

User's Manual

HDMI-CEC

Demonstration Board

CEC-78K0/KE2C

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CAUTION

- Do not give any physical damage to this equipment such as dropping
- Do not superimpose voltage to this equipment.
- Do not use this equipment with the temperature below 0°C or over 40°C.
- Make sure the USB cables are properly connected.
- Do not bend or stretch the USB cables.
- Keep this equipment away from water.
- Take extra care to electric shock.
- This equipment should be handled like a CMOS semiconductor device. The user must take all precautions to avoid build-up of static electricity while working with this equipment.
- All test and measurement tool including the workbench must be grounded.
- The user/operator must be grounded using the wrist strap.
- The connectors and/or device pins should not be touched with bare hands.

INTRODUCTION

CEC-78K0/KE2C is designed for users who wish to evaluate HDMI-CEC features with 8-bit microcontroller 78K0/Kx2 series from Renesas Electronics.

It is assumed that the readers have been familiar with basics of HDMI and CEC. The overview and terms are available at "High-Definition Multimedia Interface Specification" in the following web site.

<http://www.hdmi.org/manufacturer/specification.aspx>

Please use the system with all necessary tests. Tessera Technology Inc. assumes no responsibility for any losses from the use of CEC-78K0/KE2C.

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1. CEC-78K0/KE2C

In this chapter, features and hardware specifications of CEC-78K0/KE2C, 8-bit microcontroller 78K0/Kx2-C series from Renesas Electronics, are described.

1.1 Features

CEC-78K0/KE2C has following features.

- 2 HDMI channels
- 10 general purpose key inputs (AD input)
- Infrared remote control function
- MINICUBE2 connection (on-chip debug, writing on flash memory)
- USB connection with PC
- 1 7segLED
- 15x6 holes universal area

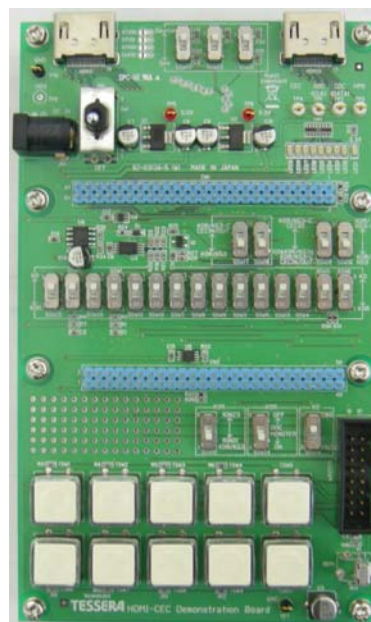
1.2 Hardware Structure

CEC-78K0/KE2C is a combined product of TK-78K0/KE2C and HDMI-CEC Demonstration Board.



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HDMI-CEC Demonstration Board



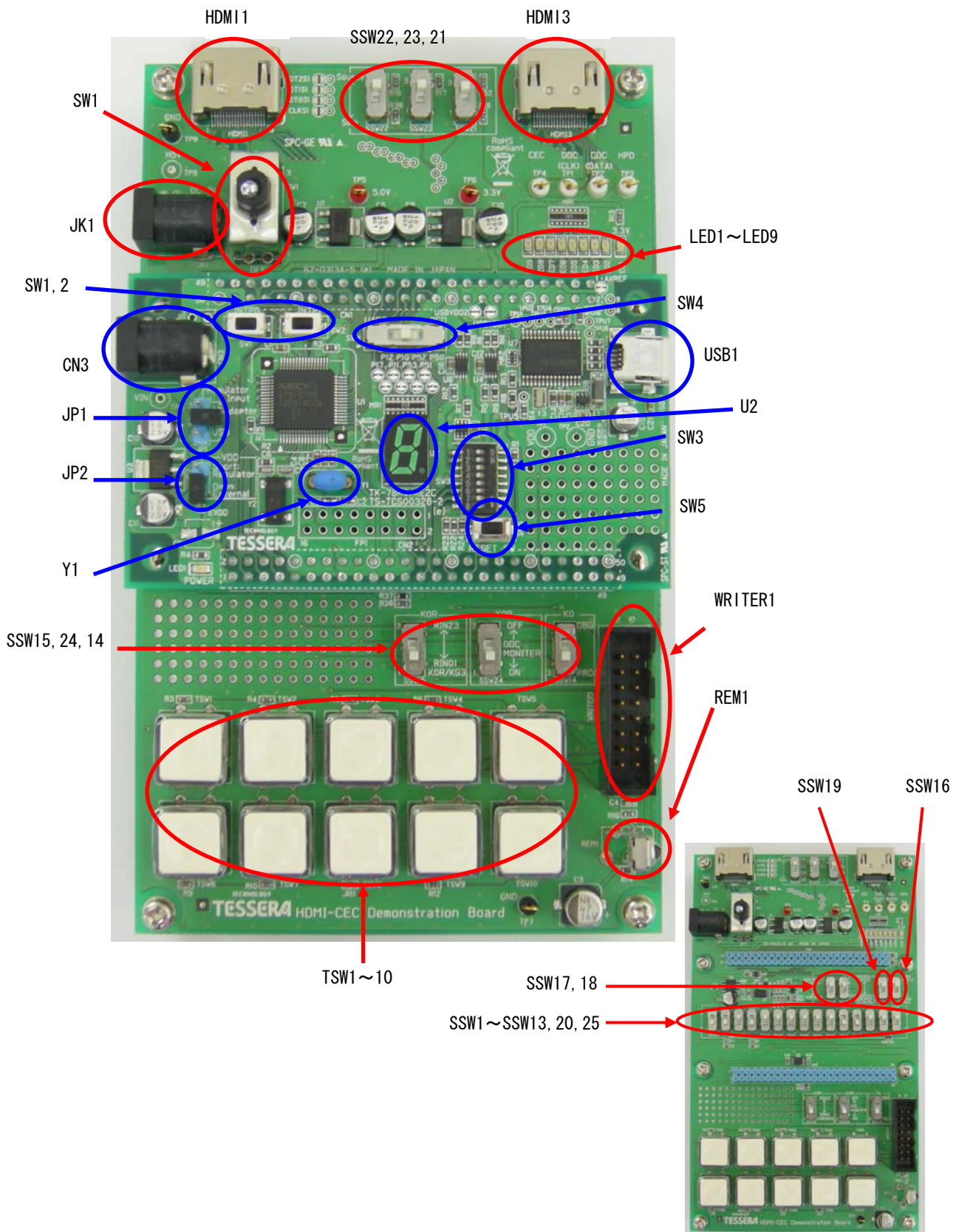
·Following connectors are mounted.



1.3 Hardware Specifications

| | |
|-------------------|---|
| CPU | uPD78F0765 (78K0/KE2-C) |
| Clock | Main system clock: 20MHz, Sub system clock: 32.768KHz |
| Interface | HDMI connector 2ch MINICUBE2 connector (16pin) USB (mini B connector) |
| Operating Voltage | 3.3V (DC 12V input) |

1.4 Layout of Hardware Functions



1.5 Hardware Functions

1.5.1 HDMI-CEC Demonstration Board

- HDMI1, HDMI3
They are HDMI connectors. All the pins of HDMI1 and HDMI3 are connected.
- JK1
JK1 is a connector for AC adapter. Connect the bundled AC adapter here.
- SW1
SW1 is the power switch. Power on when you shift it to ON and then LED1 is lighted.
- LED1
LED1 is Power LED. It is lighted when the power is on.
- LED2-LED9
These are LED that are connected to the following port of CPU. They are lighted when they output Low.

| | | | | | | | |
|------|------|------|------|------|------|------|------|
| LED9 | LED8 | LED7 | LED6 | LED5 | LED4 | LED3 | LED2 |
| P77 | P76 | P75 | P74 | P73 | P71 | P70 | P63 |

- SSW1-SSW13, 20, 25
All those 19 switches must be set the following setting. (default setting)

| | | | | | | |
|---------------------------------------|----|----|--|----|--------------------------|----|
| KOR/KG3-C CECIN/OUT (3pin) side | ■ | ■ | KOR/KG3-C CEC10 (3pin) side | ■ | KOR/KG3-C (3pin) side | ■ |
| KOR/KG3 (1pin) side | | | KO&KOR/KG3& KOR/KG3-C CECIN/OUT (1pin) side | | KOR/KG3 (1pin) side | |
| SSW | 17 | 18 | SSW | 19 | SSW | 16 |

| | | | | | | | | | | | | | | | |
|--------------|----|---|----|---|----|----|---|---|----|---|---|----|---|---|---|
| KO (3pin) 側 | | | ■ | | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | |
| KOR (1pin) 側 | ■ | ■ | | ■ | | | | | | ■ | ■ | | | | |
| SSW | 25 | 2 | 20 | 1 | 12 | 10 | 7 | 8 | 11 | 3 | 9 | 13 | 4 | 5 | 6 |

- SSW14
Set this when you connect MINICUBE2 to WRITE1 connector.
 - 【DBG】 To start the debugger ID78K0-QB
 - 【PROG】 To start the flash programmer QB-Programmer
 This setting does not affect anything when you do not connect MINICUBE2.

- SSW15, 24
Not is use.
- SSW21-SSW23
These are extended switched for HPD and DDC. Switch them with "Source" or "Sink".
 - > Set it to "Source" when you use as Monitor mode.
 - > Set it to "Sink" when you use as Pseudo TV mode.
 - > Set it to "Source" when you use as Pseudo DVR mode.

- TSW1-TSW10
These are use as inputs for general purpose switches. They are connected to A/D conversion ports.

By pressing the switches, following voltages are input.

| Switch | CPU Pin | CPU Input Voltage | Switch | CPU Pin | CPU Input Voltage |
|--------|---------|-------------------|--------|---------|-------------------|
| TSW1 | ANI2 | 0V | TSW6 | ANI3 | 0V |
| TSW2 | ANI2 | 0.51V | TSW7 | ANI3 | 0.51V |
| TSW3 | ANI2 | 0.96V | TSW8 | ANI3 | 0.96V |
| TSW4 | ANI2 | 1.41V | TSW9 | ANI3 | 1.41V |
| TSW5 | ANI2 | 1.88V | TSW10 | ANI3 | 1.88V |

- WRITER1
This is MINICUBE2 connector.
- REM1
This is the light receiving element for infrared remote control function.

1.5.2 TK-78K0/KE2C Board

In this section, the hardware functions are briefly described. For details, refer to "TK-78K0/KE2C User's Manual".

- CN3
This is a connector for AC adapter, but not in use. Use the JK1 AC adapter connector on HDMI-CEC Demonstration Board.
- SW1
SW1 is a push-switch that is connected to P120. However, it cannot be used as it is connected to infrared CEC control function. Do not touch when application is running.
- SW2
SW2 is a push-switch that is connected to P30. However, it cannot be used as it is connected to infrared remote control function. Do not touch when application is running.
- U2
This is 7segLED. U2 is connected to P50-P53, P10-P12, P17.
- JP1
JP1 sets the regulator power selection. Set this as open. (default setting)
- JP2
JP2 sets the CPU power selection. Set this as open. (default setting)
- USB1
This is a USB connector. Use bundled USB cable.
- SW3-1-SW3-4, SW4
These are used as setting the operation mode.

| Switch | MINICUBE2 is in Use | | Bundled with TK-78K0/KE2C | | |
|--------|--|----------------------------|--|---------------------------------|----|
| | ID78K0-QB is in Use CEC Viewer is in Use (default setting) | QB-Programmer is in Use | Flash Programmer WriteEZ5 is in Use | Debugger ID78K0-QB is in Use | |
| SW3 | 1 | OFF | OFF | ON | ON |
| | 2 | OFF | OFF | ON | ON |
| | 3 | OFF | OFF | ON | ON |
| | 4 | OFF | OFF | OFF | ON |
| SW4 | UART | Center | UART | OCD | |

※ To use the debugger ID78K0-QB(MINICUBE2)

- Set SSW14 to **【DBG】**
- Connect 78K0-OCD board that is bundled with MINICUBE2
- Set the switches for MINICUBE2 to "M2" and "T"

- ※ To use the flash programmer QB-Programmer
 - Set SSW14 to 【PROG】
 - Disconnect 78K0-OCD board that is bundled with MINICUBE2
 - Set the switches for MINICUBE2 to "M2" and "T"
- Set QB-Programmer settings as "Port: UART-Ext-OSC" and "Frequency: 10.00"

- SW3-5 – SW3-8
These are connected to P00, 02, 03, 04 of CPU.

- SW5
This is the CPU reset switch.

- Y1
This is the CPU operation clock. Do not change this from default setting, 20MHz. The sample program will not work if it is changed.

1.6 Pin Function List

| CN1 | Pin Name | Used For |
|-----|----------|------------------------------------|
| 1 | AVREF | |
| 2 | GND | |
| 3 | NC | |
| 4 | NC | |
| 5 | VDD | |
| 6 | P130 | |
| 7 | NC | |
| 8 | FLMDO | Connect to WRITE1 Connector(16Pin) |
| 9 | VDD | 3.3V |
| 10 | (+12V) | |
| 11 | GND | GND |
| 12 | (+12V) | |
| 13 | VDD | 3.3V |
| 14 | RESET | Connect to WRITE1 Connector(16Pin) |
| 15 | VDD | 3.3V |
| 16 | (+12V) | |
| 17 | NC | |
| 18 | P140 | Connect to Remote Control Module |
| 19 | P31 | Connect to WRITE1 Connector(16Pin) |
| 20 | P32 | Connect to WRITE1 Connector(16Pin) |
| 21 | P141 | |
| 22 | P11 | 7segLED |
| 23 | P12 | 7segLED |
| 24 | P10 | 7segLED |
| 25 | P13 | Connect to WRITE1 Connector(16Pin) |
| 26 | P14 | Connect to WRITE1 Connector(16Pin) |
| 27 | P17 | 7segLED |
| 28 | P15 | |
| 29 | NC | |
| 30 | P16 | Connect to Over Current(+5V) |
| 31 | P60 | DDC(CLK) |
| 32 | P61 | DDC(DATA) |
| 33 | GND | GND |
| 34 | EVDD | |
| 35 | P62 | HPD |
| 36 | NC | |
| 37 | P70 | LED2 |
| 38 | P71 | LED3 |
| 39 | P72 | LED4 |
| 40 | P73 | LED5 |
| 41 | P74 | LED6 |
| 42 | P75 | LED7 |
| 43 | P76 | LED8 |
| 44 | P77 | LED9 |
| 45 | P120 | |
| 46 | NC | |
| 47 | NC | |
| 48 | NC | |
| 49 | NC | |
| 50 | NC | |

| CN2 | Pin Name | Used For |
|-----|----------|---------------------|
| 1 | P20 | |
| 2 | P21 | |
| 3 | P22 | KEY input (KEY1~5) |
| 4 | P23 | KEY input (KEY6~10) |
| 5 | P24 | |
| 6 | P25 | |
| 7 | P26 | |
| 8 | P27 | |
| 9 | P42 | |
| 10 | P50 | 7segLED |
| 11 | P51 | 7segLED |
| 12 | P52 | 7segLED |
| 13 | P53 | 7segLED |
| 14 | NC | |
| 15 | P40 | CEC-OUT Output |
| 16 | NC | |
| 17 | NC | |
| 18 | NC | |
| 19 | GND | GND |
| 20 | EVDD | |
| 21 | NC | |
| 22 | P43 | |
| 23 | P33 | |
| 24 | P30 | |
| 25 | P00 | DipSW(SW3-5) |
| 26 | P01 | |
| 27 | P02 | DipSW(SW3-6) |
| 28 | P03 | DipSW(SW3-7) |
| 29 | P04 | DipSW(SW3-8) |
| 30 | P05 | |
| 31 | P06 | |
| 32 | NC | |
| 33 | NC | |
| 34 | NC | |
| 35 | NC | |
| 36 | NC | |
| 37 | NC | |
| 38 | NC | |
| 39 | NC | |
| 40 | NC | |
| 41 | P72 | CEC |
| 42 | NC | |
| 43 | NC | |
| 44 | NC | |
| 45 | NC | |
| 46 | NC | |
| 47 | P41 | CEC-IN input |
| 48 | NC | |
| 49 | NC | |
| 50 | NC | |

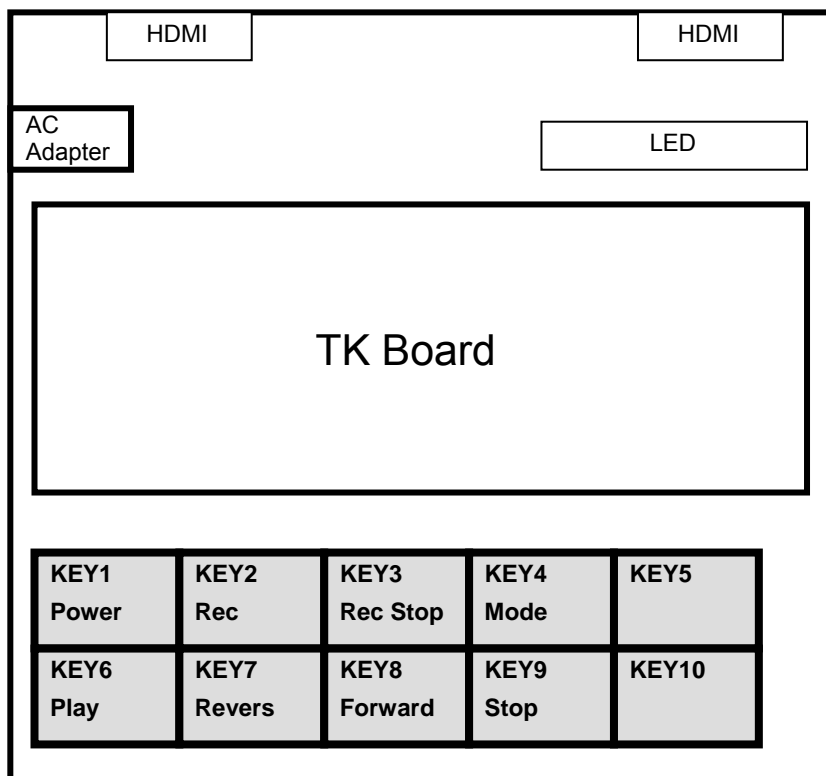
1.7 Circuit Diagram

Please refer to product version CD.

Please refer to product version CD.

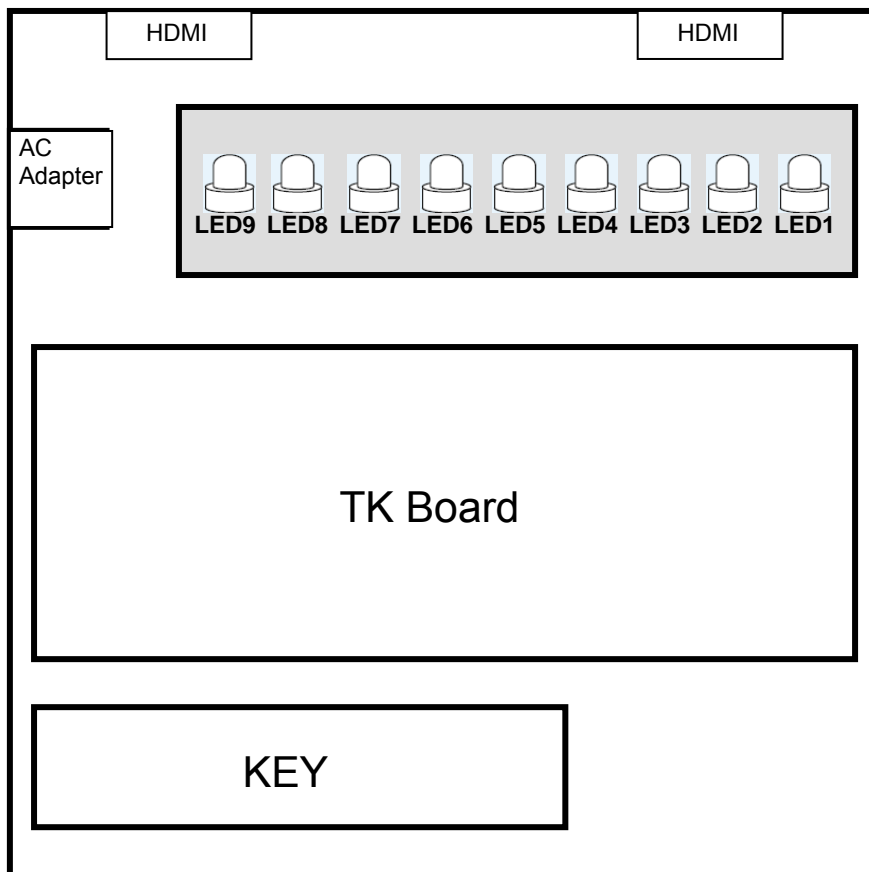
2. Settings for Sample Demonstration Program

2.1 KEY Settings



| KEY | Used For |
|-------|--|
| KEY1 | Power |
| KEY2 | Record |
| KEY3 | Record Stop |
| KEY4 | Mode Change (Monitor Mode at startup) Push to change the mode, "Pseudo TV"(LED9 light), "Pseudo DVR"(LED8 light), "Pseudo TV"(LED9 blinking), "Pseudo DVR"(LED8 blinking), "Monitor". Please evaluate it by the combination in blinking in lighting when evaluating it with the board. |
| KEY5 | (Not in use) |
| KEY6 | Play |
| KEY7 | Rewind |
| KEY8 | Fast-forward |
| KEY9 | Stop |
| KEY10 | Select Remote Controller Display (Remote Controller Code / Key Name) |

2.2 LED Settings



| LED | Used For |
|-------------|-------------------------------------|
| LED1(green) | Lighted when the board power is on. |
| LED2(red) | Pseudo device power |
| LED3(red) | Playing |
| LED4(red) | Fast-forwarding |
| LED5(red) | Reversing |
| LED6(red) | Recording |
| LED7(red) | |
| LED8(red) | Pseudo DVR mode |
| LED9(red) | Pseudo TV mode |
| LED Scroll | Monitor mode |

3. GUI

In this chapter, GUI to control CEC of HDMI from PC (CEC Viewer) is described.

- The sample program (78K0_Kx2-C.hex) is pre-installed on the TK-78K0/KE2C.
If you wrote other programs on the system, you can write the sample program (78K0_Kx2-C.hex) again by using following tools.
 - Flash memory programmer "WroteEZ5" that you can find in bundled CD-ROM.
 - Flash memory programmer for MINICUBE2 "QB-Programmer" or debugger "ID78K0-QB".
- This sample program works only if 10MHz oscillator is mounted on Y1 socket of TK-78K0/KE2C board.
- The remote control receiving function of this sample program (78K0_Kx2-C.hex) supports only NEC format.
- CEC Viewer works with Microsoft Excel. (operation check has been done on Excel 2000 and Excel 2003)

3.1 CEC Viewer Functions

CEC Viewer has following functions.

- Monitor sending/receiving CEC data
- Send specific commands from user input
- Pre-set command data, 20 KEY
- Output log data with Excel format
- Reproducing function by loading log data with Excel format

3.2 CEC Viewer Files

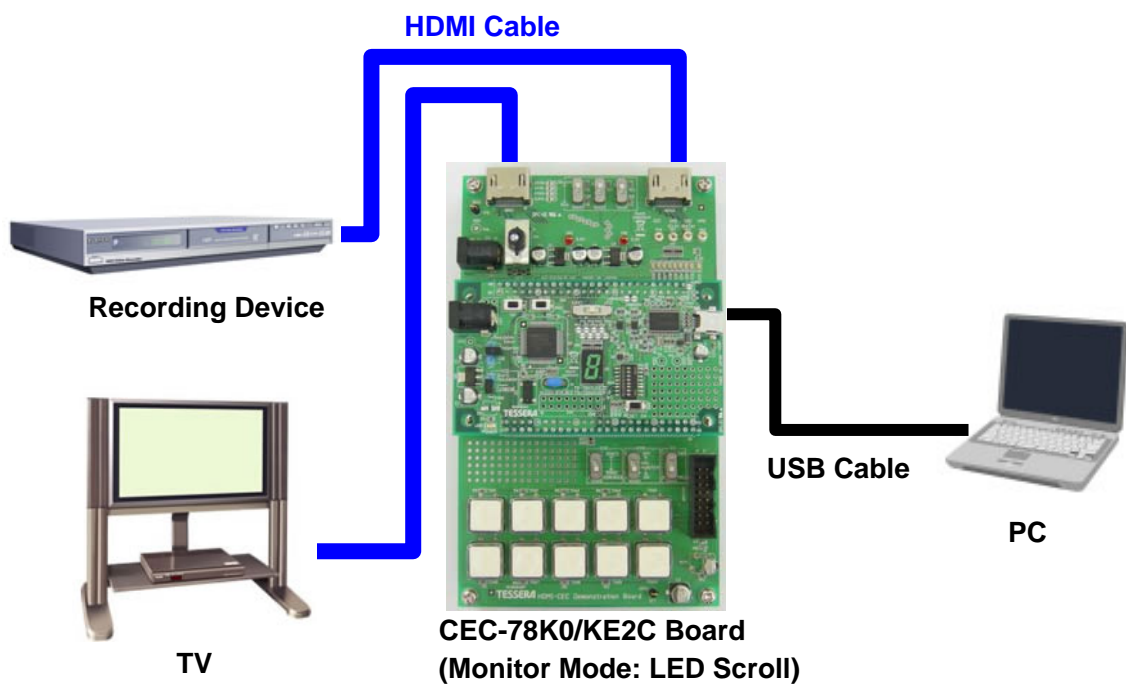
| File | Description |
|---------------|--|
| CECViewer.exe | Start CEC Viewer by executing this file. |
| command.xls | CEC command (Opcode) data file. With using this file, you can add new Opcode. Since the program retrieves the command data from this file, do not close this file while CEC Viewer is running. |
| cecviewer.ini | Pre-set key data that is registered with GUI is stored in this file. |

3.3 Connection Example

Connection examples of the board for using CEC Viewer are described.

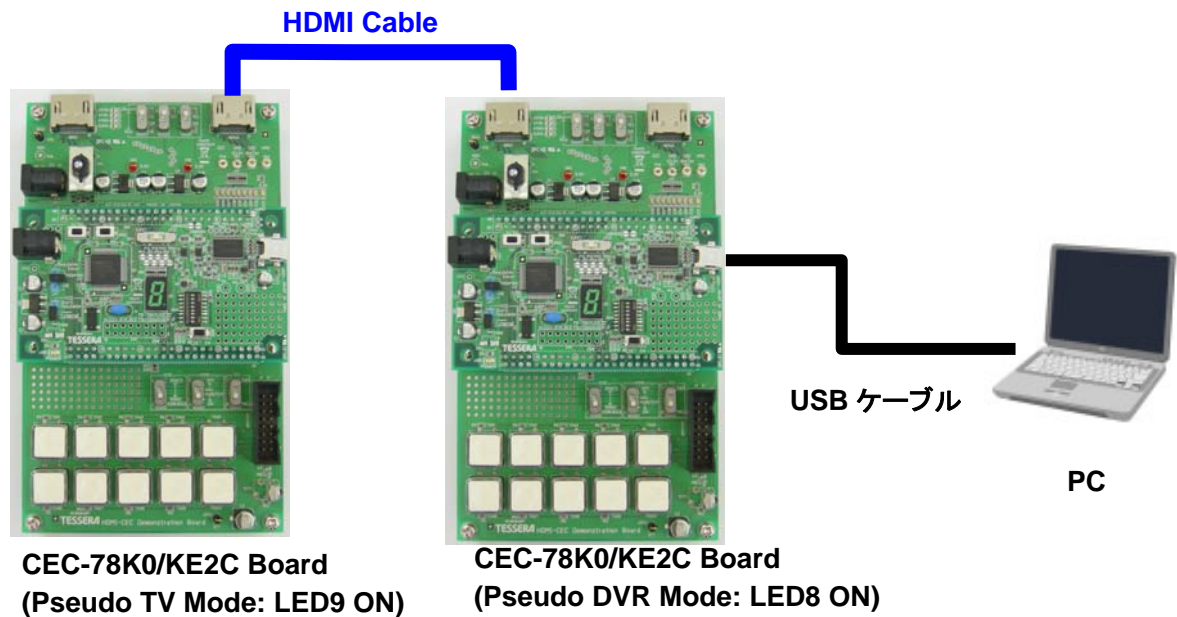
3.3.1 Example 1: Monitor Mode

You can monitor the data communication between devices by connecting the devices through the board. Following figure shows the connection example to monitor the communication between TV and recording device.



3.3.2 Example 2: Pseudo DVR Mode / Pseudo TV Mode

To operate the board as a pseudo DVR or TV, you need to connect the board to board together. You can reproduce functions, such as turning on the power of pseudo TV automatically by turning on the power of pseudo DVR, and turning off the power of pseudo DVR automatically by turning off the power of pseudo TV.



3.4 CEC Viewer Window

In this section, CEC Viewer window is explained.

3.4.1 Window Overview

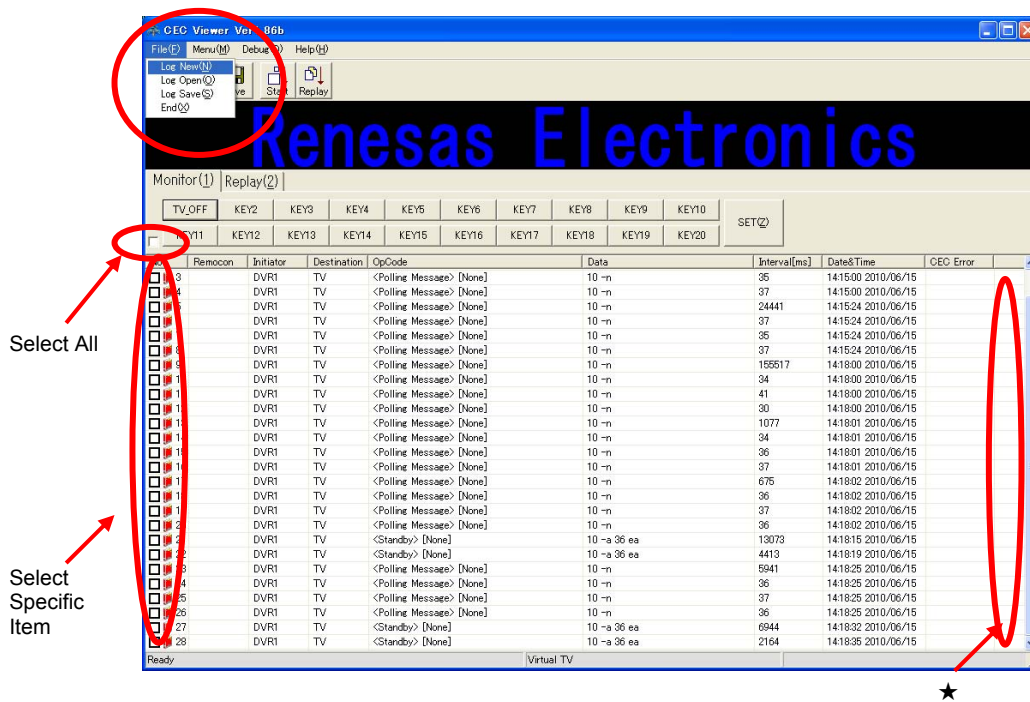





CEC Communication Data

| No | Communication orders |
|--------------|--|
| Remocon | Remote controller code or remote controller code name |
| Initiator | Initiator Address name * |
| Destination | Destination Address name * |
| Opcode | Opcode name and its operand structure * |
| Data | Frame communication result It displays data on odd byte and EOM+ACK on even byte. It displays "e" when it has EOM, otherwise "-". It displays "a" when it has ACK, otherwise "n". |
| Interval[ms] | Interval time between CEC communication (or DDC communication offered as optional function) |
| Date & Time | Date and time when it gets the frame data |

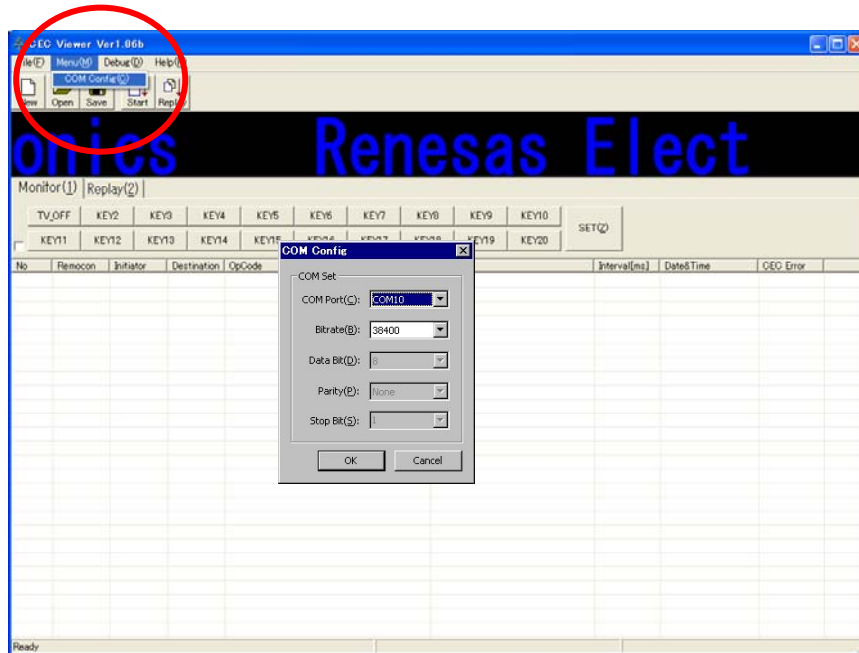
* It gets the information from "command.xls". If you close this file, it will not be able to display the logical address and Opcode.

3.4.2 "File" Menu



| | |
|----------|---|
| Log New | Clear log data displaying. It is the same as the shortcut key  . |
| Log Open | This does not work with current version of CEC Viewer. It is the same as the shortcut key  . |
| Log Save | Save the current log data with Excel format. It is the same as the shortcut key  . *You can select specific rows by checking the check box. *You can select all rows by checking the check box above "No". Please select * on the No row again after clicking the area of * once when all not selecting it. |
| End | Close CEC Viewer. |

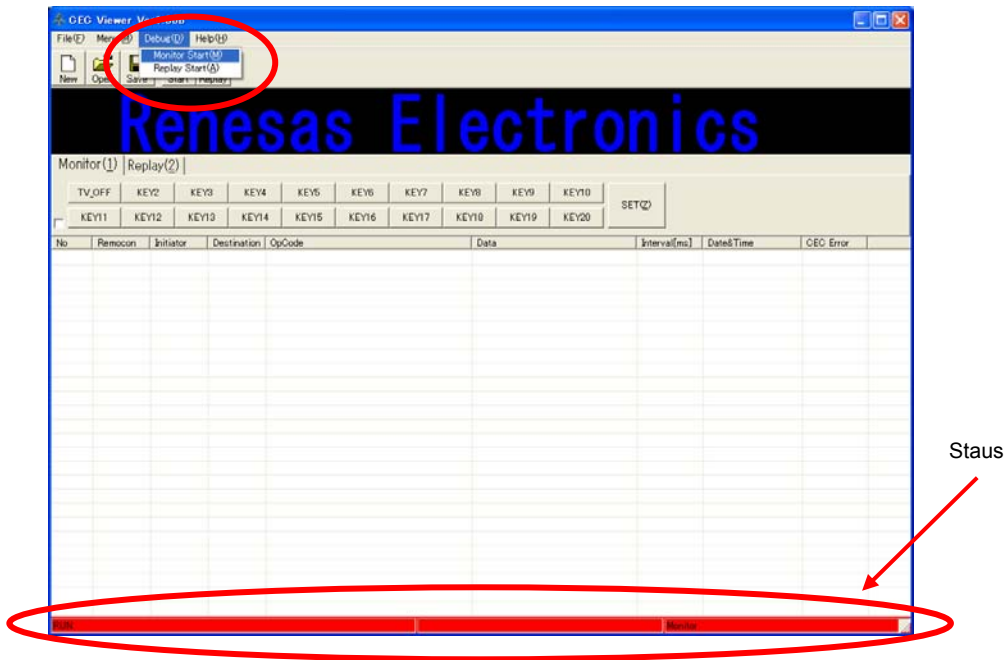
3.4.3 "Menu" Menu





COM Config (Settings for UART communication)

| | |
|----------|---|
| COM Port | Select the COM port that is assigned for TK-78K0/KE2C. (COM Port 1-19) |
| Bit rate | Select from 9600, 14400, 19200, 38400 (default), 57600, 115200, 128000. (Select the default setting, 38400) |
| Data Bit | Fixed with 8 bit. |
| Parity | Fixed with None. |
| Stop Bit | Fixed with 1 bit. |

3.4.4 "Debug" Menu



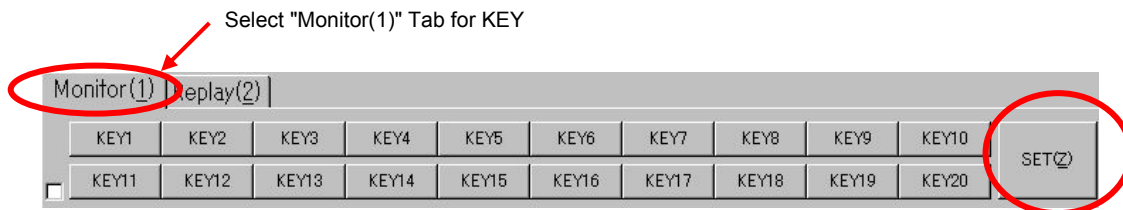
| | |
|----------------------|--|
| <p>Monitor Start</p> | <p>Start monitoring CEC. When it starts monitoring, the bottom of the window becomes red color to show RUN status. Communication results are displayed only when the status bar shows RUN. Select this menu when you wish to monitor communication between devices or to send commands from CEC Viewer. To stop monitoring, select this menu again. It toggles like RUN, STOP, and RUN.</p> <p>It is the same as the shortcut key  .</p> |
| <p>Replay Start</p> | <p>Replay the CEC communication based on log data saved with Excel format. Set replay tag properly and execute. *For detail about replay function, refer to "3.6.4 Replay Function"</p> <p>It is the same as the shortcut key  .</p> |

3.5 Control From CEC Viewer

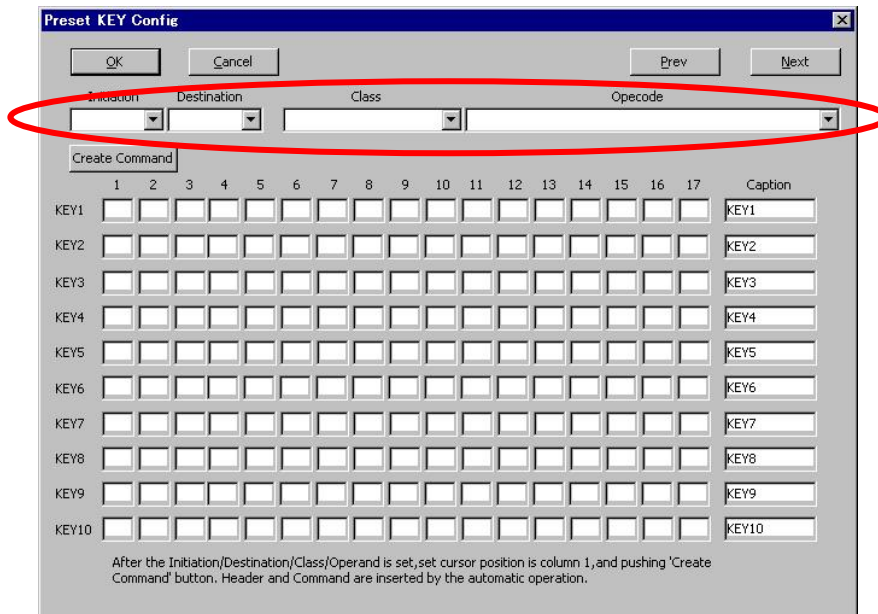
CEC data can be sent from CEC Viewer.

3.5.1 "Monitor" Tab

It sends user defined CEC data from preset keys.



Following "Preset KEY Config" screen is displayed by clicking "SET" key.

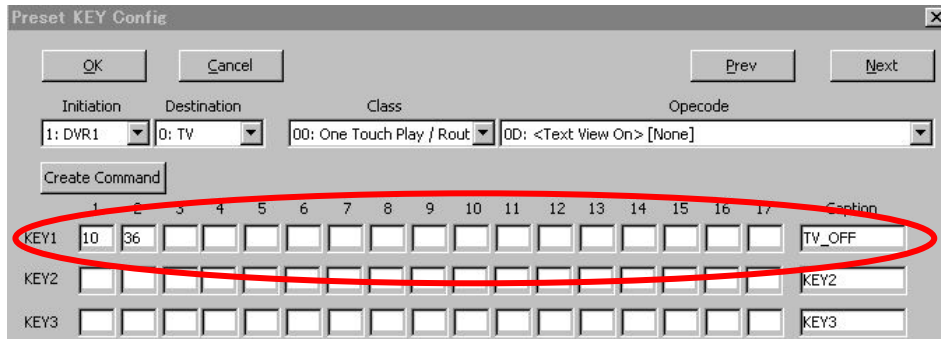


<KEY Setting>

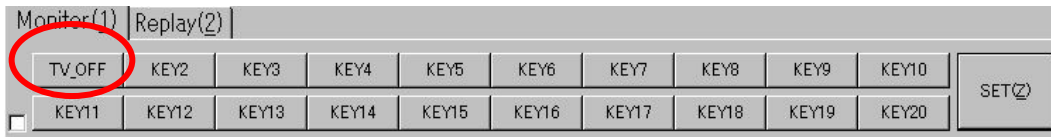
Select Header and Opcode for the sending CEC data at combo box shown above red area. (You can also enter it at the KEY input area directly.)

1. Select sender's initiator address at "Initiation".
2. Select receiver's destination address at "Destination".
3. Select the class of sending Opcode at "Class".
4. Select Opcode at "Opcode"
5. Move the cursor at the first byte of specific KEY, and click "Create Command" key. Header and Opcode will be automatically set.
6. Enter Operand for Opcode at the KEY input area directory as needed.

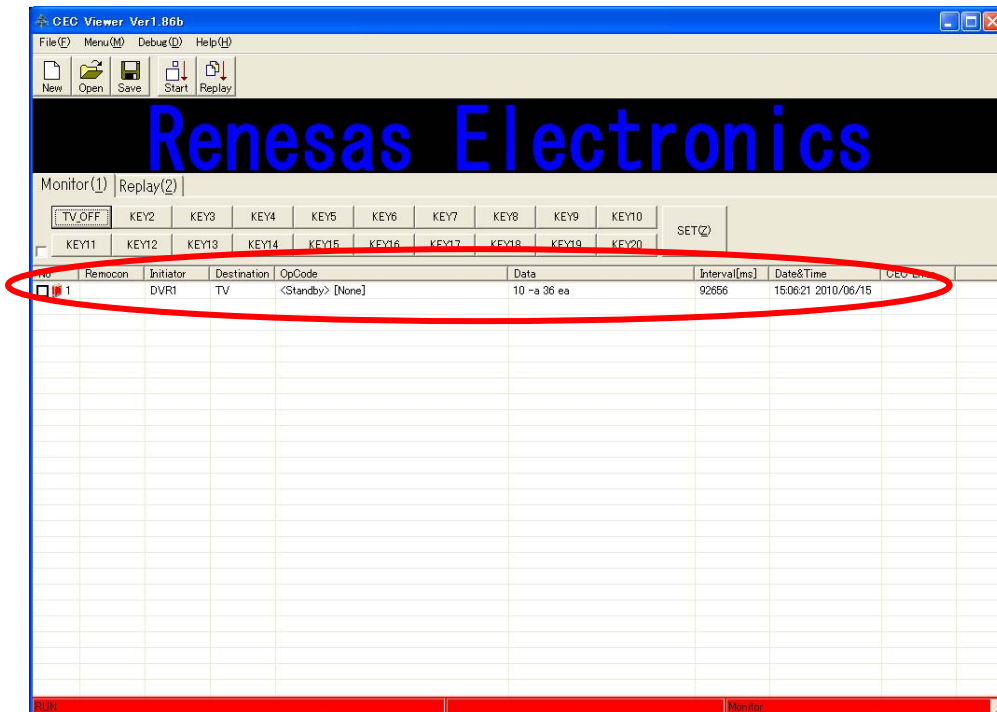
Also, captions of KEY on CEC Viewer can be changed.
 Change the caption to "TV_OFF", then set the data [10] [36].



The caption of KEY1 is changed to "TV_OFF".



By clicking "TV_OFF" key, it outputs CEC data ([10][36]), then the log data is displayed.



3.5.2 "Replay" Tab

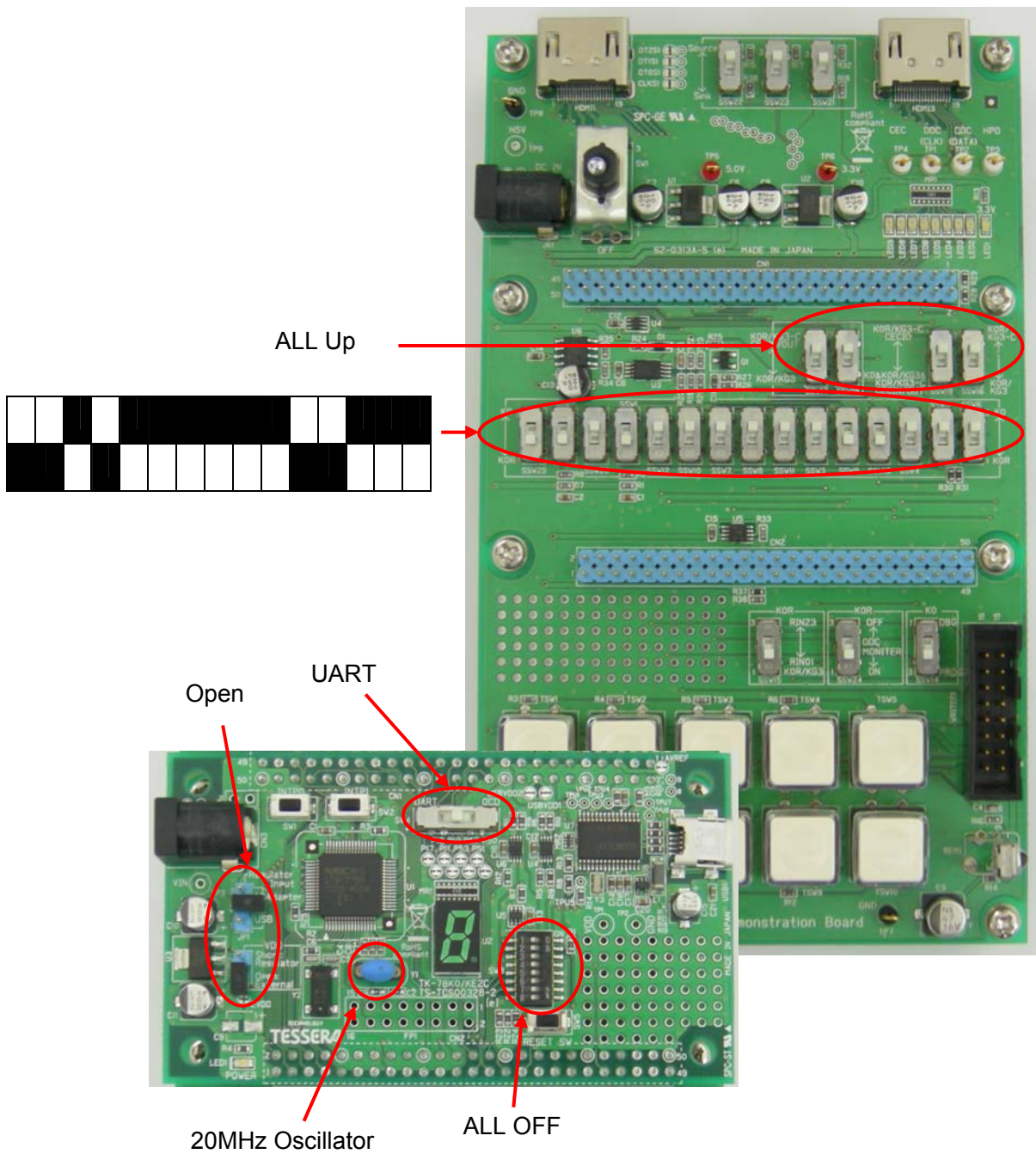
It loads monitoring information, the board becomes a unit on the CEC, and then it replays the same CEC command communication.

For detail, refer to "3.6.4 Replay Function".

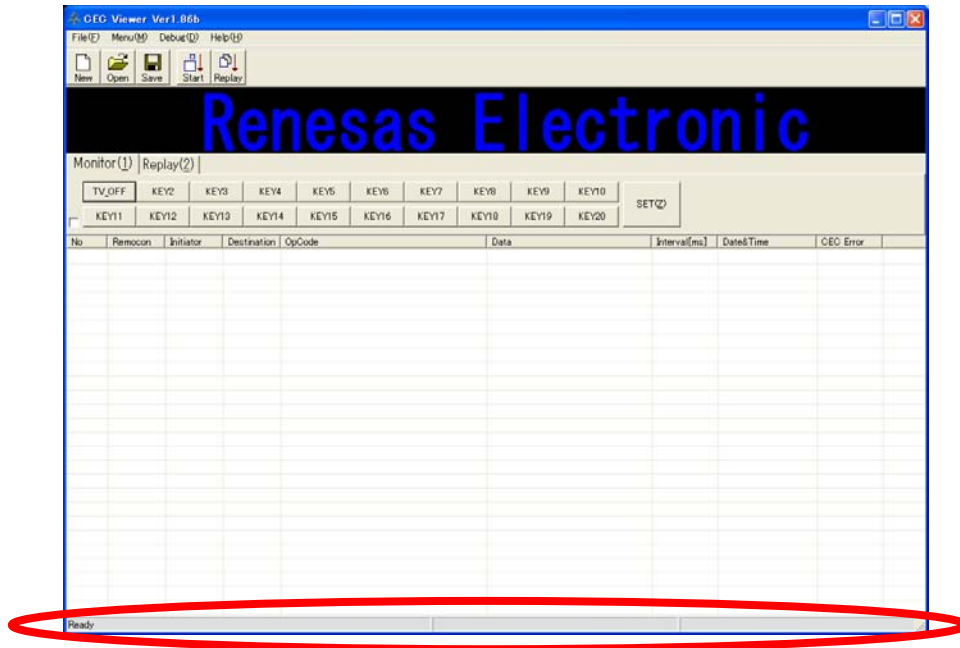
3.6 Specific Usages

3.6.1 Switch Settings

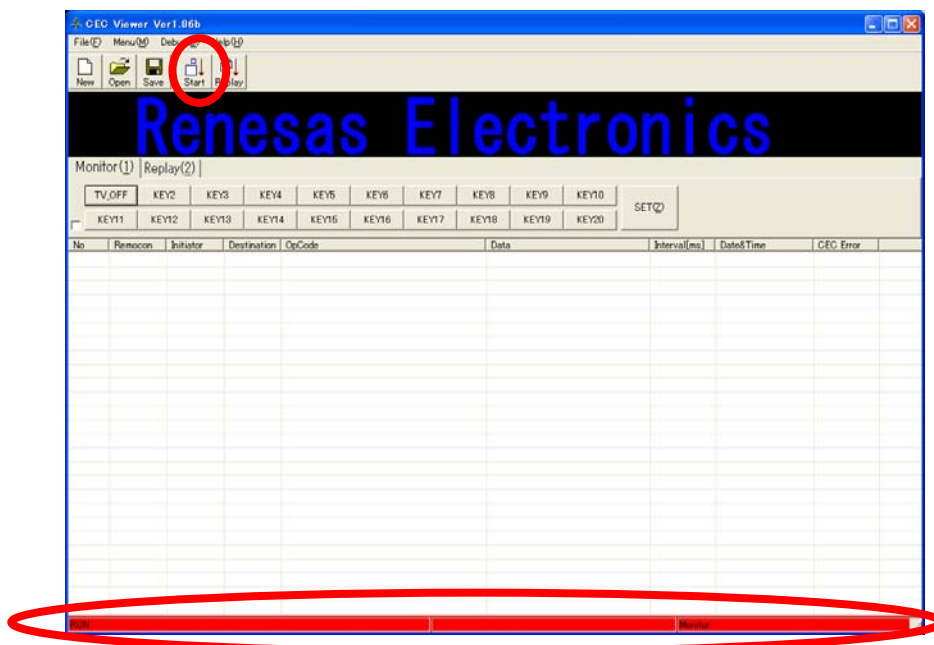
Set the switches as shown below.



3.6.2 Use As Monitor



When CEC Viewer is just started, the color of status bar is white to show "Ready". At this status, it does not display any CEC data.



Click "Start" button to start monitoring by CEC Viewer.
 The status bar becomes red to show "Run" status.
 With this status, CEC communication data between the boards will be displayed.
 Click "Start" button again to stop monitoring ("Ready" status).

3.6.3 Pseudo Device Sample Program

You just need to run CEC Viewer to use the Pseudo Device mode that is the same as Monitoring mode.

Click "TSW4(KEY4)" to select Pseudo Device (TV/DVR) mode. The multipurpose window displays the status of current pseudo device.

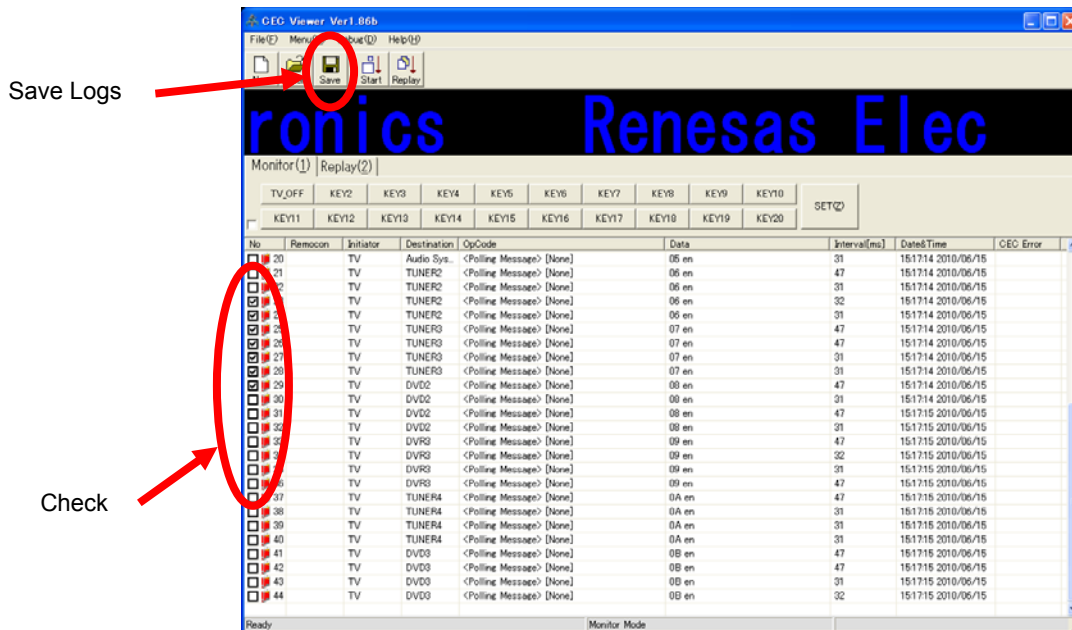


This is the example when you press power key with pseudo DVR mode. The multipurpose window displays "Power ON" to show the pseudo DVR is turned up.

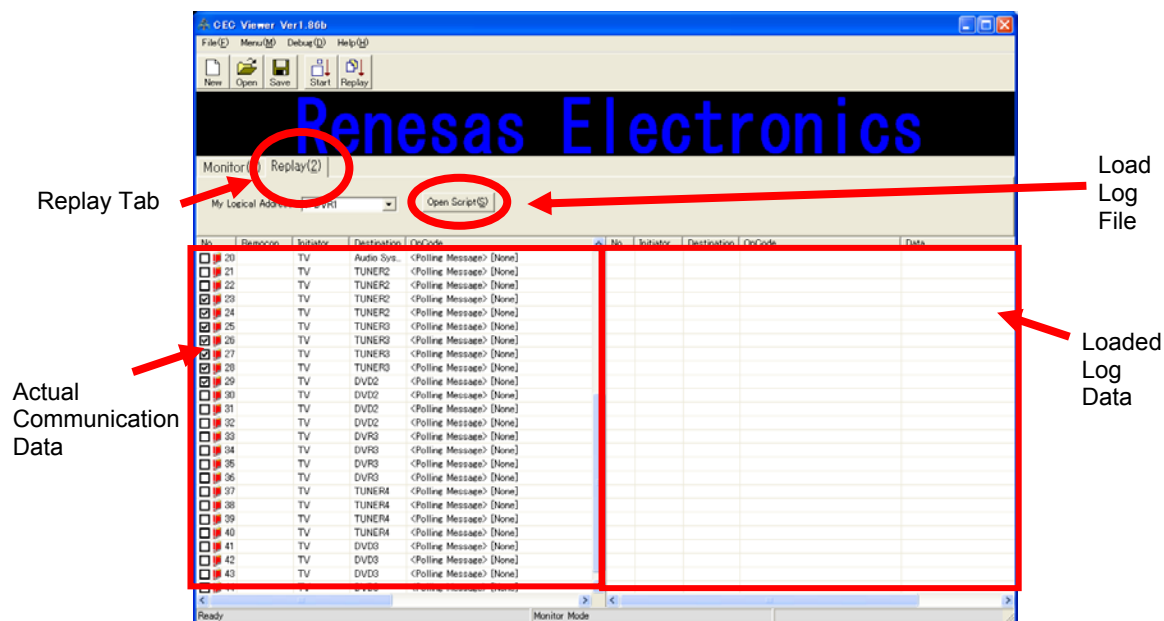
| Mode | Multipurpose Window | Status |
|--------------------|---------------------------|------------------------------------|
| Pseudo TV Mode | Power ON | Power ON |
| | Power OFF | Power OFF |
| | HDMI Input Change | TV input is switched to HDMI input |
| Pseudo DVR Mode | Power ON | Power ON |
| | Power OFF | Power OFF |
| | PLAY | Playing |
| | STOP | Stopped |
| | FORWARD | Fast-forwarding |
| | REVERSE | Rewinding |
| | REC | Recording |
| | REC STOP | Recording Stop |
| | PLAY(Recording) | Playing While Recording |
| | STOP(Recording) | Stopped While Recording |
| | FORWARD(Recording) | Fast-forwarding While Recording |
| REVERSE(Recording) | Rewinding While Recording | |

3.6.4 Replay Function

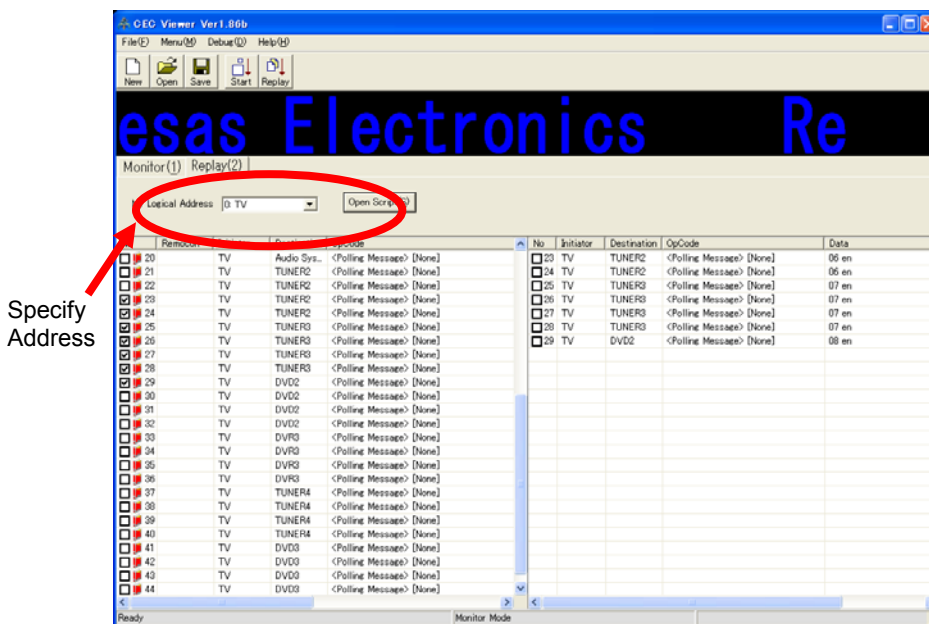
1. Monitor replaying communication. Operation mode should be monitor mode (LED is scroll status on the board).
2. Select the saving rows from monitoring CEC communication data and check the check boxes. Then, click "Save" button to save the data in a file.



3. Next, replay the saved CEC communication data. Click "Open Script" button on "Replay" tab and select the log file that you have just saved before.



- Set the logical address to alternative address for the board. Specify the address at "My Logical Address".



- The preparation for the replay process is completed. Now, you can start the replay by clicking "Replay" button.

* The replay operation will be terminated when it received the data that is different from the log data. Use the replay function with the same environment as the one when you save the log data.

<Example>

When you replay the TV power operation, make sure the elapsed time after you turned off the TV power is the same as the time in the log file.

