

# M65847FP/SP

## DIGITAL KEY CONTROLLER

### DESCRIPTION

The M65847 is Complementary Metal Oxide Semiconductor Integrated Circuit used to control the key of music in karaoke players.

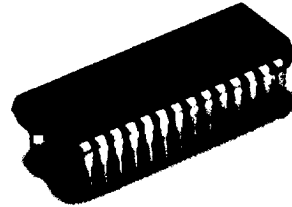
This device is suitable for providing a karaoke system such as a CD radio cassette recorder, a mini component stereo system or VCR, with a key control function.

### FEATURES

- I/O low-pass filter, A/D, D/A converters and control logic circuit which are required for digital key control are built-in to allow one-chip configuration of a digital key controller.
- Built-in 16K-bit RAM
- 3 modes are selectable for control: self mode, easy mode and MCU mode.
  - Self mode: Key conversion by push switch
  - Easy mode: Key conversion by parallel data
  - MCU mode: Key conversion by serial data
- Built-in clocks without an external circuit.
- Built-in auto reset circuit (The IC reset as power is turned on.)
- Single power supply (5V)



Outline 28P2W-A (FP)  
1.27mm pitch 450mil SOP  
(8.4mm×17.5mm×2.0mm)

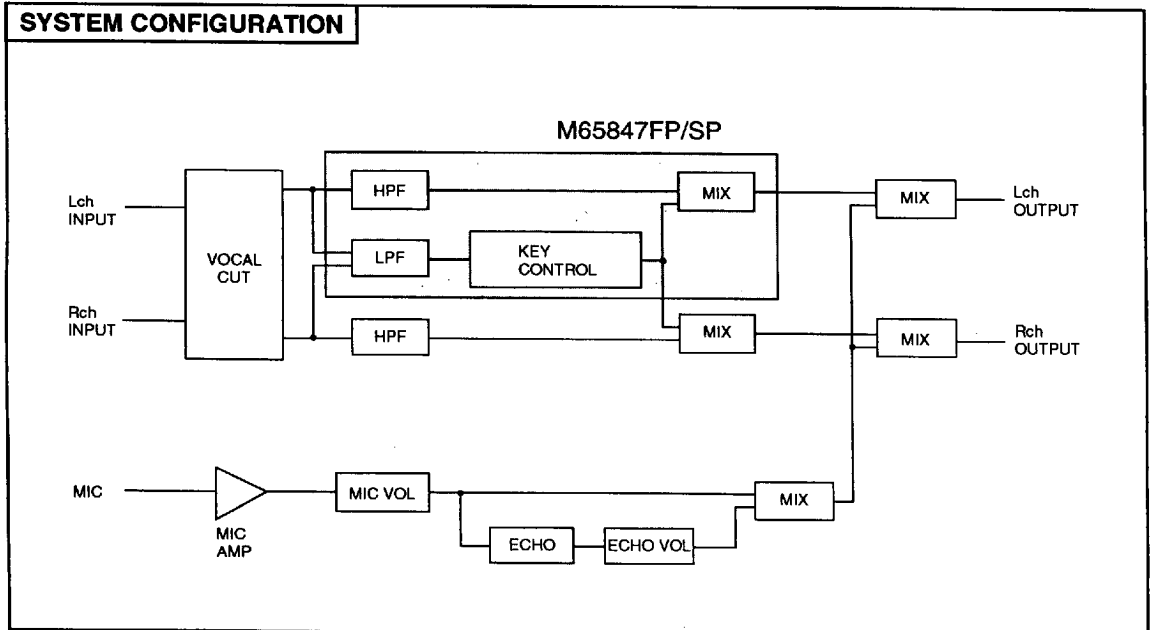


Outline 28P4B (SP)  
1.778mm pitch 400mil SDIP  
(8.9mm×28.0mm×3.8mm)

### RECOMMENDED OPERATING CONDITION

Supply voltage range.....  $V_{CC}=4.5$  to  $5.5V$   
Rated supply voltage.....  $V_{CC}=5V$

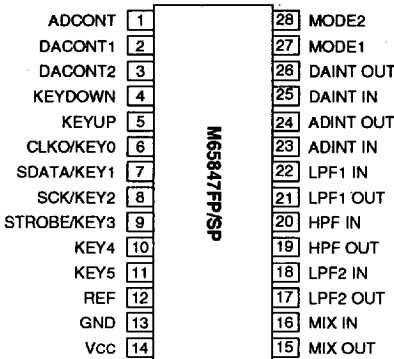
### SYSTEM CONFIGURATION



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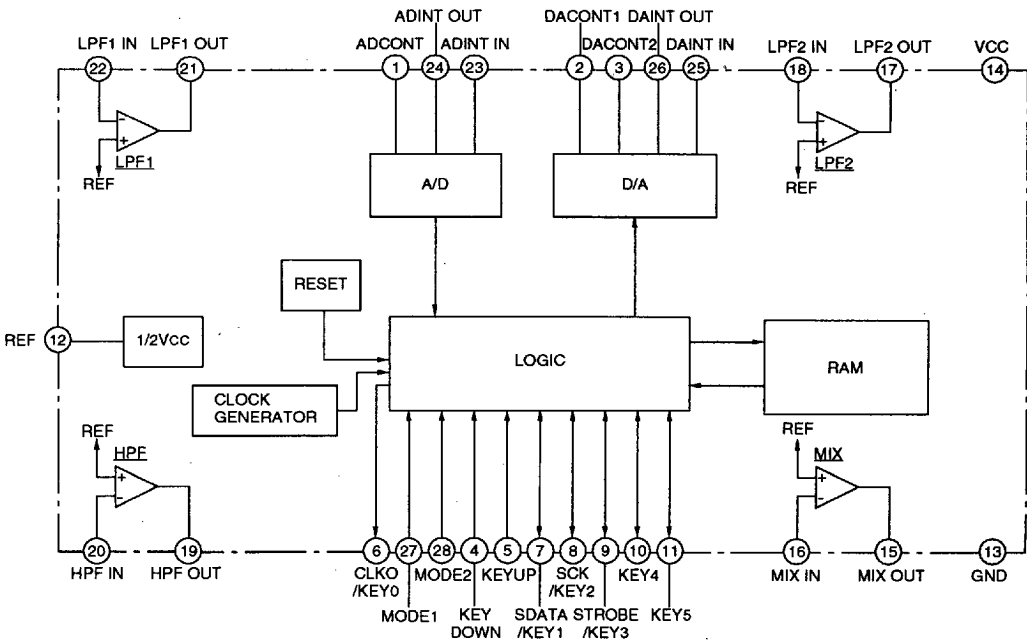


PIN CONFIGURATION (TOP VIEW)



Outline 28P2W-A (FP)  
28P4B (SP)

IC INTERNAL BLOCK DIAGRAM



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## DIGITAL KEY CONTROLLER

## PIN DESCRIPTION

| Pin No. | Symbol      | Name                     | I/O                                | Function                                                                                                                         |                                                                  |                   |         |         |       |
|---------|-------------|--------------------------|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|-------------------|---------|---------|-------|
|         |             |                          |                                    | Self mode                                                                                                                        | Easy mode                                                        | MCU mode          |         |         |       |
| ①       | ADCONT      | A/D control              | —                                  | Determines adaptive time constant for A/D conversion by ADM system                                                               |                                                                  |                   |         |         |       |
| ②       | DACONT1     | D/A 1 control            | —                                  | Determines adaptive time constant for D/A conversion by ADM system                                                               |                                                                  |                   |         |         |       |
| ③       | DACONT2     | D/A 2 control            | —                                  |                                                                                                                                  |                                                                  |                   |         |         |       |
| ④       | KEYDOWN     | Key down                 | I:CMOS<br>50kΩ ↓                   | Key conversion (down)                                                                                                            | Clock output at pin ⑥ is controlled by setting pins ④ and ⑤.     | L                 | L       | H       | H     |
| ⑤       | KEYUP       | Key up                   | I:CMOS<br>50kΩ ↓                   | Key conversion (up)                                                                                                              |                                                                  | L                 | H       | L       | H     |
| ⑥       | CLKO/KEY0   | Clock output/Key0        | O:CMOS                             |                                                                                                                                  |                                                                  | OFF               | 320 kHz | 450 kHz | 2 MHz |
| ⑦       | SDATA/KEY1  | Serial data/Key1         | I:CMOS Schmitt<br>50kΩ ↓<br>O:CMOS | Key setting status output:<br><br>LEDs can be driven directly. Key setting status can be indicated by connecting LEDs to outside | Key setting input:<br><br>Voltage applied to each pin sets a key | Serial data input |         |         |       |
| ⑧       | SCK/KEY2    | Shift clock/Key2         | I:CMOS Schmitt<br>50kΩ ↓<br>O:CMOS |                                                                                                                                  |                                                                  | Shift clock input |         |         |       |
| ⑨       | STROBE/KEY3 | Strobe/Key3              | I:CMOS Schmitt<br>50kΩ ↓<br>O:CMOS |                                                                                                                                  |                                                                  | Strobe input      |         |         |       |
| ⑩       | KEY4        | Key4                     | I:CMOS 20kΩ ↓<br>O:CMOS            |                                                                                                                                  |                                                                  | —                 |         |         |       |
| ⑪       | KEY5        | Key5                     | I:CMOS 20kΩ ↓<br>O:CMOS            |                                                                                                                                  |                                                                  | —                 |         |         |       |
| ⑫       | REF         | Reference                | —                                  | Analog reference ≈ 1/2Vcc                                                                                                        |                                                                  |                   |         |         |       |
| ⑬       | GND         | GND                      | —                                  |                                                                                                                                  |                                                                  |                   |         |         |       |
| ⑭       | Vcc         | Power supply             | —                                  |                                                                                                                                  |                                                                  |                   |         |         |       |
| ⑮       | MIX OUT     | Mix output               | O:Operational amplifier output     | Combine key-controlled low-pass signal and through high-pass signal                                                              |                                                                  |                   |         |         |       |
| ⑯       | MIX IN      | Mix input                | I:Operational amplifier input      |                                                                                                                                  |                                                                  |                   |         |         |       |
| ⑰       | LPF2 OUT    | Low-pass filter 2 output | O:Operational amplifier output     | Forms Post-filters following D/A conversion for key control                                                                      |                                                                  |                   |         |         |       |
| ⑱       | LPF2 IN     | Low-pass filter 2 input  | I:Operational amplifier input      |                                                                                                                                  |                                                                  |                   |         |         |       |
| ⑲       | HPF OUT     | High-pass filter output  | O:Operational amplifier output     | Forms High-pass filter                                                                                                           |                                                                  |                   |         |         |       |
| ⑳       | HPF IN      | High-pass filter input   | I:Operational amplifier input      |                                                                                                                                  |                                                                  |                   |         |         |       |
| ㉑       | LPF1 OUT    | Low-pass filter 1 output | O:Operational amplifier output     | Forms Pre-filter precedent to A/D conversion for key control                                                                     |                                                                  |                   |         |         |       |
| ㉒       | LPF1 IN     | Low-pass filter 1 input  | I:Operational amplifier input      |                                                                                                                                  |                                                                  |                   |         |         |       |
| ㉓       | ADINT IN    | A/D integrator input     | I:Operational amplifier input      | Forms A/D conversion integrator with external C                                                                                  |                                                                  |                   |         |         |       |
| ㉔       | ADINT OUT   | A/D integrator output    | O:Operational amplifier output     |                                                                                                                                  |                                                                  |                   |         |         |       |
| ㉕       | DAINT IN    | D/A integrator input     | I:Operational amplifier input      | Forms D/A conversion integrator with external C                                                                                  |                                                                  |                   |         |         |       |
| ㉖       | DAINT OUT   | D/A integrator output    | O:Operational amplifier output     |                                                                                                                                  |                                                                  |                   |         |         |       |
| ㉗       | MODE1       | Mode1                    | I:CMOS 20kΩ ↓                      | Set to L.                                                                                                                        | Set to H.                                                        | Set to L.         |         |         |       |
| ㉘       | MODE2       | Mode2                    | I:CMOS 20kΩ ↓                      | Set to H.                                                                                                                        | Set to L.                                                        | Set to L.         |         |         |       |

↓ : With pull-down resistor

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ABSOLUTE MAXIMUM RATINGS (Ta=25°C, unless otherwise noted)

| Symbol | Parameter              | Ratings            | Unit |
|--------|------------------------|--------------------|------|
| Vcc    | Maximum supply voltage | 6.0                | V    |
| Icc    | Circuit current        | 100                | mA   |
| Vi     | Input voltage          | -0.3 to Vcc+0.3    | V    |
| Pd     | Power dissipation      | 1.35 (SP)/1.2 (FP) | W    |
| Topr   | Operating temperature  | -20 to +75         | °C   |
| Tstg   | Storage temperature    | -40 to +125        | °C   |

RECOMMENDED OPERATING CONDITION

| Symbol | Parameter                  | Test conditions                                | Limits          |      |               | Unit |
|--------|----------------------------|------------------------------------------------|-----------------|------|---------------|------|
|        |                            |                                                | Min.            | Typ. | Max.          |      |
| Vcc    | Supply voltage             |                                                | 4.5             | 5.0  | 5.5           | V    |
| VIH    | Input voltage ( "H" level) | pin ④ ⑤ ⑩ ⑪ ⑰ ⑱<br>pin ⑦ ⑧ ⑨ serial data input | 0.7Vcc<br>Vcc-1 | —    | Vcc<br>Vcc    | V    |
| VIL    | Input voltage ( "L" level) | pin ④ ⑤ ⑩ ⑪ ⑰ ⑱<br>pin ⑦ ⑧ ⑨ serial data input | 0<br>0          | —    | 0.3Vcc<br>0.8 | V    |

ELECTRICAL CHARACTERISTICS (Vcc=5V, f=1kHz, Vi=100mVrms, F0, Ta=25°C, unless otherwise noted)

| Symbol | Parameter              | Test conditions              | Limits   |          |           | Unit |
|--------|------------------------|------------------------------|----------|----------|-----------|------|
|        |                        |                              | Min.     | Typ.     | Max.      |      |
| Icc    | Circuit current        | No signal                    | —        | 20       | 40        | mA   |
| Gv     | Voltage gain           |                              | -3       | 0        | +3        | dB   |
| THD    | Output distortion      | Vo=100mVrms, 30kHz L. P. F   | —        | 1.3      | 3         | %    |
| No     | Output noise voltage   | JIS-A                        | —        | -80      | -65       | dBV  |
| Vomax  | Maximum output voltage | THD=10%                      | 0.7      | 1.5      | —         | Vrms |
| fck    | Clock frequency        |                              | 6.8      | 8        | 9.2       | MHz  |
| IoH    | H output current       | pin ⑥ ⑦ ⑧ ⑨ ⑩ ⑪<br>Self mode | —        | -10      | -4        | mA   |
| IoL    | L output current       |                              | 12       | 18       | —         | mA   |
| Rid    | Pull-down resistance   | pin ④ ⑤ ⑦ ⑧ ⑨<br>pin ⑩ ⑪ ⑰ ⑱ | 25<br>10 | 50<br>20 | 100<br>40 | kΩ   |

## FUNCTION DESCRIPTION

### 1. Operation control

Operation control is provided in the following 3 modes:

- (1) Self mode
- (2) Easy mode
- (3) Microcomputer mode

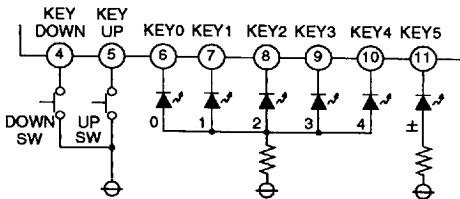
## MODE SETTING METHOD

| ⑦MODE1 | ⑧MODE2 | MODE | Key conversion method                   |
|--------|--------|------|-----------------------------------------|
| L      | L      | MCU  | Serial data from microcomputer          |
| H      | L      | Easy | Parallel data                           |
| L      | H      | Self | UP/DOWN Key (no microcomputer required) |
| H      | H      | Test | Test mode (normally not available)      |

### 2. Self mode

#### (1) Key setting

A key can be set using the push switch connected to pin ④ KEYDOWN and pin ⑤ KEYUP.



The key goes down by one (chromatic) each time the DOWNSW is pushed, and goes up by one (chromatic) each time the UPSW is pushed. Once going down to -4, the key remains unchanged even if the DOWNSW is pushed. Also, once going up to +4 the key remains unchanged even if the UPSW is pushed. Keeping on pushing either switch changes the key in chromatic every 524msec (fck=8MHz).

Pushing both DOWNSW and UPSW simultaneously sets the key to ±0. The switch input anti-chattering time is 16msec (fck=8MHz).

#### (2) LED indication

Connecting LEDs to outside as shown previously allows LED indication of key setting status through the outputs of pin ⑥ KEY0 to pin ⑪ KEY5 can be used to set a key.

| Key setting | ⑥KEY0 | ⑦KEY1 | ⑧KEY2 | ⑨KEY3 | ⑩KEY4 | ⑪KEY5 |
|-------------|-------|-------|-------|-------|-------|-------|
| F+4         | H     | H     | H     | H     | L     | H     |
| F+3         | H     | H     | H     | L     | H     | H     |
| F+2         | H     | H     | L     | H     | H     | H     |
| F+1         | H     | L     | H     | H     | H     | H     |
| F 0         | L     | H     | H     | H     | H     | H     |
| F-1         | H     | L     | H     | H     | H     | L     |
| F-2         | H     | H     | L     | H     | H     | L     |
| F-3         | H     | H     | H     | L     | H     | L     |
| F-4         | H     | H     | H     | H     | L     | L     |

0 1 2 3 4 ± indication

### 3. Easy mode

#### (1) Key setting

Paralled data entered into pin ⑦ KEY1 to pin ⑪ KEY5 can be used to set a key.

| Key setting | ⑦ KEY1 | ⑧ KEY2 | ⑨ KEY3 | ⑩ KEY4 | ⑪ KEY5 |
|-------------|--------|--------|--------|--------|--------|
| F+4         | H      | H      | H      | L      | H      |
| F+3         | H      | H      | L      | H      | H      |
| F+2         | H      | L      | H      | H      | H      |
| F+1         | L      | H      | H      | H      | H      |
| F 0         | H      | H      | H      | H      | H      |
| F-1         | L      | H      | H      | H      | L      |
| F-2         | H      | L      | H      | H      | L      |
| F-3         | H      | H      | L      | H      | L      |
| F-4         | H      | H      | H      | L      | L      |

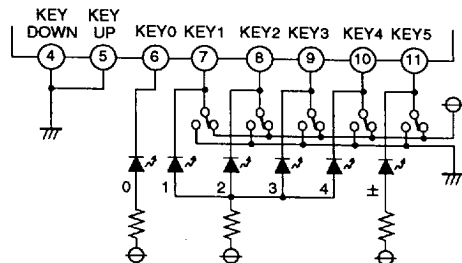
#### (2) Clock output

Data entered into pin ④ KEYDOWN and pin ⑤ KEYUP can be used to output square-wave clocks from pin ⑥ CLKO.

| ④ KEYDOWN | ⑤ KEYUP | ⑥CLKO<br>Clock frequency<br>(fck=8MHz) | Remarks                                                |
|-----------|---------|----------------------------------------|--------------------------------------------------------|
| L         | L       | OFF                                    | Key setting status output for F0.F0:L, other than F0:H |
| L         | H       | 320kHz                                 | Clock for M65843P/AP (digital echo IC)                 |
| H         | L       | 450kHz                                 | Clock for M65830AP/CP (digital echo IC)                |
| H         | H       | 2MHz                                   | Clock for M65831P/AP (digital echo IC)                 |

#### (3) LED indication

Like the self mode, connecting LEDs to outside as shown below allow LED indication of key setting status.

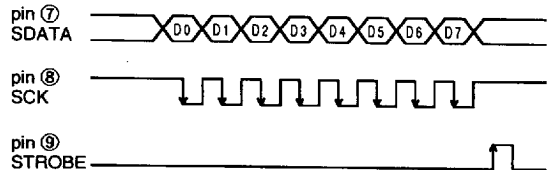


When the LEDs go on, current flows into the external L level setting, not into the IC. Thus, provide the L side with LED drive capability.

### 4. MCU mode

#### (1) key setting

Serial data from the microcomputer allows key setting.



Data is taken inside at the falling edge of SCK and the last-packed 8 bits are latched at the raising edge of STROBE.

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DIGITAL KEY CONTROLLER

(2) Data format

| Key setting |      | D4 | D3 | D2 | D1 | D0 |
|-------------|------|----|----|----|----|----|
| VSC         | VMC  |    |    |    |    |    |
| F+20        |      | H  | H  | H  | H  | H  |
| F+18        |      | H  | H  | H  | H  | L  |
| F+16        |      | H  | H  | H  | L  | H  |
| F+14        |      | H  | H  | H  | L  | L  |
| F+13        |      | H  | H  | L  | H  | H  |
| F+11        |      | H  | H  | L  | H  | L  |
| F+ 9        |      | H  | H  | L  | L  | H  |
| F+ 8        | F+ 8 | H  | H  | L  | L  | L  |
| F+ 7        | F+ 7 | H  | L  | H  | H  | H  |
| F+ 6        | F+ 6 | H  | L  | H  | H  | L  |
| F+ 5        | F+ 5 | H  | L  | H  | L  | H  |
| F+ 4        | F+ 4 | H  | L  | H  | L  | L  |
| F+ 3        | F+ 3 | H  | L  | L  | H  | H  |
| F+ 2        | F+ 2 | H  | L  | L  | H  | L  |
| F+ 1        | F+ 1 | H  | L  | L  | L  | H  |
| F 0         | F 0  | H  | L  | L  | L  | L  |
| F- 1        | F- 1 | L  | H  | H  | H  | H  |
| F- 2        | F- 2 | L  | H  | H  | H  | L  |
| F- 3        | F- 3 | L  | H  | H  | L  | H  |
| F- 4        | F- 4 | L  | H  | H  | L  | L  |
| F- 5        | F- 5 | L  | H  | L  | H  | H  |
| F- 6        | F- 6 | L  | H  | L  | H  | L  |
| F- 7        | F- 7 | L  | H  | L  | L  | H  |
| F- 8        | F- 8 | L  | H  | L  | L  | L  |
| F- 9        |      | L  | L  | H  | H  | H  |
| F-11        |      | L  | L  | H  | H  | L  |
| F-12        |      | L  | L  | H  | L  | H  |
| F-13        |      | L  | L  | H  | L  | L  |
| F-14        |      | L  | L  | L  | H  | H  |
| F-16        |      | L  | L  | L  | H  | L  |
| F-18        |      | L  | L  | L  | L  | H  |
| F-20        |      | L  | L  | L  | L  | L  |

| Mode setting                      |                                   | D5 | D6 | D7 |
|-----------------------------------|-----------------------------------|----|----|----|
| VSC/VMC                           | VSC                               | H  | —  | —  |
|                                   | VMC                               | L  |    |    |
| Mute<br>(key control output mute) | Mute ON                           | —  | H  | —  |
|                                   | Mute OFF                          |    | L  |    |
| Test                              | Test<br>(normal setting disabled) | —  | —  | H  |
|                                   | Normal                            |    |    | L  |

There are two major modes to change the key; VMC (variable music control) and VSC (variable speech control). VMC provides relatively small variable range but maintains high sound quality, which is mainly used key control orchestra music for singing (called KARAOKE). On the other hand VSC provides lower sound quality but variable key range as wide as  $\pm 1$  octave or more, which is used key compensation in reproduction of source music in double speed.

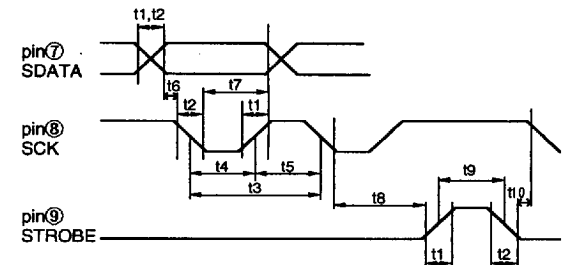
D/A converter output (pin ③ DAINT OUT) after key control is muted.

(3) Clock output

Like the easy mode, data entered into pin ④ KEYDOWN and pin ⑤ KEYUP can be used to output square-wave clocks from pin ⑥ CLKO.

| ④ KEYDOWN | ⑤ KEYUP | ⑥ CLKO<br>Clock frequency<br>(f <sub>clk</sub> =8MHz) | Remarks                                    |
|-----------|---------|-------------------------------------------------------|--------------------------------------------|
| L         | L       | OFF                                                   | Hi-impedance                               |
| L         | H       | 320kHz                                                | Clock for M65843P/AP<br>(digital echo IC)  |
| H         | L       | 450kHz                                                | Clock for M65830AP/CP<br>(digital echo IC) |
| H         | H       | 2MHz                                                  | Clock for M65831P/AP<br>(digital echo IC)  |

(4) Data input timing



| Symbol | Name                   | Min. | Typ. | Max. | Unit |
|--------|------------------------|------|------|------|------|
| t1     | Data rise time         | —    | —    | 500  | ns   |
| t2     | Data fall time         | —    | —    | 500  | ns   |
| t3     | SCK clock width        | 250  | —    | —    | ns   |
| t4     | SCK "L" pulse width    | 100  | —    | —    | ns   |
| t5     | SCK "H" pulse width    | 100  | —    | —    | ns   |
| t6     | SDATA setup time       | 100  | t3/2 | —    | ns   |
| t7     | SDATA hold time        | 100  | t3/2 | —    | ns   |
| t8     | STROBE rise hold time  | 200  | —    | —    | ns   |
| t9     | STROBE "H" pulse width | 100  | —    | —    | ns   |
| t10    | SCK setup time         | 100  | —    | —    | ns   |

(5) Clock oscillator circuit

The M65847 incorporates a clock oscillator circuit in it, thus allowing supply of master clocks without an external circuit.

The oscillator frequency is:

$$f_{clk}=8\text{MHz}$$

6. Reset

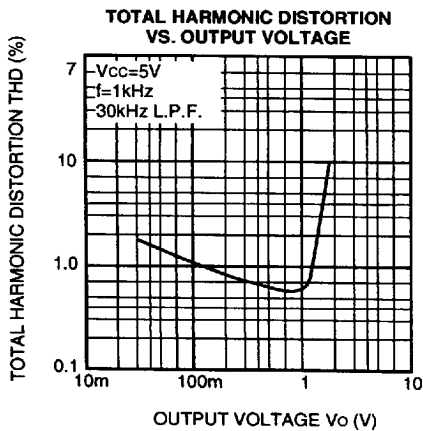
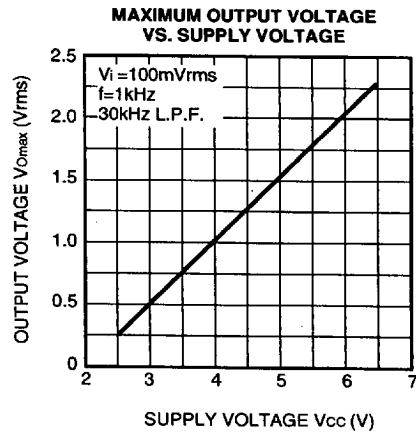
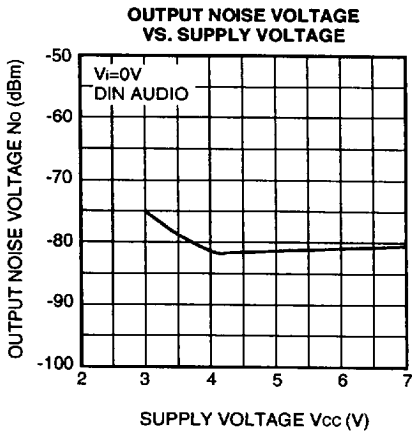
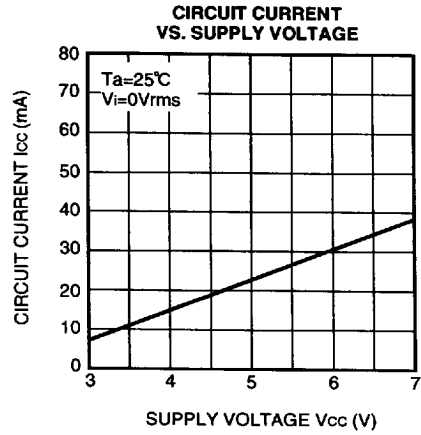
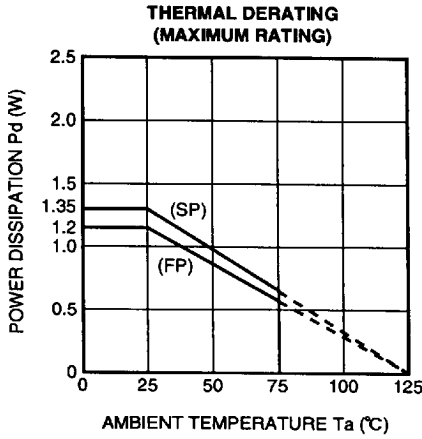
The M65847 is automatically reset when the power is turned on, and is automatically canceled nearly 120msec later.

Self mode.....Key F0

Microcomputer mode.....Key F0, VMC, Mute OFF

Easy mode..... Depending on setting of pin ⑦ to ⑩

TYPICAL CHARACTERISTICS



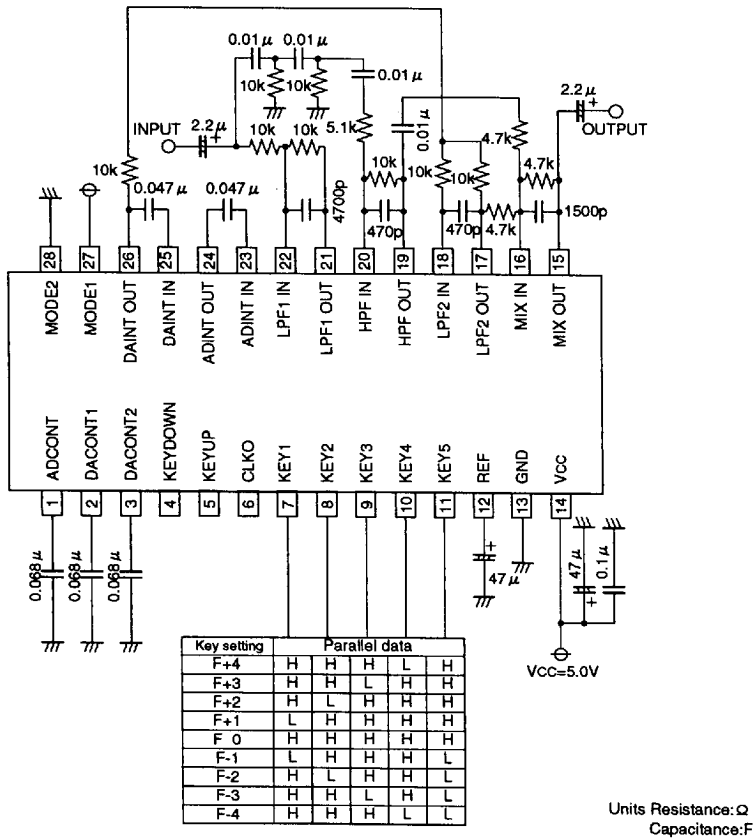
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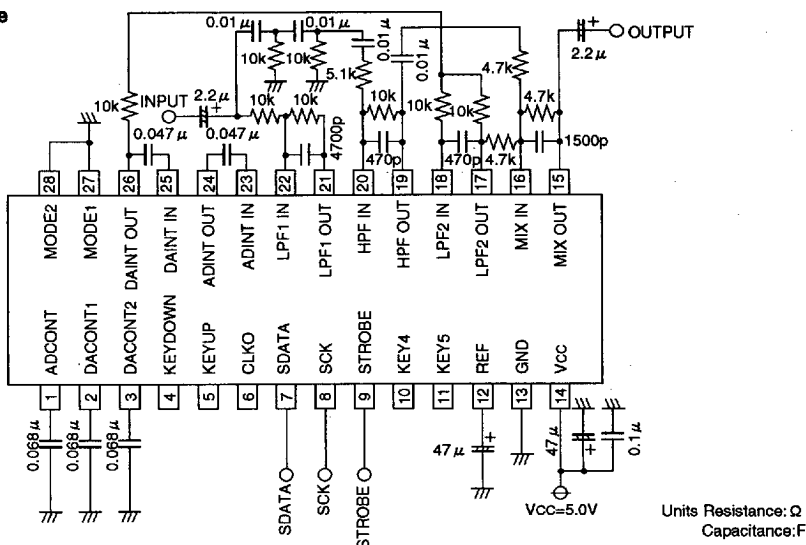




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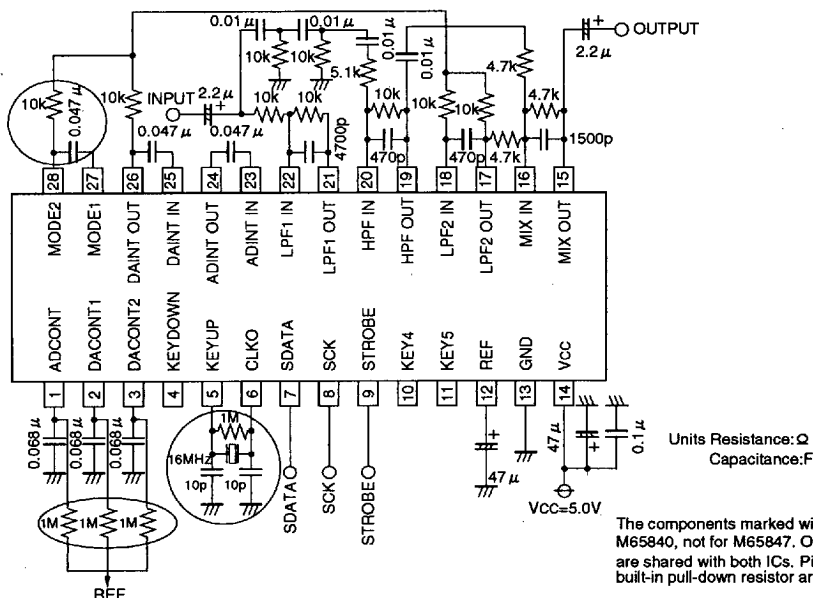
## 2. Easy mode





In the MCU mode, the M65847 is compatible with our key controller IC M65840 as follows:

- (1) Control data format  
The setting function, data format and data input timing are the same as those of M65840
- (2) Pin configuration and external components  
The pin configuration and external components are almost the same as those of M65840 part of external components can be reduced (See below)



As mentioned above, the M65847 can be replaced with M65840 without changing the program and board of the microcomputer

- (3) Electrical characteristics
- Because of a sampling frequency of 250kHz (M65840:500kHz), the M65847 has different electrical characteristics
- |                                    |                             |
|------------------------------------|-----------------------------|
| Noise: 80dBVtyp (M65840: 85dBVtyp) | THD: 1.3%typ (M65840: 0.8%) |
|------------------------------------|-----------------------------|