

Development of Electrical Systems for 2018 Gold Wing –Infotainment and HMI–

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ABSTRACT

An infotainment system incorporating state-of-the-art features suitable for flagship models was developed for the 2018 Gold Wing. The system incorporates Apple CarPlay, which has been adopted for motorcycle use for the very first time, enabling hand operation while riding. As for the Human Machine Interface, operation load and stroke were designed especially for motorcycles, bearing in mind the exposed environment and operation with gloves. The result of all this is the latest infotainment system created specifically for motorcycles.

1. Introduction

Gold Wing, which made a full model change for the first time in seventeen years since 2001, was updated with equipment to make riding the Honda flagship model more enjoyable⁽¹⁾. One significant feature is the enhanced infotainment system, including audio function⁽²⁾. Electronic equipment, such as smartphones, have advanced greatly since a minor Gold Wing model change in 2012, and it was high time for a complete update. This paper describes the world's first use of Apple CarPlay (Apple CarPlay is a trademark of the Apple Inc.) in motorcycles, voice input via Bluetooth, and the restructuring of Human Machine Interface (HMI) to match vehicle multi-functionalization.

2. Infotainment System

The conventional audio unit and navigation system were redesigned to work with smartphones. Infotainment system functions were expanded to include hands-free phone and Bluetooth audio, as well as Apple CarPlay, all functions usually found in automobiles.

The issues we faced when applying these to a motorcycle were making the entire system small enough to fit into the space available and being able to operate the HMI system without releasing hands from the handlebar. This chapter describes the system constructed for a motorcycle, the issues we faced when connecting the system to smartphones, and the solutions to those issues.

2.1. System Configuration

The system first used in the 2001 model was updated and functions enhanced several times in the ensuing seventeen years (Table 1).

We assumed that the system would grow in size as functions of the developed model were enhanced, so we reviewed system configuration to see if we could simplify it as a way to control the added size and weight of the enhancement.

The previous system was complicated. It had three systems: a meter and audio unit as its core, with navigation unit systems added to the 2006 model. These systems were connected by voice, video signal, serial communication and control signal lines (Fig. 1). In this latest development project, the system was configured as two units consisting of the navigation system built into the head unit and meters with a built-in LCD monitor (Fig. 2). In addition, the unit size and the number of harnesses have been reduced by consolidating data input and output in the CAN bus. The transmission of the video signal has been digitalized to enhance noise tolerance and use thinner wires. Moreover, the head unit has been waterproofed and can be positioned with a greater degree of freedom. These changes made it possible to put the head unit in the space above the rear fender, contributing to overall high-density, compact vehicle packaging.

The rod-type radio antenna previously attached to the trunk was downsized and stored in the saddleback. Differences in specifications with and without trunks have

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Table 1 Major updating points of electrical features

Model year	Major changing points
2003	- Complete redesign of audio system in accordance with full change of model
2006	- Vast scale minor changes including installation of navigation system (the first generation) - Addition of power amplifier and changes in operation switches
2008	- Addition of XM radio (satellite radio service receiver) to navigation system for US market
2009	- Change of audio unit outer configuration and separation of switches in accordance with addition of air-bag equipped model option
2012	- Re-designing of audio unit and navigation system (the third generation) - Change of installation location of audio system - Termination of CD changer adoption - Addition of audio connectivity with iPod and USB inputs (iPod is trademark of Apple Inc.) - Addition of navigation route information installation capability by SD card

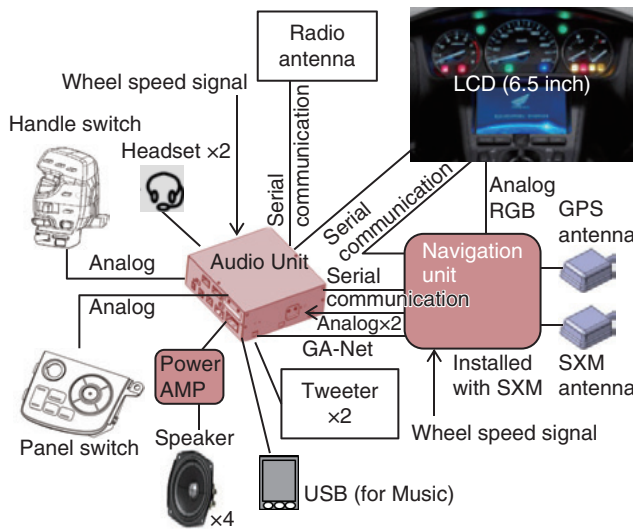


Fig. 1 Connection conceptual diagram of 2012 model

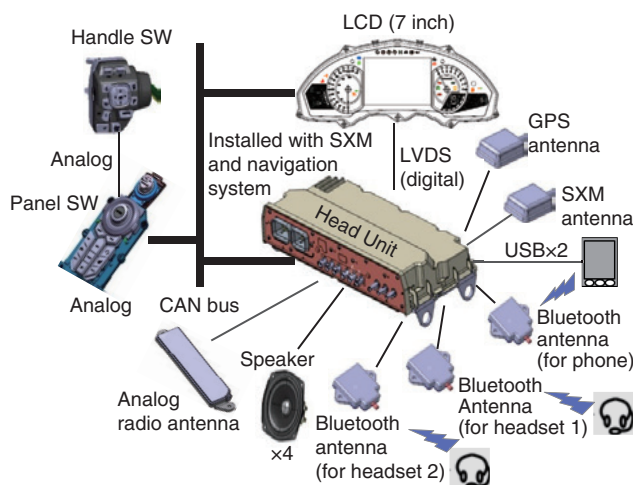


Fig. 2 Connection conceptual diagram of 2018 model

Table 2 Comparison of infotainment system structure

2012 model		2018 model	
Unit	Feature	Unit	Feature
Audio unit	Speed pulse Input	Head unit (audio and navigation)	CAN
	Serial communication (to meter)		LVDS
	Serial communication (to navigation)		AM/FM antenna input
	GA-Net		SP out × 4ch
	Analog I/O × 2		Bluetooth antenna input × 3
	Switch I/O × 2		GPS antenna input
	AM/FM antenna input		SXM antenna input
	Headset × 2		USB
	SP out × 6ch		
	USB		
Navigation unit	GPS antenna input	Navigation unit	GPS antenna input
	SXM antenna input		SXM antenna input
	Speed pulse Input		USB
	Serial communication (to meter)		
	Serial communication (to audio)		
	Analog RGB out		
	GA-Net		

been eliminated, which contributes to a better styling. The structure of the two systems are shown in Table 2 for comparison.

2.2. Smartphone Connection System

This was the first system for motorcycles in the

world that used Apple CarPlay (Fig. 3). Our goal was to link smartphones to the vehicle system to make it more convenient to use smartphone functions.

By adopting Apple CarPlay, immediate response to application updates is now possible, enabling continuous enhancement for user convenience. In addition, since navigation is provided via GPS apps with online connection, users always have the latest map information.

By adopting Apple CarPlay, the system can be operated either using 2-system switches or by voice via a Bluetooth headset, making it possible for the rider to use it without letting go of the handlebars.

The first system entails making necessary commands while riding using direction arrow and Enter keys installed on the handlebar switch.

The second system for switch operation uses the interface dial located on the center panel, and deals with the detailed operations and settings that are not necessary while riding. The switches for the two systems are shown in Fig. 4.

Vocal input is made via the Bluetooth headset. Both hands and feet are used to operate a motorcycle, so vocal input is one of the most suitable ways to operate a system

and it can be done intuitively. Apple CarPlay makes it possible to search for destinations on a map, select music stored on a smartphone, make calls and write and send messages. These are the first voice-operated input and output functions for motorcycles using a Bluetooth headset to correspond to the Hands-Free Profile (HFP) with a sampling frequency of 16 kHz. With it Honda has achieved high-resolution voice input and enhanced vocal recognition accuracy.

3. HMI

New functions have been added with each Gold Wing model change, and the number of switches has increased accordingly. Over the years, switches that could not fit on the handlebars were installed on the body panel and elsewhere. In our development, we added many more new functions and decided to completely rethink the concept of motorcycle switches. Switches were removed from the body panel and concentrated on the center panel. Photographs of the instrument panel of an earlier model and the latest Gold Wing model are shown in Fig. 5.

3.1. Reorganization of Switches

A major premise when developing the operation system was that each function be operated accurately. To do

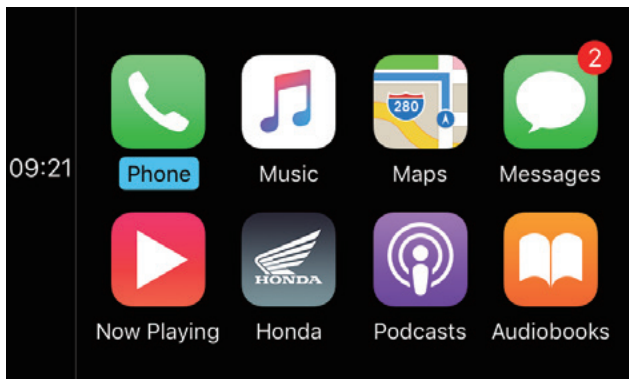


Fig. 3 Apple CarPlay main screen

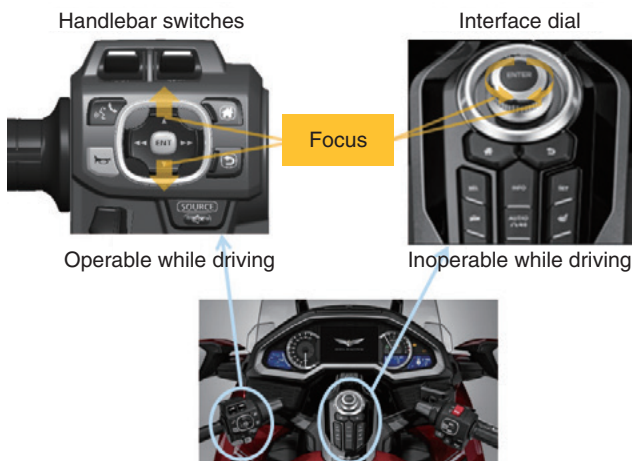


Fig. 4 Operational switches



Fig. 5 Arrangement of indicators and control switches (upper side: previous model, lower side: developed model)

this, the display had to be easy to see and understand, the layout of switches organized according to function, and all operated with minimum movement of fingers.

In the past, all functions for audio and navigation for Gold Wing were configured to be operated directly by the switches arranged on the panels at the lower sides of the meters. Since the switches were all visually recognizable, the arrangement was excellent in terms of being easy to understand.

As we mentioned earlier, the many functions added to Gold Wing 2018 meant that there could not be a designated switch for each function. For the developed model, the role of each switch was reviewed according to function. First, the importance of each switch was organized into a matrix based on frequency of use and operation necessity while riding (Fig. 6). Then, each function was scored. Based on these results, functions were divided into those operated by switch and those that could be displayed in a menu on the LCD (Fig. 7).

Top priority was given to the group of functions that were evaluated as important and used frequently, such as audio volume and raising and lowering the electronic screen. They are operated directly by switches arranged on the handlebar area (Fig. 7 A). Functions, such as the heater

and odometer/trip-meter switch, which were determined not necessarily used while riding, and functions not used continuously while riding and therefore have a low use frequency are positioned as panel switches (Fig. 7 B). Further, functions designated as neither important nor frequently used are now items that can be selected from a menu on the LCD screen, available at a certain stratum (Fig. 7 C).

3.2. Limiting Larger Switches

To make a switch unit structure smaller and a harness finer, adoption of switches that could be used in conjunction with minute electric currents was examined. The study resulted in adoption of a rubber contact-type switch that can secure load and keystroke necessary for contact (Fig. 8). In addition, the whole substrate was sealed for better waterproofing.

3.3. For Switch Operability

Many motorcycle riders wear gloves while riding. It is not easy for them to feel a switch via the extra layer, so it is important for switches to be able to provide gloved fingers with textural feedback. Building this feedback into the design is important to help ensure switches are operated

			Degree of importance			
			4	3	2	1
			1. May lead to injury or fatality 2. May lead to breakdown of drive system 3. If not properly functioning, causes irritation of users 4. May be against regulations	1. Crucial loss of function 2. If not properly functioning, causes discomfort of users	1. Partial loss of function	1. Practically no impacts
Frequency of use	4	Everyday	Legislated functions Cruise-control DCT, Hazard lamp A	Infortaimnet control Motorized screen level adjustment Reverse	Heater control HOMELINK B	
	3	Once a day				
	2	Once a week	B	Trip meter control	Screen brightness adjustment C	Beep sound setting
	1	Once a month	Fog lamp		HSTC level adjustment Language settings	Bluetooth device registration

Fig. 6 Classification of switches depending on criticality and frequency of use

	Classification	Display top	1st layer	2nd layer
A	Frequently checked up daily	Includable (to be operated without manual)	Prohibited	Prohibited
B	Checked up frequency is not high. To be able to operate without manual when item is set as custom setting.	Includable	Includable (to be located as permanent item)	Prohibited
C	Checked up frequency is not low. To be able to operate without manual after once referred to manual.	Includable	Includable	Includable

Fig. 7 Classification of information items displayed on LCD panel

as intended. However, there is a limited amount of space for installing switches. We put a great deal of effort into switch operability using gloved fingers and methods of help preventing erroneous operation. The methods we used are described below.

3.3.1. Right handlebar switch

Accelerator Angular Position Sensor (APS) is located on the right hand edge of the right handlebar switch housing. The cruise control lever is near the throttle grip below the APS to be able to set the motorcycle speed and increase/decrease the set speed while holding the throttle.

The mode button to switch the riding mode is positioned at the front of the APS mounting. The mode button was shaped like a lever to make it easy to operate with the index finger (Fig. 9). However, the lever shape resulted in leverage coming into play, reducing the operating load to about 2.3 N which was too small. Accordingly, a ball plunger was adopted to increase the load to about 3.5 N which is necessary for toggling. This resulted in a click sensation that could be fully transmitted to a gloved hand (Fig. 10).

3.3.2. Left handlebar switch

The turn signal switch, the switch used most frequently

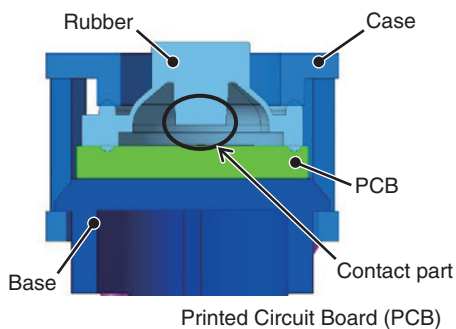


Fig. 8 Rubber dome contact

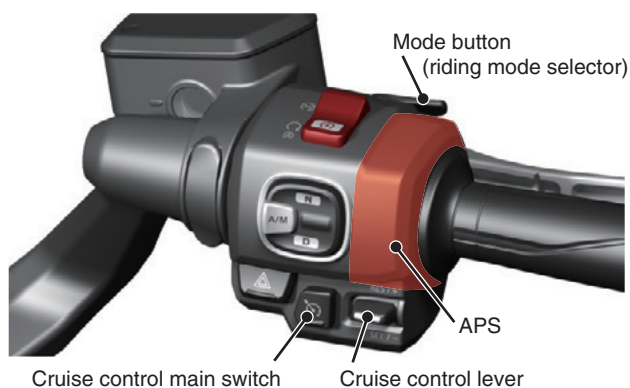


Fig. 9 Locations of cruise control switches and riding mode selector (on right hand grip)

while riding, was given the highest positioning priority. The turn signal switch knob unit was inclined by 10° to make it easy to put a finger on the knob when preparing to turn left (Fig. 11).

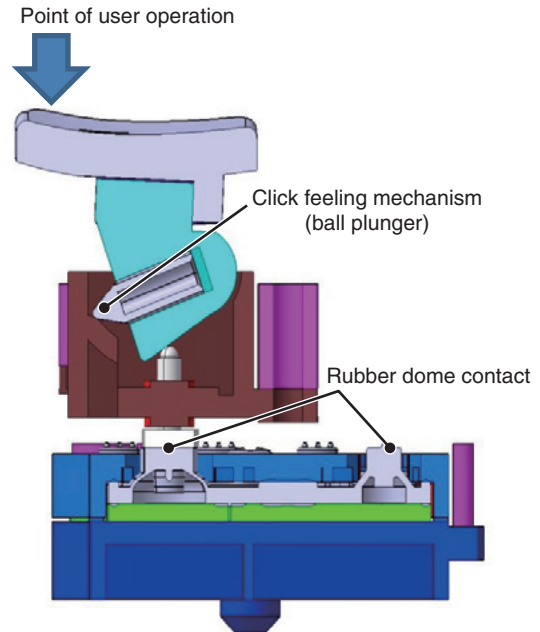


Fig. 10 Click feeling mechanism

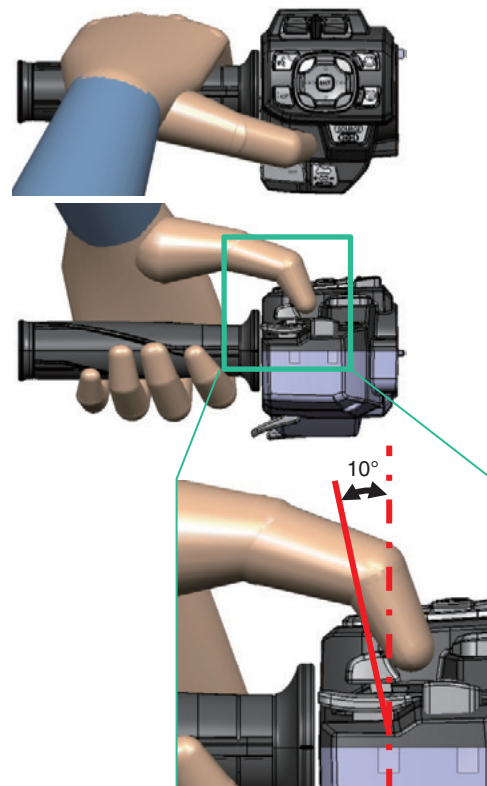


Fig. 11 Turn signal switch

The windscreen adjustment lever and the voice volume adjustment lever are adjoined above the switch housing. Since the shape and operating direction of the two levers are the same, a separator is installed between them to help prevent operation error (Fig. 12).

3.3.3. Switch on center panel

The interface dial is installed on the center panel (Fig. 13). The angles between clicks are set to 22.5° so that a click sensation is transmitted to the gloved hand when the dial is rotated. This angle is twice as large as that commonly used for automobiles. A sophisticated operation feeling is achieved by providing the optimum load value. The force-stroke characteristic chart of this switch and the dial switch of automobiles is shown in Fig. 14. The figure shows the operation feel with the operation torque on the vertical axis and the operation angle on the horizontal axis.

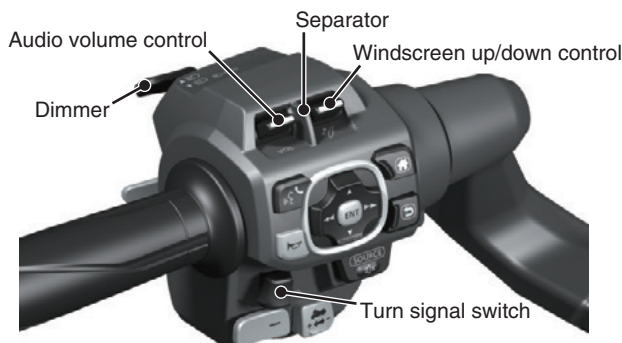


Fig. 12 Turn signal, volume, and windscreen up/down controls



Fig. 13 Interface dial

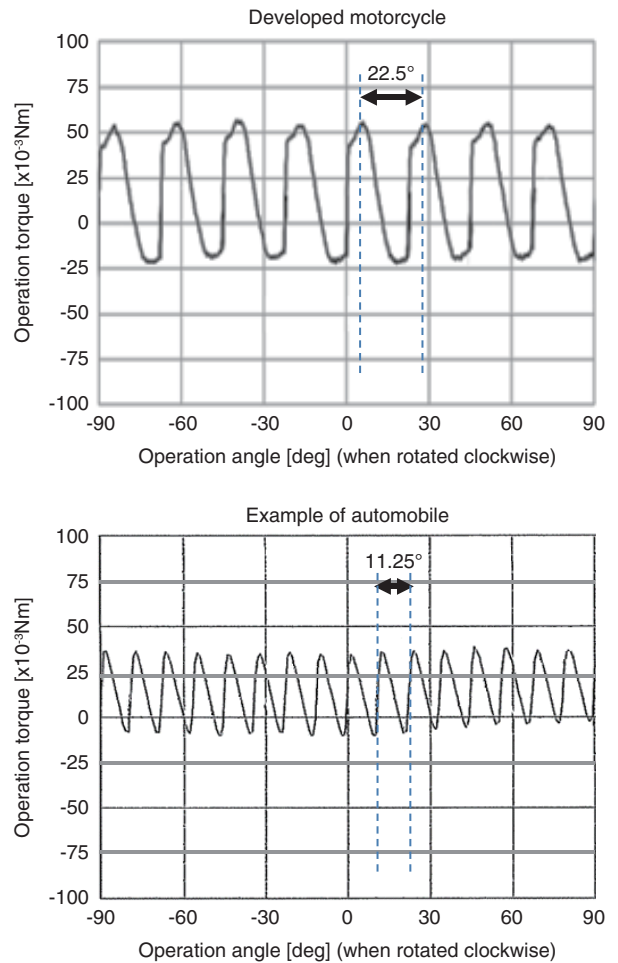


Fig. 14 Comparison of Force-Stroke characteristic of center console rotational switches between developed Gold Wing and automobile

4. Conclusion

We have described the Gold Wing infotainment system, which uses Apple CarPlay and represents a unique function of the model, as well as the restructured HMI.

- (1) The latest infotainment system has been achieved using Apple CarPlay, which operates in connection with smartphones, and adopted measures geared specifically to the distinctive motorcycle operation system and the Bluetooth headset.
- (2) To deal with the increase in switches due to new functions, switches were positioned in different stratum depending on frequency of use, etc., and HMI was restructured along with the new handlebar switches.

By adopting these technologies, it was possible to provide the latest infotainment system and multi-function vehicle system as an HMI that takes aspects unique to motorcycles into consideration.

References

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