

# Newly Evolved Electronic Time and Alarm Control System (ETACS) of 2008 eK WAGON

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## Abstract

Mitsubishi Motors Corporation (MMC) greatly evolved the ETACS of the eK WAGON for the 2008 model. The improved ETACS has greater customer appeal owing to new functionality that includes the first driver's-door-only unlocking function among minicars; greater customizability of functions to accommodate customer preferences; and stronger fault-diagnosis functions.

**Key words:** *Electronic Control, Electric Equipment, Multiplexing, Diagnostics*

## 1. Introduction

The Electronic Time and Alarm Control System (ETACS) provided the preceding generation eK WAGON with a variety of useful functions that go beyond the mini-car level by controlling the vehicle body's various electric/electronic functions and equipment through a multiplex communication network working on 8-bit microcomputers<sup>(1)</sup>. The ETACS on the 2008 model eK WAGON has even greater functionality and performance, thanks to upgraded electronic components including 16-bit microcomputers. In addition to the new components, this paper also introduces the ETACS software that incorporates the latest control logic and allows for future system expansion.

## 2. Overview of the new ETACS

### 2.1 System configuration

The vehicle body electronic control system of the 2008 model eK WAGON is configured using the MMC original Smart Wiring System (SWS) as the communications bus and three control units (ECUs), i.e., the ETACS that works as a master control node and the column switch and power window switch ECUs that work as slave nodes. The loads connected to the system include the headlamps, tail lamps, an anti-theft alarm horn, turn signal lamps, wipers, interior lamps, centralized door locks, power windows, electrically retractable door mirrors and various indicators. The ETACS forms an integral part of the junction block that collectively contains power circuit components (fuses, relays, etc.), and it centrally controls the flasher and door lock circuits, keyless entry receivers and antenna. There is no significant difference in system configuration and input/output devices between the ETACS of the new and preceding model eK WAGONS. **Fig. 1** shows an external view of the ETACS and **Fig. 2** shows a block diagram of the system.



**Fig. 1** Appearance of ETACS unit

### 2.2 Communication specifications

Communication control of the SWS is handled by the column switch ECU that performs control using its internal communication ICs and also by the ETACS and power window switch ECU that control communications by means of the software programmed in their microcomputers.

The ECUs form a decentralized control type network and operate under the following specifications:

- Transmission cycle of 40 ms, at which there is practically no delay in switch response
- Transmission rate of 5 kbps, at which noise radiated from communication lines can be suppressed
- Bit synchronizing Manchester code that requires no high-accuracy clocks

**Table 1** shows the details of the communication protocol for the SWS. Like with the system configuration referred to in section 2.1, the communication protocol of the 2008 eK WAGON's SWS is similar to that of the preceding model.

However, there are two features that characterize the 2008 model eK WAGON's system: one is that the SWS has an increased data communication capacity, and the other is that the system is capable of bilateral communication with the Multi-Use Tester III (MUT-III), a

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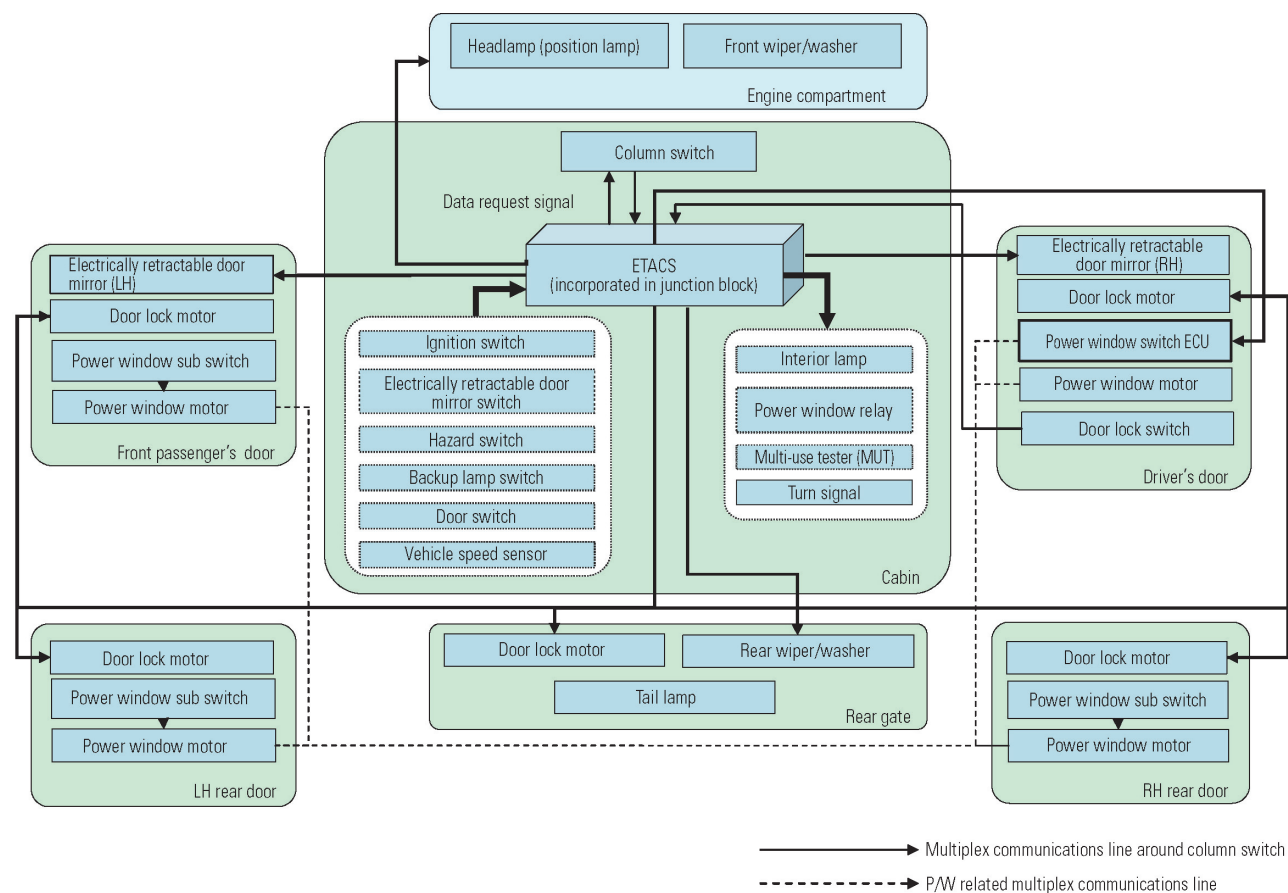


Fig. 2 Overview of system

Table 1 Communication protocol

	Item	Specification
Physical layer	Network configuration	Bus type topology
	Transmission medium	CAVS line
	Transmission speed	5 kbps
	Code type	Bus phase (Manchester Code)
	Transmission type	Single wire voltage transmission
	Maximum number of nodes	8
	Synchronization method	Asynchronous
Data link layer	Frame configuration	SOM: 1
		Data: 4 – 16 (variable length)
		CRC: 5 bits
		EOM: 1
	Error detection	CRC, frame length check

fault diagnosis tool used by dealers. Thanks to this capability, the new model can be customized to an even greater level. The 2008 model eK WAGON is called “08 eK WAGON” hereafter in this paper.

3. New functions

The 08 eK WAGON has ten new functions (Table 2) and a total of 19 functions available for vehicle cus-

tomization (Table 3), thus greatly boosting product appeal in the market. Since the MUT-III can also be used for customization, dealers can now install any of these functions easily at the customer’s request.

Broadly classified, the newly added functions consist of convenience-oriented functions, such as the comfort flasher used in the latest MMC vehicles and the electrically retractable door mirrors with remote control; safe driving functions such as the vehicle speed-

**Table 2 Function comparison chart**

		08 eK	Previous model eK
Warning buzzers and indicators	Backup buzzer	○	○
	Security alarm buzzer	○*	
	Ajar door alarm buzzer	○*	
	Key reminder buzzer	○	○
	Light monitor buzzer	○	○
	Customization adjustment function buzzer	○	○
	Auto-light manner function buzzer	○*	
	Turn signal buzzer	○*	
Comfort flasher		○*	
Front wiper		○	○
Rear wiper		○*	○*
Reverse-interlocked rear wiper (A/T model)		○	○
Rear wiper washer		○	○
Power window key-off timer		○*	○*
Electrically retractable door mirror key-off timer		○*	
Lighting (headlamp, tail lamp)		○	○
Headlamp auto-cut function		○*	○*
Centralized door lock	Driver's-door-only unlocking function	○*	
Key-left-in-switch prevention function		○	○
Multi-mode keyless entry system	Opening/closing of power window	○*	○*
	Deployment/retraction of electrically retractable door mirror	○*	
Dimming interior lamp		○*	○*
Answerback function of keyless entry system		○*	○*
Opening/closing of power slide door		○	○
Customization function using MUT-III		○	
Function of adjustment by special operation		○	
SWS communication	Communication with MUT-III possible	○	
	Communication with MUT-III impossible		○
Fault diagnosis related functions	Input check function	○	○
	SWS diagnosis code output	○	○
	Transmission of switch input signal status	○	
	Transmission of analog input signal status	○	
	Transmitter switch status data transmission	○	

\*: customization items available

sensitive front wipers and intermittent rear wiper that can be switched for continuous operation at the single touch of the control; and anti-theft functions such as the security alarm and driver's-door-only unlocking system. Many of these new functions offer detailed settings that can be selected according to the customer's preference. The body electrical equipment/function control system of the 08 eK WAGON provides a super mini-car level functionality. The major new functions are described in the following paragraphs.

### 3.1 Driver's-door-only unlocking function

The driver's-door-only unlocking function refers to an additional keyless entry function that allows only the driver's door to be unlocked whereas the traditional keyless entry system unlocks all door locks simultaneously. Specifically, when the UNLOCK switch of the keyless entry transmitter is pressed once, only the dri-

ver's door is unlocked, and when pressed twice, all doors are unlocked. This function is already fitted on MCC vehicles for the North American market to meet the demand for security (to prevent entry by intruders from the passenger side when the driver is the only occupant of the vehicle). The same demand is increasing in Japan, particularly among female drivers who often use the vehicle alone, and so this function was adopted in the 08 eK WAGON. It is the first of its kind to be used in mini-cars, and is one of the most appealing features of the 08 eK WAGON (**Fig. 3**).

### 3.2 Security alarm function

This function gives an alarm by sounding the horn and making the hazard warning lamps flash when any of the doors (including tailgate) is opened by a method other than the keyless entry transmitter. The system includes an LED indicator inside the cabin, which con-

**Table 3 Function customization chart**

Equipment	Function available for customization	Setting	08 eK	Previous model eK
Keyless entry system	Signaling of door lock operation by flashing of hazard warning lamps when door is locked/unlocked using remote control switch	a. No flashing	○	○ Only settings "a" and "b" are selectable
		b. 1-time flashing for locking/2-time flashing for unlocking		
		c. 1-time flashing for locking/No flashing for unlocking		
		d. No flashing for locking/2-time flashing for unlocking		
		e. 2-time flashing for locking/1-time flashing for unlocking		
		f. 2-time flashing for locking/No flashing for unlocking		
		g. No flashing for locking/1-time flashing for unlocking		
	Control of power window and door mirror operation using remote control switch	a. Not activated	○	○ Mirror cannot be operated
		b. Power window: Opening and closing Door mirror: Deployment and retraction		
		d. Power window: Closing Door mirror: Deployment and retraction		
	Time till door is automatically locked after pressing UNLOCK switch on remote control switch	a. 30 seconds	○	×
		b. 60 seconds		
		c. 120 seconds		
		d. 180 seconds		
	Door location(s) that can be unlocked when UNLOCK switch on remote control switch is pressed once	a. All doors	○	×
		b. Only driver's door		
Door mirror	Conditions for automatic retraction and deployment of electrically retractable door mirror	a. Deployment at approx. 30 km/h	○	×
		b. Retraction and deployment interlocked with starter switch position		
		c. Retraction and deployment upon locking and unlocking of doors		
		d. No automatic retraction and deployment		
Wiper	Wiper operation after spray of washer fluid	a. Yes	○	×
		b. No		
	Rear wiper intermittent operation interval	a. 4 seconds; continuously operating mode also available	○	×
		b. 8 second; continuously operating mode also available		
		c. 16 second; continuously operating mode also available		
		d. 0 second; continuous operation only		
		e. 4 seconds		
		f. 8 seconds		
Headlamp	Headlamp automatic cut-off (automatic turning off)	a. Headlamps automatically turn off	○	×
		b. Headlamps do not automatically turn off		
	Position of light switch at which headlamps can be used for illumination after getting off the vehicle	a. Functional only in headlamp-on position	○	×
		b. Functional in headlamp-on and position-lamp-on position		
Interior lighting	Time till interior light goes out after all doors and tailgate are closed (delayed turning off function)	a. On for 7.5 seconds	○ Default value "b" selectable	○ Default value is "c". "b", "c" or "g" are selectable
		b. On for 15 seconds		
		c. On for 30 seconds		
		d. On for 1 minute		
		e. On for 2 minutes		
		f. On for 3 minutes		
		g. No dimming		
Audible alarm	Security alarm activation/deactivation	a. Functional	○	×
		b. Non-functional		
	Warning by buzzer when running with door ajar	a. Buzzer sounds for set time	○	×
		b. Buzzer does not sound		
Power window	Time for which power window can be opened and closed after starter switch is turned off (timer function)	a. 0 second	○	×
		b. 30 seconds		
		c. 3 minutes		
		d. 10 minutes		
	Door window location(s) that can be opened and closed using driver's control during time set by key-off timer after starter switch is turned off	a. Can be opened and closed at all window locations	○	×
		b. Can be both opened and closed only at driver's window (can be only closed at front passenger's and rear windows)		
	Door window location(s) that can be opened and closed using driver's control with lock switch ON	a. All windows (operation of all other windows permitted)	○	×
		b. Driver's window only (operation of all other windows inhibited)		
Turn signal lamp	Three-time flashing for signaling a lane change	a. Functional	○	×
		b. Non-functional		
	Lever operation time till three-time flashing function is activated for signaling a lane change	a. Standard setting	○	×
		b. Longer setting		
	Tone(s) of buzzer that sounds intermittently while turn signal lamps are flashing	a. High- and low-pitch tones	○	×
		b. Low-pitch tone		
	Starter switch position at which turn signal lamp can operate	a. Only at ON	○	×
		b. At ON or ACC		

The shading indicates factory settings.

○: Available for customization

×: Not available for customization

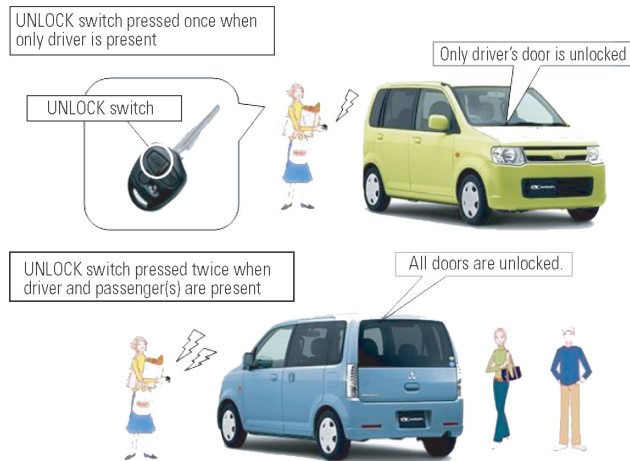


Fig. 3 Driver's door limited unlocking function

tinues to flash during parking to deter unauthorized entry.

### 3.3 Electrically retractable door mirrors

The electrically retractable door mirrors have three automatic operation modes, any of which is selectable. The mode (3), for example, gives the driver reassurance about safety because he/she can check that all the doors are locked.

- (1) The mirrors automatically deploy from their retracted position when the vehicle reaches a speed of 30 km/h.
- (2) The mirrors retract when the driver gets off the vehicle (turns off the ignition switch and opens the driver's door), and deploy when the driver gets on the vehicle (turns on the starter switch).
- (3) The mirrors retract when the doors are locked with the keyless entry transmitter and deploy when the doors are unlocked.

### 3.4 Ajar door warning

The most common type of warning given to the driver when any of the doors or tailgate is left open (or "ajar" as expressed elsewhere in this paper) is the illumination of the door indicator in the combination meter. The door warning system of the eK WAGON causes the door indicator to flash and also a buzzer to sound if the vehicle is in motion (at 8 km/h or faster) with a door ajar. These simultaneous visual and audible warnings can minimize the chance of moving off without the driver realizing that a door is open.

### 3.5 Comfort flasher

The comfort flasher is a function that makes the turn signal lamps flash three times consecutively when the turn signal lever is operated for a short time. As this function eliminates the need to move the lever back to the original position, it reduces the workload on the driver when changing lanes.



Fig. 4 MUT-III

## 4. Ease of service

By connecting the diagnosis tester MUT-III (Fig. 4) to the vehicle, the following servicing tasks can be performed.

### 4.1 Customization of vehicle

The previous model eK WAGON could be customized through special operation of the steering column switch but this was complicated, and there were not enough functions that could be customized to meet customers' varied preferences. For this reason, the number of functions available for customization has been substantially increased in the 08 eK WAGON and customization at the dealership using the MUT-III is now much easier.

### 4.2 Service data

The MUT-III can display useful diagnosis data (see Table 4) such as SWS communication line data, ETACS input data on hard wire switch ON/OFF status, and physical conversion values of ETACS processed data. This improvement helps to diagnose the 08 eK WAGON more precisely and quickly.

## 5. Conclusions

In recent years, vehicle electrical systems have become ever more sophisticated and complicated, and are now called "electronic platforms"<sup>(2)</sup>. Meanwhile, for the communication protocol, it has become commonplace to use a controller area network (CAN) and local interconnect network (LIN) which are the standard in the industry. In the 08 eK WAGON, which features minor changes over the previous model, the ETACS was innovated not by making extensive changes to the electronic platform but by changing mainly the internal electronic components and software, in order to greatly improve the body-related electrical functions. As a result, the new model has many additional functions that appeal to customers, such as the driver's-door-only unlocking function. The new functions also include an upgraded fault diagnosis function that is advantageous to dealers. Also, the remarkably improved reception

Table 4 Service data list

Function	Setting	Output ECU	Item name (MUT displayed)	Switch status
Wiper	INT	Steering column ECU	INT wiper SW	ON
			LO wiper SW	OFF
			HI wiper SW	OFF
			Mist wiper SW	OFF
			Front washer SW	OFF
	LO	ETACS	Ignition switch ACC	ON
			Wiper INT time	Time T
			INT wiper SW	OFF
			LO wiper SW	ON
			HI wiper SW	OFF
Lighting	LO	Steering column ECU	Mist wiper SW	OFF
			Front washer SW	OFF
	HI	ETACS		OFF
			Ignition switch IG1	ON
			HD lamp auto cut	OFF
Security alarm	Security alarm	Steering column ECU	Headlamp SW	ON
			Dimmer SW	ON
			Passing SW	OFF
Security alarm	Security alarm	ETACS	Ignition switch IG1	ON
			HD lamp auto cut	OFF
Security alarm	Security alarm	ETACS	Security alarm	ON

performance and operational response of the keyless entry system is the result of using the latest electronic components. We will continue with research and development to create innovative body electric system capabilities that outperform those of our competitors in the mini-car sector.

Finally, we sincerely thank OMRON Co., Ltd. and all others concerned for their assistance in the development process.

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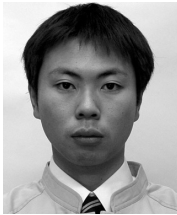
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