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RENESAS

Application Note

Controlling Fluorescent Lamp Ballasts by Using 78K0/Ix2

This application note describes how to control fluorescent lamp ballasts by using the various features of the 78K0/Ix2 microcontroller. Details about <u>power factor correction (PFC)</u> controlled by using a PWM timer that operates in conjunction with internal comparators, <u>half-bridge control with dead time</u> performed by using the PWM timer, protection performed by detecting an overcurrent or overvoltage by using the internal comparators, and DALI communication are provided.

Target devices 78K0/IY2 microcontroller 78K0/IA2 microcontroller 78K0/IB2 microcontroller

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CHAPTER 1 OVERVIEW

This application note describes how to control fluorescent lamp ballasts by using the 78K0/lx2 microcontroller.

The features for controlling fluorescent lamp ballasts by using the 78K0/lx2 microcontroller are as follows.

- Power factor correction (PFC) can be controlled by using a PWM timer that operates in conjunction with internal comparators. Therefore, no IC is required for controlling PFC.
- Inverter output with dead time is available. Therefore, no IC is required for performing half-bridge control.
- A 99% power factor can be achieved when the load is about 90 $W^{\mbox{\tiny Note 1}}.$
- The dimming of fluorescent lamps can be controlled.
- Timer output can be stopped immediately when an overvoltage, overcurrent, or installation or uninstallation of a fluorescent lamp is detected.
- Slave transmission and reception using the DALI communication protocol are supported^{Note 2}.
- The widths of pulses can be measured to easily receive infrared rays.
- A buzzer can be sounded and the dimming of LEDs can be controlled.

Notes 1. This is measured by using HIOKI 3332 POWER HITESTER.

2. Peripheral hardware units that support DALI communication are mounted on the 78K0/IA2 and 78K0/IB2 microcontrollers.

Figure 1-1 shows an example of the system block diagram for controlling a ballast by using the 78K0/lx2 microcontroller. Table 1-1 shows an example of the assignment of the microcontroller pins. Chapter 2 and the following chapters describe how to control a ballast when a ballast board is created according to this block diagram and pin assignment.

Figure 1-1. Example of the System Block Diagram for Controlling a Ballast by Using the 78K0/lx2 Microcontroller



78K0/lx2 microcontroller

Port Name	Name of the Used Function Pin	I/O	Function
P00	TI000	Input	Infrared signal input
P01	ТО00	Output	Sounding the buzzer
P20	ANIO	Input	Analog input for monitoring the boosted DC voltage
P21	ANI1/PGAIN	Input	Analog input for protecting the lamp or operational amplifier input
P22	ANI2	Input	Analog input for protecting the lamp
P23	CMP2+	Input	Comparator input for detecting zero currents (to control PFC)
P24	CMP0+	Input	Comparator input for detecting installation or uninstallation of a fluorescent lamp
P25	CMP1+	Input	Comparator input for detecting overcurrents
P26	ANI6	Input	Analog input for detecting the AC power supply voltage
P27	ANI7	Input	Analog input for switching the dimming mode
P30	TOH1	Output	Lighting LEDs
P31	TOX00	Output	Output for PFC
P33	TOX10	Output	Half-bridge output (low side)
P34	TOX11	Output	Half-bridge output (high side)
P37	P37	Input	Switch input for switching the infrared reception channel
P60	TxD6	Output	Output for DALI transmission
P61	RxD6	Input	Input for DALI reception
P70	ANI8	Input	Analog input for dimming

Table 1-1. Example of the Pin Assignment of the 78K0/IB2 Microcontroller

CHAPTER 2 CONTROLLING THE FEATURES

2.1 PFC and Half-Bridge Control

2.1.1 PFC control

Figure 2-1 (a) shows ideal waveforms of the AC power supply voltage and current. Here, the voltage and current have the same phase, are sine waves, and have a power factor of 100%. Figure 2-1 (b) shows the waveforms of the actual supply voltage and supply current of a power supply for which PFC control is not performed. Here, the conduction time is short and the peak current is large. Moreover, this causes the peak of the voltage waveform to flatten out. When the power factor decreases in this way, the following problems occur.

- High harmonic waves are generated that might prevent the compliance of products with regulations and their shipment.
- Excessively thick electric wires are required due to the large peak current.
- Breakers trip more easily.

Due to the above problems, PFC control is required for improving the power factor. For controlling PFC, the fluorescent lamp ballast board has relatively few components and generally uses the critical conduction mode (CRM) because there is little switching noise. Figure 2-1 (c) shows the waveforms of the AC power supply voltage and current when PFC control is used. The supply current is alternated and the average value of the distributed current values is controlled to have the same phase as the supply voltage and to be a sine wave. PFC can be controlled in the critical conduction mode by using the 78K0/Ix2 microcontroller.



Figure 2-1. Waveforms of the Supply Voltage and Current and PFC Control

2.1.2 Overview of PFC control

Figure 2-2 shows a schematic example of a boost PFC circuit that uses the 78K0/Ix2 microcontroller. Pins for PFC output (TOX00 pin), zero-current detection input (CMP2+ pin), and DC output voltage monitoring input (ANI0 pin) are required for PFC control. A pin for AC power supply voltage monitoring input (the ANI6 pin), which is indicated by the broken line, is required only if using the 78K0/Ix2 in an environment where the AC power supply voltage differs over time.

Figure 2-3 shows the waveform generated when PFC control is performed using this configuration. If PFC output (TOX00 output) is enabled, IoN is equal to (VIN/L) multiplied by toN. Therefore, by fixing the toN output time, IoN becomes proportional to VIN, and the waveform of the IoN peak current IPEAK will have the same phase as VIN and be a sine wave. In addition, because the current waveform is triangular, the average current IAVERAGE is equal to IPEAK/2, which is also proportional to VIN. Therefore, the waveforms of the average current and supply voltage will have the same phase and be sine waves and a waveform whose power factor is close to 100% can be generated.



Figure 2-2. Configuration Example of a Boost PFC Circuit

Figure 2-3. PFC Control Waveforms Generated by Using the 78K0/Ix2



The peripheral hardware units of the 78K0/Ix2 microcontroller used for PFC control and their features are described below.

- 16-bit timer X0: PFC output
- Comparators: Zero-current detection
- A/D converter: DC output voltage monitoring and AC power supply voltage monitoring^{Note}

Note This is used if the 78K0/Ix2 is used in an environment where the AC power supply voltage differs over time.

The features of PFC control performed by using these peripheral hardware units are as follows:

- By using 16-bit timer X0 with the internal comparators, PFC output can be automatically enabled when a zero current is detected (without software processing).
- 40 MHz can be selected for the count clock of 16-bit timer X0 and the time during which PFC output is enabled can be controlled in 25 ns units.
- The time during which PFC output is enabled can be changed without stopping 16-bit timer X0.
- The DC output voltage and AC power supply voltage can be monitored by using an A/D converter that has a 10bit resolution.

(1) Initialization before starting PFC control

The peripheral hardware units of the 78K0/Ix2 microcontroller must be initialized before starting PFC control. An example of the setup for initializing 16-bit timer X0 and the internal comparators, which are the main peripheral hardware units to control PFC, is provided below.

Note This applies if PLL clock mode is used and 40 MHz is specified for the clock supplied to 16-bit timer X0.

However, during the actual initial setup, the clock, ports, and interrupts must be set up. For details, see the 78K0/Ix2 User's Manual.

(2) Starting PFC control

Figure 2-4 shows the waveform generated when PFC control starts.



Figure 2-4. Waveform Generated When PFC Control Starts

The operations are summarized below.

- <1> The internal comparators start.
- <2> The time PFC output is enabled is specified.
- <3> The PFC output pin is set to input. This sets PFC output to high impedance and the MOSFET is disabled by an external pull-down resistor.
- <4> The default status of PFC output is set to high level.
- <5> 16-bit timer X0 starts.
- <6> The PFC output pin is set to output. This cancels high-impedance output and PFC output starts.
- <7> While a zero current cannot be detected, PFC output restarts in the cycle specified by using compare register TX0CR1 and the MOSFET is repeatedly enabled for a fixed period.
- <8> When a zero current is detected, PFC output starts and the MOSFET is enabled for a fixed period.
- **Remark** Controlling high-impedance output as in operations <3> and <6> is not required, but recommended to be set up for safety if interrupt servicing that takes a relatively long time might occur between operations <4> and <5>.

After PFC output starts in operation <6>, PFC output restarts before a zero current is detected and PFC output is enabled immediately when a zero current is detected by hardware, without performing software processing. Therefore, there is no delay due to CPU processing or CPU load for these operations.

Sample code for operations <1> to <6> is shown below.

(3) PFC control if the load changes

Figure 2-5 shows the PFC control waveform generated when the load changes, such as during the time from the fluorescent lamp being preheated until it lights up or when the dimming frequency is changed after the voltage is boosted. When the load changes due to dimming and by how much the load changes can be estimated, because the 78K0/lx2 microcontroller is used for dimming. Therefore, even if the load changes significantly due to dimming, PFC output according to the dimming can be performed easily and fluctuation in the DC output voltage and drastic decreases in the power factor can be prevented.





The operations are summarized below.

- <1> The period of time PFC is enabled (TX0CR0 in Figure 2-5) is changed to a value according to the load (TX0CR0' in Figure 2-5).
- <2> The zero-current detection interrupt (INTCMP2) is unmasked^{Note}.
- <3> The pulse cycle (TX0CR1) value is rewritten or the same value is written immediately after a zero-current detection interrupt occurs.
- <4> The zero-current detection interrupt (INTCMP2) is masked^{Note}.
- <5> The period of time PFC output is enabled is updated when the next zero-current detection interrupt occurs.
- **Note** Specifying the masking of zero-current detection interrupt is not required. Masking of zero-current detection interrupt must be specified if performing operation <3> during zero-current detection interrupt servicing.

Sample code for operations <1> to <4> is shown below.

<The following processing is executed around when the load changes.>

```
TXOCR0 += 100;/* <1> Increases the period of time PFC output is enabled by 2.5 us. */CMPIF2 = 0;/* <2> Clears the comparator 2 interrupt request flag. */CMPMK2 = 0;/* <2> Unmasks comparator 2 interrupt. */
```

<The following processing is executed during the interrupt servicing immediately after an INTCMP2 interrupt occurs.>

(4) DC output voltage feedback

To make sure that the DC output voltage is constant, it must be monitored using the A/D converter, and the period of time PFC output is enabled must be controlled. The DC output voltage can be fed back by calculating the average DC output voltage by using the A/D converter and changing the period of time PFC output is enabled, such as at every half cycle of the AC power supply (10 ms at 50 Hz), because changes in the DC output voltage are moderate except when the load is intentionally changed. In addition, the period of time TOX00 output is enabled can be controlled in 25 ns units and the DC output voltage can be finely controlled, because 40 MHz can be selected for the count clock of 16-bit timer X0. Figure 2-6 shows an example in which feeding back the DC output voltage is controlled.





The operations are summarized below.

- <1> It is detected that the average ANI0 input is the minimum permissible DC output voltage or less and that the voltage is falling, and the value of the compare register TX0CR0 is incremented by 1 (which adds 25 ns) by software.
- <2> The zero-current detection interrupt (INTCMP2) is unmasked^{Note}.
- <3> The pulse cycle (TX0CR1) value is rewritten or the same value is written immediately after a zero-current detection interrupt occurs.
- <4> The zero-current detection interrupt (INTCMP2) is masked^{Note}.
- <5> The period of time PFC output is enabled is updated when the next zero-current detection interrupt occurs.
- **Note** Specifying the masking of zero-current detection interrupt is not required. Masking of zero-current detection interrupt must be specified if performing operation <3> during zero-current detection interrupt servicing.

Sample code for operations <1> to <4> is shown below.

<The following processing is executed around when the load changes.>

```
TXOCR0 += 1;/* <1> Increases the period of time PFC output is enabled by 25 ns. */CMPIF2 = 0;/* <2> Clears the comparator 2 interrupt request flag. */CMPMK2 = 0;/* <2> Unmasks comparator 2 interrupt. */
```

<The following processing is executed during the interrupt servicing immediately after an INTCMP2 interrupt occurs.>

```
TXOCR1 = 10000 - 1; /* <3> Writes the same value to the PFC output restart cycle (250 us). */
CMPMK2 = 1; /* <4> Masks comparator interrupt. */
```

(5) Detecting the AC power supply voltage

To support different AC input voltages (AC 100 V to 240 V) by using the same control program, the parameters for PFC output must be changed according to the AC power supply voltage level. This can be achieved by detecting the rectified AC power supply voltage level by using the A/D converter and specifying these parameters when the power is turned on or at every fixed period after the power is turned on. However, supporting different AC input voltages and A/D converter input is not required for a ballast board that uses only one AC power supply.

A control example is provided below.

- <1> After the power is turned on, the AC power supply voltage level is detected for a fixed period by using the A/D converter (ANI6 input) and the average value is calculated.
- <2> The parameters for PFC output are specified according to the average value calculated in <1>.
- <3> Hereafter, the AC power supply voltage level is detected at fixed periods by using the A/D converter (ANI6 input) and, if this voltage changes significantly, the parameters for PFC output are changed accordingly.

(6) Stopping PFC control

To stop PFC control, use the following procedure.

- <1> Set the PFC output pin to input. This sets PFC output to high impedance and the MOSFET is disabled by an external pull-down resistor.
- <2> Stop 16-bit timer X0.
- <3> Set the default status of PFC output to low level.
- <4> Set the PFC output pin to output. This cancels high-impedance output and a low-level signal is output from the PFC output pin.
- <5> Stop the internal comparators.

Controlling high-impedance output as in steps <1> and <4> is not required, but recommended to be set up for safety if interrupt servicing that takes a relatively long time might occur between steps <2> and <3>. The comparators do not have to be stopped as in step <5>, either, but the power consumption of the microcontroller can be reduced by doing so.

Sample code for steps <1> to <5> is shown below.

```
/* 16-bit timer X0 setup */
PM3.1 = 1;  /* <1> Sets the PFC output port to input.*/
TX0TMC = 0;  /* <2> Disables the timer from counting. */
TX0TOL0 = 0;  /* <3> Sets the default status of TOX00 output to low level.*/
PM3.1 = 0;  /* <4> Sets the PFC output port to output. */
/* Comparator setup */
CMP2EN = 0;  /* <5> Disables comparator 2. */
CVRE = 0;  /* <5> Disables the generation of the internal reference voltage. */
C20E = 0;  /* <5> Disables internal output for comparator 2.*/
```

2.1.3 Overview of half-bridge control

Figure 2-7 shows an example of the configuration of a half-bridge circuit that uses the 78K0/lx2 microcontroller. Pins for low-side output (TOX10 pin) and high-side output (TOX11 pin) are required for half-bridge control.

Figure 2-8 shows an example of the waveform generated when half-bridge control is performed by using this configuration. As shown below, inverter output can be performed from the MOSFET by alternately enabling low-side output and high-side output with a fixed dead time (without enabling both at the same time).





Figure 2-8. Half-Bridge Control Waveform Example



The peripheral hardware unit of the 78K0/lx2 microcontroller used for half-bridge control and the features are described below.

• 16-bit timer X1: Low-side output and high-side output for half-bridge control

The features of half-bridge control performed by using this peripheral hardware unit are as follows:

- Synchronous 2-channel PWM output with dead time and flexible half-bridge control can be easily performed by using the dual output of 16-bit timer X1 (TOX10 and TOX11 output) and four compare registers (TX1CR0, TX1CR1, TX1CR2, and TX1CR3).
- 40 MHz can be selected for the count clock of 16-bit timer X1, the dead time can be controlled in 25 ns units, and the half-bridge output cycle can be controlled in 50 ns units.
- The inverter output frequency and dead time can be changed without stopping 16-bit timer X1.

(1) Initialization before starting half-bridge control

The peripheral hardware units of the 78K0/Ix2 microcontroller must be initialized before starting half-bridge control. An example of the setup for initializing 16-bit timer X1, which is typical for half-bridge control, is provided below.

Note This applies if PLL clock mode is used and 40 MHz is specified for the clock supplied to 16-bit timer X1.

However, during the actual initial setup, the clock, ports, and interrupts must be set up. For details, see the 78K0/Ix2 User's Manual.

(2) Starting half-bridge control

Figure 2-9 shows the waveform generated when half-bridge control starts.





The operations are summarized below.

- <1> The dead time and frequency of half-bridge control are specified.
- <2> Half-bridge control starts.
- <3> The inverter output voltage gradually increases and it becomes a fixed voltage when it reaches the DC output voltage generated by PFC control.

After half-bridge control is started in operations <1> and <2>, half-bridge control is executed by hardware. Therefore, there is no delay due to CPU processing or CPU load for these operations.

Sample code for operations <1> and <2> is shown below.

```
TX1CR0 = 40 - 1;/* <1> Sets the dead time to 1 us.*/TX1CR1 = 200 - 1;/* <1> Sets the duty factor to 50%. */TX1CR2 = 200 + 40 - 1;/* <1> Sets the dead time to 1 us.*/TX1CR3 = 400 - 1;/* <1> Sets the frequency to 100 kHz. */TX1TMC = 1;/* <2> Enables the timer to count. */
```

(3) Changing the half-bridge output cycle (to control dimming and sweep the frequency during preheating) Figure 2-10 shows an example of the waveform generated when the half-bridge output cycle changes, such as during the time from the fluorescent lamp being preheated until it lights up or when it is dimmed.



Figure 2-10. Waveform When the Half-Bridge Output Cycle Changes

The operations are summarized below.

- <1> The settings of the dead time and duty factor 50% are changed according to the new half-bridge output frequency.
- <2> The INTTMX1 interrupt is unmasked^{Note}.
- <3> The pulse cycle (TX1CR3) value is rewritten immediately after an INTTMX1 interrupt occurs.
- <4> The INTTMX1 interrupt is masked^{Note}.
- <5> When the next INTTMX1 interrupt occurs, the half-bridge output frequency is changed, but the dead time and duty factor 50% are maintained.
- **Note** Specifying the masking of INTTMX1 interrupt is not required. Masking of INTTMX1 interrupt must be specified if performing operation <3> during INTTMX1 interrupt servicing.

Sample code for operations <1> to <4> is shown below.

<The following processing is executed around when the load changes.>

```
      TX1CR1 = 400 - 1;
      /* <1> Sets the duty factor of the new frequency to 50%. */

      TX1CR2 = 400 + 40 - 1;
      /* <1> Maintains the dead time of 1 us. */

      TMIFX1 = 0;
      /* <2> Clears the INTTMX1 interrupt request flag. */

      TMMKX1 = 0;
      /* <2> Unmasks INTTMX1 interrupt. */
```

Remark The value of TX1CR0 must also be changed when changing the dead time.

<The following processing is executed during the interrupt servicing immediately after an INTTMX1 interrupt occurs.>

```
TX1CR3 = 800 - 1;/* <3> Changes the half-bridge output frequency to 50 kHz. */TMMKX1 = 1;/* <4> Masks INTTMX1 interrupt. */
```

(4) Stopping half-bridge control

Specify the following setting to stop half-bridge control.

<1> Stop 16-bit timer X1.

Sample code for this specification is shown below.

TX1TMC = 0;

/* Disables the timer from counting. */

2.1.4 Software flowchart for PFC control and half-bridge control



2.2 Protection

2.2.1 Overview of protection

The outputs of 16-bit timers X0 and X1 can be changed immediately by using them with an internal comparator or INTPO input. This operation enables PFC output and half-bridge output to be stopped immediately when an overvoltage or overcurrent is detected or the lamp is installed or uninstalled. No delay due to software processing or CPU load occurs because this operation is performed by hardware.

Figure 2-11 shows an example of a circuit in which PFC output and half-bridge output are stopped immediately when the internal comparator detects an overcurrent flowing to the MOSFET for PFC control. Figure 2-12 shows an example of the waveform generated when an overcurrent is detected in this circuit.

Figure 2-11. Example of the Circuit When Timer Output Is Stopped Immediately When an Overcurrent Is Detected by the Internal Comparators







The operations are summarized below.

(1) Initialization

- <1> The pins that perform PFC output (TOX00 pin) and half-bridge output (TOX10 and TOX11 pins) are specified as the pins controlling high-impedance output^{Note 1} and internal comparator 1 is selected as the trigger.
- <2> A setting is specified so that the high-impedance status cannot be canceled while the input signal of internal comparator 1 has an abnormal detection level^{Note 2}.
- <3> Trigger signal input and high-impedance output control are enabled.

(2) Immediate high-impedance output when an abnormality is detected

- <4> PFC output (TOX00 pin) and half-bridge output (TOX10 and TOX11 pins) change to high-impedance output when the CMP1+ pin input signal exceeds the reference voltage of the internal comparator.
- <5> PFC output (TOX00 pin) and half-bridge output (TOX10 and TOX11 pins) are stopped, such as by INTCMP1 interrupt servicing, and these timer outputs are set to low level^{Note 3}.

(3) Canceling high-impedance output

- <6> If HZA0DCC0 is set to 1 by mistake while the input signal of internal comparator 1 has an abnormal detection level, the setting is invalid and high-impedance output is not canceled.
- <7> If HZA0DCC0 is set to 1 while the input signal of internal comparator 1 does not have an abnormal detection level, high-impedance output is canceled.

Notes 1. Whether to use high-impedance control can be specified for each pin.

- 2. A setting that enables cancellation of the high-impedance status can be specified regardless of the input signal.
- **3.** When high-impedance output is canceled using this setting, a low-level signal is output from the pins. A setting that restarts control when high-impedance output is canceled, without stopping the PFC control timer, can also be used.

Sample code for operations <1> to <3>, <6>, and <7> is shown below.

<Initialization>

Note Setting the HZA0DCC0 bit to 1 cancels the high-impedance status of the target pins (the TOX00, TOX10, and TOX11 pins in this example) and enables the output of the pins.

<Canceling high-impedance output>

```
HZAODCCO = 1; /* <6> <7> Cancels the high-impedance output status. */
```

2.2.2 Software flowchart for protection



Note When performing these operations, processing that exits the loop if this loop is repeated for a specific period of time must be added, because this loop might be an infinite loop.

2.3 Communication

2.3.1 DALI communication

DALI (Digital Addressable Lighting Interface) is a communication protocol for controlling lighting, standardized in accordance with international open standards, and is mainly used to control the dimming of multiple fluorescent lamps and LEDs. DALI is used in a network consisting of up to 64 short addresses and 16 group addresses that performs half-duplex command communication between one master and one or more slaves. DALI commands are used to specify the dimming level in 8-bit accuracy, save any dimming level as a scene and switch between different scenes, and specify other settings. The communication speed is $1,200 \text{ Hz} \pm 10\%$.

The main specifications are described below.

(1) Data structure

<1> Bit definitions

DALI communication uses Manchester code. Therefore, bits are defined as 0 at falling edges and as 1 at rising edges and fixed to high level when no communication is performed.





<2> Frames

· Forward frame

A forward frame is a frame transmitted from the master to a slave. Such a frame has 19 bits.





a: Start bit

This bit indicates the start of the frame. The waveform of this bit is always equal to 1.

b to d: Address byte

This byte specifies where to transmit the frame.

e: Data byte

This byte specifies a command.

f: Stop bits

These bits indicate the end of the frame. These bits are fixed to high level.

• Backward frame

A backward frame is a frame transmitted from a slave to the master. Such a frame has 11 bits.

Figure 2-15. Structure of a Backward Frame

1 bit ◀ ►	8 bits	2 bits
а	b	с

a: Start bit

This bit indicates the start of the frame. The waveform of this bit is always equal to 1.

b: Data byte

This byte replies to the master.

c: Stop bits

These bits indicate the end of the frame. These bits are fixed to high level.

(2) Specifying the transmission and reception timing

<1> Timing within a frame

1 bit width in DALI is 833.3 μ s ±10% for both forward and backward frames.





Note Because there are two stop bits, their timing is 1666.67 μ s.

<2> Timing between frames

The following timing control is required in frame units in DALI.

- Forward frame width: 15.83 ms $\pm 10\%$
- Backward frame width: 9.17 ms $\pm 10\%$
- Communication interval between a forward and backward frame: 2.92 to 9.17 ms
- Interval between a forward frame and the next forward frame: At least 9.17 ms
- Interval between a backward frame and the next forward frame: At least 9.17 ms





From the start of a forward frame to the start of a backward

2.3.2 Overview of DALI communication

The 78K0/IA2 and 78K0/IB2 microcontrollers are provided with the serial interface UART6/DALI to transmit and receive data as a slave of DALI communication by using hardware. Therefore, no CPU load due to software processing occurs when data is transmitted or received via DALI.

Figure 2-18 shows a schematic example of a DALI communication circuit. Pins for DALI reception input (RxD6 pin) and DALI transmission output (TxD6 pin) are required for performing DALI communication.





Remarks 1. PS2561AL-1 is a photocoupler made by NEC Electronics.

2. RD2.7S is a Zener diode made by NEC Electronics.

(1) Initialization

An example of initializing the serial interface UART6/DALI when performing DALI communication is shown below.

```
UADLSEL = 1;  /* Specifies DALI mode. */
ASICL6.1 = 0;  /* Specifies that the MSB is first. */
CKSR6 = 5;  /* Sets the count clock to 625 kHz<sup>Note 1</sup>. */
BRGC6 = 130;  /* Sets the baud rate to 1,200 bps<sup>Note 1</sup>. */
ASIM6.0 = 0;  /* Specifies INTSRE6<sup>Note 2</sup> as the interrupt generated when a reception
error occurs.*/
```

- **Notes 1.** This applies if PLL clock mode is used and 20 MHz is specified for the clock supplied to the peripheral hardware units.
 - 2. The interrupt generated when data is received successfully (INTSR6) can also be specified.

(2) Timing chart when receiving data

Figure 2-19 shows an example of the timing chart when data is received from the master during DALI communication.



Figure 2-19. Timing Chart When Receiving Data During DALI Communication

The operations are summarized below.

<Enabling reception>

- <1> The internal operation clock of the serial interface UART6/DALI is enabled.
- <2> Reception is enabled and a status in which reception can be performed is specified.
- <3> If data is received successfully from the master during DALI communication, the interrupt INTSR6 is generated and received data is stored into the RXBDL register. If a reception error occurs, an INTSRE6 interrupt is generated and the reception error status is stored into the ASIS6 register. (Figure 2-19 shows a timing chart for when data was received successfully.)

<Processing after an INTSR6 interrupt is generated when data was received successfully>

- <4> The received data (16 bits) is saved.
- <5> Reception is disabled.
- <6> The internal operation clock of the serial interface UART6/DALI is disabled.

<Processing after an INTSRE6 interrupt is generated when a reception error occurred>

- <7> The reception error status is read.
- <8> The received data (16 bits) is discarded.
- <9> Reception is disabled.
- <10> The internal operation clock of the serial interface UART6/DALI is disabled.

Sample code for operations <1>, <2>, and <4> to <10> is shown below.

<Enabling reception>

```
POWER6 = 1;/* <1> Enables the internal operation clock. */RXE6 = 1;/* <2> Enables reception. */
```

<Processing after an INTSR6 interrupt is generated when data was received successfully>

```
ushRxCode = RXBDL;/* <4> Saves the received dataNote 1. */RXE6 = 0;/* <5> Disables reception. */POWER6 = 0;/* <6> Disables the internal operation clock. */
```

<Processing after an INTSRE6 interrupt is generated when a reception error occurred>

```
ucRxeCode = ASIS6;/* <7> Reads the reception error status<br/>Note 2. */ushTemp = RXBDL;/* <8> Discards the received data<br/>Note 1. */RXE6 = 0;/* <9> Disables reception. */POWER6 = 0;/* <10> Disables the internal operation clock. */
```

Notes 1. ushRxCode and ushTemp are 16-bit variables.

2. ucRxeCode is an 8-bit variable.

(3) Timing chart when transmitting data

Figure 2-20 shows an example of the timing chart when data is transmitted to the master during DALI communication.



Figure 2-20. Timing Chart When Transmitting Data During DALI Communication

The operations are summarized below.

<Starting transmission>

- <1> The internal operation clock of the serial interface UART6/DALI is enabled.
- <2> Transmission is enabled and a status in which reception can be performed is specified.
- <3> An NOP instruction (which consumes two clocks) is executed so that the system waits at least one base clock cycle.
- <4> The data to transmit is stored into the TXB6 register and transmission starts^{Note}.
- <5> An INTST6 interrupt is generated when transmission ends.

<Processing after an INTST6 interrupt is generated when transmission ends>

- <6> Transmission is disabled.
- <7> The internal operation clock of the serial interface UART6/DALI is disabled.
- **Note** As shown in Figure 2-20, the transmitted data is directly input to the reception pin during DALI communication. Therefore, preventing the generation of reception error interrupts is recommended by disabling reception (RXE6 = 0) before starting transmission.

Sample code for operations <1> to <4>, <6>, and <7> is shown below.

<Starting transmission>

```
      POWER6 = 1;
      /* <1> Enables the internal operation clock. */

      TXE6 = 1;
      /* <2> Enables transmission. */

      NOP();
      /* <3> Waits at least 1 base clock. */

      TXB6 = 0b1111111;
      /* <4> Starts transmitting the data 1111111. */
```

<Processing after an INTST6 interrupt is generated when transmission ends>

TXE6 = 0;/* <6> Disables transmission. */POWER6 = 0;/* <7> Disables the internal operation clock. */

2.3.3 Software flowcharts for DALI communication







APPENDIX A REFERENCE CIRCUIT DIAGRAM

APPENDIX B REFERENCE PARTS TABLE

	Part Numbe 771	rProduct Name and Specifications UPD78F0756MC-CAB-AX	Function	Manufacturer	Manufacturer Product Name UPD78F0756MC-CAB-AX
	773	UPD78F0756MC-CAB-AX UPC78M05AHF-AZ	Microcontroller 3-pin regulator	NEC Electronics Corporation NEC Electronics Corporation	UPD78F0756MC-CAB-AX UPC78M05AHF-AZ
	301	PS2561AL-1	Photocoupler	NEC Electronics Corporation	PS2561AL-1
	302	PS2561AL-1	Photocoupler	NEC Electronics Corporation	PS2561AL-1
ZD	301	RD2.7S-T1-A	Zener diode	NEC Electronics Corporation	RD2.7S-T1-A
LF	1	SU10VD-20010	AC 250 V 2 A line filter	NEC TOKIN Corporation	SU10VD-20010
LF	2	SS24H-R20045-CH	AC 250 V 2 A line filter	NEC TOKIN Corporation	SS24H-R20045-CH
ΒZ	0	PS1440P02BT	Buzzer	TDK Corporation	PS1440P02BT
	101	2KV 1000p	Ceramic capacitor	Murata Manufacturing Co., Ltd.	DEHR33D102KB3B
	102	2KV 1000p	Ceramic capacitor	Murata Manufacturing Co., Ltd.	DEHR33D102KB3B
	103	50V 470p	Monolithic ceramic capacitor	Murata Manufacturing Co., Ltd.	GRM2162C1H471JA01D
	104	25V 0.47u	Monolithic ceramic capacitor	Murata Manufacturing Co., Ltd.	GRM219B31E474KA88D
	105	50V 470p	Monolithic ceramic capacitor	Murata Manufacturing Co., Ltd.	GRM2162C1H471JA01D
	111	400V 0.18u	Film capacitor	Panasonic Corporation	ECWF4184JB
	112	4700p 2KV	Film capacitor	Nippon Chemi-Con Corporation	FHACD202V472JKLDZ0
	211	400V 0.18u	Film capacitor	Panasonic Corporation	ECWF4184JB
	212	4700p 2kV	Film capacitor	Nippon Chemi-Con Corporation	FHACD202V472JKLDZ0
	220	50V 0.1u	Monolithic ceramic capacitor	Murata Manufacturing Co., Ltd.	GRM21BR11H104KA01L
	301	25V 22u	Electrolytic capacitor	NICHICON CORPORATION	UPS1E220MDD
	401	25V 10u	Electrolytic capacitor	NICHICON CORPORATION	UPS1E100MDD
	513	10V 100u	Electrolytic capacitor	NICHICON CORPORATION	UPS1A101MDD
	601	50V 0.1u	Monolithic ceramic capacitor	Murata Manufacturing Co., Ltd.	GRM21BR11H104KA01L
	602	10V 1u	Monolithic ceramic capacitor	Murata Manufacturing Co., Ltd.	GRM216B11A105KA01
	701	250VAC 0.33u	Film capacitor	NISSEI ELECTRIC CO., LTD.	MMDF 0250 K 334 0000 0150
	702	250VAC 0.33u	Film capacitor	NISSEI ELECTRIC CO., LTD.	MMDF 0250 K 334 0000 0150
	703	50V 0.1u	Monolithic ceramic capacitor	Murata Manufacturing Co., Ltd.	GRM21BR11H104KA01L
	704	2kV 1000p	Ceramic capacitor	Murata Manufacturing Co., Ltd.	DEHR33D102KB3B
	705	2kV 1000p	Ceramic capacitor	Murata Manufacturing Co., Ltd.	DEHR33D102KB3B
	706	2kV 1000p	Ceramic capacitor	Murata Manufacturing Co., Ltd.	DEHR33D102KB3B
	711	450V 1u	Film capacitor	Rubycon Corporation	450MMK105K
	712	450V 1u	Film capacitor	Rubycon Corporation	450MMK105K
	713	1KV 470p	Ceramic capacitor	Murata Manufacturing Co., Ltd.	DEHR33A332KA3B
	714	450V 47u	Electrolytic capacitor	Rubycon Corporation	450BXA47MCC(18×31.5)
	717	25V 22u	Electrolytic capacitor	NICHICON CORPORATION	UPS1E220MDD
	719	50V 100u	Electrolytic capacitor	NICHICON CORPORATION	UPS1H101MPD
	723	10V 1u	Monolithic ceramic capacitor	Murata Manufacturing Co., Ltd.	GRM216B11A105KA01
	775	25V 47u	Electrolytic capacitor	NICHICON CORPORATION	UPS1E470MPDDD
CN		B5P-VH (LF)(SN)	Connector	J.S.T. Mfg. Co., Ltd.	B5P-VH (LF)(SN)
CN		B5P-VH (LF)(SN)	Connector	J.S.T. Mfg. Co., Ltd.	B5P-VH (LF)(SN)
CN		ML-800-S1V-2P	Connector	SATO PARTS CO., LTD.	ML-800-S1V-2P
CN		ML-800-S1V-2P	Connector	SATO PARTS CO., LTD.	ML-800-S1V-2P
CN		B2P3-VH (LF)(SN)	Connector	J.S.T. Mfg. Co., Ltd.	B2P3-VH (LF)(SN)
	101 102	EP04RA60	FRD	Nihon Inter Electronics Corporatio	
		EP04RA60	FRD	Nihon Inter Electronics Corporatio	
	103 104	1SS133	Diode Diode	ROHM Co., Ltd.	1SS133
	104	1SS133	Diode	ROHM Co., Ltd.	1SS133
	105	1SS133	Diode	ROHM Co., Ltd. ROHM Co., Ltd.	1SS133
	301	1SS133 1SS133	Diode	ROHM Co., Ltd.	1SS133 1SS133
	501 501	1SS133	Diode	ROHM Co., Ltd.	
	702				1SS133
		D1N60 5060	Diode Diode	Shindengen Electric Manufacturing Co., Ltd	
	703 704	1SS133		ROHM Co., Ltd. ROHM Co., Ltd.	1SS133
	704 707	1SS133 D5L60 7000	Diode FRD	Shindengen Electric Manufacturing Co., Ltd.	1SS133
	708	30PUB60	FRD	Nihon Inter Electronics Corporatio	
	709	30PUB60	FRD	Nihon Inter Electronics Corporatio	
	710	1SS133	Diode	ROHM Co., Ltd.	1SS133
	711	1SS133	Diode	ROHM Co., Ltd.	1SS133
DB		D4SB60 L 7000	D bridge (AC)	Shindengen Electric Manufacturing Co., Lto	D43B00 L /000
DB		S1NBC60-7101	D bridge	Shindengen Electric Manufacturing Co., Lto YOUBON Corporation	
F		3.0A F-105	Glass tube fuse Fuse holder		2MF-3 F-105
	1 772	MIP0221SU	IPD	SATO PARTS CO., LTD.	MIP0221SU
	401	GP1UX511QS 38KHz	Remote light receiving unit	Panasonic Corporation Sharp Corporation	GP1UX511QS 38KHz
	401 401A	DSP02-002-431G	Short plug	KEL Corporation	DSP02-002-431G
	401A 401B	DSP02-002-431G	Short plug	KEL Corporation	DSP02-002-431G DSP02-002-431G
	4016 401C	DSP02-002-431G DSP02-002-431G	Short plug	KEL Corporation	DSP02-002-431G DSP02-002-431G
	401C 401D	DSP02-002-431G	Short plug	KEL Corporation	DSP02-002-431G DSP02-002-431G
	401D 401E	DSP02-002-431G	Short plug	KEL Corporation	DSP02-002-431G
	401E 401F	DSP02-002-431G	Short plug	KEL Corporation	DSP02-002-431G
	401F 401G	DSP02-002-431G	Short plug	KEL Corporation	DSP02-002-431G
	401G 401H	DSP02-002-431G DSP02-002-431G	Short plug	KEL Corporation	DSP02-002-431G DSP02-002-431G
	401H 401I	DSP02-002-431G	Short plug	KEL Corporation	DSP02-002-431G
	4011 401J	DSP02-002-431G DSP02-002-431G	Short plug	KEL Corporation	DSP02-002-431G DSP02-002-431G
	401 <u>J</u> 101	77-L002	Inductor 1mH	Tashiro Densetsu Corporation	77-L002
	201	77-L002	Inductor ImH Inductor 1mH	Tashiro Densetsu Corporation	77-L002 77-L002
	701	2200uH	Inductor	TDK Corporation	TSL1112-2222JR33
ED.		SLR332VR3F	LED	ROHM Co., Ltd.	SLR332VR3F
ED		SLR332VR3F SLR332VR3F	LED	ROHM Co., Ltd.	SLR332VR3F
				LICI IN OU., LIU.	OLINUZVINI

Table B-1. Reference Parts Table (1/3)

NTC INTE Murals Muralschurg, Co., Ltd. INTE/1100.DK80 0101 RLK0012DPF-00-12 Power MOSPET Reenast Technology Corp. RLK0012DPF-00 01102 RLK0012DFF-00-12 Power MOSPET Reenast Technology Corp. RLK0012DFF-00 01104 RLK0012DFF-00 Power MOSPET Reenast Technology Corp. RLK0012DFF-00 01104 S2A1027Art146 Power MOSPET ROHM Co., Ltd. S2A0127Art146 01105 S2A1027Art146 Power MOSPET View minterchrology, Inc. RFH432APET 01106 S2A1027Art146 Power MOSPET View minterchrology, Inc. RFH432APET 0110 S2S2412KT146R NPN transistor ROHM Co., Ltd. S2S2412KT146R 0110 S2S2412KT146R NPN transistor ROHM Co., Ltd. S2S2412KT146R 0201 S2S2412KT146R NPN transistor ROHM Co., Ltd. S2S2412KT146R 0201 S2S2412KT146R NPN transistor ROHM Co., Ltd. S2S2412KT146R 0206 S2S2412KT146R NPN transistor ROHM Co., Ltd. S2S2412KT146R	Dort Do	ort Numbor	Product Name and Specificationd	Eurotion	Manufacturer	Manufacturer Product Name
G (10) RUG012DPP:00-12 Power MOSFET Renesal Tochnology Com. RUG012DPP:00 G (103) RUG012DP:00-12 Power MOSFET Renesal Tochnology Com. RUG012DPP:00 G (103) S2C2412XT1461 NPN transitor ROHM Co., Ltd. S2C2412XT1461 G (105) S2C2412XT1461 NPN transitor ROHM Co., Ltd. S2C2412XT1461 G (105) RIFR430APPE Power MOSFET Values Interfactonlogy, Inc. RFR430APE G (106) RIFR430APPE Power MOSFET Values Interfactonlogy, Inc. RFR430APE G (106) RISC412RT1468 NPN transitor ROHM Co., Ltd. S2C2412XT1461 G (107) RISC412RT1468 NPN transitor ROHM Co., Ltd. S2C2412XT1461 G (102) RISC412RT1468 NPN transitor ROHM Co., Ltd. S2C2412XT1461 G (102) RISC412RT1468 NPN transitor ROHM Co., Ltd. S2C2412XT1461 G (102) RISC412RT1468 NPN transitor ROHM Co., Ltd. S2C2412XT1461 G (102) RISC412RT1468 NPN transitor ROHM Co., Ltd. S2C2412XT1461 </th <th></th> <th></th> <th></th> <th>Function</th> <th></th> <th></th>				Function		
G 102 RLKG012DPP-00-T2 Power MOSFET Reness Technology Comp. RLKG012DPP-00 G 103 SSC2412KT148R PINP transition RCML 6.0., Ltd. SSC2412KT148R G 104 SSA1037AKT148R PINP transition RCML 6.0., Ltd. SSA1037AKT148 G 107 FIRFASAPFE Power MOSFET Visitau Interpecting, RCML 6.0., Ltd. SSC2412KT148R G 108 SSC2412KT148R RVN transitor RCML 6.0., Ltd. SSC2412KT148R G 109 SSC2412KT148R RVN transitor RCML 6.0., Ltd. SSC2412KT148R G 109 SSC2412KT148R RVN transitor RCML 6.0., Ltd. SSC2412KT148R G 201 SSC2412KT148R RVN transitor RCML 6.0., Ltd. SSC2412KT148R G 401 SSC2412KT148R RVN transitor RCML 6.0., Ltd. SSC2412KT148R G 703 RLKG012DPP-0.12 Power MOSFET Reness Technology Corp. RLKG012DPF G 703 RLKG12DPF Power MOSFET ROHM 6.0., Ltd. SSC2412KT148R G 704 SSC2412KT148R RVN transistor ROHM 6.0., Ltd. SSC2412KT148R						
OI 103 ESC2412KT146F NPN transitor ROHM Co., Ltd. 25X2412KT146F OI 104 ESA1027AKT146F NPN transitor ROHM Co., Ltd. 25X2412KT146F OI 105 ESA1027AKT146F NPN transitor ROHM Co., Ltd. 25X2412KT146F OI 107 BIFFR30APF Power MO2ET Value Interfactoropy, Inc. IFFR30APF OI 103 ESC2412KT146R NPN transitor ROHM Co., Ltd. 25X2412KT146F OI 103 ESC2412KT146R NPN transitor ROHM Co., Ltd. 25X2412KT146F OI 103 ESC2412KT146R NPN transitor ROHM Co., Ltd. 25X2412KT146F OI 204 ESC2412KT146R NPN transitor ROHM Co., Ltd. 25X2412KT146F O 402 ESC412XT146R NPN transitor ROHM Co., Ltd. 25X2412KT146F O 704 ESC2412XT146R NPN transitor ROHM Co., Ltd. 25X2412KT146F O 705 ESC2412KT146R NPN transitor ROHM Co., Ltd. 25X2412KT146F O 706 ESC2412KT146R NPN transitor ROHM Co., Ltd. 25X2412KT146F O 7076<						RJK5012DPP-00-T2
C) 104 ESA1037AKT148P PNP Instruction ROHM Co., Ltd. 252A1037AT148P C) 105 ESCA113XT148P PNP Instruction ROHM Co., Ltd. 252A1037AT148P C) 105 ESCA113XT148P PNP Instruction ROHM Co., Ltd. 252A1037AT148P C) 100 ESCA113XT148P RNP Instruction ROHM Co., Ltd. 252A1037AT148P C) 101 ESCA113XT148P RNP Instruction ROHM Co., Ltd. 252A1147T148P C) 101 ESCA113XT148P RNP Instruction ROHM Co., Ltd. 252A1147T148P C) 101 ESCA113XT148P RNP Instruction ROHM Co., Ltd. 252A1147T148P C) 203 ESCA113XT148P RNP Instruction ROHM Co., Ltd. 252A1147T148P C) 204 ESCA113XT148P RNP Instruction ROHM Co., Ltd. 252A1147T148P C) 205 ESCA113XT148P RNP Instruction ROHM Co., Ltd. 252A1147T148P C) 205 ESCA113XT148P RNP Instruction ROHM Co., Ltd. 252A1147T148P C) 205 ESCA113XT148P RNP Instruction ROHM Co., Ltd. 252A1147T148P						
G 106 ESA1037AKT148F PNP transistor ROHM Co., Ltd. 25A1037AKT148F G 107 IRFR430APEF Power MOSFET Visual instructionlogy, Inc. RFR430APEF G 108 SSC412XT148F NPN transistor ROHM Co., Ltd. 25C2412XT148F G 101 SSC412XT148F NPN transistor ROHM Co., Ltd. 25C2412XT148F G 101 SSC412XT148F NPN transistor ROHM Co., Ltd. 25C2412XT148F G 401 SSC412XT148F NPN transistor ROHM Co., Ltd. 25C2412XT148F G 402 SSC412XT148F NPN transistor ROHM Co., Ltd. 25C2412XT148F G 704 SSC2412XT148F NPN transistor ROHM Co., Ltd. 25C2412XT148F G 705 SSC2412XT148F NPN transistor ROHM Co., Ltd. 25C2412XT148F G 706 SSC2412XT148F NPN transistor ROHM Co., Ltd. 25C2412XT148F G 7079 SSC2412XT148F NPN transistor ROHM Co., Ltd. 25C2412XT148F G 7079 SSC2412XT148F NPN transistor ROHM Co., Ltd. SSC2412XT148F G			2SA1037AKT146R	PNP transistor	ROHM Co., Ltd.	2SA1037AKT146R
C 107 IFFR430APbf Power MOSFET Visitary Interdentional (m. 25C2412K1146) IFFR430APbf C 108 25C2412K1146) NPN transistor ROHM Co., Ltd. 25C2412K1146) C 108 25C2412K1146) NPN transistor ROHM Co., Ltd. 25C2412K1146) C 201 25C2412K1146) NPN transistor ROHM Co., Ltd. 25C2412K1146) C 201 25C2412K1146) NPN transistor ROHM Co., Ltd. 25C2412K1146) C 202 25C2412K1146) NPN transistor ROHM Co., Ltd. 25C2412K1146) C 202 25C2412K1146) NPN transistor ROHM Co., Ltd. 25C2412K1146) C 706 25C2412K1146) NPN transistor ROHM Co., Ltd. 25C2412K1146) C 708 25C2412K1146) NPN transistor ROHM Co., Ltd. 25C2412K146) C 708 25C2412K1146) NPN transistor ROHM Co., Ltd. 25C2412K146) C 708 25C2412K146) NPN transistor ROHM Co., Ltd. 25C2412K146) R 108 14C 26C412K146) NPN transistor ROHM Co., Ltd. <	Q 10					2SC2412KT146R
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D 109 25C2412KT146F NPN transistor FIOHM Co., Ltd. 25C2412KT146F 0 301 25C2412KT146F NPN transistor FIOHM Co., Ltd. 25C2412KT146F 0 401 25C2412KT146F NPN transistor FIOHM Co., Ltd. 25C2412KT146F 0 401 25C2412KT146F NPN transistor FIOHM Co., Ltd. 25C2412KT146F 0 703 RAK0912DPP to T2 PN transistor FIOHM Co., Ltd. 25C2412KT146F 0 704 25C2412KT146F NPN transistor FIOHM Co., Ltd. 25C2412KT146F 0 706 25C2412KT146F NPN transistor FIOHM Co., Ltd. 25C2412KT146F 0 707 25A1027AT146F NPN transistor FIOHM Co., Ltd. 25C2412KT146F 0 708 25C2412KT146F NPN transistor FIOHM Co., Ltd. 25C2412KT146F 0 708 25C2412KT146F NPN transistor FIOHM Co., Ltd. 25C2412KT146F 10 104 24C 25C412KT146F NPN transistor FIOHM Co., Ltd. 25C2	Q 10	07	IRFR430APbF	Power MOSFET	Vishay Intertechnology, Inc.	IRFR430APbF
G D110 25C2412KT146F NPN transistor PIOH Co., Ltd. 25C2412KT146F G 401 25C2412KT146F NPN transistor PIOH Co., Ltd. 25C3412KT146F G 401 25C2412KT146F NPN transistor PIOH Co., Ltd. 25C3412KT146F G 703 R1x6012DP-0.012 Power MOSFET PIOH Co., Ltd. 25C3412KT146F G 704 S2C3412KT146F NPN transistor PIOH Co., Ltd. 25C3412KT146F G 706 25C3412KT146F NPN transistor PIOH Co., Ltd. 25C3412KT146F G 706 25C3412KT146F NPN transistor PIOH Co., Ltd. 25C3412KT146F G 707 25C3412KT146F NPN transistor PIOH Co., Ltd. 25C3412KT146F G 708 25C3412KT146F NPN transistor ROH Co., Ltd. 25C3412KT146F G 709 25C3412KT146F NPN transistor ROH Co., Ltd. 25C3412KT146F G 709 25C3412KT146F NPN transistor ROH Co., Ltd. 25C3412KT146F G 709 25C3412KT146F NPN transistor ROH Co., Ltd. 25C3412KT146F						2SC2412KT146R
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G A01 2252412KT146R NPN transistor ROHM Co., Ltl. 2252412KT146R G 703 RLKG012DPP-00-T2 Power MOSFET Reneasa Technology Corp. RLK6012DPP. G 704 S2C2412KT146R NPN transistor ROHM Co., Ltl. 2252412KT146R G 705 S2C2412KT146R NPN transistor ROHM Co., Ltl. 2252412KT146R G 706 S2C2412KT146R NPN transistor ROHM Co., Ltl. 2252412KT146R G 708 S2C2412KT146R NPN transistor ROHM Co., Ltl. 2252412KT146R G 708 S2C2412KT146R NPN transistor ROHM Co., Ltl. 2252412KT146R R 101 100.3216 Char presistor KOA Corporation MR3282BTT044 R 103 2.44, 3216 Char presistor KOA Corporation MR3282BTT044 R 104 2.44, 3216 Char presistor KOA Corporation RR3282TT026 R 108 2.42, 225 Char presistor KOA Corporation RR3282ATT026						
G 402 25A1037AKT146F PNV transistor POHM Co., Ltd. 25A1037AKT146 G 703 RUK5012PP-00-T2 Power MOSFET Renesas Technology Corp. AKK012DPF-00 G 704 25C2412KT146R NPM transistor ROHM Co., Ltd. 25C2412KT146F G 706 25C2412KT146R NPM transistor ROHM Co., Ltd. 25C2412KT146F G 706 25C412KT146R NPM transistor ROHM Co., Ltd. 25C2412KT146F G 708 25C412KT146R NPM transistor ROHM Co., Ltd. 25C2412KT146F G 708 25C412KT146R NPM transistor ROHM Co., Ltd. 25C2412KT146F G 708 25C412KT146R NPM transistor ROA Compariston RM7382BTT124K R 101 1010 24K 3216 Chip resistor KOA Corporation RM7382BTT124K R 103 24K 3216 Chip resistor KOA Corporation RK7382BTT124K R 104 24K 3216 Chip resistor KOA Corporation RK7382ATT102K R 104 24K 2125 Chip resistor KOA Corporation RK7382ATT102K <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td></t<>						
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Q 705 25C2412KT146R NPM transistor ROHM Co., Ltd. 25C2412KT146R Q 707 25A1037AKT146R PNP transistor ROHM Co., Ltd. 25C412KT146R Q 709 25C412KT146R NPM transistor ROHM Co., Ltd. 25C412KT146R Q 709 25C4212KT146R NPM transistor ROHM Co., Ltd. 25C4212KT146R R 101 101, 216 Cho resistor ROA Coporation RV3282PTT100 R 101 101, 216 Cho resistor ROA Coporation RV3282PTT100 R 104 2.4K 3216 Cho resistor KOA Coporation RV3282TTD20 R 106 200, 2125 Cho resistor KOA Coporation RV3282TTD20 R 108 6.5K 2125 Cho resistor KOA Coporation RV3282TTD24 R 108 6.5K 2125 Cho resistor KOA Coporation RV3282TTD24 R 110 200, 2125 Cho resistor KOA Coporation RV3282TTD24 R 111 200, 2125 Cho resistor KOA Coporation RV3282TTD24 R 111 200, 2125 Cho resistor						
C 706 252412XT146R NPN transistor ROHM Co., Ltd. 2524212XT146R C 707 25A1037XAT146R NPN transistor ROHM Co., Ltd. 2524212XT146R C 708 2522412XT146R NPN transistor ROHM Co., Ltd. 2524212XT146R R 101 102, 3216 Chip resistor ROHM Co., Ltd. 2524212XT146R R 102 5.1K 2W Coal insulation metal film resistor ROA Corporation RV3282TT126 R 103 2.4K 3216 Chip resistor KOA Corporation RV3282TT126 R 105 2.00 2.01 Chip resistor KOA Corporation RV3282TT126 R 106 10K 2W Coal insulation metal film resistor KOA Corporation RV3282TT126 R 108 8.8 2125 Chip resistor KOA Corporation RV3282TT126 R 110 2.4K 2125 Chip resistor KOA Corporation RV3282TT1262 R 111 2.00 2125 Chip resistor KOA Corporation RV3282TT1262 R 111 2.00 2125 Chip resistor KOA Corporation RV3282TT1262 R						
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C 709 28C2412KT146R NPN transistor ROHM Co., Lt. 2SC2412KT146R R 101 100, 2216 Chip resistor KOA Comporation MK7382BTTD100 R 102 5.1K 2W Coat insulation metal film resistor KOA Comporation MK7382BTTD24 R 104 2.4K 3216 Chip resistor KOA Comporation RK7382BTTD24 R 104 2.4K 3216 Chip resistor KOA Comporation RK7382BTTD24 R 106 10K 2W Coat insulation metal film resistor KOA Comporation RK7382ATTD20 R 106 10K 2W Coat insulation metal film resistor KOA Comporation RK7382ATTD24 R 110 20X 2125 Chip resistor KOA Comporation RK7382ATTD24 R 111 20X 2125 Chip resistor KOA Comporation RK7382ATTD34 R 113 430 2125 Chip resistor KOA Comporation RK7382ATTD34 R 114 20 2125 Chip resistor KOA Comporation RK7382ATTD34 R 114 20 2125 Chip resistor KOA Comporation RK7382ATTD34 R 114						
R 101 100. 2216 Chain resistor KOA Corporation RK73828TTD24 R 103 2.4K 3216 Chip resistor KOA Corporation RK73828TTD24 R 104 2.4K 3216 Chip resistor KOA Corporation RK73828TTD24 R 105 200. 2125 Chip resistor KOA Corporation RK7382ATTD20 R 106 10K ZW Coat insulation metal film resistor KOA Corporation RK7382ATTD20 R 108 6.8K 2125 Chip resistor KOA Corporation RK7382ATTD30 R 109 11K 2125 Chip resistor KOA Corporation RK7382ATTD30 R 110 2402 2125 Chip resistor KOA Corporation RK7382ATTD30 R 111 2402 2125 Chip resistor KOA Corporation RK7382ATTD30 R 114 200 2125 Chip resistor KOA Corporation RK7382ATTD30 R 114 200 2125 Chip resistor KOA Corporation RK7382ATTD30 R 114 200 2125						
FI 102 5.1K 2W Coat insulation metal film resistor KOA Corporation MK052C(T52A5) FI 104 2.4K 3216 Chip resistor KOA Corporation FK7382BTTD24, FI 105 200 2125 Chip resistor KOA Corporation FK7382BTTD24, FI 106 10K 2W Coat insulation metal film resistor KOA Corporation FK7382ATTD20, FI 106 6.6K 2125 Chip resistor KOA Corporation FK7382ATTD20, FI 109 14K 2125 Chip resistor KOA Corporation FK7382ATTD20, FI 110 24K 2125 Chip resistor KOA Corporation FK7382ATTD20, FI 111 200 2125 Chip resistor KOA Corporation FK7382ATTD20, FI 113 450 2125 Chip resistor KOA Corporation FK7382ATTD20, FI 114 200 2125 Chip resistor KOA Corporation FK7382ATTD20, FI 115 6.8K 2125						
R 103 2.4K 3216 Chip resistor KOA Corporation RK73828TTD24, R 105 200 2125 Chip resistor KOA Corporation RK7382ATTD20, R 106 200 2125 Chip resistor KOA Corporation RK7382ATTD20, R 106 20125 Chip resistor KOA Corporation RK7382ATTD20, R 109 11K 2125 Chip resistor KOA Corporation RK7382ATTD24, R 111 200 2125 Chip resistor KOA Corporation RK7382ATTD44, R 111 200 2125 Chip resistor KOA Corporation RK7382ATTD43, R 114 200 2125 Chip resistor KOA Corporation RK7382ATTD43, R 114 200 2125 Chip resistor KOA Corporation RK7382ATTD43, R 114 20 2125 Chip resistor KOA Corporation RK7382ATTD40, R 119 10K 2125						
R 104 2.4X 3216 Chip resistor KOA Corporation RK73828TTD20 R 105 200 2125 Chip resistor KOA Corporation RK73828TTD20 R 106 10K 2W Coat insulation metal film resistor KOA Corporation RK7382ATTD20 R 108 6.8K 2125 Chip resistor KOA Corporation RK7382ATTD20 R 110 24K 2125 Chip resistor KOA Corporation RK7382ATTD20 R 111 200 2125 Chip resistor KOA Corporation RK7382ATTD20 R 111 200 2125 Chip resistor KOA Corporation RK7382ATTD20 R 113 430 2125 Chip resistor KOA Corporation RK7382ATTD20 R 114 200 2125 Chip resistor KOA Corporation RK7382ATTD20 R 115 6.8K 2125 Chip resistor KOA Corporation RK7382ATTD40 R 114 200 2125 Chip resistor KOA Corporation RK7382ATTD42 <						RK73B2BTTD242G
P 105 200 2125 Chip resistor KOA Corporation PKY382ATTD203 P 106 10K ZW Coat invaliation metal tim resistor KOA Corporation PKY382ATTD203 P 109 11K 2125 Chip resistor KOA Corporation PKY382ATTD203 R 109 11K 2125 Chip resistor KOA Corporation PKY382ATTD243 R 111 200 2125 Chip resistor KOA Corporation PKY382ATTD243 R 114 200 2125 Chip resistor KOA Corporation PKY382ATTD243 R 114 200 2125 Chip resistor KOA Corporation PKY382ATTD243 R 114 200 2125 Chip resistor KOA Corporation PKY382ATTD243 R 117 5 6.8K 2125 Chip resistor KOA Corporation PKY382ATTD263 R 117 5 124 Chip resistor KOA Corporation PKY382ATTD263 R 114						RK73B2BTTD242G
F 106 104 2W Coat insulation metal film resistor KOA Corporation MCS2C(TS2A)10 R 102 20 2125 Chip resistor KOA Corporation RK73BATTD068 R 109 1K 2125 Chip resistor KOA Corporation RK73BATTD064 R 110 24K 2125 Chip resistor KOA Corporation RK73BATTD047 R 111 200 2125 Chip resistor KOA Corporation RK73BATTD68 R 113 430 2125 Chip resistor KOA Corporation RK73BATTD68 R 113 20 2125 Chip resistor KOA Corporation RK73BATTD68 R 114 20 2125 Chip resistor KOA Corporation RK73BATTD60 R 115 10 2125 Chip resistor KOA Corporation RK73BATTD67 R 120 10K 2125 Chip resistor KOA Corporation RK73BATTD67 R 124 4.7K 2125 <td></td> <td></td> <td></td> <td></td> <td></td> <td>RK73B2ATTD201G</td>						RK73B2ATTD201G
F 108 6.8K 2125 Chip resistor KOA Corporation RK73BATTD08; R 109 11K 2125 Chip resistor KOA Corporation RK73BATTD04; R 111 200 2125 Chip resistor KOA Corporation RK73BATTD04; R 111 200 2125 Chip resistor KOA Corporation RK73BATTD06; R 113 430 2125 Chip resistor KOA Corporation RK73BATTD06; R 114 200 2125 Chip resistor KOA Corporation RK73BATTD06; R 115 6.8K 2125 Chip resistor KOA Corporation RK73BATTD16; R 115 10.4K 2125 Chip resistor KOA Corporation RK73BATTD16; R 120 10.4K 2125 Chip resistor KOA Corporation RK73BATTD16; R 121 4.7K 2125 Chip resistor KOA Corporation RK73BATTD16; R 123 4.7K 2125 Chip resistor KOA Corporation RK73BATTD16; R 124 10.4K 2125 Chip resistor KOA Corporation RK73BATTD16; R 123 10.4K 2125 C	R 10	06				MOS2C(T52A)103J
F 109 11. 2125 Chip resistor KOA Corporation RK7382ATTD24 R 11.1 20.0 2125 Chip resistor KOA Corporation RK7382ATTD24 R 11.1 20.0 2125 Chip resistor KOA Corporation RK7382ATTD68 R 11.1 430 2125 Chip resistor KOA Corporation RK7382ATTD68 R 11.4 20.2 12.6 Chip resistor KOA Corporation RK7382ATTD63 R 11.7 51.2 12.6 Chip resistor KOA Corporation RK7382ATTD61 R 11.7 51.2 12.6 Chip resistor KOA Corporation RK7382ATTD61 R 11.1 10.4 21.2 Chip resistor KOA Corporation RK7382ATTD61 R 11.2 10.4 7.K 12.6 Chip resistor KOA Corporation RK7382ATTD61 R 12.3 4.7K 12.6 Chip resistor KOA Corporation RK7382ATTD62 R 12.6 </td <td>R 10</td> <td>07</td> <td></td> <td>Chip resistor</td> <td></td> <td>RK73B2ATTD200G</td>	R 10	07		Chip resistor		RK73B2ATTD200G
F 110 24K 2125 Chip resistor KOA Corporation RK7382ATTD20 R 111 200 2125 Chip resistor KOA Corporation RK7382ATTD63 R 111 400 2125 Chip resistor KOA Corporation RK7382ATTD63 R 111 400 2125 Chip resistor KOA Corporation RK7382ATTD68 R 111 51 6.5K 2125 Chip resistor KOA Corporation RK7382ATTD61 R 112 6.4K 2125 Chip resistor KOA Corporation RK7382ATTD61 R 110K 2125 Chip resistor KOA Corporation RK7382ATTD62 R 124 4.7K 2125 Chip resistor KOA Corporation RK7382ATTD62 R 124 10K 2125 Chip resistor KOA Corporation RK7382ATTD62 R 124 10K 2125 Chip resistor KOA Corporation RK7382ATTD62 R 124 10K <td< td=""><td></td><td></td><td></td><td></td><td></td><td>RK73B2ATTD682G</td></td<>						RK73B2ATTD682G
F 111 200 2125 Chip resistor KOA Corporation RK7382ATTD68 R 113 430 2125 Chip resistor KOA Corporation RK7382ATTD68 R 114 20 2125 Chip resistor KOA Corporation RK7382ATTD68 R 114 20 2125 Chip resistor KOA Corporation RK7382ATTD68 R 115 5.8.K 2125 Chip resistor KOA Corporation RK7382ATTD67 R 112 10K 2125 Chip resistor KOA Corporation RK7382ATTD67 R 124 4.7K 2125 Chip resistor KOA Corporation RK7382ATTD67 R 124 10K 2125 Chip resistor KOA Corporation RK7382ATTD67 R 124 10K 2125 Chip resistor KOA Corporation RK7382ATTD67 R 124 10K 2125 Chip resistor KOA Corporation RK7382ATTD68 R 126 10K 2						RK73B2ATTD102G
F 112 6.8K 2125 Chip resistor KOA Corporation RK7382ATTD63 R 114 20 2125 Chip resistor KOA Corporation RK7382ATTD63 R 114 20 2125 Chip resistor KOA Corporation RK7382ATTD68 R 117 51 2125 Chip resistor KOA Corporation RK7382ATTD63 R 117 51 2125 Chip resistor KOA Corporation RK7382ATTD63 R 120 10K 2125 Chip resistor KOA Corporation RK7382ATTD63 R 121 4.7K 2125 Chip resistor KOA Corporation RK7382ATTD63 R 124 10K 2125 Chip resistor KOA Corporation RK7382ATTD63 R 124 10K 2125 Chip resistor KOA Corporation RK7382ATTD63 R 126 10K 2125 Chip resistor KOA Corporation RK7382ATTD63 R 303 30 2125<		-				
F 113 430 2125 Chip resistor KOA Corporation FK/382ATTD20 R 114 20 2125 Chip resistor KOA Comparison FK/382ATTD20 R 117 51 2125 Chip resistor KOA Comparison FK/382ATTD51 R 119 10K 2125 Chip resistor KOA Comparison FK/382ATTD47 R 121 4.7K 2125 Chip resistor KOA Comparison FK/382ATTD47 R 124 4.7K 2125 Chip resistor KOA Comparison FK/382ATTD47 R 124 4.7K 2125 Chip resistor KOA Comparison FK/382ATTD47 R 124 10K 2125 Chip resistor KOA Comparison FK/382ATTD47 R 126 10K 2125 Chip resistor KOA Comparison FK/382ATTD47 R 126 10K 2125 Chip resistor KOA Comparison FK/382ATTD47 R 301 1.2K 2125						
B Intervention ENCrateStor KCA Comportation ENCrateStarTTDega R 1117 51 2125 Chip resistor KOA Comportation ENCrateStarTTDega R 1119 10K 2125 Chip resistor KOA Comportation ENCrateStarTTDega R 120 10K 2125 Chip resistor KOA Comportation ENCrateStarTTDega R 121 4.7K 2125 Chip resistor KOA Comportation ENCrateStarTTDega R 122 4.7K 2125 Chip resistor KOA Comportation ENCrateStarTTDega R 124 4.7K 2125 Chip resistor KOA Comportation ENCrateStarTTDega R 124 10K 2125 Chip resistor KOA Comportation ENCrateStarTTDega R 124 10K 2125 Chip resistor KOA Comportation ENCrateStarTTDega R 105 1.2K Chip resistor KOA Comportation ENCrateStarTTDega R 302 330						
R 1115 6.8K 2125 Chip resistor KOA Corporation RK73B2ATTD682 R 1119 10K 2125 Chip resistor KOA Corporation RK73B2ATTD101 R 1120 10K 2125 Chip resistor KOA Corporation RK73B2ATTD102 R 121 4.7K 2125 Chip resistor KOA Corporation RK73B2ATTD472 R 124 10K 2125 Chip resistor KOA Corporation RK73B2ATTD472 R 124 10K 2125 Chip resistor KOA Corporation RK73B2ATTD472 R 126 10K 2125 Chip resistor KOA Corporation RK73B2ATTD102 R 126 10K 2125 Chip resistor KOA Corporation RK73B2ATTD122 R 301 1.2K 2125 Chip resistor KOA Corporation RK73B2ATTD32 R 303 3.3k 2125 Chip resistor KOA Corporation RK73B2ATTD432 R 304 4.7 2125 Chip resistor KOA Corporation RK73B2ATTD432 R 305 11K 2125 Chip resistor KOA Corporation RK73B2ATTD432 R 306 0 21						
R 1117 51 2125 Chip resistor KOA Corporation RK73B2ATTD51 R 1120 10K 2125 Chip resistor KOA Corporation RK73B2ATTD10 R 1120 10K 2125 Chip resistor KOA Corporation RK73B2ATTD47 R 1123 4.7K 2125 Chip resistor KOA Corporation RK73B2ATTD107 R 1124 10K 2125 Chip resistor KOA Corporation RK73B2ATTD107 R 1125 10K 2125 Chip resistor KOA Corporation RK73B2ATTD107 R 1126 10K 2125 Chip resistor KOA Corporation RK73B2ATTD33 R 302 330 2125 Chip resistor KOA Corporation RK73B2ATTD33 R 303 3.8 11k 2125 Chip resistor KOA Corporation RK73B2ATTD107 R 306 11k 2125 Chip resistor KOA Corporation RK73B2ATTD107 R 306						
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R 521 100 2125 Chip resistor KOA Corporation RK73B2ATTD10 R 522 1k 2125 Chip resistor KOA Corporation RK73B2ATTD102 R 523 10K 2125 Chip resistor KOA Corporation RK73B2ATTD102 R 523 10K 2125 Chip resistor KOA Corporation RK73B2ATTD102 R 701 10K 2125 Chip resistor KOA Corporation RK73B2ATTD102						
R 522 1k 2125 Chip resistor KOA Corporation RK73B2ATTD102 R 523 10K 2125 Chip resistor KOA Corporation RK73B2ATTD102 R 701 10K 2125 Chip resistor KOA Corporation RK73B2ATTD102 R 701 10K 2125 Chip resistor KOA Corporation RK73B2ATTD102						
R 523 10K 2125 Chip resistor KOA Corporation RK73B2ATTD103 R 701 10K 2125 Chip resistor KOA Corporation RK73B2ATTD103						
R 701 10K 2125 Chip resistor KOA Corporation RK73B2ATTD103						RK73B2ATTD103G
						RK73B2ATTD103G
						RK73B2ATTD103G
						RK73B2ATTD103G
						MOSX3C(T52A)R10J
						MOS2C(T52A)100G
				Chip resistor		RK73B2BTTD334G

art_ Pa	art NumberPro	oduct Name and Specifications	Function	Manufacturer	Manufacturer Product Nam
R 70	07 33	80K 3216	Chip resistor	KOA Corporation	RK73B2BTTD334G
R 70			Chip resistor	KOA Corporation	RK73B2ATTD682G
R 70			Chip resistor	KOA Corporation	RK73B2BTTD473G
R 71			Chip resistor	KOA Corporation	RK73B2ATTD103G
R 71			Chip resistor	KOA Corporation	RK73B2ATTD103G
R 71			Chip resistor	KOA Corporation	RK73B2ATTD103G
R 71			Chip resistor	KOA Corporation	RK73B2ATTD103G
R 71			Chip resistor	KOA Corporation	RK73B2ATTD472G
R 71		K 2125	Chip resistor	KOA Corporation	RK73B2ATTD103G
R 71			Chip resistor	KOA Corporation	RK73B2ATTD472G
R 71			Chip resistor	KOA Corporation	RK73B2ATTD221G
R 71			Chip resistor	KOA Corporation	RK73B2ATTD221G
R 71			Chip resistor	KOA Corporation	RK73B2ATTD221G
R 72			Chip resistor		
R 72				KOA Corporation	RK73B2ATTD100G
R 72			Chip resistor	KOA Corporation	RK73B2ATTD682G
		30k 3216	Chip resistor	KOA Corporation	RK73B2BTTD334G
R 72			Chip resistor	KOA Corporation	RK73B2BTTD334G
R 72			Chip resistor	KOA Corporation	RK73B2ATTD682G
R 72			Chip resistor	KOA Corporation	RK73B2BTTD473G
R 76			Chip resistor	KOA Corporation	RK73B2ATTD222G
SW 1			Power switch	NIHON KAIHEIKI IND. CO., Ltd.	M2T-12AAP1
SW 40	01 SS	SSF014800	Selector switch	ALPS ELECTRIC CO., LTD.	SSSF014800
SW 40)2 SS	S-12SDP2	Slide switch	NIHON KAIHEIKI IND. CO., Ltd.	SS-12SDP2
SW 50			Tact switch	ALPS ELECTRIC CO., LTD.	SKHRAAA010
T 1			Inductor	Tashiro Densetsu Corporation	77-L001
TP 1			Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 2			Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 3			Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 4			Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 5			Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 6					
TP 7			Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
			Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 11			Test pin	Mac-Eight Co., Ltd.	LC-2-G -black
TP 12			Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 13			Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 14			Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 15			Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 16		C-2-G -green	Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 17			Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 19			Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 20			Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 21		C-2-G -green	Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 22			Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 23		C-2-G -green	Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 24	LC	C-2-G -green	Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 25	5 LC	C-2-G -green	Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 26			Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 29			Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 30			Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 31			Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 32		C-2-G -green	Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 33		C-2-G -green	Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 34			Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 34			Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
TP 35			Test pin	Mac-Eight Co., Ltd. Mac-Eight Co., Ltd.	LC-2-G -green
TP 37 VR 40			Test pin	Mac-Eight Co., Ltd.	LC-2-G -green
		00K	Volume dial	Bourns Inc.	3386F-1-104TLF

ROHM Co., Ltd. ROHM Co., Ltd.

MTZJ T-77 4.7B MTZJ T-77 7.5B

Zener diode Zener diode

4.7V 7.5V

ZD 201 ZD 701

Table B-1 Reference Parts Table (3/3)

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