

**NSP2080/2170/2340-T06E**

**NSP2080/2170/2340-T16L**

## **Data Sheet**

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## 1. General Description

NSP2340T06E series and NSP2340T16L series are powerful Voice IC with embedded Flash to implement Voice Assistance applications with Cap Touch. It provides hardware I2C, UART and firmware Two-Wire interface to communicate with host MCU, and support In-System-Program (ISP) to update content with high data transition rate. It equips with up to 16 Cap Touch pads, which is suitable for all the voice assistance applications.

The NSP2340T06E series and NSP2340T16L series include 6 part numbers with different durations, shown as following selection guide:

| Part No.    | Package | Duration (S) |       | V <sub>DD</sub> (V) | LVR (V) | Cap Touch | Voice CH | ISP | Audio Output (8Ω, THD+N < 1%) |      | MCU I/F     |          |
|-------------|---------|--------------|-------|---------------------|---------|-----------|----------|-----|-------------------------------|------|-------------|----------|
|             |         | 12KHz        | 16KHz |                     |         |           |          |     | 3.3V                          | 5.5V | H/W         | F/W      |
| NSP2080T06E | TSSOP28 | 96           | 72    | 2.1~5.5             | 1.9     | 6         | 2        | V   | 0.2W                          | 0.5W | I2C<br>UART | Two-Wire |
| NSP2170T06E |         | 177          | 133   |                     |         |           |          |     |                               |      |             |          |
| NSP2340T06E |         | 420          | 315   |                     |         |           |          |     |                               |      |             |          |
| NSP2080T16L | LQFP48  | 96           | 72    |                     |         | 16        |          |     | 0.2W                          | 0.5W |             |          |
| NSP2170T16L |         | 177          | 133   |                     |         |           |          |     |                               |      |             |          |
| NSP2340T16L |         | 420          | 315   |                     |         |           |          |     |                               |      |             |          |

## 2. Features

- Operating voltage : 2.1 ~ 5.5V
- Operating temperature : -40°C ~ 85°C
- Interface with MCU : UART, I2C (Slave), Two-Wire
- Audio output : PWM Output, 0.5 Watt @ 5.5V (THD + N < 1%, 8Ω)
- Provide ISP (In System Program) to update content from Host MCU
- Voice channel : 2-ch Voice
- Cap Touch pin:
  - NSP2080T06E, NSP2170T06E, NSP2340T06E: 6 Cap Touch pins
  - NSP2080T16L, NSP2170T16L, NSP2340T16L: 16 Cap Touch pins
- Cap Touch with auto calibration
- Individual parameter setting for each cap touch pad
- Low Voltage Reset (LVR)
- Flash Data Retention : 10-Year
- Flash Program/Erase Cycling Endurance : 100K
- Package form : TSSOP28, LQFP48
- Package is Halogen-free, RoHS-compliant and TSCA-compliant

### 3. PIN Description

NSP2080T06E / NSP2170T06E / NSP2340T06E

| Pin Name     | I/O   | Function  |
|--------------|-------|---|
| BP00<br>BP01 | I/O   | <ul style="list-style-type: none"> <li>● General input / output pins</li> <li>● BP00, BP01 share with ICPCLK and ICPDATA</li> <li>● Each pin can be set as I2C, UART, Two-Wire interface</li> </ul> |
| BP02         | I/O   | General input / output pin  |
| INT          | O     | Connect to Host MCU GPIO  |
| SINT1        | I/O   | Connect to SINT2 pin for Cap Touch calibration  |
| SINT2        | I/O   | Connect to SINT1 pin for Cap Touch calibration  |
| BP05         | I/O   | Connect with /RESET2  |
| SDA1         | I/O   | Connect to SDA2 pin for Cap Touch calibration   |
| SDA2         | I/O   | Connect to SDA1 pin for Cap Touch calibration   |
| SCLK1        | I/O   | Connect to SCLK2 pin for Cap Touch calibration  |
| SCLK2        | I/O   | Connect to SCLK1 pin for Cap Touch calibration  |
| IP0 ~ IP5    | I     | 6 x Cap Touch input pins  |
| VDD1         | Power | Positive power supply   |
| VDD2         | Power | Positive power supply for Cap Touch   |
| REG1         | Power | Internal regulator for Voice Assistance, 0.1uF capacitor is needed  |
| REG2         | Power | Internal regulator for Cap Touch, 4.7uF capacitor is needed   |
| VSS          | Power | Negative power supply   |
| VSS_SPK      | Power | Negative power supply for speaker driving   |
| PWM+         | O     | PWM driver positive output to drive speaker directly  |
| PWM-         | O     | PWM driver negative output to drive speaker directly  |
| VDD_SPK      | Power | Positive power supply for speaker driving   |
| /RESET1      | I     | IC reset input, low active  |
| /RESET2      | I     | IC reset input, low active  |

Note1: Program pin includes BP00 (ICPCLK), BP01(ICPDATA), /RESET1, VDD1, VSS

Note2: VDD1, VDD2 must have same voltage power input.

VDD\_SPK, VDD1 can have different voltage power input.

## NSP2080T16L / NSP2170T16L / NSP2340T16L

| Pin Name     | I/O   | Function  |
|--------------|-------|---|
| BP00<br>BP01 | I/O   | <ul style="list-style-type: none"> <li>● General input / output pins</li> <li>● BP00, BP01 share with ICPCLK and ICPDATA</li> <li>● Each pin can be set as I2C, UART, Two-Wire interface</li> </ul> |
| BP02         | I/O   | General input / output pin  |
| INT          | O     | Connect to Host MCU GPIO  |
| SINT1        | I/O   | Connect to SINT2 pin for Cap Touch calibration  |
| SINT2        | I/O   | Connect to SINT1 pin for Cap Touch calibration  |
| BP05         | I/O   | Connect with /RESET2  |
| SDA1         | I/O   | Connect to SDA2 pin for Cap Touch calibration   |
| SDA2         | I/O   | Connect to SDA1 pin for Cap Touch calibration   |
| SCLK1        | I/O   | Connect to SCLK2 pin for Cap Touch calibration  |
| SCLK2        | I/O   | Connect to SCLK1 pin for Cap Touch calibration  |
| IP0 ~ IP15   | I     | 16 x Cap Touch input pins   |
| VDD1         | Power | Positive power supply   |
| VDD2         | Power | Positive power supply for Cap Touch   |
| REG1         | Power | Internal regulator for Voice Assistance, 0.1uF capacitor is needed  |
| REG2         | Power | Internal regulator for Cap Touch, 4.7uF capacitor is needed   |
| VSS1         | Power | Negative power supply   |
| VSS2         | Power | Negative power supply for Cap Touch   |
| VSS_SPK      | Power | Negative power supply for speaker driving   |
| PWM+         | O     | PWM driver positive output to drive speaker directly  |
| PWM-         | O     | PWM driver negative output to drive speaker directly  |
| VDD_SPK      | Power | Positive power supply for speaker driving   |
| /RESET1      | I     | IC reset input, low active  |
| /RESET2      | I     | IC reset input, low active  |

Note1: Program pin includes BP00 (ICPCLK), BP01(ICPDATA), /RESET1, VDD1, VSS1

Note2: VDD1, VDD2 must have same voltage power input.

VDD\_SPK, VDD1 can have different voltage power input.

## 4. Electrical Characteristics

### 4.1 Absolute Maximum Ratings

| Parameter       | Symbol          | Conditions | Rated Value                                  | Unit |
|-----------------|-----------------|------------|--|------|
| Input Voltage   | V <sub>IN</sub> | All Inputs | V <sub>SS</sub> -0.3 to V <sub>DD</sub> +0.3 | V    |
| Storage Temp.   | TSTG            | -          | -55 to +150                                  | °C   |
| Operating Temp. | TOPR            | -          | -40 to +85                                   | °C   |

Noted: Exposure to conditions beyond those listed under the absolute Maximum ratings table may adversely affect the life and reliability of the device.

### 4.2 D.C. Characteristics

(V<sub>DD</sub> – V<sub>SS</sub> = 4.5V, T<sub>A</sub> = 25° C, No Load unless otherwise specified)

| Parameter                              | Sym              | Conditions                                    | Min                 | Typ  | Max                 | Unit |
|--|------------------|---|---------------------|------|---------------------|------|
| Operating Voltage                      | V <sub>DD</sub>  |   | 2.1                 | -    | 5.5                 | V    |
| Operating Current                      | I <sub>OP1</sub> | No load                                       | -                   | 5    | -                   | mA   |
| Standby Current                        | I <sub>SB</sub>  | No load                                       | -                   | -    | 2                   | μA   |
| Standby Current with Cap Touch         | I <sub>SB</sub>  | VDD:3.0V, 1 cap touch                         | -                   | 3.5  | 4.0                 | μA   |
|  |                  | VDD: 3.0V, 2 cap touch                        | -                   | 3.8  | 4.4                 | μA   |
|  |                  | VDD: 3.0V, 3 cap touch                        | -                   | 4.1  | 4.7                 | μA   |
|  |                  | VDD: 3.0V, 5 cap touch                        | -                   | 4.8  | 5.6                 | μA   |
|  |                  | VDD: 3.0V, 10 cap touch                       | -                   | 6.6  | 7.7                 | μA   |
|  |                  | VDD: 3.0V, 16 cap touch                       | -                   | 8.6  | 10.1                | μA   |
|  |                  | VDD:5.5V, 1 cap touch                         | -                   | 5.9  | 6.9                 | μA   |
|  |                  | VDD: 5.5V, 2 cap touch                        | -                   | 7.4  | 8.7                 | μA   |
|  |                  | VDD: 5.5V, 3 cap touch                        | -                   | 9.0  | 10.6                | μA   |
|  |                  | VDD: 5.5V, 5 cap touch                        | -                   | 10.7 | 12.6                | μA   |
|  |                  | VDD: 5.5V, 10 cap touch                       | -                   | 16.6 | 19.7                | μA   |
|  |                  | VDD: 5.5V, 16 cap touch                       | -                   | 19   | 22.6                | μA   |
| Input Low Voltage                      | V <sub>IL</sub>  | All input pins                                | V <sub>SS</sub>     | -    | 0.3 V <sub>DD</sub> | V    |
| Input High Voltage                     | V <sub>IH</sub>  | All input pins                                | 0.7 V <sub>DD</sub> | -    | V <sub>DD</sub>     | V    |
| Pull High resistor<br>BP00, BP01, BP02 | RPH              | VDD = 4.5V                                    | 105K                | 150K | 195K                | Ω    |
| Output Current<br>BP00, BP01, BP02     | I <sub>OL</sub>  | V <sub>DD</sub> = 3V, V <sub>OUT</sub> = 0.4V | 8                   | -    | -                   | mA   |
|  | I <sub>OH</sub>  | V <sub>DD</sub> = 3V, V <sub>OUT</sub> = 2.6V | -4                  | -    | -                   | mA   |

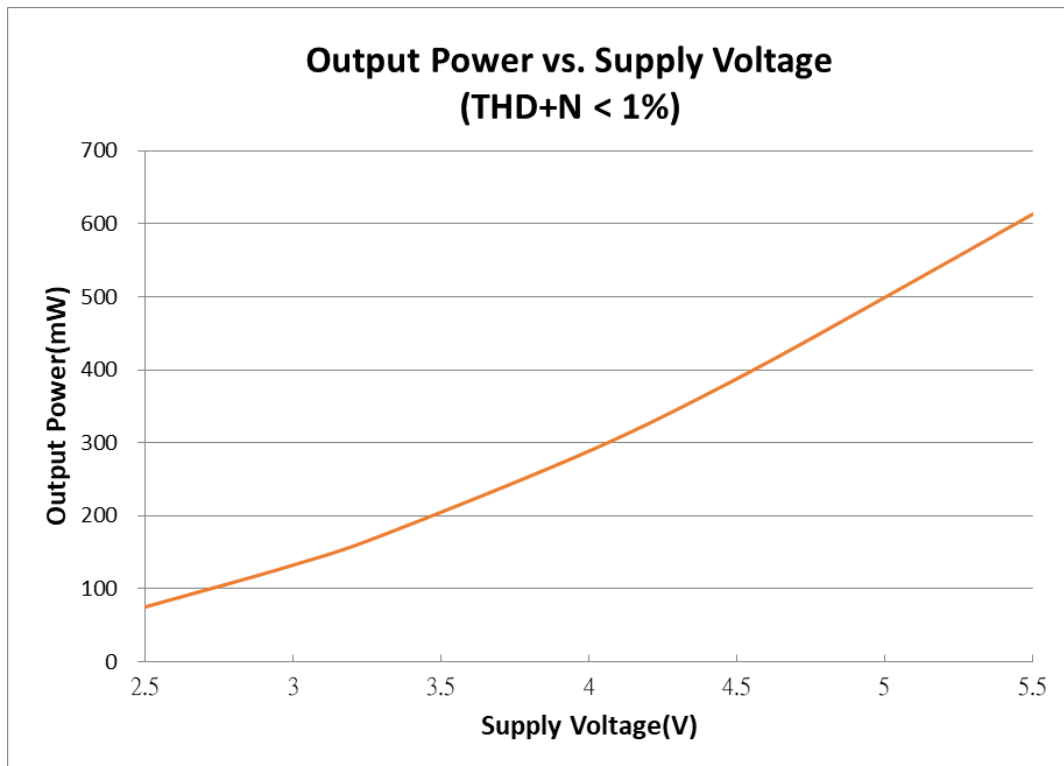
**4.3 A.C. Characteristics**

(VDD = 4.5V, TA = 25°C, No Load unless otherwise specified)

| Parameter                           | Sym          | Conditions                             | Min | Typ | Max | Unit |
|-------------------------------------|--------------|--|-----|-----|-----|------|
| Frequency Deviation by Voltage Drop | $\Delta F/F$ | (Fmax – Fmin)/Fmin<br>@VDD: 2.1 ~ 5.5V | -   | -   | 3   | %    |

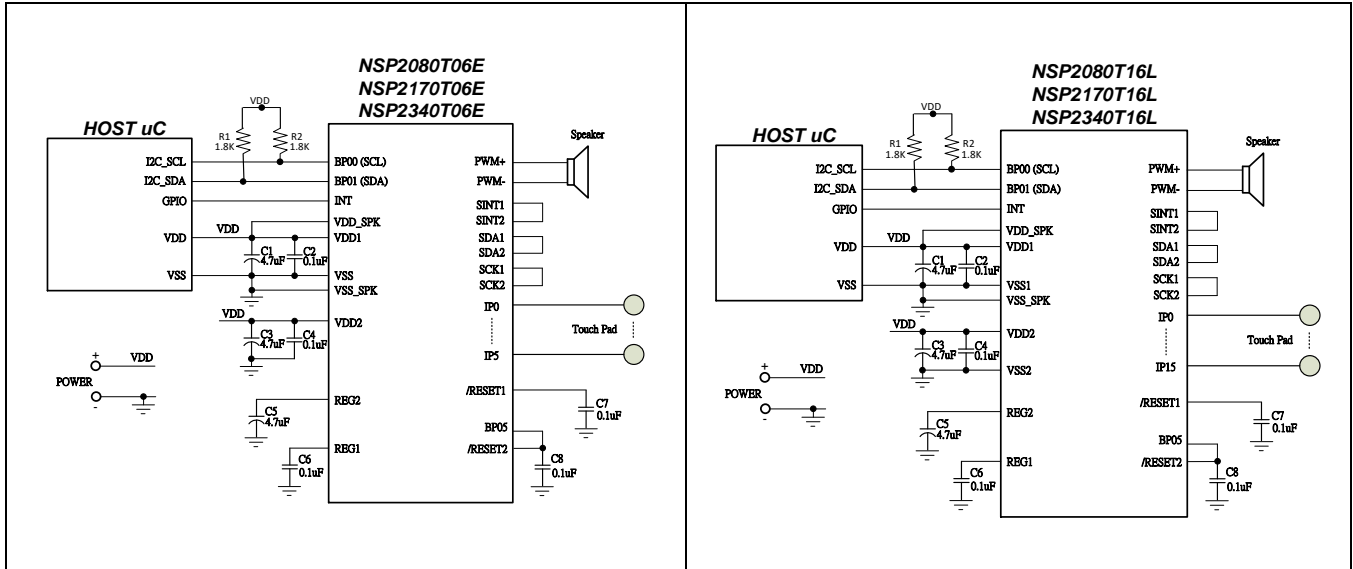
**4.4 Output Power**

Frequency Input = 1KHz Sine Wave, RL=8Ω, THD+N < 1%

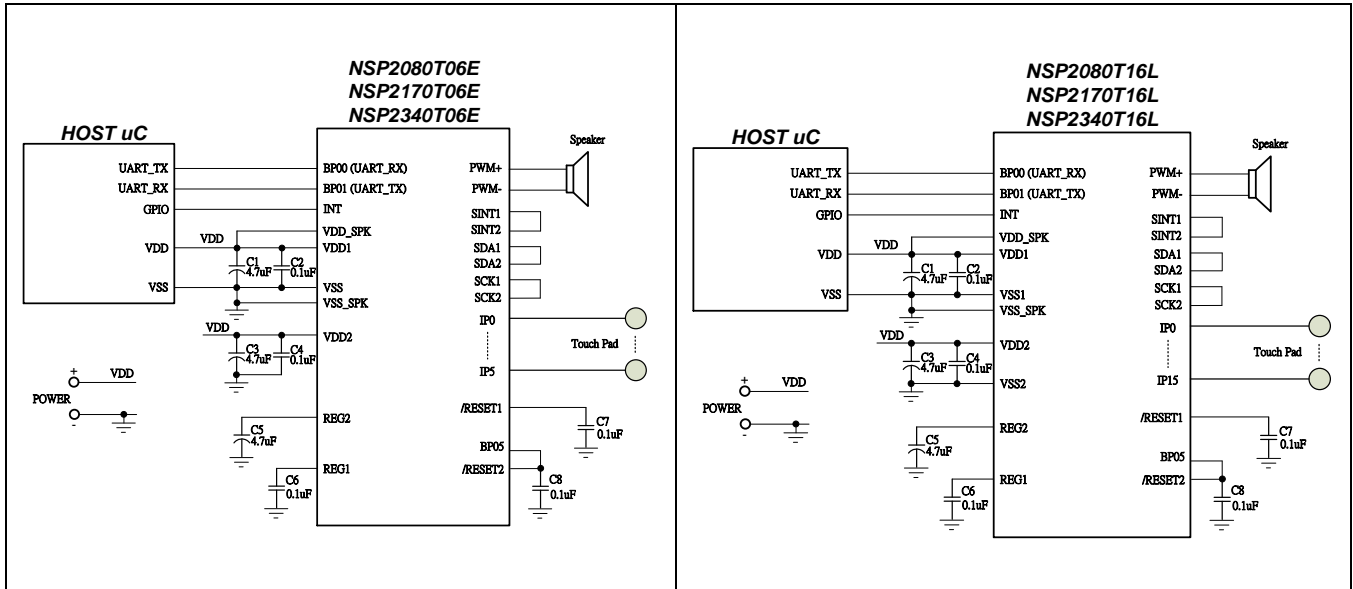


## 5. Typical Application Circuit

### 5.1 Connect to Host uC by I2C Interface

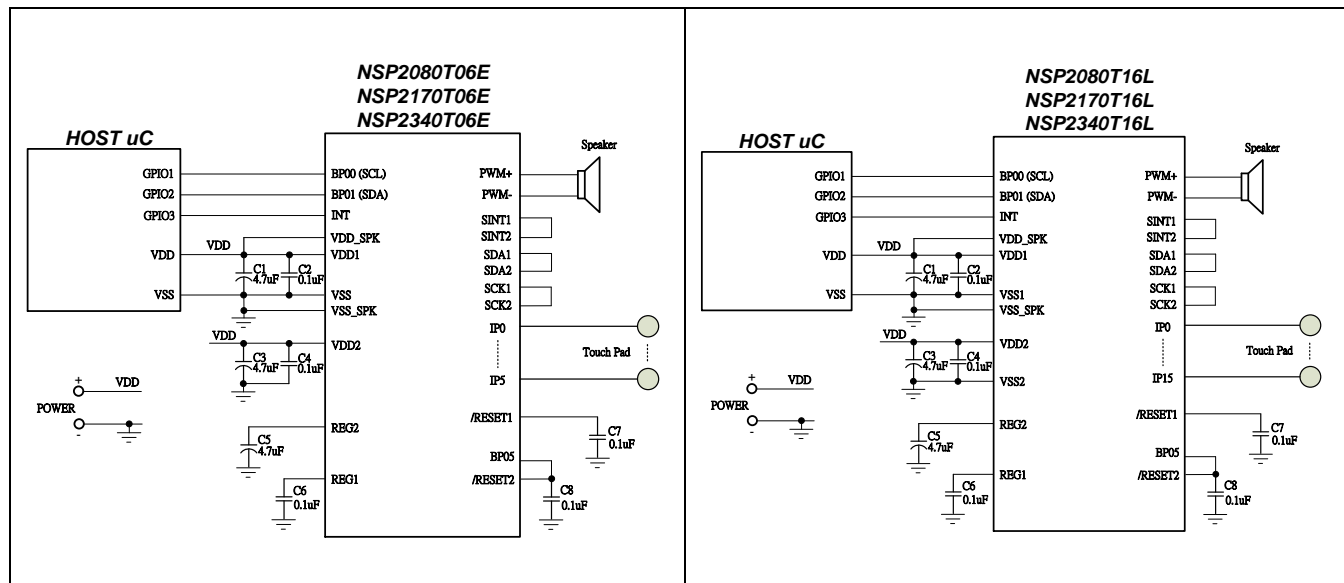


### 5.2 Connect to Host uC by UART Interface





### 5.3 Connect to Host uC by Two-Wire Interface

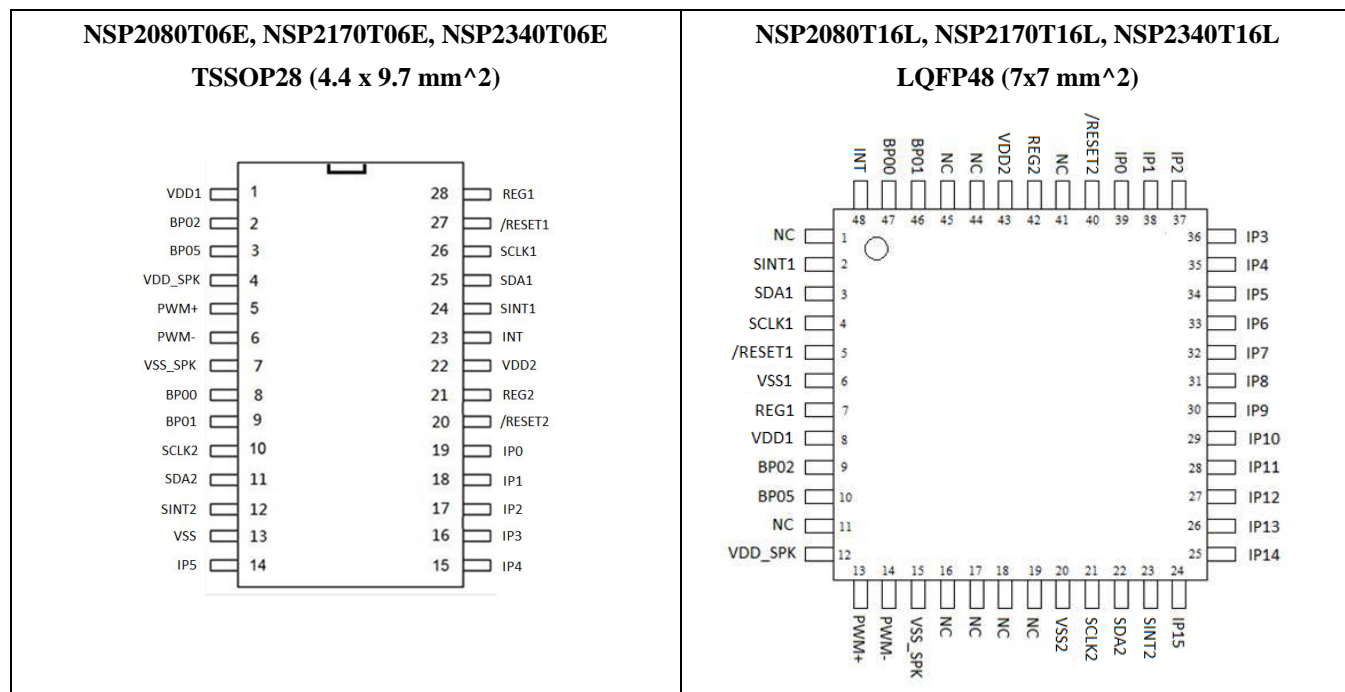


### 5.4 PCB Layout Notice

- The C1, C2, C3, C4, C5 and C6 connected to NSP2340T chip as near as possible.

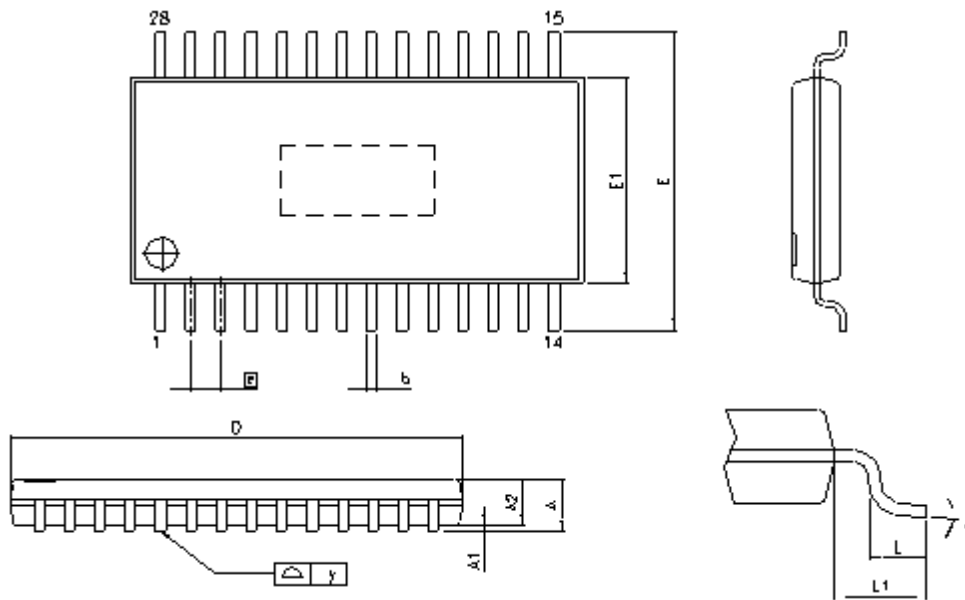
## 6. Package Information

### 6.1 Pin Assignment



6.2 Package Dimension

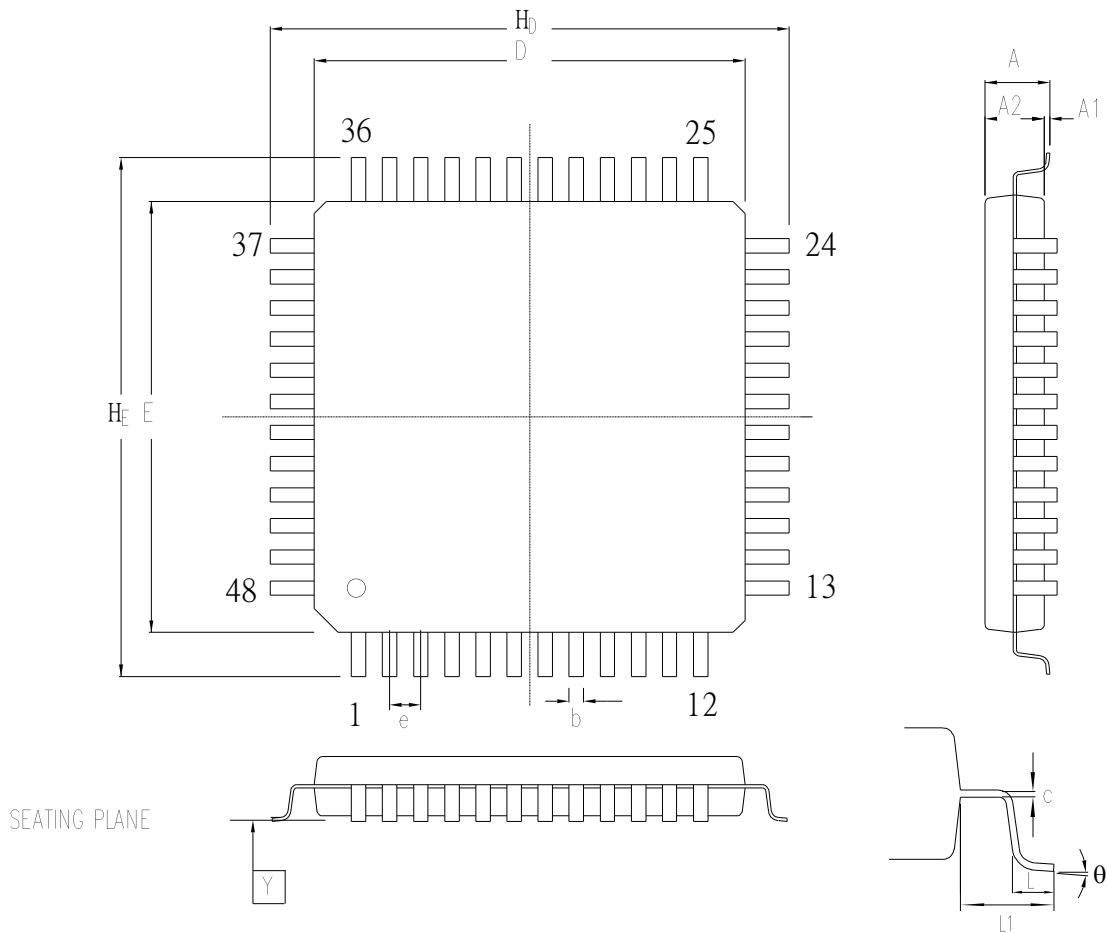
TSSOP28 (4.4 x 9.7 mm<sup>2</sup>)



Controlling Dimension :Millimeters

| SYMBOLS | Dimension in mm |      |      | Dimension in inch |         |        |
|---------|-----------------|------|------|-------------------|---------|--------|
|         | MIN.            | NOM. | MAX. | MIN.              | NOM.    | MAX.   |
| A       | -               | -    | 1.20 | -                 | -       | 0.0472 |
| A1      | 0.00            | -    | 0.15 | 0.00              | -       | 0.0059 |
| A2      | 0.80            | 1.00 | 1.05 | 0.0314            | 0.0393  | 0.4133 |
| b       | 0.19            | -    | 0.30 | 0.0074            | -       | 0.0118 |
| D       | 9.60            | 9.70 | 9.80 | 0.3779            | 0.3818  | 0.3858 |
| E1      | 4.30            | 4.40 | 4.50 | 0.1692            | 0.1732  | 0.1771 |
| E       | 8.40 BSC        |      |      | 0.2519 BSC        |         |        |
| e       | 0.65 BSC        |      |      | 0.0255 BSC        |         |        |
| L1      | 1.00 REF        |      |      | 0.0393 REF        |         |        |
| L       | 0.45            | 0.60 | 0.75 | 0.0177            | 0.0236  | 0.0295 |
| φ       | φ               | -    | φ    | φ                 | -       | φ      |
| γ       |                 | 0.05 |      |                   | 0.00196 |        |

LQFP48 (7 x 7 mm<sup>2</sup>)



Controlling dimension : Millimeters

| Symbol               | Dimension in inch |       |       | Dimension in mm |      |      |
|----------------------|-------------------|-------|-------|-----------------|------|------|
|                      | Min               | Nom   | Max   | Min             | Nom  | Max  |
| <b>A</b>             | —                 | —     | —     | —               | —    | —    |
| <b>A<sub>1</sub></b> | 0.002             | 0.004 | 0.006 | 0.05            | 0.10 | 0.15 |
| <b>A<sub>2</sub></b> | 0.053             | 0.055 | 0.057 | 1.35            | 1.40 | 1.45 |
| <b>b</b>             | 0.006             | 0.008 | 0.010 | 0.15            | 0.20 | 0.25 |
| <b>c</b>             | 0.004             | 0.006 | 0.008 | 0.10            | 0.15 | 0.20 |
| <b>D</b>             | 0.272             | 0.276 | 0.280 | 6.90            | 7.00 | 7.10 |
| <b>E</b>             | 0.272             | 0.276 | 0.280 | 6.90            | 7.00 | 7.10 |
| <b>e</b>             | 0.014             | 0.020 | 0.026 | 0.35            | 0.50 | 0.65 |
| <b>H<sub>b</sub></b> | 0.350             | 0.354 | 0.358 | 8.90            | 9.00 | 9.10 |
| <b>H<sub>E</sub></b> | 0.350             | 0.354 | 0.358 | 8.90            | 9.00 | 9.10 |
| <b>L</b>             | 0.018             | 0.024 | 0.030 | 0.45            | 0.60 | 0.75 |
| <b>L<sub>1</sub></b> | —                 | 0.039 | —     | —               | 1.00 | —    |
| <b>Y</b>             | —                 | —     | 0.004 | —               | —    | 0.10 |
| <b>θ</b>             | 0°                | —     | 7°    | 0°              | —    | 7°   |

## 7. Ordering Information

| Part No.                                  | Shape                     | Type  | Remark |
|---|---------------------------|---|--------|
| NSP2080T06E<br>NSP2170T06E<br>NSP2340T06E | E: Tube<br>T: Tape & Reel | Package: TSSOP28 (4.4 x 9.7 mm <sup>2</sup> ) | Blank  |
| NSP2080T16L<br>NSP2170T16L<br>NSP2340T16L |                           | Package: LQFP48 (7 x 7 mm <sup>2</sup> )      |        |

## 8. Revision History

| Version | Date     | Substantial Changes | Page |
|---------|----------|---------------------|------|
| 1.0     | May 2023 | Initial Release     | All  |

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