machine interface (HMI). The integration is made among mutually interrelated information on the display and device operations. That enables the intuitive operation and information presented in the most natural way minimizing riders' stress. For the instrument cluster of this particular vehicle, a beautiful appearance is also a crucial design factor. The design objects range the operation parts, the surface textures and the shapes. For those, further advanced designs were implemented aiming at the relevance to the current generation and luxurious feels. By doing that, we tried to make the vehicle worthy deserving the motorcycle of the highest class. These efforts resulted in achieving both the functionality and beautiful appearance at high level. The design contributed to the owners to have joy of riding while satisfying the pride of ownership of a globally recognized motorcycle. In addition, the design has helped the new Gold Wing has received excellent customers' reviews.

1. Introduction

The Gold Wing is Honda's premiere large touring motorcycle. It began with the launch of the GL1000 in 1975, with its pet name "Gold Wing" becoming an iconic brand name over its history that spans over 40 years⁽¹⁾.

For the first full model change of the Gold Wing in seventeen years since 2001, the development concept underwent a complete redesigning given the changes in the market and the generations who buy motorcycles, while also considering taking the Gold Wing brand far into the future. A drastic change was made: the new model would have a light-weight, high-density package for ultimate enjoyment of riding, while maintaining the luxurious presence that has been a Gold Wing tradition. This was a drastic change from the direction of luxury and grandness that the previous Gold Wings have pursued⁽¹⁾. From this complete overhaul of the vehicle's concept, another requirement was established: the new Gold Wing would offer the maximum enjoyment a rider can experience, from its riding performance and daily usability to comfort during long-distance touring.

As such, it was decided that this luxury motorcycle model deserves a full-suite in-vehicle infotainment (IVI)

system utilizing the latest technologies. "Infotainment" refers to the concept of providing information and entertainment in one system. This technical paper provides introduction on the IVI system and its controls, the human-machine interface (HMI), as well as their exterior designs.

Starting with the 1980 GL1100 model, the Gold Wings of the past have come equipped with the latest audio devices for motorcycle applications (Fig. 1)⁽²⁾. The Gold Wing also became the first motorcycle to apply a GPS system in its 2006 minor model change (for north America; 2008 for Japan), cumulating in the establishment of an IVI system integrated with audio.

In the twelve years following this, however, the IVI technologies in the automotive world have advanced greatly, exemplified in the smartphone connectivity functions. This created the necessity for the new Gold Wing to have function updates as well.

The electronic control technologies in the motorcycle world have also made great strides, which led to electronic controls being used in all the key components of the Gold Wing in this development, including the engine, suspension system, throttle, brakes, and transmission. This allows for the rider to have a wider array of options to choose from to

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Fig. 1 History of the Gold Wing from perspective of their infotainment systems

meet personal preferences and scenes, such as riding modes and various settings. The expansion of the IVI system functionality and general advancement of electronic control technologies led to an increase in the volume of information communicated to the rider through the instrument cluster (an integrated unit containing all the various gauge units essential to vehicle operation), as well as an increase in how much a rider must or can do to operate the motorcycle. The overall styling design of the new Gold Wing was also completely refreshed to be in line with the project concept, while maintaining a high-quality feel that has been the hallmark of this iconic motorcycle model. The styling designs of the instrument cluster and handlebar switches/buttons had to be harmonious to be integrated into the overall styling.

Since the styling designs of these components would have a direct impact when the vehicle is being operated on the road, good legibility and ease of use should be prioritized over their shapes and textures.

With that said, large touring motorcycles such as the Gold Wing are also seen as luxury leisure products and their users expect beautiful forms, colors, textures and feel in these products to command the high prices at which they are offered. When parked in a street corner, people will recognize a motorcycle's instrument cluster as part of the vehicle's exterior design. The team took this into consideration and engaged in developing a styling design that leaves a strong impression of beauty and quality even when the motorcycle isn't being operated. Figure 2 shows the area in a complete vehicle.

2. Changes of User-related Information and Expectations for the New Gold Wing

2.1. Up-to-date IVI and Vehicle Body Electronic Control Technology Enhancement

Apple CarPlay (Apple CarPlay is a trademark of Apple Inc.) released in 2014 and Google Android Auto™ (Google Android Auto™ is a trademark of Google LLC), are services



Fig. 2 Instrument cluster, handlebar switches, and center panel of developed Gold Wing

developed to allow people to use their smartphones in their cars that have been applied to products by automotive makers and IVI device makers worldwide^{(4), (5)}. This led to the establishment of an environment in which the functions of smartphones the people have become familiar with, such as communication, audio and GPS navigation, can also be used while driving.

This change in operational environment in automotive caused motorcycle users to want the same. The functionality of such systems were considered especially useful for the Gold Wing, which is primarily for touring purpose, particularly the voice-command operation seemed more beneficial to motorcycle riders than automotive drivers. The Gold Wing being Honda's only motorcycle with IVI, the team saw the potential in customer demand for the latest infotainment system with excellent connectivity befitting this model. As such, it was determined that the new Gold Wing would have the IVI system compatible with Apple CarPlay, the first in motorcycle application.

The new electronic controls added to the model include Walking Mode⁽¹⁾ in which the vehicle can be more easily maneuvered when feet are touching the ground, and four ride modes⁽³⁾ of Tour, Sport, Rain, Econ to best match the scene and rider's riding style.

2.2. New Challenges

(A) Method of displaying increased amount of information

The enhancement of IVI and electronic controls created the need to add a variety of status indications, and that means that necessary information must be immediately recognized without causing misunderstanding.

Enlarging the instrument cluster to accommodate the increased number of items to be displayed would go against the development goal of making the vehicle body more compact. Making the icons and text smaller would not be acceptable for the reason of negatively impacting their legibility. The challenge here became the organization and streamlining of the information and displaying them in the most clearly and easily understandable way.

(B) Redesigning switches to accommodate information increase

With the increase of available options, items needing user input were added; the focus then here is to allow the rider to operate the system as needed quickly and easily without causing any errors to be made.

Up to the previous model, most of the operations related to the audio or GPS navigation systems had one control switch or button per function. This meant that the body panel was full of control switches and buttons but remembering where they were allowed for simple and easy operation. The handlebar switch boxes were also at the largest possible size that the fingers could reach (Fig. 3). Increasing the number of controls to correspond with the additional operation items would contradict the team's goal of making vehicle body more compact. Making the control switches and buttons smaller would also not be acceptable for that would impact the model's maneuverability. Making the control switches and buttons smaller would also not be acceptable for that would affect vehicle operability. It was therefore determined that the operational method should be redesigned from ground up for simplification of operation, as well as decreasing the number of controls and making them smaller.



Fig. 3 Instrument cluster, handlebar switches, and body panels of previous model

3. Solving Challenges with HMI

It is of utmost importance that the riding operation not be hindered by visual recognition of information and operation of devices, therefore the target became an excellent linkage between the information display and the operation controls designed in a way that is clearly understandable and intuitive to use. Which means that there should be a strong awareness of HMI in creating a design that integrates the information display in the instrument cluster and the operation controls. Also, the styling design of the instrument cluster of a motorcycle should be in harmony with the styling design of the overall vehicle as it is also part of the exterior design.

- Realize excellent instrument cluster legibility suitable for a premier motorcycle
- Maintain proportions and voluminousness of overall vehicle
- Create a feel of quality and class in the exterior requisite to keep Gold Wing's legacy

More details will be described below with consideration to these points of legibility, operability, and design.

4. Legibility of Instrument Cluster

4.1. Configuration of the Overall Instrument Cluster

As part of the instrument cluster that already requires only minimum eye-scanning amount, a 7-inch, multi-functional and full-color TFT liquid crystal display (LCD) unit was applied. Its size, at 7 inches, is among the largest in motorcycle application. It also allows the settings to be made for the navigation, audio, telephone and various other functions.

The speedometer and tachometer were applied with an analog styling design using pointers and dial faces and placed on the left and right of the center display respectively, creating a more stretched out, streamlined look. This is a change in direction from the previous model, which had the two gauge units placed above the center display creating a stack in the center. With the new configuration, the functions are placed along a narrow line between the two rear view mirrors, allowing for the rider to check the information effortlessly and efficiently within the eye gaze area to check the rear view mirrors (Fig. 4).

4.2. Targeted Effect of Analog-style Gauge Units from HMI Perspective

As indicated in Section 4.1., much of the information displayed in the instrument cluster including the full-color TFT-LCD screen is in text. To counterbalance that, the traditional "analog" style of gauge display design was chosen on the basis of allowing the rider to understand engine speeds and vehicle speeds intuitively by position of the pointers rather than reading numbers in text.

The "analog" display method also allows to add functions to the direction to which the pointer points. The

tachometer can be set at an angle so the pointer points straight up at peak power output to notify the drivers and riders when to shift the gear during motorsport and races (Fig. 5). The same can be done with speedometers to point up when cruising on highways.

In this development of the new Gold Wing, the system was designed so the pointers of the speedometer and tachometer point close to horizontal and perpendicular angles at 55 mph and 1800 rpm (in main market of USA), respectively.

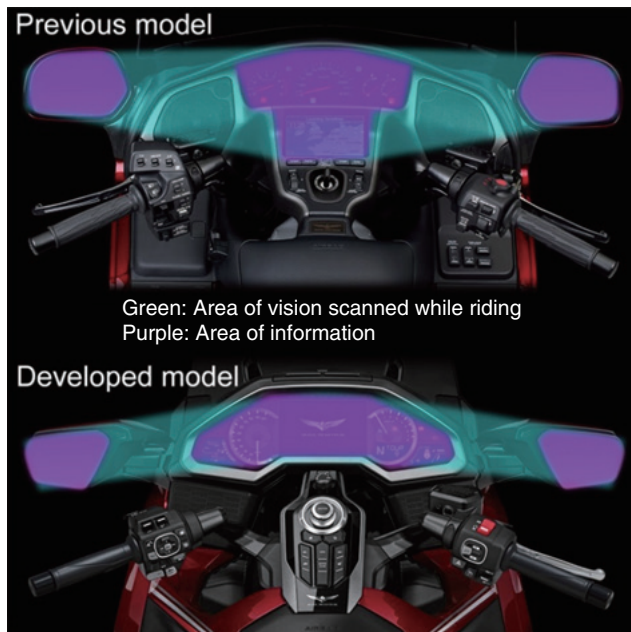


Fig. 4 Comparison of visual areas classified by gazing time of rider's eyes

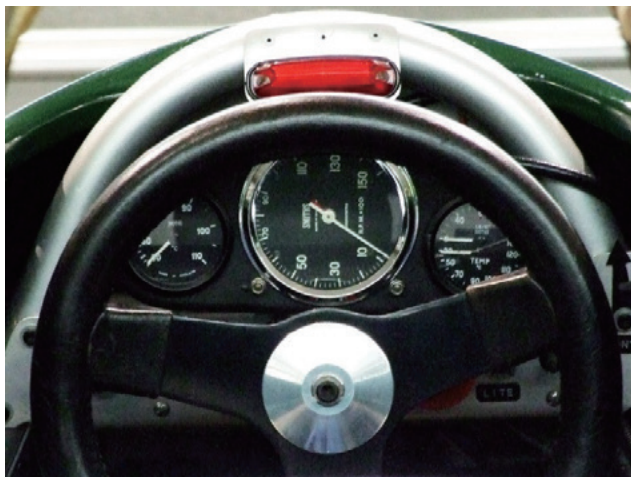


Fig. 5 Rotated tachometer on 1980 Ralt Honda racing car optimized to show upshifting of gears

4.3. Analog Gauge Unit Placements

4.3.1. Smaller size

If good legibility is needed for an analog-style gauge unit, it should be made large. However, a larger instrument cluster would greatly impact the exterior form of the vehicle and go against the development concept. The challenge here was to secure excellent visibility for an instrument cluster with limited area.

Visibility and legibility are also related to eyepoint distances. The gauge units would appear larger if seen from close proximity, so making them smaller while providing good legibility is possible. Here, the sizes in appearance are shown as areas covered by rider's view by using viewing angles. The gauge units of the previous model were approximately 1000 mm away from the eyepoint of a rider with an average build; the same distance for this development model is approximately 800 mm (Fig. 6). This is due to the rider position shifting forward with smaller vehicle body and power unit, as well as the steering axis offset to the rear that occurred as a result of the application of double wishbone front suspension⁽¹⁾. To secure the same level of viewing angle as the previous model with gauge unit diameter of 110 mm, the new Gold Wing with a shorter distance was set at 90 mm diameter (Fig. 6).

4.3.2. Compact arrangement

Simply placing two 90 mm gauge units on the right and left of the 7-inch, full-color TFT-LCD screen would create a center distance of 263 mm. From an appearance styling design perspective, the balance seemed off with the two gauge units being too far off to their respective sides. Also

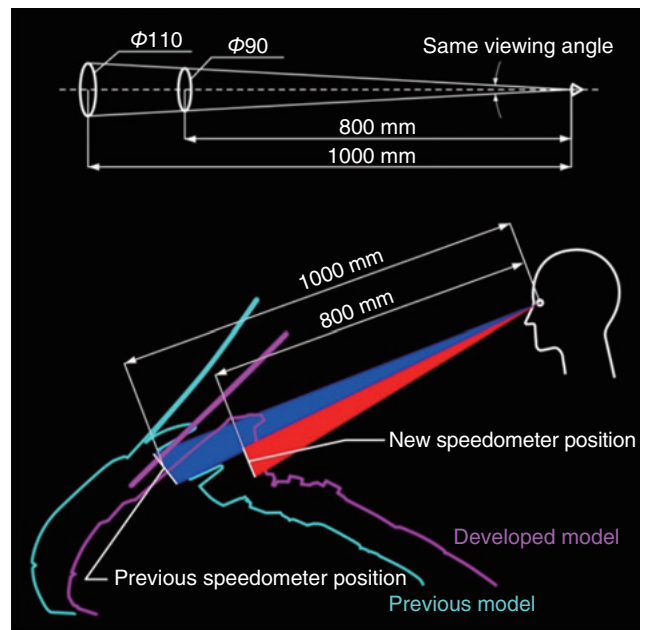


Fig. 6 Comparison of positions and diameters of speedometers in light of viewing angle

from an HMI perspective, this placement overly stretched the viewing angle in the horizontal direction, creating too great a distance between the sets of information seen on the right and left sides of the display to glance during riding. The components had to be brought closer to center. A simulation was carried out with even smaller gauge units at 80 mm diameter. From a styling design perspective, the inner widths remained unchanged even with a smaller diameter, resulting in the two circles on the sides appearing even more separated. The pointer travel distance remained at approximately 5.5 mm in mixed traffic, proving the decreasing of the right-left pitch being not as effective in comparison to the legibility sacrifice made with a smaller gauge unit diameter (Fig. 7).

Unlike the clock, the pointers of “analog” style circular gauge units such as speedometers and tachometers will not go around 360 degrees. It is therefore possible to cut out areas where pointers do not need to reach. The inner areas of the gauge units facing the center display were cut out in an attempt to decrease the necessary amount of eye scanning. The cut out ratio was set at 15% to maintain the impression of the gauge units appearing circular. The center distance was shortened from 263 mm to 235 mm while maintaining the 90 mm diameter for the gauge units, giving good legibility of essential information for riding with an overall width equivalent to the previous model (Fig. 8).

4.4. Details of Instrument Cluster Layout

Figure 9 shows the overall layout of the instrument cluster. A full-color TFT-LCD screen is positioned in the center. Black-and-white LCD screens are placed in the lower left part of the speedometer and from the bottom

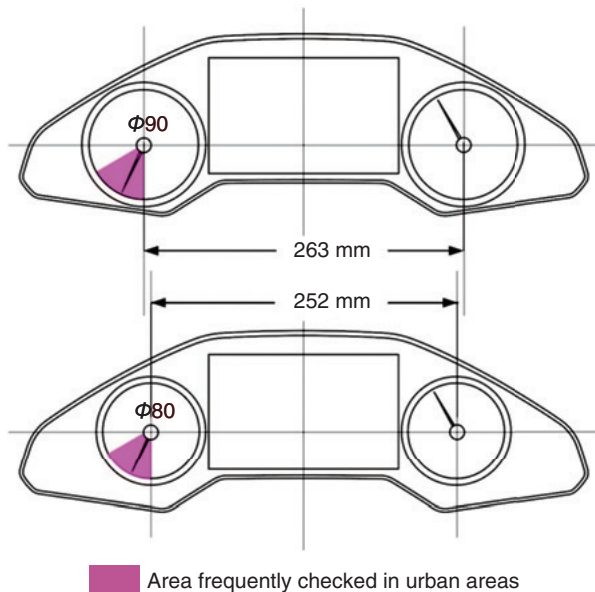


Fig. 7 Study of gauge display arrangement applying composition of full circles

to the lower right part of the tachometer, indicated by red frames numbered 1, 2 and 3. These areas display at all times the information necessary for riding the motorcycle. Their exact placements and the types of information shown will be explained hereafter.

The warning lights that indicate failures of functions are placed toward the center top of the area necessitating minimum eye scanning effort for immediate recognition (4, 5, 6 and 7 in Fig. 9). The low fuel indicator light (8 in Fig. 9) and water temperature warning light (9 in Fig. 9) are positioned above the fuel gauge and water temperature gauge in the black-and-white LCD screens on the left and right, respectively, to allow the rider to understand at first glance what is being warned.

Items related to the speedometer and distance are consolidated on the left side of the instrument cluster. This area contains the odometer, trip meter, cruise control setting, fuel gauge, and remaining fuel indicator related to cruising distance, among others (1 in Fig. 9). The status of cruise control is displayed on the speedometer face (10

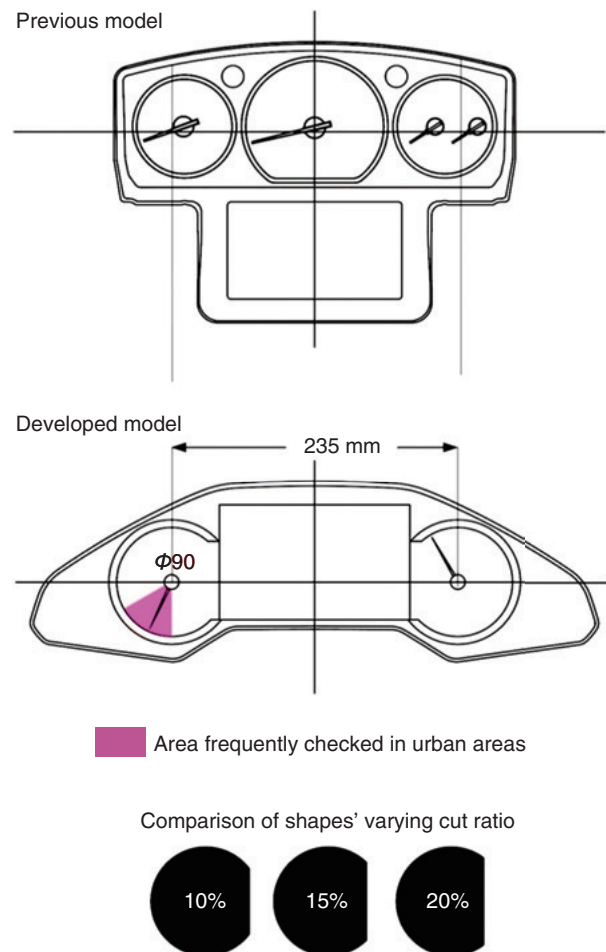


Fig. 8 Examples of space reduction arrangement for rotating pointer type gauge displays maintaining required visual diameters

in Fig. 9), so related information such as the set speed, operating condition, and current speed can be checked in the same area.

Information related to the engine is grouped on the right side of the instrument cluster.

The gear position is shown in letters at a maximum height of 16 mm on the left end of the black-and-white LCD screen (2 in Fig. 9) below the tachometer. Riding mode settings are also displayed in the same area. On the dial face of the tachometer are the neutral indicator and the “idling stop off” indicator (11 in Fig. 9).

The black-and-white LCD screen on the far right (3 in Fig. 9) shows items that are checked and/or set when not in motion or are seldom checked when riding, such as side stand indicator, trunk open indicator, suspension pre-load indicator (set as needed based on number of passengers and amount of luggage), heater indicators, etc., in pictograms.

4.5. Legibility on Multi-functional Information Display

Apple CarPlay and Honda’s proprietary system (for IVI and vehicle settings) are displayed on the same screen, therefore it is important that switching between the two can be clearly recognized and be done smoothly without awkwardness.

The corners on the square icons on Honda’s IVI home

screen were rounded to match the styling of those seen on Apple CarPlay’s home screen. Differentiation was made by giving Honda’s IVI system a different color tone. The text indicating icon names were also made larger and placed next to the icons to clearly differentiate from the Apple CarPlay display. Great care was made in treatment of the text, considering the use of the system while riding a motorcycle. Out of the humanist typefaces known for high legibility, Frutiger was selected for its excellent visibility and legibility⁽⁶⁾, its size on the home screen set at approximately 6.8 mm (Fig. 10). Apple CarPlay uses San Francisco, an Apple Inc. system font, and the size on the home screen is approximately 4.8 mm.

4.6. Settings Display and Limit on Amount of Information Displayed

The setting display is designed so the items appear in a list after reaching a category’s level from the home screen. This shows the options in a vertical manner, simplifying and reducing time of operation of viewing and selecting the items with up/down and select buttons.

In understanding the limit on the number of items on the list that can be recognized in a short time, we referred to American psychologist George A. Miller’s theory of the capacity for human short-term memory being “seven, plus

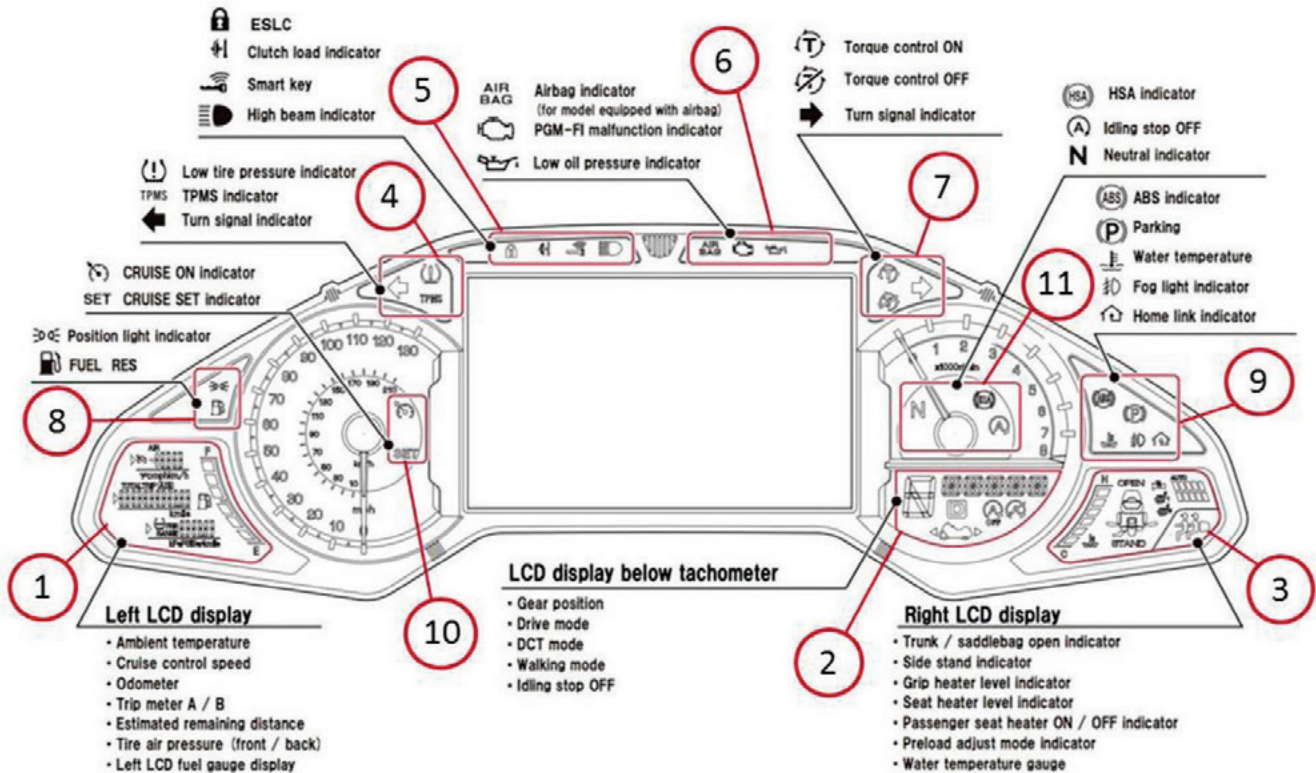


Fig. 9 Arrangement of display components on instrument cluster

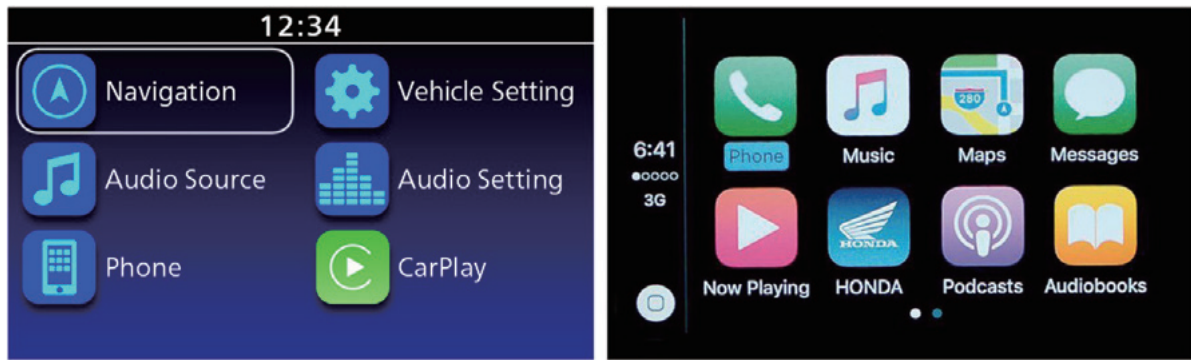


Fig. 10 Honda HMI home screen (left) and Apple CarPlay™ home screen (right)

or minus two” at a time. The “items” here refers to “chunks of information” with meaning, and in this context they are the items on the list including the color tones and settings⁽⁷⁾. In this development of the Gold Wing, we opted to display five (seven minus two) at a time based on aforementioned theory, to allow for recognition of information with a good margin even when riding the motorcycle (Fig. 11).

4.7. Guidance and Feedback Through Colors

In information display, it is important to give feedback as guidance to prompt the rider to make correct inputs, and show response to the inputs made. Those were done through changes in tones of colors on the Gold Wing, taking advantage of the full-color system. The basic colors were white and cyan, with gray added for only when needed.

The following four were applied to the system to allow for the rider to intuitively understand the operations without being explained.

- (1) Selectable options (in white text inside white frame)
- (2) Option user is on to make selection (highly visible cyan with tones reversed inside frame for accentuation)
- (3) Feedback showing selection has been made (migrate to

next operation screen page, or show only the frame in cyan)

- (4) Options that are not selectable (text and frame in gray to decrease the presence)

An example of an actual setting page is shown in Fig. 12.

4.8. Tone and Brightness of Colors on Display

As mentioned above, the new Gold Wing applies three types of display: full-color TFT-LCD, analog-like design of gauges and pointers for speedometer and tachometer, and black-and-white LCDs on the right and left.

First, the difference in their lighting methods and considerations to visibility and legibility will be described. The colored and black-and-white LCDs use the light emittance technology with backlights similar to smartphones and computer displays. With the analog gauge units, indirect lighting from the pointer bases are used to illuminate the gauge unit faces, and light transmitted from the backlight is used on the gauges, letters, and marks, etc.

Motorcycles are used in various lighting conditions such as daytime, nighttime, dusk and dawn, etc., so it is

Menu list items contain group of properties of text, color, and status

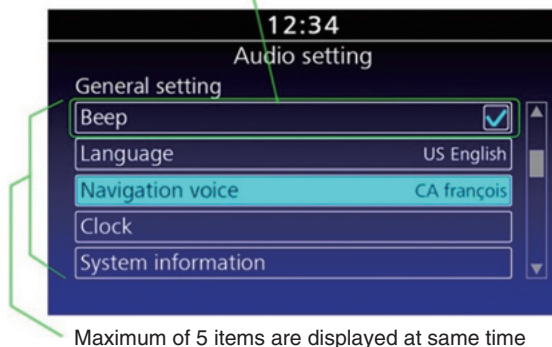


Fig. 11 Example of menu list

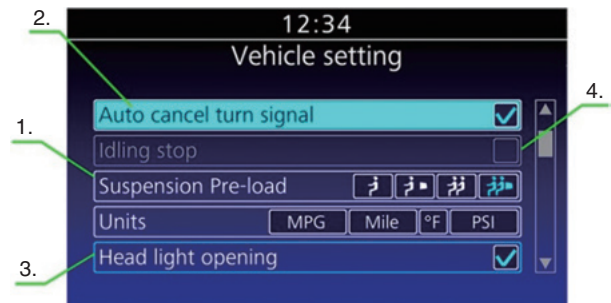


Fig. 12 Example of screen design

essential to give secure good legibility to the gauge units using multiple lighting systems with varying brightness and characteristics. If looking only at the full-color TFT-LCD, giving it a dramatic contrast between the visuals (e.g., in white) and the background (e.g., in black or other dark colors) would allow for good legibility. However, if the rider turns his eyes to the analog-like gauge units after looking at a bright screen, the legibility would be negatively affected by the residual visual effect (Fig. 13). Residual visual effect is a phenomenon in which the light/shade contrast and hues appear reversed. In this development of the Gold Wing, black was selected for the analog-like gauge units for minimum impact from external lighting and a similarly dark color for the background of the full-color TFT-LCD screen to match the analog gauge units, creating an environment in which no dramatic brightness difference will be made. The black-and-white LCD screens on the sides of the instrument panel appear to have white text on black background in daylight, but the background turns dark blue when the backlights come on at night. This is done so the units have the highest possible contrast between the visuals and background for optimum legibility even when the backlights are on. The full-color screen in the center also uses a similar dark shade of blue to give the entire instrument cluster a consistent color scheme (Fig. 14).



Fig. 13 Residual visual effect caused by excessively high contrast on display screen



Fig. 14 Color tone coordination by using unified colors

5. Objective and Configuration of Switches/Buttons for Operability Enhancement

5.1. Coordination Between Display and Operation

It is assumed that riders wear gloves when riding motorcycles, so making the operation switches and buttons smaller would affect vehicle operability. To solve this issue, each switch/button was given multiple functions with the new Gold Wing. To enable this, as was described in the information display section, the information to be displayed on the full-color TFT-LCD in the center was to have multiple levels and the information to be linked with the operational switches/buttons (Fig. 15). The aim here was to have the rider quickly understand visually the system's feedback on what's already selected or what changes were made.

This linkage of display and controls contributed to the streamlining of the switches and buttons by simplifying the basic operations to “select” and “decide.” This method was applied to many other items including various settings changes, music, phonebook, and setting of destination on the navigation, eliminating the complications that could arise from a system having multiple different operation methods.

Operation of the system during riding of the motorcycle must be done without letting go of the handles, so the items are selected using the cross-shaped switch unit on the left handlebar, then decided with the Enter button in its center. The interface dial on the center panel and the Enter key on the dial surface have the same function, but they cannot be actuated when the vehicle is being driven. This dial is used only when detailed settings need to be made when stopped, as well as for complicated operations such as entering text.

Separate buttons were made for the “return” function to take back to the previous page and the “home” function to go all the way back to the home screen for the sake of simplifying rider operation, since these two functions were assumed to be used relatively frequently.

The relation between ease of use and the number of switches/buttons is determined by the balance between operating directly and in stratified menus. In this development, we studied automotive models that are advanced in terms of IVI and identified what functions

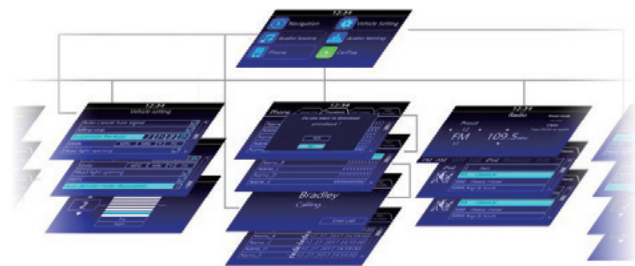


Fig. 15 Layered screen display structure

should be operated directly. Our finding was that those functions that directly impact human senses or cause the driver to feel stress if it cannot be controlled immediately after feeling the need, such as cabin temperature setting and audio volume setting, usually had buttons dedicated to the respective function.

In this development of the Gold Wing, the volume adjustment function for the audio equipment, audio source switching function, and the switches/buttons for opening and closing windscreen, and HVAC functions fall under this category.

The audio source switching button can also mute the sound by pressing it down for a while. This is a convenient feature for when the rider wants to quickly mute the sound in situations such as using the telephone function or having a conversation using the intercom. Attributes such as engine output characteristics, suspension damper attenuation characteristics, DCT models' shifting characteristics also directly impact the rider's feeling. In this development of the Gold Wing, these were integrated to make four riding modes that can be selected with the riding mode selector switch on the right handlebar. The finished right and left handlebar switch units are shown below (Fig. 16).

5.2. Striving to Make a Stress-free Operation System

One element of what makes switch/button operation effortless is to take advantage of what have become the de facto standards after being in use over a long time.

One such example is the on/off dial, where turning clockwise turns the system on and counterclockwise turns it off as does the ignition dial. In terms of using a dial to control the amount or values, a popular method is to turn clockwise to increase and counterclockwise to decrease.

The interface dial applied to the center panel of this Gold Wing can function as a dial-type switch unit as well as to make selections on the display by rotating in eight directions of up, down, right, left and the four points between them (Fig. 17).

Rotating the interface dial allows for a quick scroll-through of the menu listing in a vertical orientation used often in the Gold Wing. This contributes to quick access to lists with a large number of items to choose from, such as music title list and telephone number list imported from a smartphone.

With a list, the general reaction is to start from the top and go down and therefore going down is "going forward" and going up is "going back." The operation of the interface dial of the Gold Wing follows this to "go forward" by turning clockwise and "go back" by turning counterclockwise. The item selected is positioned in the center of the screen at all time, so going down a list would make the list move relatively upward. This means the images on the screen seem to be moving in the reverse direction, but since the rider is going down the list this operation will feel natural and intuitive.

As described above, the system was designed so the

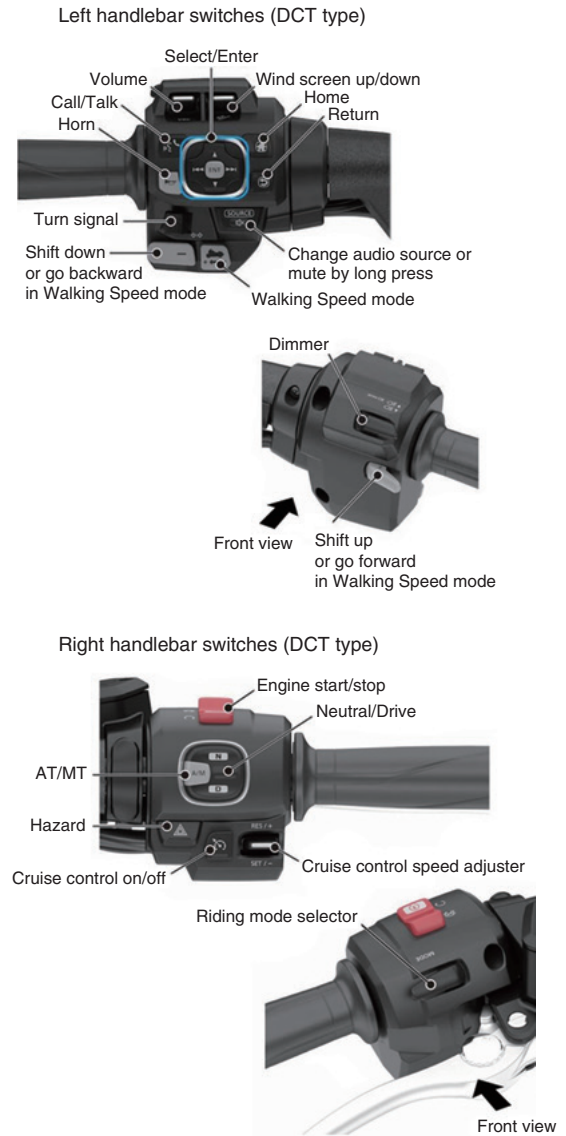


Fig. 16 Handlebar switches

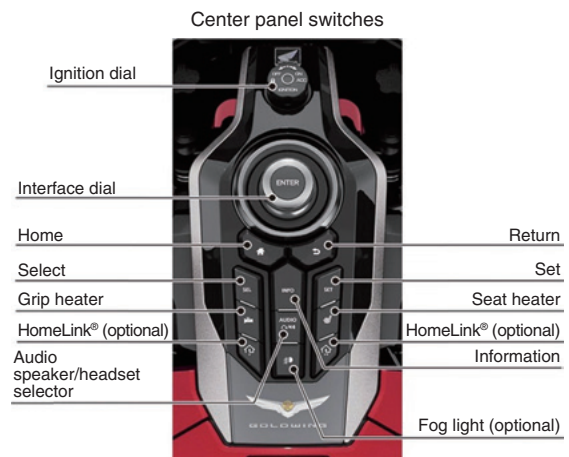


Fig. 17 Switches and dials on center panel

rider will feel that its operation and the information on the displays would feel natural, effortless and intuitive. This did cause the number of items needing rider input to increase, however the operation was streamlined to be only “select” and “decide” for simplicity. This also helped in reducing the number of switches and buttons, contributing to making the vehicle more compact.

6. Creating Attractive Appearance

6.1. Value of Physically Built Analog Gauge Units

The speedometer and tachometer designed in an analog manner are composed of pointers and dial face with an additional metallic decoration ring on their periphery (Fig. 18). This design specifically targets at creating an appropriately luxurious feel for the Gold Wing.

Technically it is possible to display images of gauge units in an analog style using high-resolution computer graphics on the large full-color TFT-LCD screen, as many automotive models already do. The blackness of the surface when the screen is turned off actually adds a feel of powerful presence and depth. The attractiveness of the area can be further improved through the designs of surrounding parts and components (Fig. 19). In case of motorcycles, however, the same approach as automotive cannot be taken as there are much fewer parts around the instrument cluster that can be used to build on beautiful appearance.

The instrument cluster is seen as a part of the styling design of a motorcycle, so it is ideal to have it appear attractive even when the power is turned off. In the case of the Gold Wing, the instrument cluster should become a key feature in creating a feel of luxury by its appearance as well.

There are many interpretations of what “luxury” is. One such definition is that its value withstands the test of time.

In the world of watches, a product segment very similar to instrument cluster design, analog watches remain the most popular^{(8), (9)}.

Supported from this example, we determined that having gauge units actually built with real pointers and dial faces would be essential in creating a universal feel of luxury and high value.

6.1.1. Outer decoration ring on analog gauge units

The outer decoration ring for the gauge units was changed from the chrome plated type used throughout previous Gold Wing models was changed to a circular hairline finish type. The aim was to have the hairline finish evoke a feeling of something that has been machined out of a solid piece of metal, fine lines of diffused reflections and soft reflections of light in the machined direction creating subtle elegance (Fig. 20).

Gauge blocks placed along the decoration ring were made with a transparent material to have a chiseled and mechanical form (Fig. 21). The frame around the instrument cluster was applied with a semi-matte dark silver paint to give the overall tone a well-coordinated look.



Fig. 19 Instruments cluster unit of Honda NSX as example of automotive application



Fig.18 Decoration ring with metallic texture



Fig. 20 Hairline finish on decoration ring

6.1.2. Attractiveness created with light and reflection of light

The outer decoration ring described in the previous section is comprised of a surface that is curved inward in a bowl-like manner, and in combination with the illuminated gauge blocks serves as the receiving end for the pointer tip. This construction created a well-defined three-dimensional form and depth for the overall dial face. This arrangement of components also allows for the light being emitted at the illuminated pointer's end to be reflected at the decoration ring, showcasing the gauge unit in a distinctively alluring "analog" styling (Fig. 22).

The light emitted from the pointer's tip reflects onto the outer ring and moves with the pointer. This gives the impression that the surface being pointed by the pointer is glowing.

The reflection occurs further out from the end of the pointer itself, so this effect makes the gauge units to look larger than their actual dimensions. Doing this with chrome plating would create a single point of strong reflection, but this being hairline-finished, the light diffuses lightly in stripes and the afterglow of the reflection moving along the ring makes it look like a band (Fig. 23).



Fig. 21 Exploded view showing gauge ring construction

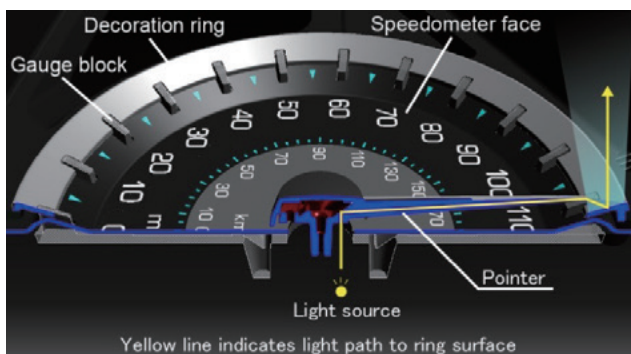


Fig. 22 Cross sectional view of rotating pointer type gauge and light paths of illumination

6.2. Attractiveness of Dynamic Movement

6.2.1. Tachometer pointer

The revving up and down of an engine can be felt through the motorcycle's exhaust sound, vibration and pulsation, as well as seen with the movement on the tachometer. The joy of riding a motorcycle is often likened to having a conversation: riders often feel that there is an exchange between them, and that the changes in engine revolution is more than a referential number on the display. This means that the movement of the tachometer also contributes to making the experience of riding an enjoyable one.

If a dynamic pointer movement is required, for example, the pointer's operational angle can be increased so even a small amount of RPM change can show a greater pointer movement. However, a large area cannot be used for tachometer alone given the limited space given for information display. In an early prototype had the gauges placed at an even interval.

But the engine speed would remain in the 1000-4000 rpm zone if using a big-engined Gold Wing on normal speed roads, making the pointer to appear to be just vibrating near the top of the tachometer. This led to the conclusion that this arrangement would fall short of achieving of "having a conversation with the vehicle."

For this reason, the gauges were marked at uneven intervals and the operation angle of the pointer expanded for frequently used engine speed range. However, having only one area with uneven gauges would make it appear awkward. The solution to this was to apply a gradual change to the gauges on both sides of the said area for a smooth, seamless integration. With this, the angle between 1000 rpm and 4000 rpm were expanded from 45 to 57 degrees to make visible greater movements of the pointer in the normal usage area, which would make the riding experience even more enjoyable (Fig. 24). The pointer movement and the metallic texture, combined with the light reflection design, we were able to create a beautiful, attractive instrument cluster design worthy of a world-class touring motorcycle.

6.2.2. Animations on instrument cluster and full-color TFT-LCD screen

The full-color TFT-LCD screen in the center displays an opening animation when the switch is on and an ending

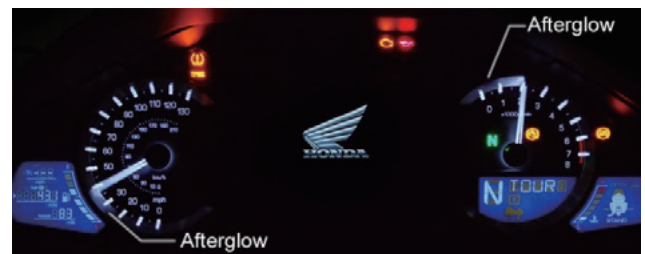


Fig. 23 Afterglow effects following rotation of pointer

animation when the main switch is off. When turning the system on, the black-and-white LCD screens turn on and the pointers on the gauge units move to the end before coming back. A chrome-plated style of the Honda wing emblem then appears on the center of the full-color TFT-LCD screen, then the screen transitions to the function menu. This process has two purposes: making system startup more entertaining, and checking of the instrument cluster display working properly. In the main switch turn-off animation, the Gold Wing emblem appears and fades out. This was done particularly to give the rider a lingering feel after enjoying riding the Gold Wing (Fig. 25).

This application of an “opening” effect using the analog gauge units, black-and-white LCD screens and full-color TFT-LCD screen was Honda’s first.

6.3. Center Panel

In the center of the center panel is an interface dial finished with aluminum-like semi-gloss paint, with matte black buttons behind it. The dial and the panel around the buttons is finished with piano black. The panels covering the sides are painted in the same color as the frame around the instrument cluster of silver, with a lower level of gloss and brightness. The clear contrast between the low-gloss

side covers and interface dial and the glossy black panel helped create a new feel of luxury.

The redesigned Gold Wing emblem was also applied towards the rear end of the black center panel. This was done with the aim of further accentuating the brilliance of the emblem, one of the very few chrome-plated parts used, by placing it in a black background. The entire center panel is shown in Fig. 26.

6.4. Integration with the Overall Styling Design

Much of the attractive appearance of the individual parts described so far have been based on their surface treatments.

Both the instrument cluster and center panel are, as is with the engine, mechanical parts that also impact the vehicle’s appearance. A measure was taken to create a well-integrated look by referring to the engine color management concept⁽¹⁰⁾.

The form, too, was designed to maximize the attractiveness of the appearance of the entire vehicle. First, the outline of the instrument cluster was made to match the silhouette of the upper vehicle body from the rider’s view. The lower center of the instrument cluster and the front end of the center panel must have a way to avoid being contacted by the handlebars when the

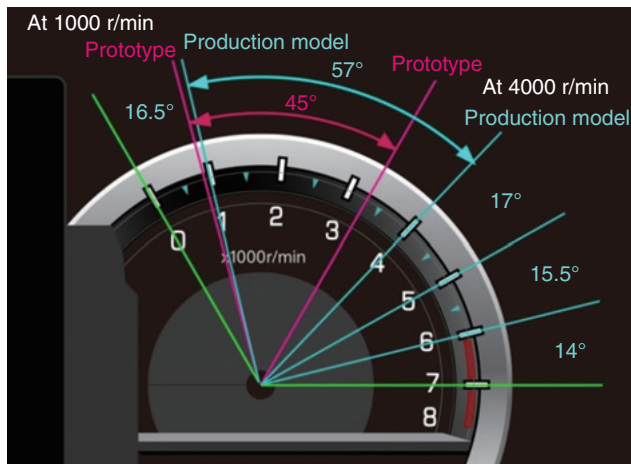


Fig. 24 Comparison of angular intervals of gauge among divisions for tachometer



Fig. 26 Center panel



Fig. 25 Animations displayed at turning on and turning off of vehicle system



Fig. 27 Designing key lines of instrument cluster and control switches

vehicle is being steered. Two trapezoidal cut outs were made in the lower center of the instrument cluster to be in line with the directions of handlebar movements. The front end of the center panel is tapered so the direction of connection with the wide end is in the same direction. As such, much attention was given to even the directions to which the outlines of individual components point in order to be seamlessly integrated with the overall styling design (Fig. 27).

7. Summary

The instrument cluster and rider operation parts in this development of the Gold Wing were designed with much consideration to their beauty in appearance, since they are also key components in the styling of the entire vehicle. The gauge units mechanically built in a traditional “analog” style give joy to the riders, and the well-thought through information display method and operation method cleverly solved the challenge posed by a great increase in the number of operations. We believe that these greatly contributed to the IVI enhancement worthy of a premier motorcycle model, as well as executing in full the project objective of changing direction to a light-weight, high-density vehicle package.

We also believe that the insight gained on HMI through this development will greatly contribute to the future motorcycle developments at Honda.

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