

ET6144 - Constant Current Matrix LED Controller

General Description

ET6144 is a constant current array LED controller ,which supports up to 12×12 matrix output and each point has 256 steps PWM current adjustment function.

ET6144 uses the I²C interface and supports continuous read and write mode as well. It can set a variety of display effects by setting multiple Internally integrated registers.

ET6144 is mainly used in the display driver of household appliances, with the advantages of rich display effect and simple operation.

Features

- 12 constant current driver channels, max output current 50mA
- Support 1~12 scan application, the maximum application matrix is 12×12
- Each point supports 256 steps brightness adjustment
- I²C interface, two chip-address can be set
- Oscillation mode: built in RC oscillation (1MHz±10%)
- Built in power on reset circuit
- Built in automatic blanking circuit
- Package: QFN32(ET6144Y), SOP32(ET6144M), LQFP32(ET6144Q)

Device Information

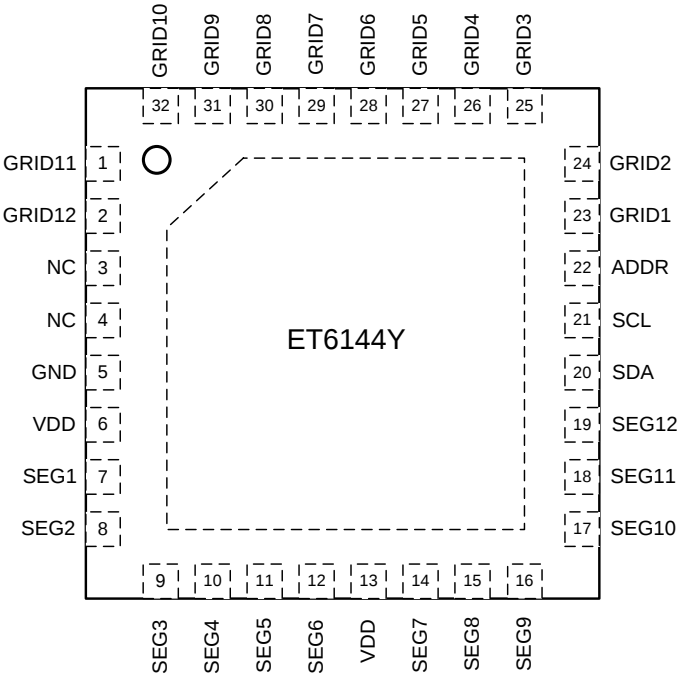
Part No.	Package	Size
ET6144Y	QFN32	4mm × 4mm
ET6144M	SOP32	7.5mm × 21mm
ET6144Q	LQFP32	7mm × 7mm

Application

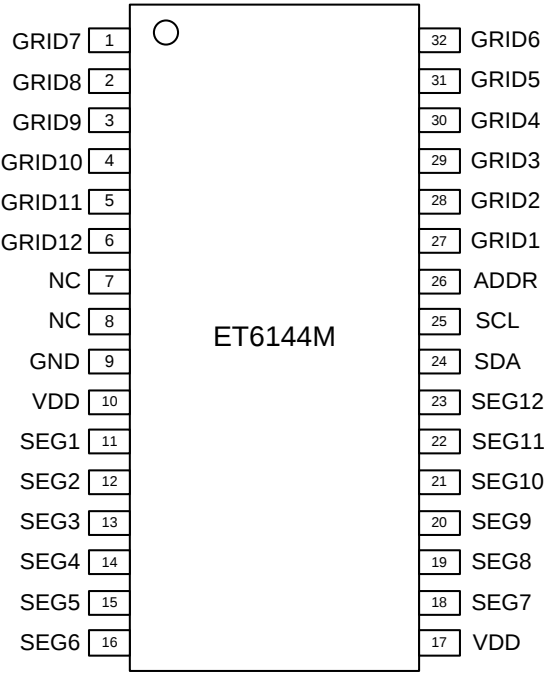
- Household appliances, Toy display
- Smart portable devices, Smart audio

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Pin Assignments

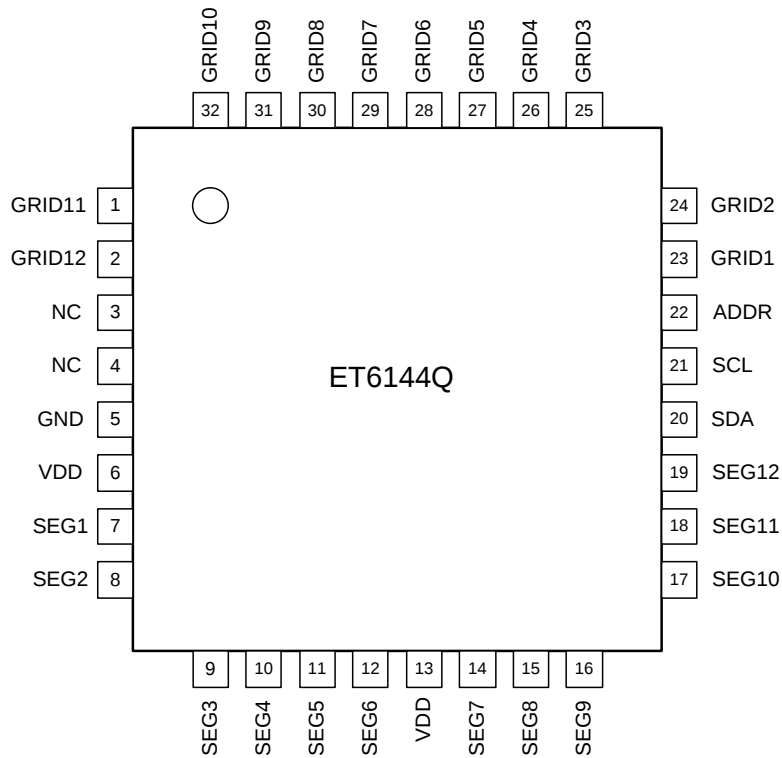


ET6144Y (QFN32)



ET6144M (SOP32)

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ET6144Q (LQFP32)

Figure 1. Pin Assignments (Top View)

Pin. Function

Pin No.		Name	Function
QFN32/LQFP32	SOP32		
23~32,1,2	27~32,1~6	GRID1~GRID12	Grid output, connected to LED cathode.
3,4	7,8	NC	-
5	9	GND	GND
6,13	10,17	VDD	Supply voltage
7~12,14~19	11~16,18~23	SEG1~SEG12	Segment output, connected to LED anode.
20	24	SDA	I ² C data input
21	25	SCL	I ² C clock input
22	26	ADDR	Chip-address select

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Block Diagram

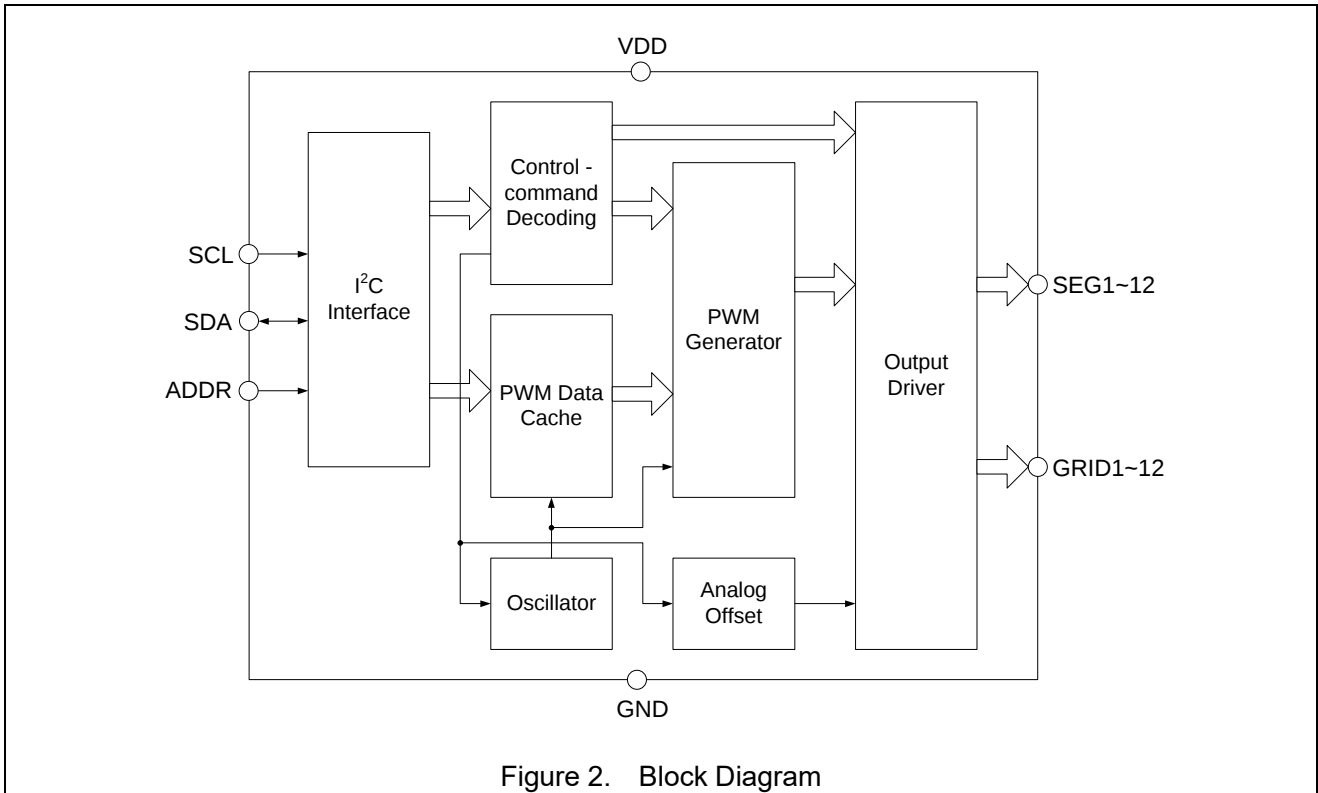


Figure 2. Block Diagram

Functions Description

Serial Port Interface

MCU can transmit data with ET6144 each other through SDA and SCL port. SDA and SCL composite bus interface, and a pull-up resistor to the power supply should be connected.

Data Validity

When the SCL signal is HIGH, the data of SDA port is valid and stable. Only when the SCL signal is low, the level on the SDA port can be changed.

Start (Re-start) and Stop Working Conditions

When the SCL signal is high, SDA signal from high to low represents start or re-start working conditions, while the SCL signal is high, SDA signal from low to high represents stop working conditions.

Byte format

Each byte of data line contains 8 bits, which contains an acknowledge bit. The first data is transmitted MSB.

Acknowledge

During the writing mode, ET6144 will send a low level response signal with one period width to the SDA port. During the reading mode, ET6144 will not send response signal and the host will send a high response signal one period width to the SDA.

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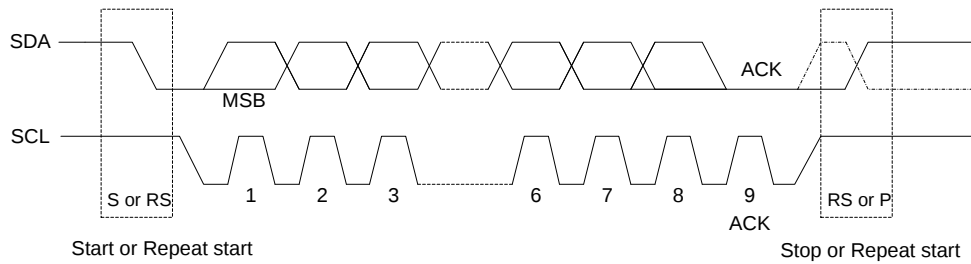


Figure 3. I²C write mode

- ACK=Acknowledge
- MSB=Most Significant Bit
- S=Start Conditions RS=Restart Conditions P=Stop Conditions
- Fastest Transmission Speed =400KBITS/S
- Restart: SDA-level turnover as expressed by the dashed line waveform

Chip-Address

ET6144 has 2 chip-address:

ADDR pin connect signal	Chip-Address(7-bit)
VDD	0110011b
GND	0110010b

I²C Writing Command Register Interface Protocol (continuous):

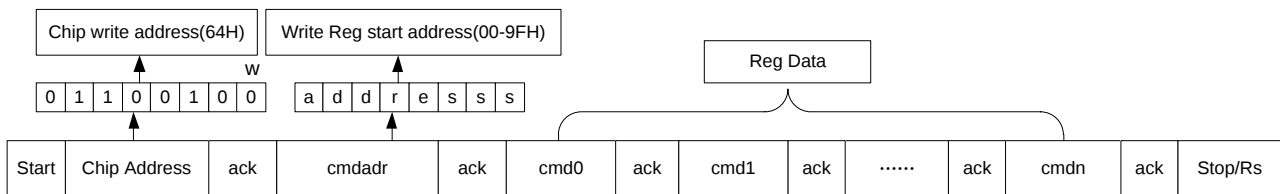
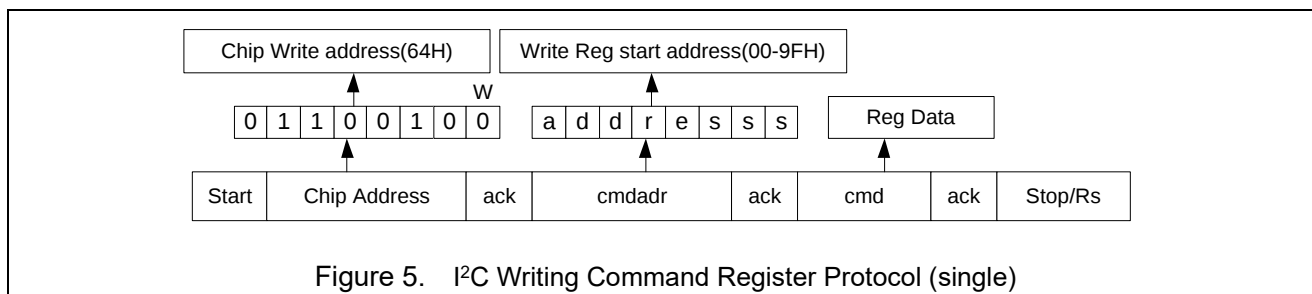


Figure 4. I²C Writing Command Register Protocol (continuous)

- Start = Start Conditions
- Chip Address = Write register address = 0110010+0(w)b
- ack = Acknowledge from ET6144
- Write Reg start address byte = cmdadr (REG's 8bit address)
- ack = Acknowledge from ET6144
- Command Reg data 0=cmd0(Command data)
- ack = Acknowledge from ET6144
-
- Command Reg data n=cmdn(Command data)
- ack = Acknowledge from ET6144
- Stop/Rs=Stop Condition/Restart Condition

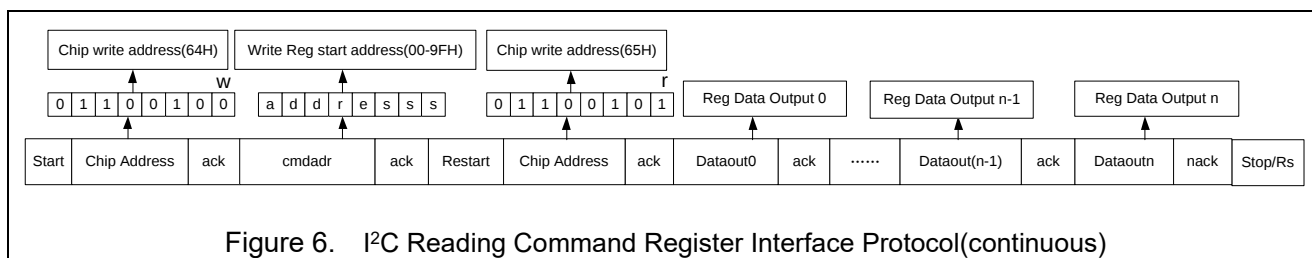
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I²C Writing Command Register Interface Protocol (single):



- Start =Start Conditions
- Chip Address = Write register address = 0110010+0(w)b
- ack = Acknowledge from ET6144
- Write Reg start address byte = cmdadr(REG's 8bit address)
- ack = Acknowledge from ET6144
- Command Reg data =cmd(Command data)
- ack = Acknowledge from ET6144
- Stop

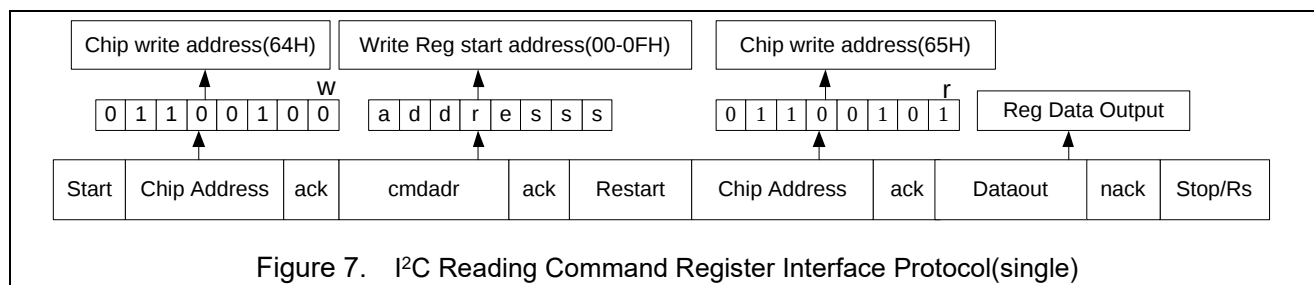
I²C Reading Command Register Interface Protocol(continuous)



- Start =Start Conditions
- Chip Address = Write register address = 0110010+0(w)b
- ack = Acknowledge from ET6144
- Write Reg start address byte = cmdadr(REG's 8bit address)
- ack = Acknowledge from ET6144
- Restart = Restart condition
- Chip address = Read register address= 0110010+1(w)b
- ack = Acknowledge from ET6144
- Dataout0=Register data output 0
- ack=Acknowledge from Host
-
- Dataoutn=Register data output n
- nack=No Acknowledge from Host
- Stop/Rs=Stop Condition/Restart Condition

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I²C Reading Command Register Interface Protocol(single)



- Start =Start Conditions
- Chip Address = Write register address = 0110010+0(w)b
- ack = Acknowledge from ET6144
- Write Reg start address byte = cmdadr(REG's 8bit address)
- ack = Acknowledge from ET6144
- Restart = Restart condition
- Chip address = Read register address= 0110010+1(w)b
- ack = Acknowledge from ET6144
- Dataout=Register data output
- nack=No Acknowledge from Host
- Stop/Rs=Stop Condition/Restart Condition

Register Map

Addr	Description
00H~03H	Status Control Register
10H~9FH	PWM Data Register

Status Control Register

Addr: 00h			Control Register 1			
Addr	Bit	Bit Name	Default	Access	Description	
00H	7:3	Soft_ Reset	00000	W/R	Write 11011b to reset all register, All other data are invalid	
	2:1	RFU	00	W/R	00	1MHz
					01	2MHz
					10	4MHz
					11	8MHz
	0	Shutdown	0	W/R	0	Shutdown
					1	Operating mode
Addr: 01h			Control Register 2			
Addr	Bit	Bit Name	Default	Access	Description	
01H	7: 6	RFU	00	-	-	
	5: 2	Scan rows	0110	W/R	1100	12 Grids

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					0110	6 Grids (default)
						
					0001	1 Grids
					Note	0000,1101~1111 is invalid
	1: 0	Line feed time	00	W/R	00	4 PWM clock cycles
					01	8 PWM clock cycles
					10	12 PWM clock cycles
11					16 PWM clock cycles	
Addr: 02h			Control Register 3			
Addr	Bit	Bit Name	Default	Access	Description	
02H	7:4	Chip ID	0110	R	Chip ID	
	3:2	SEG Blanking	01	W/R	SEG Blanking	
					00	Disable blanking
					01	Weak level blanking
					10	Middle level blanking
					11	High level blanking
	1:0	GRID Blanking	00	W/R	GRID Blanking	
					0X	Disable blanking
					10	Weak blanking
					11	High level blanking
	Addr: 03h			Control Register 4		
Addr	Bit	Bit Name	Default	Access	Description	
03H	7: 6	RFU	0	-	-	
	5:1	Brightness	01111	W/R	SEG port output constant current	
					11111	50mA
					11110	48.75mA
						
					01111	30mA (default)
						
					0000	11.25mA
	0	Status control	0	W/R	0	Display off
					1	Display on
Addr: 10~9Fh			PWM Registers			
Addr	Bit	Bit Name	Default	Access	Description	
10~9FH	7:0	PWM DATA	00H	W/R	00H	0/255
						
					FFH	255/255

Note: After power on, you can configure other registers only after the 00 register is set to operating mode.

When the chip is in the shutdown state, other registers cannot be written.

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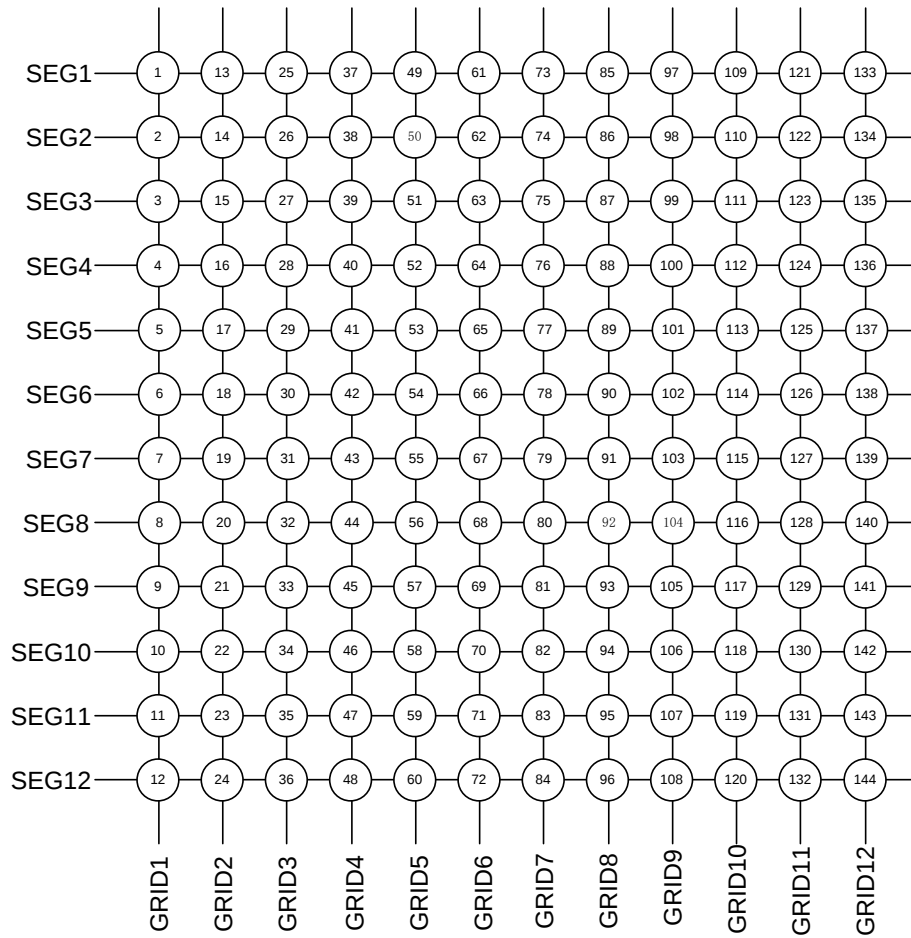


Figure 8. Output Matrix Diagram

PWM Data Register

Addr	Description	Addr	Description	Addr	Description	Addr	Description
10H	LED1PWM	11H	LED2PWM	12H	LED3PWM	13H	LED4PWM
14H	LED5PWM	15H	LED6PWM	16H	LED7PWM	17H	LED8PWM
18H	LED9PWM	19H	LED10PWM	1AH	LED11PWM	1BH	LED12PWM
1CH	LED13PWM	1DH	LED14PWM	1EH	LED15PWM	1FH	LED16PWM
20H	LED17PWM	21H	LED18PWM	22H	LED19PWM	23H	LED20PWM
24H	LED21PWM	25H	LED22PWM	26H	LED23PWM	27H	LED24PWM
28H	LED25PWM	29H	LED26PWM	2AH	LED27PWM	2BH	LED28PWM
2CH	LED29PWM	2DH	LED30PWM	2EH	LED31PWM	2FH	LED32PWM
30H	LED33PWM	31H	LED34PWM	32H	LED35PWM	33H	LED36PWM
34H	LED37PWM	35H	LED38PWM	36H	LED39PWM	37H	LED40PWM
38H	LED41PWM	39H	LED42PWM	3AH	LED43PWM	3BH	LED44PWM
3CH	LED45PWM	3DH	LED46PWM	3EH	LED47PWM	3FH	LED48PWM
40H	LED49PWM	41H	LED50PWM	42H	LED51PWM	43H	LED52PWM
44H	LED53PWM	45H	LED54PWM	46H	LED55PWM	47H	LED56PWM

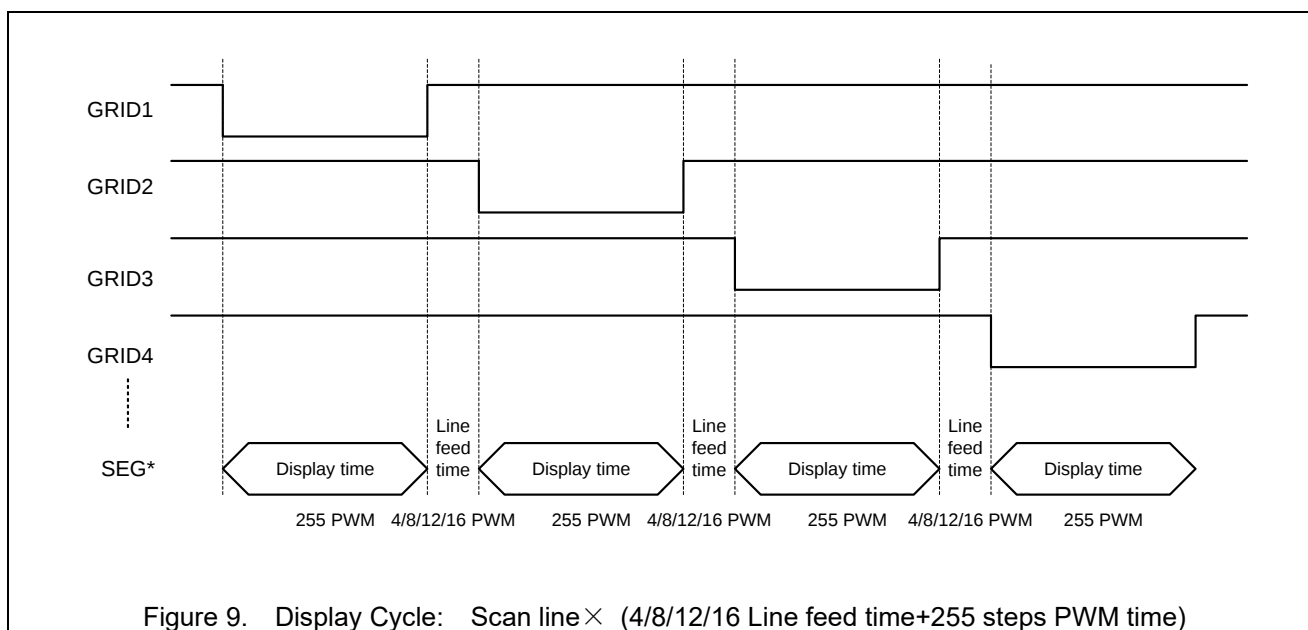
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48H	LED57PWM	49H	LED58PWM	4AH	LED59PWM	4BH	LED60PWM
4CH	LED61PWM	4DH	LED62PWM	4EH	LED63PWM	4FH	LED64PWM
50H	LED65PWM	51H	LED66PWM	52H	LED67PWM	53H	LED68PWM
54H	LED69PWM	55H	LED70PWM	56H	LED71PWM	57H	LED72PWM
58H	LED73PWM	59H	LED74PWM	5AH	LED75PWM	5BH	LED76PWM
5CH	LED77PWM	5DH	LED78PWM	5EH	LED79PWM	5FH	LED80PWM
60H	LED81PWM	61H	LED82PWM	62H	LED83PWM	63H	LED84PWM
64H	LED85PWM	65H	LED86PWM	66H	LED87PWM	67H	LED88PWM
68H	LED89PWM	69H	LED90PWM	6AH	LED91PWM	6BH	LED92PWM
6CH	LED93PWM	6DH	LED94PWM	6EH	LED95PWM	6FH	LED96PWM
70H	LED97PWM	71H	LED98PWM	72H	LED99PWM	73H	LED100PWM
74H	LED101PWM	75H	LED102PWM	76H	LED103PWM	77H	LED104PWM
78H	LED105PWM	79H	LED106PWM	7AH	LED107PWM	7BH	LED108PWM
7CH	LED109PWM	7DH	LED110PWM	7EH	LED111PWM	7FH	LED112PWM
80H	LED113PWM	81H	LED114PWM	82H	LED115PWM	83H	LED116PWM
84H	LED117PWM	85H	LED118PWM	86H	LED119PWM	87H	LED120PWM
88H	LED121PWM	89H	LED122PWM	8AH	LED123PWM	8BH	LED124PWM
8CH	LED125PWM	8DH	LED126PWM	8EH	LED127PWM	8FH	LED128PWM
90H	LED129PWM	91H	LED130PWM	92H	LED131PWM	93H	LED132PWM
94H	LED133PWM	95H	LED134PWM	96H	LED135PWM	97H	LED136PWM
98H	LED137PWM	99H	LED138PWM	9AH	LED139PWM	9BH	LED140PWM
9CH	LED141PWM	9DH	LED142PWM	9EH	LED143PWM	9FH	LED144PWM

Note: Each address has 8bits of data corresponding to the PWM order of that point (256 steps).

The default value for each set of registers is 00H.

Display cycle



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Absolute Maximum Ratings

(Unless otherwise noted , $T_A=25^{\circ}\text{C}$)

Symbol	Characteristic	Rating	Unit
V_{DD}	Supply Voltage	-0.5~6.0	V
V_I	Input Voltage	-0.5~ $V_{DD}+0.5$	V
I_{O1}	LED SEG Drive Output Current	-55	mA
I_{O2}	LED GRID Drive Output Current	660	mA
P_{DMAX}	Power Dissipation (QFN32)	1400	mW
	Power Dissipation (SOP32)	900	
	Power Dissipation (LQFP32)	700	
θ_{JA}	Thermal Resistance (QFN32)	41	$^{\circ}\text{C/W}$
	Thermal Resistance (SOP32)	70	
	Thermal Resistance (LQFP32)	89	
T_J	Junction Temperature	-40~150	$^{\circ}\text{C}$
T_{STG}	Storing Temperature	-65~150	$^{\circ}\text{C}$
ESD	HBM	± 2	KV
	CDM	± 1	KV

Recommended Operating Conditions

Symbol	Characteristic	Min	Typ	Max	Unit
V_{DD}	Supply voltage	4.5	5	5.5	V
V_{IH}	Logic high level	$0.6V_{DD}$	—	V_{DD}	V
V_{IL}	Logic low level	0	—	$0.25V_{DD}$	V
T_A	Operating Temperature	-40		+85	$^{\circ}\text{C}$

Electrical Characteristics

(Unless otherwise noted, $V_{DD}=5\text{V}$, $T_A=25^{\circ}\text{C}$)

Symbol	Characteristic	Condition	Min	Typ	Max	Unit
V_{DD}	Supply voltage			5.0		V
V_{IH}	Logic high level	SCL, SDA	$0.6 \times V_{DD}$		V_{DD}	V
V_{IL}	Logic low level	SCL, SDA	0		$0.25 \times V_{DD}$	V
I_I	Input current	SDA, SCL: $V_I = V_{DD}$	-	-	± 1	μA
I_{OH}	LED SEG drive output current	Default set is 30mA, SEGN, $V_O = V_{DD} - 1\text{V}$	-27	-30	-33	mA
I_{OL}	LED GRID drive output current	GRIDn, $V_O = 0.5\text{V}$	600		-	mA
I_{DD}	Dynamic current Dissipation	No load, Display off		3		mA
V_{RST}	Reset voltage			2.3		V
I_{SD}	Shutdown current			2	8	μA

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Switching Characteristics

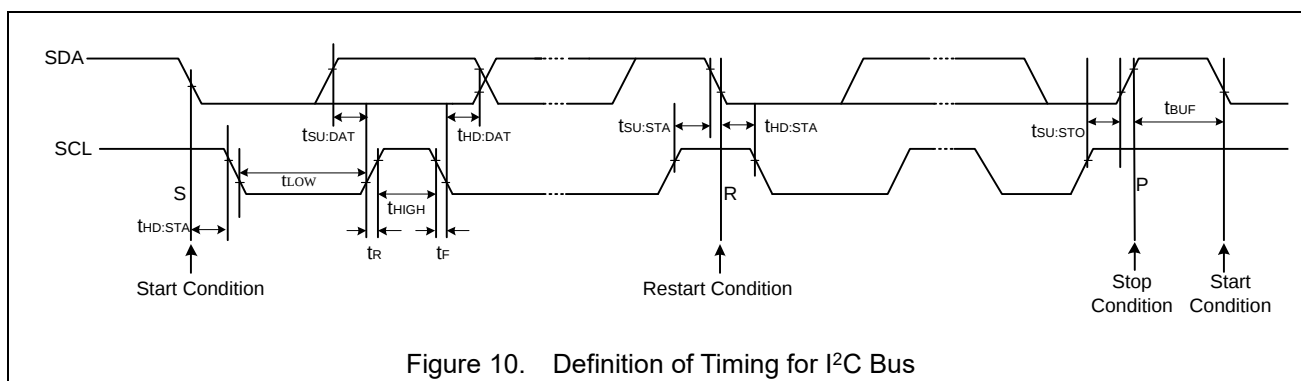
Symbol	Characteristic	Condition	Min	Typ	Max	Unit
T_{TZH}	SEGN Rising Time	$C_L=300pF, R_L=1K$			0.5	μs
T_{THZ}	GRIDn Falling Time	$C_L=300pF$			120	μs
C_I	Input capacitance	SDA , SCL			15	pF

I²C Timing Specifications

Symbol	Parameter	Min	Typ	Max	Unit
F_{SCL}	SCL Clock Frequency	0	-	400	KHz
t_{BUF}	Bus Free Time Between a STOP and START Condition	1.3	-	-	μs
$t_{HD:STA}$	Hold Time(Repeated) START Condition	0.6	-	-	μs
t_{LOW}	Low Period of SCL Clock	1.3	-	-	μs
t_{HIGH}	HIGH Period of SCL Clock	0.6	-	-	μs
$t_{SU:STA}$	Setup Time for a Repeated START Condition	0.6	-	-	μs
$t_{HD:DAT}$	Data Hold Time	0.1	-	0.9	μs
$t_{SU:DAT}$	Data Setup Time	100	-	-	ns
t_R	Data Hold Time2	-	$20+0.1Cb^{(1)}$	300	ns
t_F	Data Hold Time2	-	$20+0.1Cb^{(1)}$	300	ns
$t_{SU:STO}$	Setup Time for STOP Condition	0.6	-	-	μs

Note1: Cb=total capacitance of one bus line in PF unit.

I²C Timing Waveform



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Application circuit

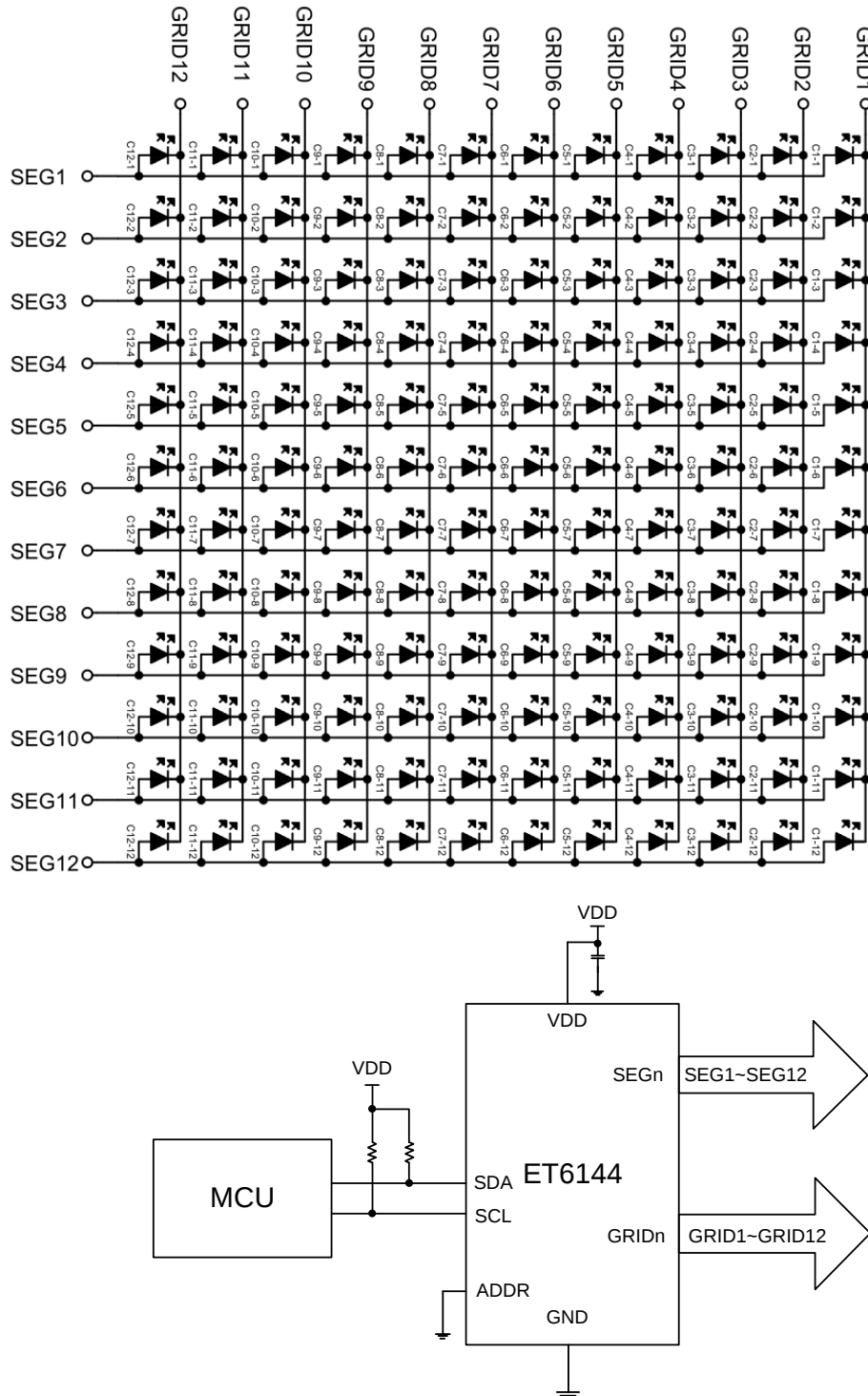


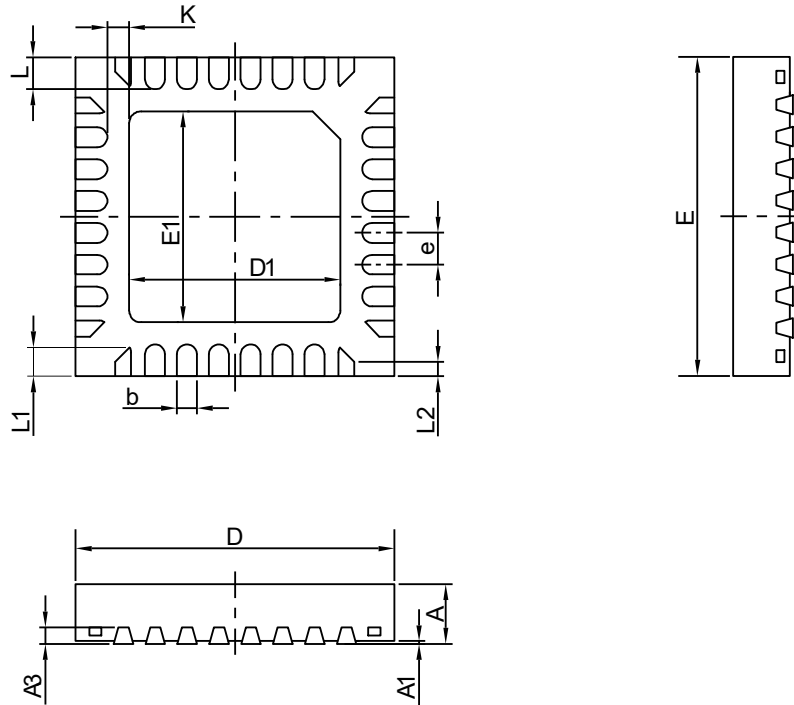
Figure 11. 12×12 LED Matrix Display Application Circuit

Note: This application circuit is only for reference.

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Package

QFN32

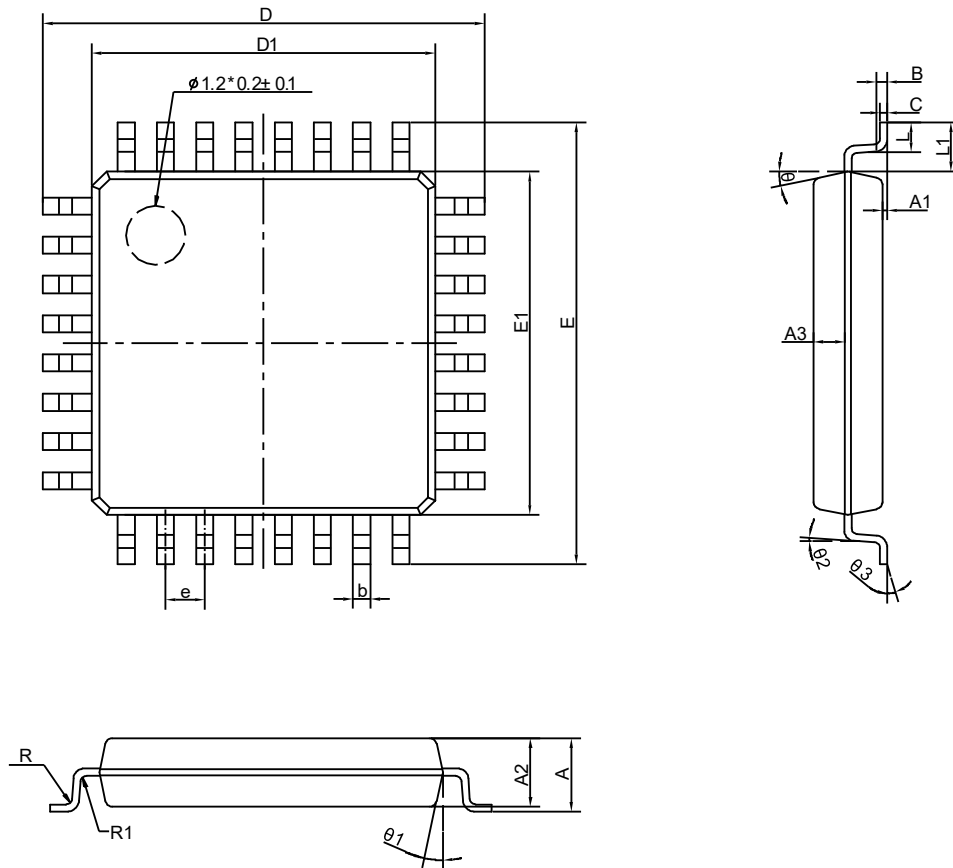


COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0.00	--	0.05
A3	0.203REF		
b	0.15	0.20	0.25
D	3.90	4.00	4.10
E	3.90	4.00	4.10
D1	2.55	2.65	2.75
E1	2.55	2.65	2.75
e	0.40TYP		
K	0.20	--	--
L	0.30	0.40	0.50
L1	0.31	0.36	0.41
L2	0.13	0.18	0.23

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LQFP32

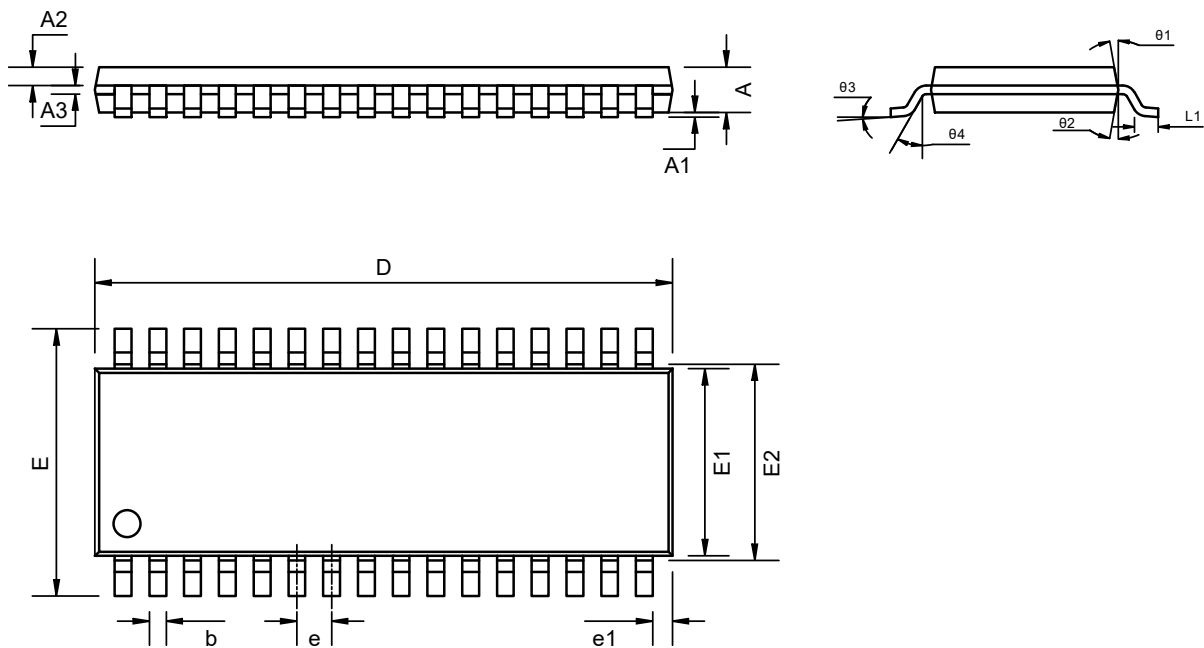


COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	MAX	SYMBOL	MIN	MAX
A	--	1.60	E1	6.90	7.10
A1	0.05	0.15	e	0.80TYP	
A2	1.35	1.45	L	0.50	0.80
A3	0.64TYP		L1	1.00BSC	
B	0.25TYP		θ	12° TYP	
b	0.32	0.43	θ_1	12° TYP	
C	0.127	0.16	θ_2	4° TYP	
D	8.80	9.20	θ_3	0° ~ 8°	
D1	6.90	7.10	R	0.15TYP	
E	8.80	9.20	R1	0.12TYP	

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SOP32

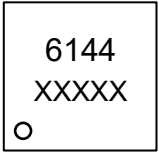


COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

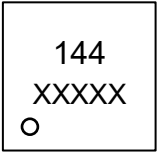
SYMBOL	MIN	MAX	SYMBOL	MIN	MAX
A	2.14	2.34	E2	8.9TYP	
A1	0.10	0.25	e	1.27TYP	
A2	0.99TYP		e1	0.77TYP	
A3	0.20	0.32	L1	0.55	0.95
b	0.3	0.5	θ1	8°TYP	
D	20.88	21.08	θ2	15°TYP	
E	10.2	10.6	θ3	4°TYP	
E1	7.42	7.62	θ4	14°TYP	

Marking

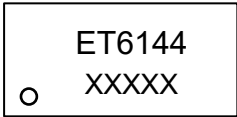
ET6144Q



ET6144Y



ET6144M



XXXXX=Tracking Number

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Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2021-06-09	Original Version	Shi Liang Jun	Shi Liang Jun	Zhu Jun Li
1.1	2022-11-15	Update form	Lvyj	Shi Liang Jun	Shi Bo
1.2	2023-9-8	VIH to 0.6VDD	Shibo	Li Chen Xuan	Shi Bo
1.3	2024-6-17	Add description of 00H register	Shibo	Li Chen Xuan	Shi Bo