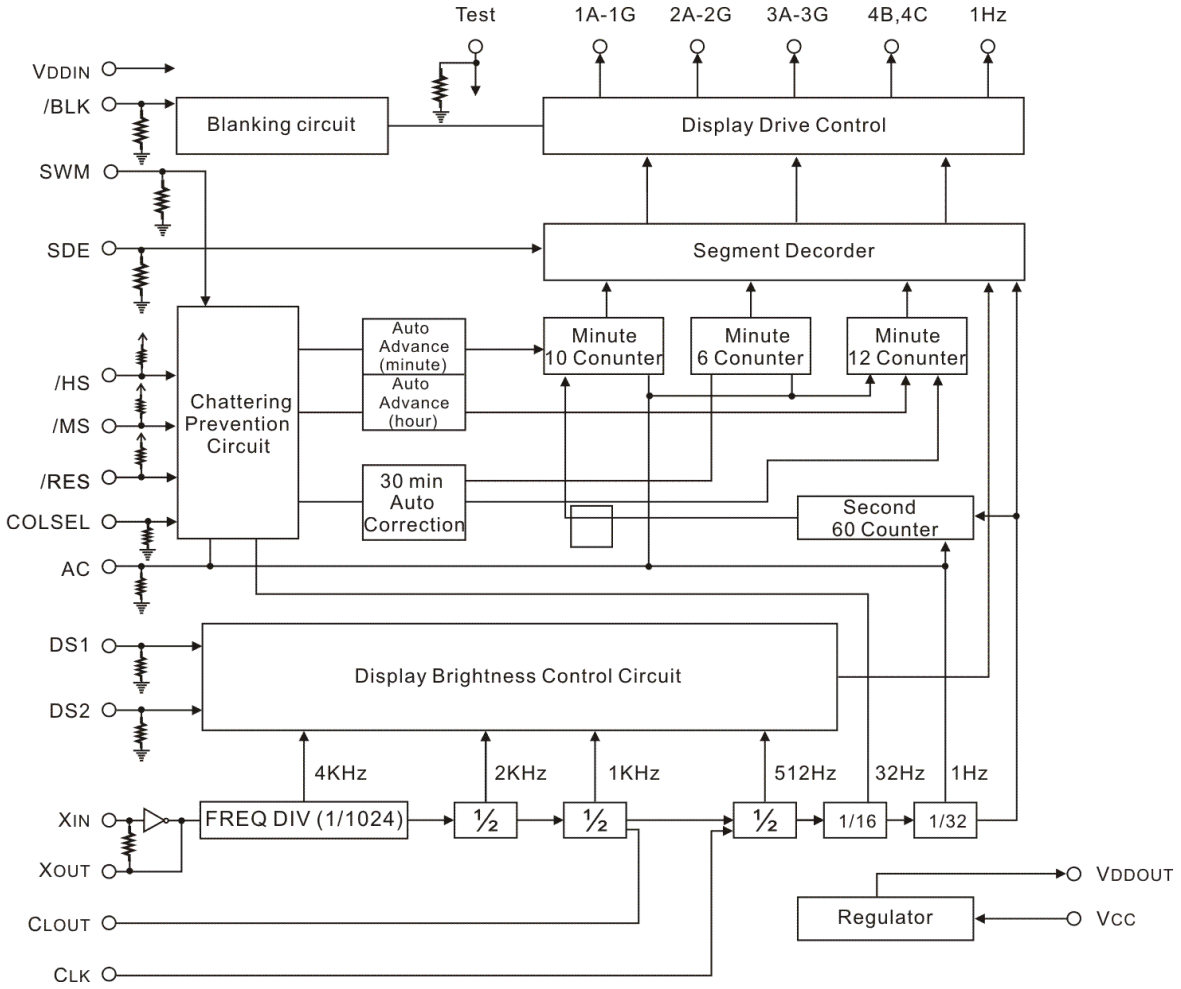
# DESCRIPTION

PT6398 is an automotive digital clock CMOS LSI. It drives fluorescent indicator panel directly. It can be driven by a 4.194304MHz crystal oscillator or an external clock signal (1024Hz). It has 4-ways display brightness control function and its display format is 12 hours.

# FEATURES

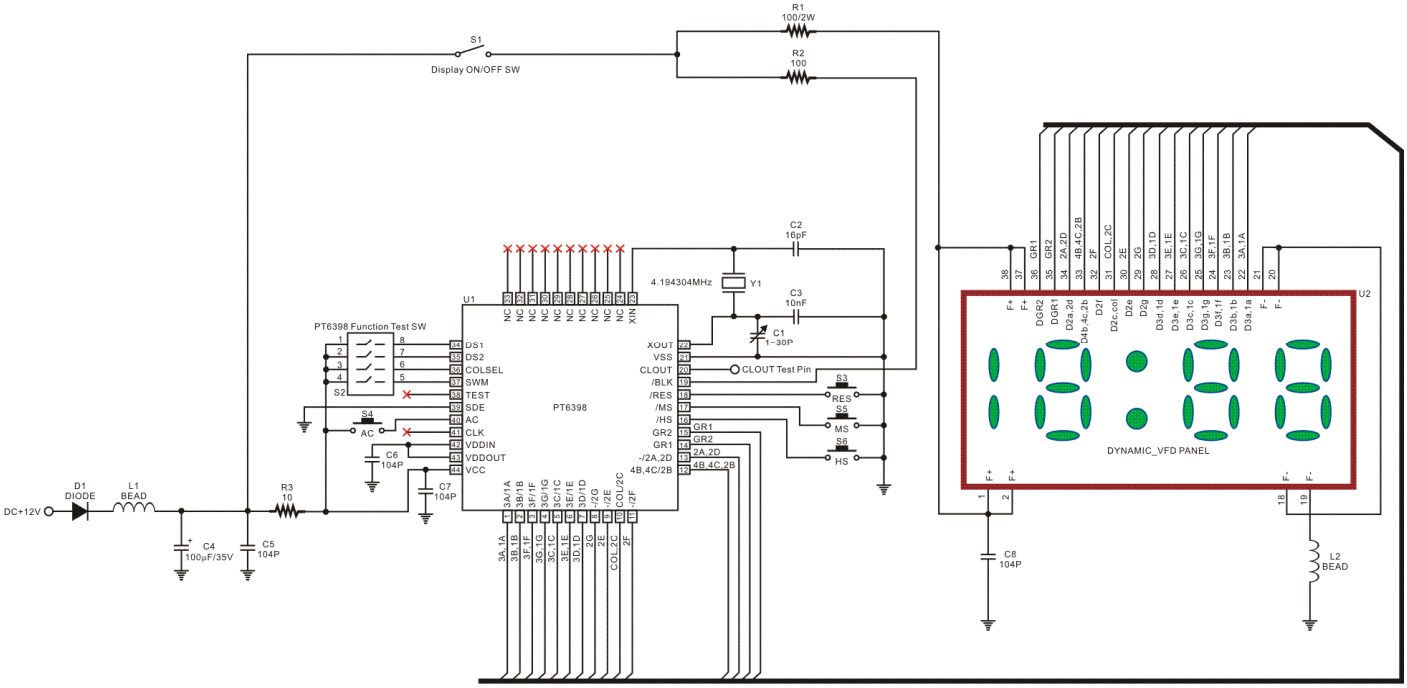
- 4.194304MHz crystal oscillator
- 4-ways display brightness control (Segment duty for Static: 1, 1/4, 1/8, 1/16; Grid duty for dynamic: 6.25%, 12.5%, 25%, 50%)
- Hour and Minutes setting
- ±30 Minutes auto correction
- 1024Hz signal output
- Segment output: CMOS output
- Internal POR (Power on Reset Circuit)
- 44 pin LQFP
- Static and dynamic driving selected

# BLOCK DIAGRAM

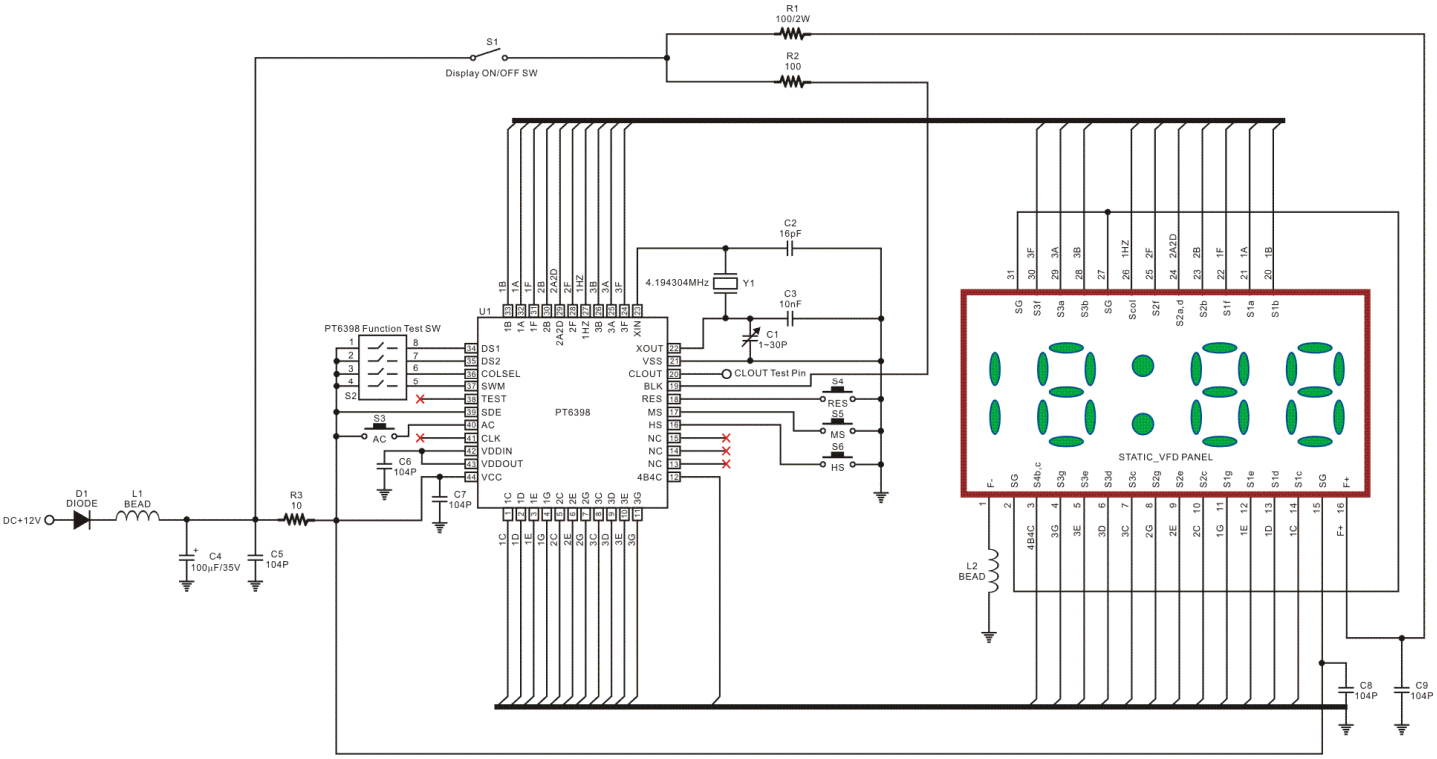


# APPLICATION CIRCUITS

## *DYNAMIC MODE*



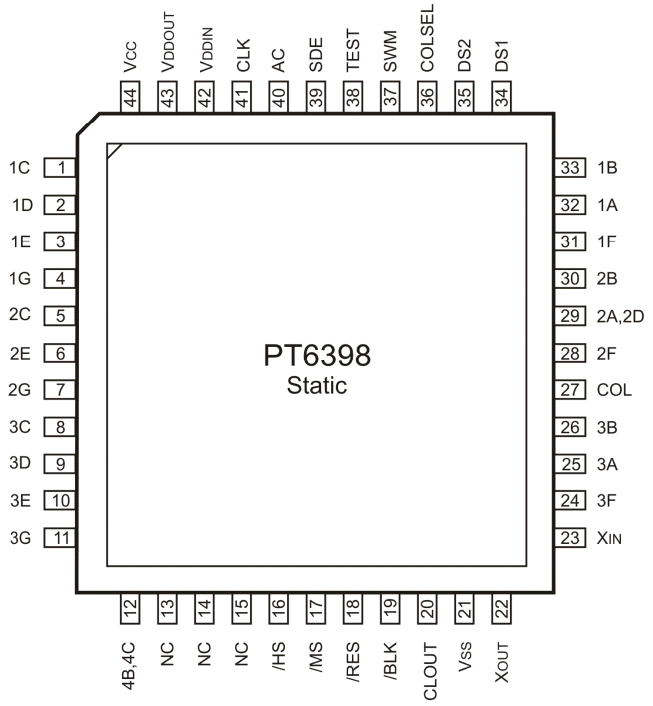

## *STATIC MODE*

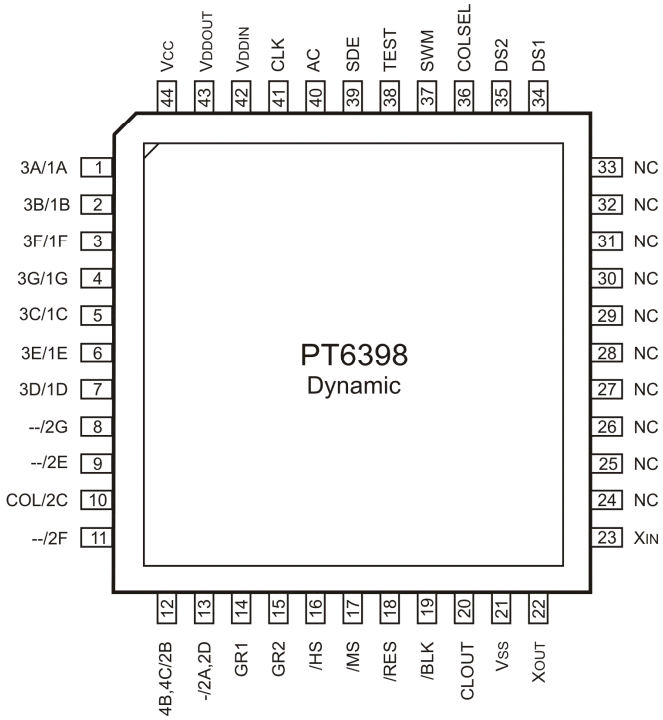


# ORDER INFORMATION

| Valid Part Number | Package Type | Top Code |
|---|---|---|
| PT6398-LQ | 44 Pins, LQFP | PT6398-LQ |

# PIN CONFIGURATION

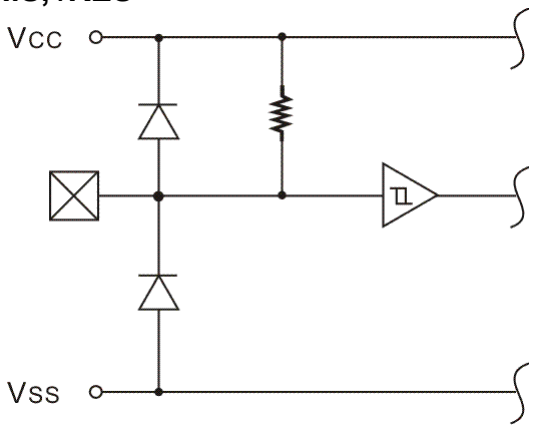


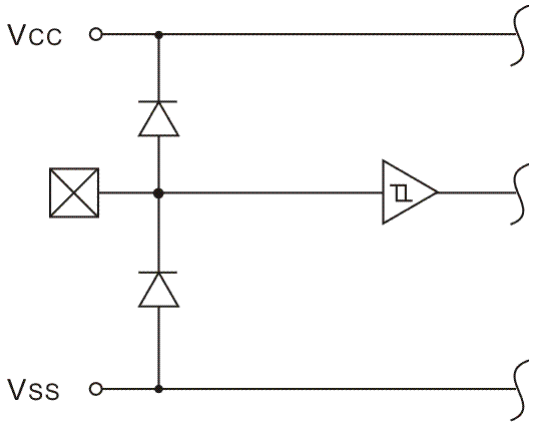
| Pin Name | I/O | Description | Pin No. |
|---|---|---|---|
| 2A, 2D | O | STATIC SEGMENT OUTPUT | |
| NC | - | NO CONNECT | |
| 2B | O | STATIC SEGMENT OUTPUT | |
| NC | - | NO CONNECT | |
| 1F | O | STATIC SEGMENT OUTPUT | |
| NC | - | NO CONNECT | |
| 1A | O | STATIC SEGMENT OUTPUT | |
| NC | - | NO CONNECT | |
| 1B | O | STATIC SEGMENT OUTPUT | |
| NC | - | NO CONNECT | |
| DS1, DS2 | I | DIMMER INPUT1, DIMMER INPUT2<br>This PIN controls the brightness of FIP.<br>Duty of segment & GRID output is determined depend on the level of DS1, DS2 | 34, 35 |
| COLSEL | I | This is the input pin for selecting flashing or lighting of the colon output | 36 |
| SWM | I | SWITCH MODE SELECT PIN | |
| TEST | I | TEST PIN | |
| SDE | I | STATIC DYNAMIC DRIVING SELECT PIN | |
| AC | I | RESET INPUT (POWER ON RESET INPUT PIN) | |
| CLK | I | External Clock Input, only test mode.<br>External clock of 1024Hz frequency can drive the IC operation | |
| $V_{DDIN}$ | I | This pin is logic power supply input pin | |
| $V_{DDOUT}$ | O | This pin is regulator voltage output | |
| $V_{CC}$ | I | POWER SUPPLY INPUT PIN | |

# *INPUT/OUTPUT PORT CONFIGURATIONS*

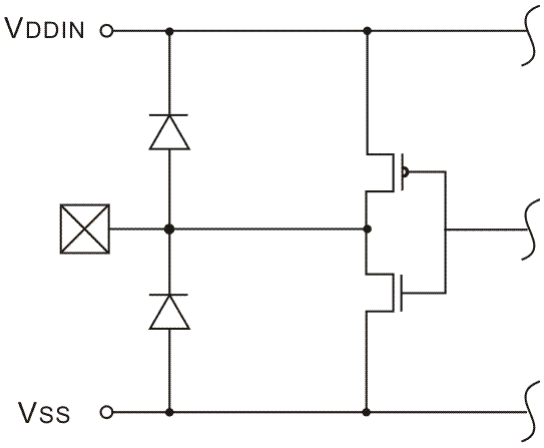
**INPUT PIN (PULL UP): /HS, /MS, /RES**



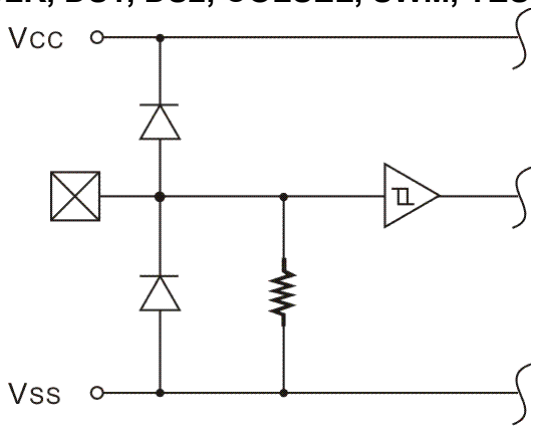

**INPUT PIN: CLK**



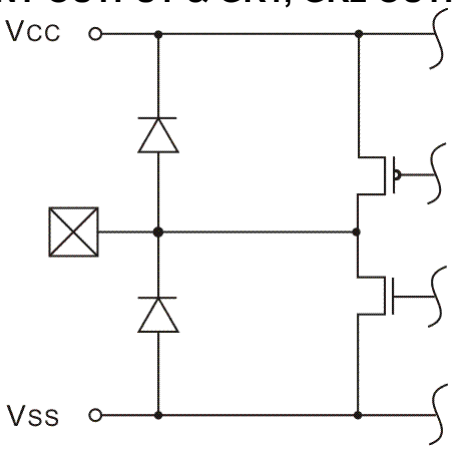

**LOGIC OUTPUT: CLOUT**



**INPUT PIN (PULL DOWN): /BLK, DS1, DS2, COLSEL, SWM, TEST, SDE, AC**




**DRIVER OUTPUT: ALL SEGMENT OUTPUT & GR1, GR2 OUTPUT, COL**



# FUNCTION DESCRIPTION

## *VFD DISPLAY ENABLE SIGNAL*

### /MS:
/MS=High, disable.
/MS=Low, enable, one push counts one minute, when continuously pushed, minute is incremented at 0.5S.

### /HS:
/HS=High, disable.
/HS=Low, enable, one push counts one hour, when continuously pushed, hour is incremented at 0.5S.

### /RES:
/RES =High, not reset.
/RES =Low, if the minute digits is less than 30 minutes, the minute and second digits are reset to 00.
Also if the minute digits exceed 30 minutes, the minute and second digits are reset to 00, and the hour digits are carried over.

### SDE:
SDE=H, static driving mode, duty of segment output is determined depend on the DS1, DS2.

| DS2 | DS1 | Segment duty |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 1/4 |
| 1 | 0 | 1/8 |
| 1 | 1 | 1/16 |

SDE=L, dynamic driving mode, duty of Grid 1 and Grid 2 is determined depend on the DS1, DS2.

| DS2 | DS1 | Grid duty |
|---|---|---|
| 0 | 0 | 50% |
| 0 | 1 | 25% |
| 1 | 0 | 12.5% |
| 1 | 1 | 6.25% |

COLSEL: Colon Flashing/Lighting select Function.

| COLSEL | Mode |
|---|---|
| L | Flashing at 1Hz |
| H | Lighting |

### SWM:
SWM=L, /HS, /MS is used, when push /MS, second is reset to “00”.
SWM=H, /HS, /MS, /RES is used, when push /RES, second is reset to “00”.

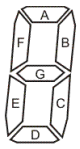
### AC:
AC=L, normal.
AC=H, reset. After reset, the display starts at “1:00”.

### $V_{DDOUT}$:
Built-in regulator output pin for logic circuits, connect the pin to the $V_{DDIN}$ pin.

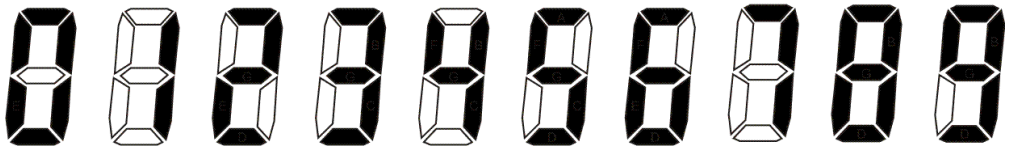
### $V_{DDIN}$:
Power supply pin for logic circuits, connect the pin to the $V_{DDOUT}$ pin.

# *SEGMENT FORMENT*

## DYNAMIC DISPLAY

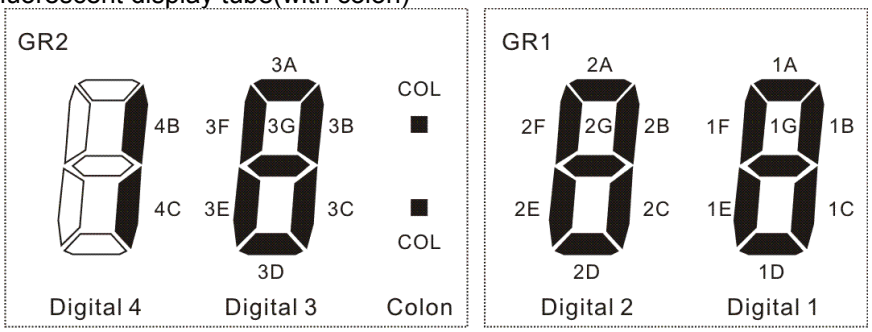



(7 Segments)

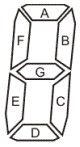


## DISPLAY DEVICE

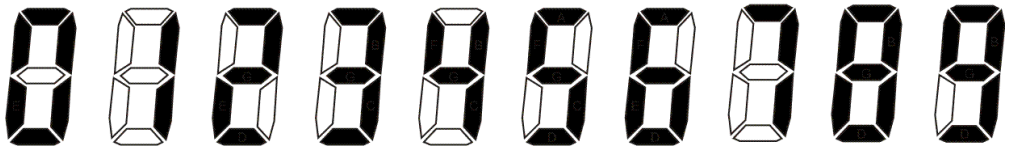
Dynamic drive 4-digit fluorescent display tube(with colon)




## STATIC DISPLAY

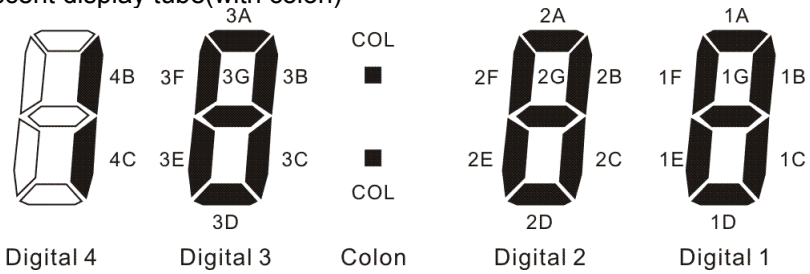



(7 Segments)



## DISPLAY DEVICE

Static drive 4-digit fluorescent display tube(with colon)



# ABSOLUTE MAXIMUM RATINGS

(Unless otherwise specified, Ta=25℃)

| Parameter | Symbol | Condition | Rating | Unit |
|---|---|---|---|---|
| Power supply voltage 1 | Vcc | High voltage power | -0.3 ~ +20 | V |
| Power supply voltage 2 | $V_{DDIN}$ | Logic power | -0.3 ~ +6.5 | V |
| Input voltage | $V_{HI}$ | High voltage input | -0.3 ~ $V_{cc}$+0.3 | V |
| | $V_{LI}$ | Logic input | -0.3 ~ $V_{DDIN}$+0.3 | V |
| Output voltage | $V_{HO}$ | High voltage output | -0.3 ~ $V_{CC}$+0.3 | V |
| | $V_{LO}$ | Logic output | -0.3 ~ $V_{DDIN}$+0.3 | V |
| Operating temperature | Topr | | -40~+85 | ℃ |
| Storage temperature | Tstg | | -55~+125 | ℃ |

# RECOMMEND OPERATING CONDITIONS

(Unless otherwise specified, Ta=25℃)

| Parameter | Symbol | Rating | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Power supply voltage (High voltage) | $V_{CC}$ | 4.0 | 12.0 | 18.0 | V |
| Power supply voltage (Logic) | $V_{DDIN}$ | 2.8 | 3.2 | 3.6 | V |
| Crystal frequency | f(X'tal) | 4.194304 | | | MHz |

# DC ELECTRONIC CHARACTERISTICS

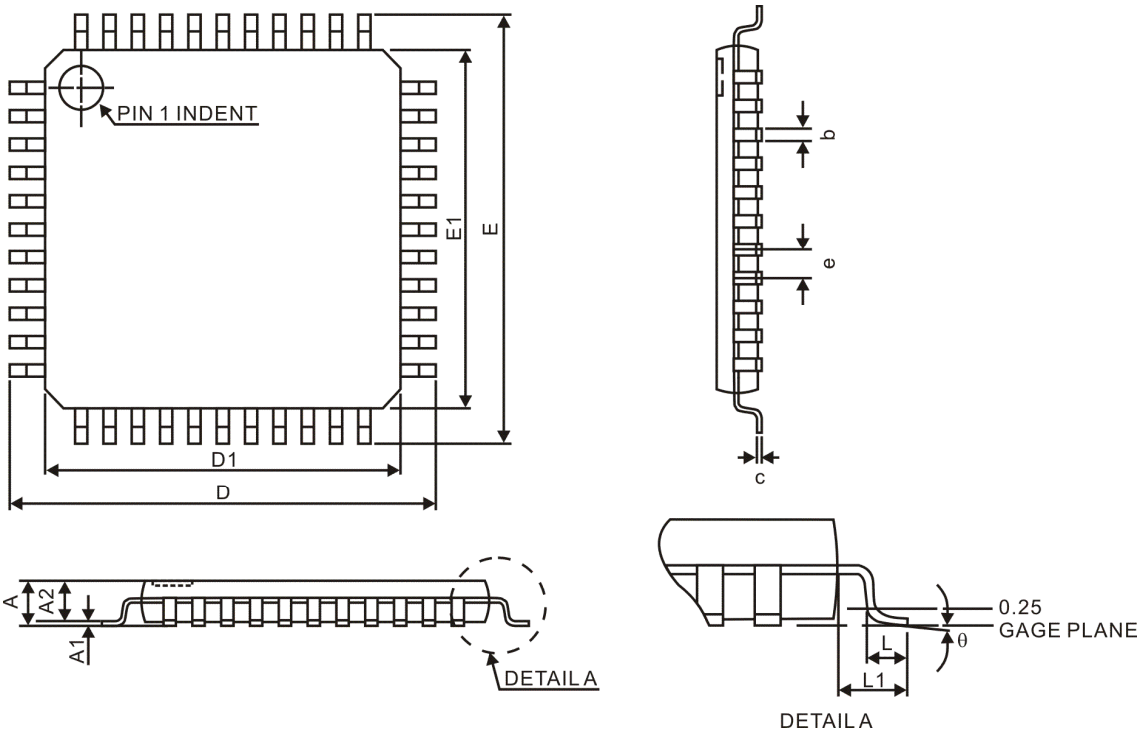
($V_{CC}$=4.0~18.0V, $V_{DDIN}$=2.8~3.6V, Ta=-40~85℃)

| Parameter | | Applicable pin | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|---|
| "H" input voltage | | *1 | VIH | $V_{CC}$=4~18V | 0.8$V_{CC}$ | - | - | V |
| "L" input voltage | | *1 | VIL | $V_{CC}$=4~18V | - | - | 0.2$V_{CC}$ | V |
| Input current | | /BLK, DS1, DS2, COLSEL,SWM, TEST, SDE, AC | $I_{IH1}$ | $V_{CC}$=12V $V_{IN}$=$V_{CC}$ | 20 | 65 | 200 | μA |
| | | | $I_{IL1}$ | $V_{CC}$=12V $V_{IN}$=OV | -2 | - | 2 | μA |
| | | /HS, /MS, /RES | $I_{IH2}$ | $V_{CC}$=12V $V_{IN}$=$V_{CC}$ | -2 | - | 2 | μA |
| | | | $I_{IL2}$ | $V_{CC}$=12V $V_{IN}$=0V | -20 | -65 | -200 | μA |
| | | CLK | $I_{IH3}$ | $V_{CC}$=12 $V_{IN}$=$V_{CC}$ | -2 | - | 2 | μA |
| | | | $I_{IL3}$ | $V_{CC}$=12V $V_{IN}$=0V | -2 | - | 2 | μA |
| Output voltage | | Pin 1~13 Pin 24~33 | $V_{OH1}$ | $V_{CC}$=12V $I_{OH1}$=-2mA | $V_{CC}$ -2V | - | - | V |
| | | | $V_{OL1}$ | $V_{CC}$=12V $I_{OL1}$=0.55mA | - | - | 2 | V |
| | | Pin 14~15 | $V_{OH2}$ | $V_{CC}$=12V $I_{OH2}$=-15mA | $V_{CC}$ -2V | - | - | V |
| | | | $V_{OL2}$ | $V_{CC}$=12V $I_{OL2}$=0.55mA | - | - | 2 | V |
| | | CLOUT | $V_{OH3}$ | $V_{DDIN}$=3.0V $I_{OH3}$=-0.1mA | $V_{DDIN}$ -0.5V | - | - | V |
| | | | $V_{OL3}$ | $V_{DDIN}$=3.0V $I_{OL3}$=0.1mA | - | - | 0.5 | V |
| Supply current | Dynamic mode | Vcc | $I_{CCd}$ | *2 | 100 | 300 | 500 | μA |
| | Static mode | Vcc | $I_{CCS}$ | *3 | 200 | 400 | 600 | |
| External clock duty | | CLK | - | - | 40 | 50 | 60 | % |
| OSC feedback resistance | | $R_F$ | - | - | - | 1.2 | - | MΩ |

Notes:
1. Application to the following pins: /BLK, SWM, SDE, /HS, /MS, /RES, COLSEL, AC, DS1, DS2
2. F=4.194304MHz, $C_L$ (Loader Capacitance)=16pF, Vcc=12V, connect $V_{DD\ OUT}$ pin to the $V_{DD\ IN}$ pin. Then other input pins open, and non-loaded output.
3. F=4.194304MHz, $C_L$ (Loader Capacitance)=16pF, $V_{CC}$=12V, connect $V_{DD\ OUT}$ pin to the $V_{DD\ IN}$ pin, SDE pin connects to GND. Then other input pins open, and non-loaded output.

# PACKAGE INFORMATION

## *44PINS, LQFP (BODY SIZE: 10MM X 10MM; PITCH=0.80MM; THK BODY: 1.40MM)*




| Symbol | Min. | Nom. | Max |
|---|---|---|---|
| A | - | - | 1.60 |
| A1 | 0.05 | - | 0.15 |
| A2 | 1.35 | 1.40 | 1.45 |
| b | 0.30 | 0.37 | 0.45 |
| D | 11.80 | 12.00 | 12.20 |
| D1 | 9.90 | 10.00 | 10.10 |
| E | 11.80 | 12.00 | 12.20 |
| E1 | 9.90 | 10.00 | 10.10 |
| e | 0.8 BSC | | |
| θ | 0° | 3.5° | 7° |
| c | 0.09 | - | 0.20 |
| L | 0.45 | 0.60 | 0.75 |
| L1 | 1.00 REF. | | |

Notes:
1. Refer to JEDEC STD MS-026
2. All dimensions are in millimeter.

# IMPORTANT NOTICE

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Princeton Technology Corp.
2F, 233-1, Baociao Road,
Sindian, Taipei 23145, Taiwan
Tel: 886-2-66296288
Fax: 886-2-29174598
http://www.princeton.com.tw