

DATA SHEET

(Tentative)

Part No.	AN32154A
Package Code No.	*QFN044-P-0606D

AN32154A (Tentative)

288 Dots Matrix LED driver IC

■ Overview

AN32154A has a 288 dots Matrix LED driver. It can drive up to 96 channel RGB LEDs.

■ Feature

- LED matrix driver $12 \times 12 \times 2$ (Total LED that can be driven = 288)
- LED Selectable Maximum Current
- LED Melody Mode Function
- LED Open/Short Detection
- LED Ghost Image Prevention Function
- SPI Interface
- I²C interface (Standard Mode, Fast Mode and Fast Mode Plus) (8 Slave address selectable)

■ Applications

- LED driver IC

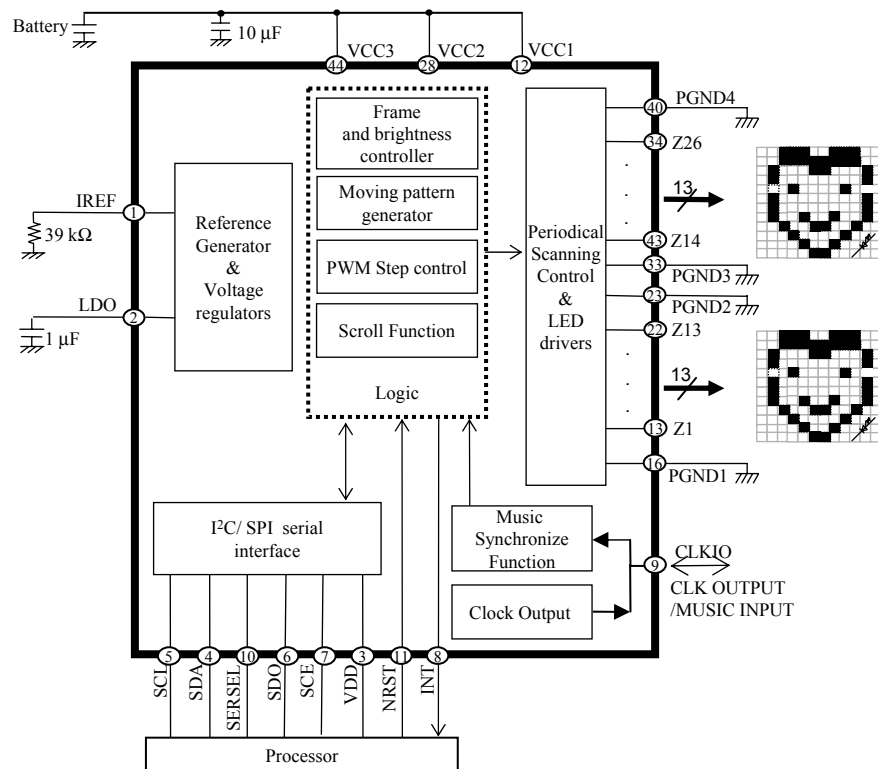
■ Package

- 44 pin Quad Flat Non-lead Package (QFN) (Size : 6.2 mm × 6.2 mm, 0.4 mm pitch)

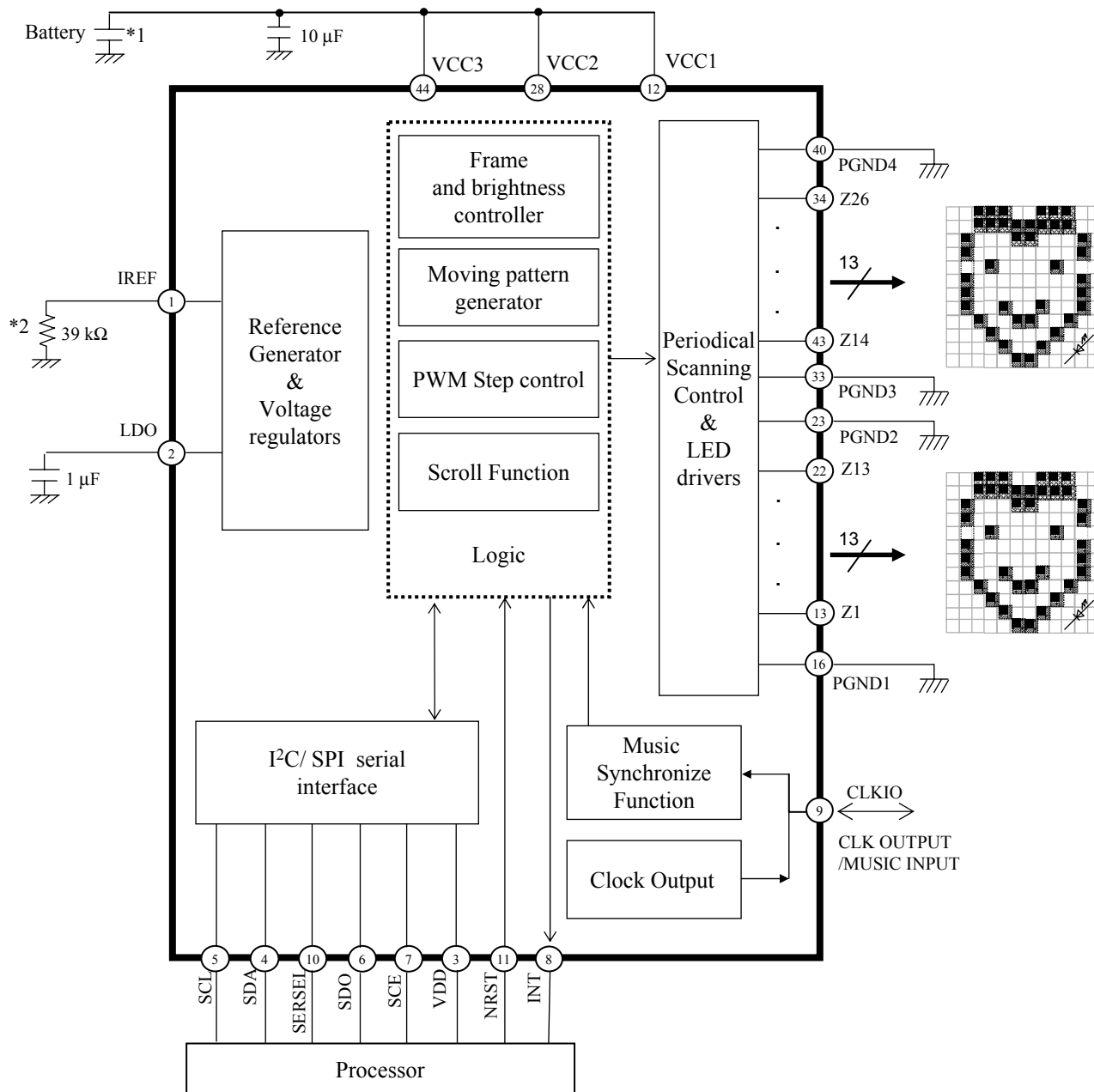
■ Type

- Bi-CMOS IC

■ System image

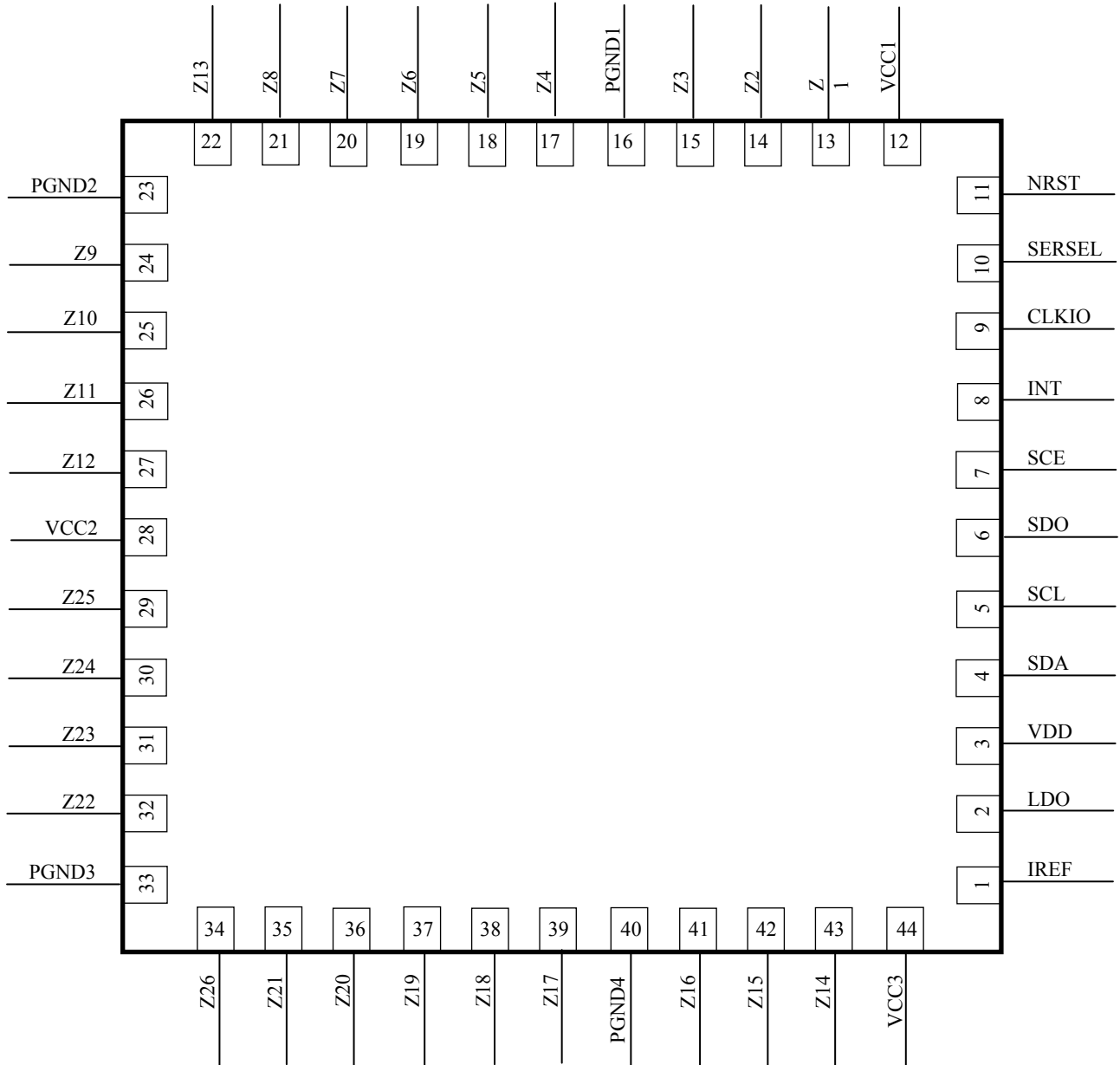


■ Application Circuit Example (Block Diagram)



- Notes)
- This application circuit is an example. The operation of mass production set is not guaranteed. You should perform enough evaluation and verification on the design of mass production set. You are fully responsible for the incorporation of the above application circuit and information in the design of your equipment.
 - This block diagram is for explaining functions. Part of the block diagram may be omitted, or it may be simplified.
- *1 : VCC capacitor is for noise cancellation. Please select an appropriate value according to PCB pattern etc.
- *2 : To ensure the accuracy of the constant current of each LED, it is recommended to use Panasonic Resistor ERJ2RHD393X (±0.5% tolerance). To ensure the accuracy of the constant current of each LED, place the resistor as close as possible to IC and parasitic capacitor of not more than 20 pF at IREF pin.

■ Pin Descriptions



■ Pin Descriptions (continued)

QFN44 Pin No.	Pin name	Type	Description	Pin processing at unused
1	IREF	Output	Resistor connection pin for constant current setup	(Required pin)
2	LDO	Output	LDO output pin	(Required pin)
3	VDD	Input	Power supply for SPI or I ² C interface	(Required pin)
4	SDA	Input/Output	Data input / output pin for SPI or I ² C interface	(Required pin)
	SCL	Input	Clock input pin for SPI or I ² C interface	(Required pin)
6	SDO	Output	Data output pin for SPI interface	SERSEL = "H". Then Open
			Slave address selection pin for I ² C interface.	SERSEL = "L". Then GND or VCC or SCL
7	SCE	Input	Chip enable signal for SPI interface.	SERSEL = "H" Then GND or VCC
			Slave address selection pin for I ² C interface.	SERSEL = "L" Then GND or VCC or SCL
8	INT*	Output	Interruption signal output pin / Open drain	Open
9	CLKIO	Input/Output	Reference clock input/output, LED control input pin	Open
10	SERSEL	Input	Serial Interface selection pin / SPI or I ² C interface	(Required pin)
11	NRST	Input	Reset input pin	(Required pin)
12	VCC1	Power Supply	Power supply for matrix driver, Internal reference circuit	Battery or External power supply
13	Z1	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
14	Z2	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
15	Z3	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
16	PGND1	Ground	Ground pin	(Required pin)
17	Z4	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
18	Z5	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
19	Z6	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
20	Z7	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
21	Z8	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
22	Z13	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open

Note) *1 : INT pin must be pulled up to VDD when it is in use.

■ Pin Descriptions (continued)

QFN44 Pin No.	Pin name	Type	Description	Pin processing at unused
23	PGND2	Ground	Ground pin	(Required pin)
24	Z9	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
25	Z10	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
26	Z11	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
27	Z12	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
28	VCC2	Power supply	Power supply for matrix driver, Internal reference circuit	Battery or External power supply
29	Z25	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
30	Z24	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
31	Z23	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
32	Z22	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
33	PGND3	Ground	Ground pin	(Must be connected)
34	Z26	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
35	Z21	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
36	Z20	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
37	Z19	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
38	Z18	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
39	Z17	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
40	PGND4	Ground	Ground pin	(Must be connected)
41	Z16	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
42	Z15	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
43	Z14	Output	Constant current circuit, PWM control output pin, Control switch pin for matrix driver	Open
44	VCC3	Power supply	Power supply for matrix driver, Internal reference circuit	Battery or External power supply

■ Absolute Maximum Ratings

Note) Absolute maximum ratings are limit values which do not result in damages to this IC, and IC operation is not guaranteed at these limit values.

A* No.	Parameter	Symbol	Range	Units	Note
1	Power Supply Voltage	VCC _{MAX}	6.0	V	*1
		VDD _{MAX}	6.0	V	*1
2	Power Supply Current	I _{CC}	—	A	—
3	Power Dissipation	P _D	TBD	mW	*2
4	Operating Ambient Temperature	T _{opr}	−30 to +85	°C	*3
5	Storage Temperature	T _{stg}	−55 to +125	°C	*3

Notes) * : A is a number for internal management of this page of Panasonic.

*1: VCC_{MAX} = VCC1, VCC2, VCC3, VDD_{MAX} = VDD

The value where the absolute maximum ratings and power dissipation should not exceed is indicated.

*2: The power dissipation shown is the value at T_a = 85°C for the independent IC package without a heat sink. When using this IC, refer to the P_D-T_a diagram of the package standard and design the heat radiation with sufficient margin so that the allowable value might not be exceeded based on the conditions of power supply voltage, load, and ambient temperature.

*3: Except for the power dissipation, operating ambient temperature, and storage temperature, all ratings are for T_a = 25°C.

■ Operating Supply Voltage Range

Parameter	Symbol	Range	Unit	Note
Power Supply Voltage Range	VCC	3.1 to 5.5	V	*1
	VDD	1.7 to 5.5	V	*1, 2

Note) Maximum Operating Supply Voltages for VCC and VDD (VCC_{max} and VDD_{max}) are 5.5 V.

*1 : The values under the condition not exceeding the above absolute maximum ratings and the power dissipation.

■ Allowable Voltage Range

- Notes)
- Allowable current and voltage ranges are limit ranges which do not result in damages to this IC, and IC operation is not guaranteed within these limit ranges.
 - Voltage values, unless otherwise specified, are with respect to GND.
GND is voltage for PGND1, PGND2, PGND3 and PGND4
 - Do not apply external currents or voltages to any pin not specifically mentioned.

QFN Pin No.	Terminal	Absolute maximum Voltage	Unit	Remark
5	SCL	- 0.5 to 6.0	V	—
4	SDA	- 0.5 to 6.0	V	*1
10	SERSEL	- 0.3 to 6.0	V	—
6	SDO	- 0.5 to 6.0	V	—
7	SCE	- 0.5 to 6.0	V	—
11	NRST	- 0.3 to 6.0	V	—
9	CLKIO	- 0.3 to 6.0	V	*1

- Note) *1: This value is absolute maximum voltage when these terminals are used as input.
External Voltage and current are prohibited when these terminals are used as output.

■ Electrical Characteristics at VCC = VCC1 = VCC2 = VCC3 = 3.6 V, VDD = 1.85 V

Note) Operating Ambient Temperature, T_a = 25°C±2°C, unless specifically mentioned

B* No.	Items	Symbol	Conditions	Limits			Unit	Note
				Min	Typ	Max		
Circuit Current								
1	Circuit Current (1) OFF Mode	ICC1	NRST = 0 V ICC1 = IP3 + IP12 + IP28 + IP44	—	0	1	μA	—
2	Circuit Current (2) OFF Mode	ICC2	NRST = High ICC2 = IP3 + IP12 + IP28 + IP44	—	300 (TBD)	500 (TBD)	μA	—
Internal Oscillator								
3	Oscillation Frequency	FDC1	VCC = 3.6 V	1.92	2.40	2.88	MHz	—
SCAN Switch								
4	Switch On Resistance	RSCAN	VCC = 3.6 V IP13~15, IP17~22, IP24~27, IP29~32, IP34~39, IP41~43 = -20 mA	—	2 (TBD)	3 (TBD)	Ω	—
Constant Voltage Source (LDO)								
5	Output voltage (1)	VL1	IP2 = -10 μA VL1 = VP2	2.75	2.85	2.95	V	—
6	Output voltage (2)	VL2	IP2 = -15 mA VL2 = VP2	2.75	2.85	2.95	V	—
CLKIO								
7	High Level Input Voltage Range	VIH2	High Level Acknowledged Voltage (At External CLK Input Mode)	0.7 × VDD	—	VDD + 0.3	V	—
8	Low Level Input Voltage Range	VIL2	Low Level Acknowledged Voltage (At External CLK Input Mode)	-0.3	—	0.3 × VDD	V	—
9	High Level Output Voltage	VOH2	IP9_1 = -1mA (At Internal CLK Output Mode)	0.8 × VDD	—	VDD + 0.3	V	—
10	Low Level Output Voltage	VOL2	IP9_1 = +1mA (At Internal CLK Output Mode)	-0.3	—	0.2 × VDD	V	—
11	High Level input Current	IIH1	VCC = 5.5 V VP9 = 5.5 V IIH1 = IP28	-1	0	1	μA	—
12	Low Level input Current	IIL1	VCC = 5.5 V VP9 = 0 V IIL1 = IP28	-1	0	1	μA	—

Note) Please refer to the Test Circuit diagram on Page 18 for symbols VP××, IP××

* : Number B from Page 10 to Page 15 is for internal management of Panasonic

■ Electrical Characteristics (continued) at VCC = VCC1 = VCC2 = VCC3 = 3.6 V, VDD = 1.85 V

Note) Operating Ambient Temperature, T_a = 25°C±2°C, unless specifically mentioned

B No.	Item	Symbol	Conditions	Limits			Unit	Note
				Min	Typ	Max		
Constant Current Source (Matrix LED)								
13	Output Current	IMX	LED Current Setting = 20 mA IMAX = [01010] VP13 to 15, VP17 to 22, VP24 to 27, VP29 to 32, VP34 to 39, VP41 to 43 = 1 V IMX = IP13 to 15, IP17 to 22, IP24 to 27, IP29 to 32, IP34 to 39, IP41 to 43	19	20	21	mA	*1
14	IMAX Current Step	IMXSTEP	Constant Current Mode VP13 to 15, VP17 to 22, VP24 to 27, VP29 to 32, VP34 to 39, VP41 to 43 = 1 V LED current setting = 22 mA, IMAX = [01011] ILED1 = IP13 to 15, IP17 to 22, IP24 to 27, IP29 to 32, IP34 to 39, IP41 to 43 LED current setting = 20 mA, IMAX = [01010] ILED2 = IP13 to 15, IP17 to 22, IP24 to 27, IP29 to 32, IP34 to 39, IP41 to 43 IMXSTEP = ILED1 – ILED2	0	2	3.5	mA	—
15	OFF Mode Leak Current 1	IMXOFF1	VCC = 5.5 V, VDD = 5.5 V OFF Mode VP13 to 15, VP17 to 22, VP24 to 27, VP29 to 32, VP34 to 39, VP41 to 43 = 5.5 V IMXOFF1 = IP13 to 15, IP17 to 22, IP24 to 27, IP29 to 32, IP34 to 39, IP41 to 43	-1	—	1	μA	—
16	OFF Mode Leak Current 2	IMXOFF2	VCC = 5.5 V, VDD = 5.5 V OFF Mode VP13 to 15, VP17 to 22, VP24 to 27, VP29 to 32, VP34 to 39, VP41 to 43 = 0 V IMXOFF2 = IP13 to 15, IP17 to 22, IP24 to 27, IP29 to 32, IP34 to 39, IP41 to 43	-1	—	1	μA	—
17	Channel Difference	IMXCH	IMAX = [01010] LED Current Setting = 20 mA Difference of Z1 to 26 current from the median current value	-5	—	5	%	—

Note) *1 : This is allowable value when recommended parts (ERJ2RHD393X) are used for the terminal IREF.

■ Electrical Characteristics (continued) at VCC = VCC1 = VCC2 = VCC3 = 3.6 V, VDD = 1.85 V

Note) Operating Ambient Temperature, T_a = 25°C±2°C, unless specifically mentioned

B No.	Item	Symbol	Conditions	Limits			Unit	Note
				Min	Typ	Max		
Minimum voltage at which LED driver can keep constant current value								
18	LED Driver Voltage	VLD	IMAX = [01010] Voltage at which LED Current change within ±5% compared with LED Current of pin voltage = 0.5 V.	0.4	—	—	V	—
SERSEL								
19	High Level Input Voltage Range	VIH1	High Level Acknowledged Voltage	0.7 × VCC	—	VCC + 0.3	V	—
20	Low Level Input Voltage Range	VIL1	Low Level Acknowledged Voltage	-0.3	—	0.3 × VCC	V	—
21	High Level Input Current	IIH1	VCC = 5.5 V VP10 = 5.5 V IIH1 = IP10	-1	0	1	μA	—
22	Low Level Input Current	IIL1	VCC = 5.5 V VP10 = 0 V IIL1 = IP10	-1	0	1	μA	—
NRST								
23	High Level Input Voltage Range	VIH3	High Level Acknowledged Voltage	1.5	—	VCC + 0.3	V	—
24	Low Level Input Voltage Range	VIL3	Low Level Acknowledged Voltage	-0.3	—	0.6	V	—
25	High Level Input Current	IIH3	VCC = 5.5 V VP11 = 5.5 V IIH3 = IP11	-1	0	1	μA	—
26	Low Level Input Current	IIL3	VCC = 5.5 V VP11 = 0 V IIL3 = IP11	-1	0	1	μA	—
INT								
27	ON Resistance	RINTON	IP8 = 5 mA	—	10	50	Ω	—
SDO (SPI Output mode)								
28	High Level Output Voltage	VOH3	IP6_1 = -3 mA	0.7 × VDD	—	VDD + 0.3	V	—
29	Low Level Output Voltage	VOL3	IP6_1 = 3 mA	0	—	0.3 × VDD	V	—

■ Electrical Characteristics (continued) at VCC = VCC1 = VCC2 = VCC3 = 3.6 V, VDD = 1.85 V

Note) Operating Ambient Temperature, T_a = 25°C±2°C, unless specifically mentioned

B No.	Item	Symbol	Conditions	Limits			Unit	Note
				Min	Typ	Max		
SDO (I ² C Input Mode)								
30	High Level Input Voltage Range	VIH1	High Level Acknowledged Voltage	0.7 × VDD	—	VDD + 0.5	V	—
31	Low Level Input Voltage Range	VIL1	Low Level Acknowledged Voltage	-0.5	—	0.3 × VDD	V	—
32	High Level Input Current	IIH1	VCC = 5.5 V VP6_2 = 5.5 V IIH1 = IP6_2	-1	0	1	μA	—
33	Low Level Input Current	IIL1	VCC = 5.5 V VP6_2 = 0 V IIL1 = IP6_2	-1	0	1	μA	—
SCE								
34	High-level input voltage range	VIH4	High Level Acknowledged Voltage	VDD × 0.7	—	VDD + 0.5	V	—
35	Low-level input voltage range	VIL4	Low Level Acknowledged Voltage	-0.5	—	VDD × 0.3	V	—
36	High-level input current	IIH4	VCC = 5.5 V VP7 = 5.5 V IIH4 = IP7	-1	0	1	μA	—
37	Low-level input current	IIL4	VCC = 5.5 V VP7 = 0 V IIL4 = IP7	-1	0	1	μA	—
I ² C bus (Internal I/O stage characteristics) SCL, SDA								
38	Low-level input voltage	V _{IL}	Voltage which recognized that SDA and SCL are Low-level	-0.5	—	0.3 × V _{DD}	V	*2
39	High-level input voltage	V _{IH}	Voltage which recognized that SDA and SCL are High-level	0.7 × V _{DD}	—	V _{DDmax} + 0.5	V	*2
40	Low-level output voltage 1	V _{OL1}	V _{DD} > 2 V IP4_2(sink current) = 3 mA	0	—	0.4	V	—
41	Low-level output voltage 2	V _{OL2}	V _{DD} < 2 V IP4_2(sink current) = 3 mA	0	—	0.2 × V _{DD}	V	—
42	Low-level output current	I _{OL}	V _{OL} = 0.4 V	20	—	—	mA	—
43	Input current each I/O pin	I _i	VCC = 5.5 V, VDD = 5.5 V VP4, 5 = 0.1VDD _{max} to 0.9VDD _{max}	-10	0	10	μA	—
44	SCL clock frequency	f _{SCL}	—	0	—	1 000	kHz	—

Note) *2: The input threshold voltage of I²C bus (V_{th}) is linked to VDD (I²C bus I/O stage supply voltage).

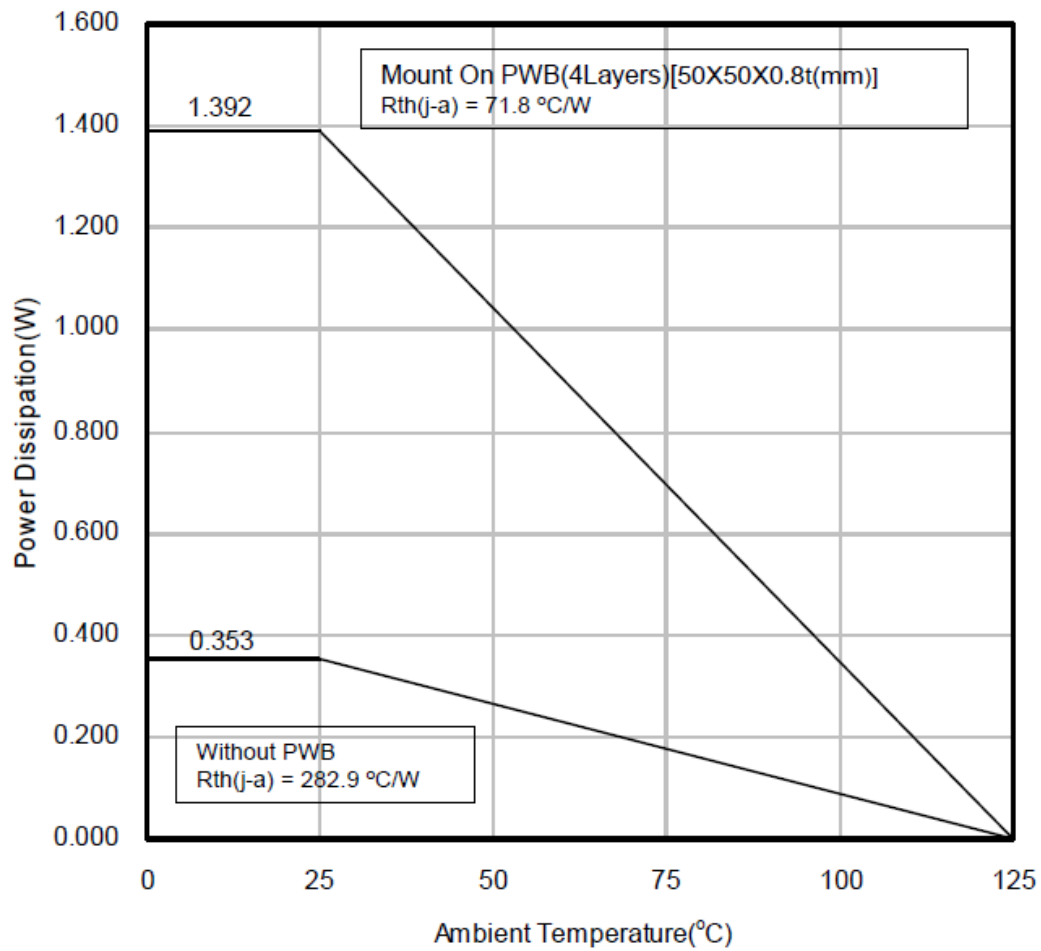
In case the pull-up voltage is not VDD, the threshold voltage (V_{th}) is fixed to ((VDD / 2) ± (Schmitt width) / 2) and High-level, Low-level of input voltage are not specified.

In this case, pay attention to Low-level (max.) value (V_{ILmax}).

It is recommended that the pull-up voltage of I²C bus is set to the I²C bus I/O stage supply voltage (VDD).

4. Power Dissipation (Technical Report)

Package Code : *QFN044-P-0606D



■ Usage Notes

• Special attention and precaution in using

1. This IC is intended to be used for general electronic equipment [Mobile phones].

Consult our sales staff in advance for information on the following applications:

- Special applications in which exceptional quality and reliability are required, or if the failure or malfunction of this IC may directly jeopardize life or harm the human body.
- Any applications other than the standard applications intended.
 - (1) Space appliance (such as artificial satellite, and rocket)
 - (2) Traffic control equipment (such as for automobile, airplane, train, and ship)
 - (3) Medical equipment for life support
 - (4) Submarine transponder
 - (5) Control equipment for power plant
 - (6) Disaster prevention and security device
 - (7) Weapon
 - (8) Others : Applications of which reliability equivalent to (1) to (7) is required

It is to be understood that our company shall not be held responsible for any damage incurred as a result of or in connection with your using the IC described in this book for any special application, unless our company agrees to your using the IC in this book for any special application.

2. Pay attention to the direction of LSI. When mounting it in the wrong direction onto the PCB (printed-circuit-board), it might smoke or ignite.
3. Pay attention in the PCB (printed-circuit-board) pattern layout in order to prevent damage due to short circuit between pins. In addition, refer to the Pin Description for the pin configuration.
4. Perform a visual inspection on the PCB before applying power, otherwise damage might happen due to problems such as a solder-bridge between the pins of the semiconductor device. Also, perform a full technical verification on the assembly quality, because the same damage possibly can happen due to conductive substances, such as solder ball, that adhere to the LSI during transportation.
5. Take notice in the use of this product that it might break or occasionally smoke when an abnormal state occurs such as output pin- V_{CC} short (Power supply fault), output pin-GND short (Ground fault), or output-to-output-pin short (load short) .
And, safety measures such as an installation of fuses are recommended because the extent of the above-mentioned damage and smoke emission will depend on the current capability of the power supply.
6. When designing your equipment, comply with the range of absolute maximum rating and the guaranteed operating conditions (operating power supply voltage and operating environment etc.). Especially, please be careful not to exceed the range of absolute maximum rating on the transient state, such as power-on, power-off and mode-switching. Otherwise, we will not be liable for any defect which may arise later in your equipment.
Even when the products are used within the guaranteed values, take into the consideration of incidence of break down and failure mode, possible to occur to semiconductor products. Measures on the systems such as redundant design, arresting the spread of fire or preventing glitch are recommended in order to prevent physical injury, fire, social damages, for example, by using the products.
7. When using the LSI for new models, verify the safety including the long-term reliability for each product.
8. When the application system is designed by using this LSI, be sure to confirm notes in this book.
Be sure to read the notes to descriptions and the usage notes in the book.

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Even when the products are used within the guaranteed values, take into the consideration of incidence of break down and failure mode, possible to occur to semiconductor products. Measures on the systems such as redundant design, arresting the spread of fire or preventing glitch are recommended in order to prevent physical injury, fire, social damages, for example, by using the products.
- (6) Comply with the instructions for use in order to prevent breakdown and characteristics change due to external factors (ESD, EOS, thermal stress and mechanical stress) at the time of handling, mounting or at customer's process. When using products for which damp-proof packing is required, satisfy the conditions, such as shelf life and the elapsed time since first opening the packages.
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