

Technical Document

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Features

- Low start-up voltage: 0.6V (Typ.)
- High efficiency: 85% (Typ.)
- High output voltage accuracy: $\pm 2.5\%$
- Output voltage: 2.7V, 3.0V, 3.3V, 3.7V, 5.0V
- Ultra low supply current I_{DD2} : 4 μ A (Typ.)
- Low ripple and low noise
- Low shutdown current: 0.5 μ A (Typ.)
- TO-92, SOT-89 and SOT-25 package

Applications

- Palmtops/PDAs
- Portable communicators/Smartphones
- Cameras/Camcorders
- Battery-powered equipment

General Description

The HT77XX series is a set of PFM step-up DC/DC converter with high efficiency and low ripple. The series features extremely low start-up voltage and high output voltage accuracy. They require only three external components to provide a fixed output voltage of 2.7V, 3.0V, 3.3V, 3.7V or 5.0V. CMOS technology ensures ultra low supply current and makes them ideal for battery-operated applications powered from one or more cells.

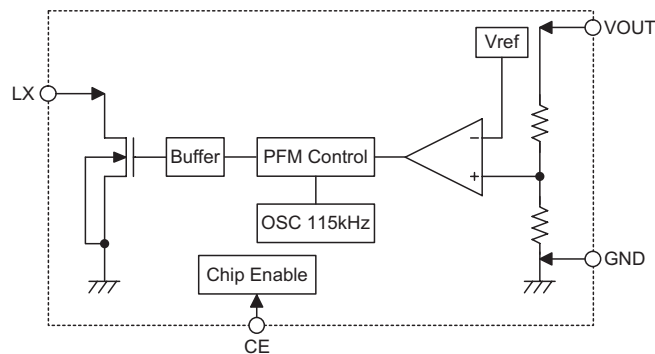
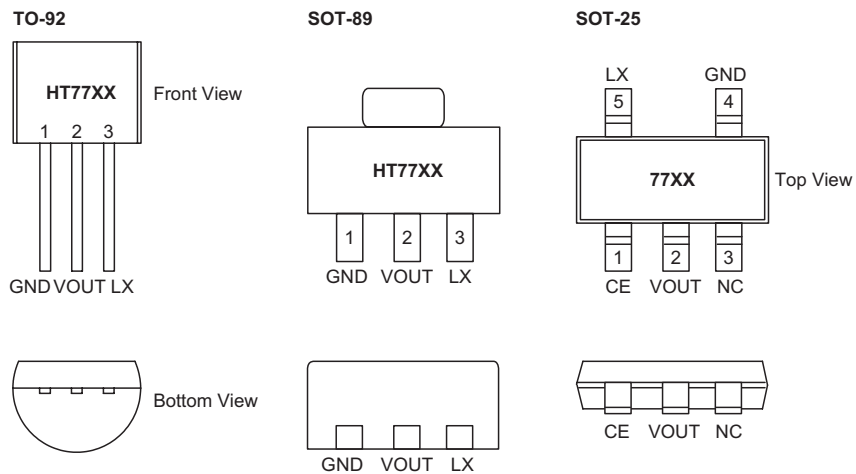
The HT77XX consists of an oscillator, a PFM control circuit, a driver transistor, a reference voltage unit, and a high speed comparator. They employ pulse frequency modulation (PFM) for minimum supply current and ripple at light output loading. These devices are available in space saving TO-92, SOT-89 and SOT-25 packages. For SOT-25 package, it also build-in a chip enable function to reduce power consumption during shutdown mode.

Selection Table

| Part No. | Output Voltage | Package | Marking |
|----------|----------------|---------------------------|--|
| HT7727 | 2.7V | TO-92 SOT-89 SOT-25 | HT77XX (for TO-92) HT77XX# (for SOT-89) 77XX# (for SOT-25) |
| HT7730 | 3.0V | | |
| HT7733 | 3.3V | | |
| HT7737 | 3.7V | | |
| HT7750 | 5.0V | | |

Note: "XX" stands for output voltages.

Only lead free devices are available. "#" stands for lead free devices. For the TO-92 package, there will be a "#" mark at the end of the date code.

Block Diagram

Pin Assignment

Pin Description

| Pin No. | | | Pin Name | Description |
|---------|--------|--------|----------|---------------------------------------|
| TO-92 | SOT-25 | SOT-89 | | |
| — | 1 | — | CE | Chip enable pin, high active |
| 2 | 2 | 2 | VOUT | DC/DC converter output monitoring pin |
| — | 3 | — | NC | No connection |
| 1 | 4 | 1 | GND | Ground pin |
| 3 | 5 | 3 | LX | Switching pin |

Absolute Maximum Ratings

| | | | |
|------------------------------|------------------------------|-----------------------------|----------------------------------|
| Supply Voltage | $V_{SS}-0.3V$ to $V_{SS}+7V$ | Storage Temperature | $-50^{\circ}C$ to $125^{\circ}C$ |
| Power Consumption (*1) | 500mW | Operating Temperature | $0^{\circ}C$ to $70^{\circ}C$ |
| Power Consumption (*2) | 250mW | | |

Note: These are stress ratings only. Stresses exceeding the range specified under "Absolute Maximum Ratings" may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

*1: applied to SOT-89 and TO-92

*2: applied to SOT-25

Electrical Characteristics
HT7727, +2.7V Output Type
 $V_{IN}=V_{OUT}\times 0.6$; $I_{OUT}=10\text{mA}$; $T_a=25^\circ\text{C}$ (Unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------|------------------------------|---|-------|------|-------|---------------|
| V_{OUT} | Output Voltage | — | 2.633 | 2.7 | 2.767 | V |
| V_{IN} | Input Voltage | — | — | — | 6 | V |
| V_{START} | Start-up Voltage | $V_{IN}: 0\rightarrow 2\text{V}$; $I_{OUT}=1\text{mA}$ | — | 0.6 | 0.7 | V |
| V_{HOLD} | Minimum Hold-on Voltage | $V_{IN}: 2\rightarrow 0\text{V}$; $I_{OUT}=1\text{mA}$ | — | — | 0.7 | V |
| I_{IN} | No load Input Current | Measured at no load | — | 10 | — | μA |
| I_{DD1} | Supply Current 1 | $V_{IN}=V_{OUT}\times 0.95$ Measured at VOUT pin | — | 40 | — | μA |
| I_{DD2} | Supply Current 2 | $V_{IN}=V_{OUT}+0.5\text{V}$ Measured at VOUT pin | — | 4 | 7 | μA |
| I_{SHDN} | Shutdown Current | $V_{CE}=V_{IL}$, $V_{IN}=V_{OUT}\times 0.95$ | — | 0.5 | — | μA |
| I_{LEAK} | LX Leakage Current | $V_{IN}=6\text{V}$ | — | — | 0.9 | μA |
| f_{OSC} | Maximum Oscillator Frequency | $V_{IN}=V_{OUT}\times 0.95$ Measured at LX pin | — | 115 | — | kHz |
| η | Efficiency | — | — | 85 | — | % |
| D_{OSC} | Oscillator Duty Cycle | $V_{IN}=V_{OUT}\times 0.95$ Measured at LX pin | 65 | 75 | 85 | % |

HT7730, +3.0V Output Type
 $V_{IN}=V_{OUT}\times 0.6$; $I_{OUT}=10\text{mA}$; $T_a=25^\circ\text{C}$ (Unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------|------------------------------|---|-------|------|-------|---------------|
| V_{OUT} | Output Voltage | — | 2.925 | 3 | 3.075 | V |
| V_{IN} | Input Voltage | — | — | — | 6 | V |
| V_{START} | Start-up Voltage | $V_{IN}: 0\rightarrow 2\text{V}$; $I_{OUT}=1\text{mA}$ | — | 0.6 | 0.7 | V |
| V_{HOLD} | Min. Hold-on Voltage | $V_{IN}: 2\rightarrow 0\text{V}$; $I_{OUT}=1\text{mA}$ | — | — | 0.7 | V |
| I_{IN} | No load Input Current | Measured at no load | — | 10 | — | μA |
| I_{DD1} | Supply Current 1 | $V_{IN}=V_{OUT}\times 0.95$ Measured at VOUT pin | — | 48 | — | μA |
| I_{DD2} | Supply Current 2 | $V_{IN}=V_{OUT}+0.5\text{V}$ Measured at VOUT pin | — | 4 | 7 | μA |
| I_{SHDN} | Shutdown Current | $V_{CE}=V_{IL}$, $V_{IN}=V_{OUT}\times 0.95$ | — | 0.5 | — | μA |
| I_{LEAK} | LX Leakage Current | $V_{IN}=6\text{V}$ | — | — | 0.9 | μA |
| f_{OSC} | Maximum Oscillator Frequency | $V_{IN}=V_{OUT}\times 0.95$ Measured at LX pin | — | 115 | — | kHz |
| η | Efficiency | — | — | 85 | — | % |
| D_{OSC} | Oscillator Duty Cycle | $V_{IN}=V_{OUT}\times 0.95$ Measured at LX pin | 65 | 75 | 85 | % |

HT7733, +3.3V Output Type
 $V_{IN}=V_{OUT}\times 0.6$; $I_{OUT}=10\text{mA}$; $T_a=25^\circ\text{C}$ (Unless otherwise specified)

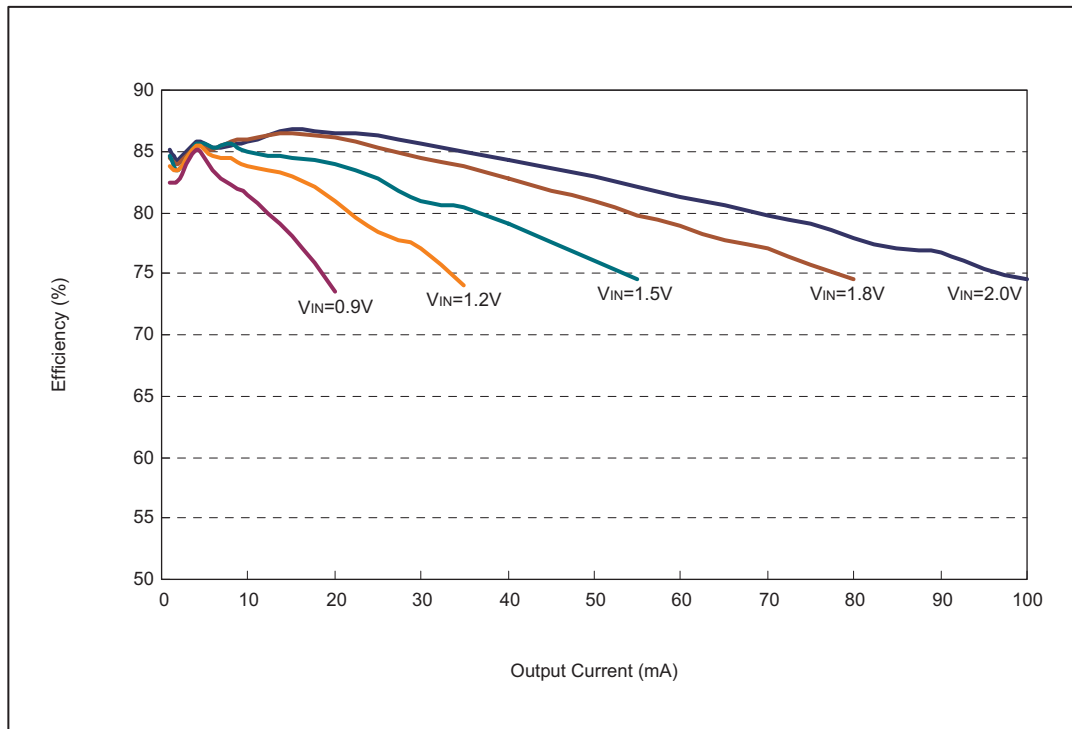
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------|------------------------------|---|-------|------|-------|---------------|
| V_{OUT} | Output Voltage | — | 3.218 | 3.3 | 3.382 | V |
| V_{IN} | Input Voltage | — | — | — | 6 | V |
| V_{START} | Start-up Voltage | $V_{IN}: 0\rightarrow 2\text{V}$; $I_{OUT}=1\text{mA}$ | — | 0.6 | 0.7 | V |
| V_{HOLD} | Min. Hold-on Voltage | $V_{IN}: 2\rightarrow 0\text{V}$; $I_{OUT}=1\text{mA}$ | — | — | 0.7 | V |
| I_{IN} | No load Input Current | Measured at no load | — | 10 | — | μA |
| I_{DD1} | Supply Current 1 | $V_{IN}=V_{OUT}\times 0.95$ Measured at VOUT pin | — | 60 | — | μA |
| I_{DD2} | Supply Current 2 | $V_{IN}=V_{OUT}+0.5\text{V}$ Measured at VOUT pin | — | 4 | 7 | μA |
| I_{SHDN} | Shutdown Current | $V_{CE}=V_{IL}$, $V_{IN}=V_{OUT}\times 0.95$ | — | 0.5 | — | μA |
| I_{LEAK} | LX Leakage Current | $V_{IN}=6\text{V}$ | — | — | 0.9 | μA |
| f_{OSC} | Maximum Oscillator Frequency | $V_{IN}=V_{OUT}\times 0.95$ Measured at LX pin | — | 115 | — | kHz |
| η | Efficiency | — | — | 85 | — | % |
| D_{OSC} | Oscillator Duty Cycle | $V_{IN}=V_{OUT}\times 0.95$ Measured at LX pin | 65 | 75 | 85 | % |

HT7737, +3.7V Output Type
 $V_{IN}=V_{OUT}\times 0.6$; $I_{OUT}=10\text{mA}$; $T_a=25^\circ\text{C}$ (Unless otherwise specified)

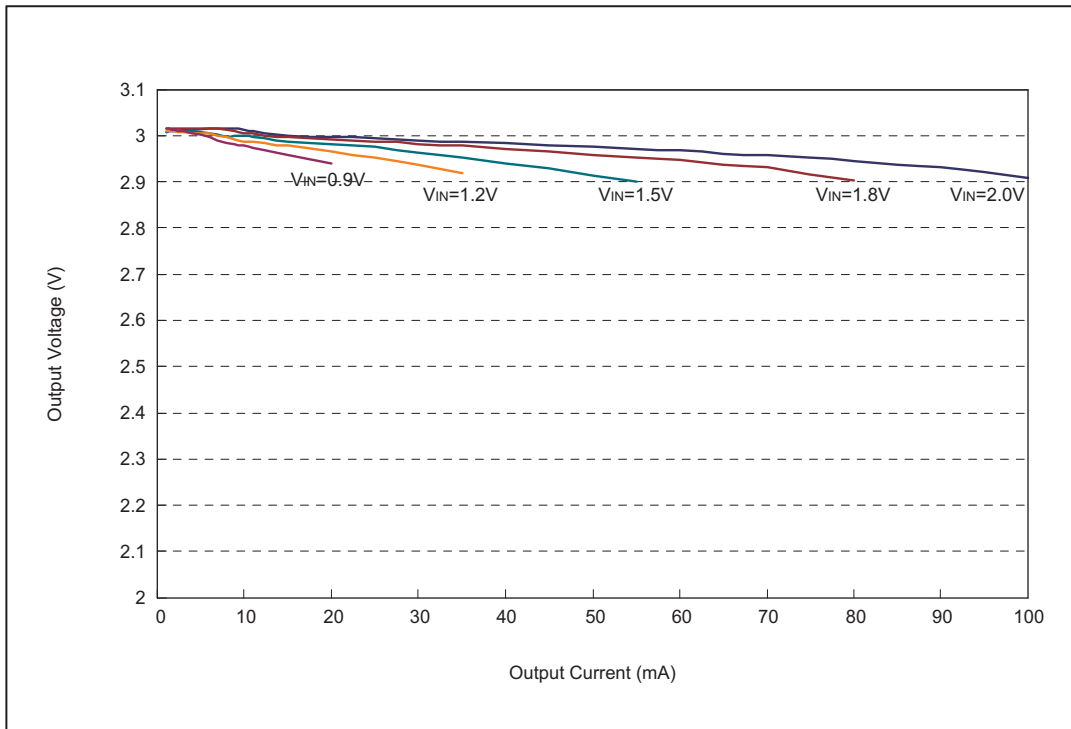
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------|------------------------------|---|-------|------|-------|---------------|
| V_{OUT} | Output Voltage | — | 3.608 | 3.7 | 3.793 | V |
| V_{IN} | Input Voltage | — | — | — | 6 | V |
| V_{START} | Start-up Voltage | $V_{IN}: 0\rightarrow 2\text{V}$; $I_{OUT}=1\text{mA}$ | — | 0.6 | 0.7 | V |
| V_{HOLD} | Min. Hold-on Voltage | $V_{IN}: 2\rightarrow 0\text{V}$; $I_{OUT}=1\text{mA}$ | — | — | 0.7 | V |
| I_{IN} | No load Input Current | Measured at no load | — | 10 | — | μA |
| I_{DD1} | Supply Current 1 | $V_{IN}=V_{OUT}\times 0.95$ Measured at VOUT pin | — | 64 | — | μA |
| I_{DD2} | Supply Current 2 | $V_{IN}=V_{OUT}+0.5\text{V}$ Measured at VOUT pin | — | 4 | 7 | μA |
| I_{SHDN} | Shutdown Current | $V_{CE}=V_{IL}$, $V_{IN}=V_{OUT}\times 0.95$ | — | 0.5 | — | μA |
| I_{LEAK} | LX Leakage Current | $V_{IN}=6\text{V}$ | — | — | 0.9 | μA |
| f_{OSC} | Maximum Oscillator Frequency | $V_{IN}=V_{OUT}\times 0.95$ Measured at LX pin | — | 115 | — | kHz |
| η | Efficiency | — | — | 85 | — | % |
| D_{OSC} | Oscillator Duty Cycle | $V_{IN}=V_{OUT}\times 0.95$ Measured at LX pin | 65 | 75 | 85 | % |

HT7750, +5.0V Output Type
 $V_{IN}=V_{OUT}\times 0.6$; $I_{OUT}=10\text{mA}$; $T_a=25^\circ\text{C}$ (Unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------|------------------------------|---|-------|------|-------|---------------|
| V_{OUT} | Output Voltage | — | 4.875 | 5 | 5.125 | V |
| V_{IN} | Input Voltage | — | — | — | 6 | V |
| V_{START} | Start-up Voltage | $V_{IN}: 0\rightarrow 2\text{V}$; $I_{OUT}=1\text{mA}$ | — | 0.7 | 0.8 | V |
| V_{HOLD} | Min. Hold-on Voltage | $V_{IN}: 2\rightarrow 0\text{V}$; $I_{OUT}=1\text{mA}$ | — | — | 0.7 | V |
| I_{IN} | Current Consumption | Measured at no load | — | 10 | — | μA |
| I_{DD1} | Supply Current 1 | $V_{IN}=V_{OUT}\times 0.95$ Measured at VOUT pin | — | 85 | — | μA |
| I_{DD2} | Supply Current 2 | $V_{IN}=V_{OUT}+0.5\text{V}$ Measured at VOUT pin | — | 4 | 7 | μA |
| I_{SHDN} | Shutdown Current | $V_{CE}=V_{IL}$, $V_{IN}=V_{OUT}\times 0.95$ | — | 0.5 | — | μA |
| I_{LEAK} | LX Leakage Current | $V_{IN}=6\text{V}$ | — | — | 0.9 | μA |
| f_{OSC} | Maximum Oscillator Frequency | $V_{IN}=V_{OUT}\times 0.95$ Measured at LX pin | — | 115 | — | kHz |
| η | Efficiency | — | — | 85 | — | % |
| D_{OSC} | Oscillator Duty Cycle | $V_{IN}=V_{OUT}\times 0.95$ Measured at LX pin | 65 | 75 | 85 | % |

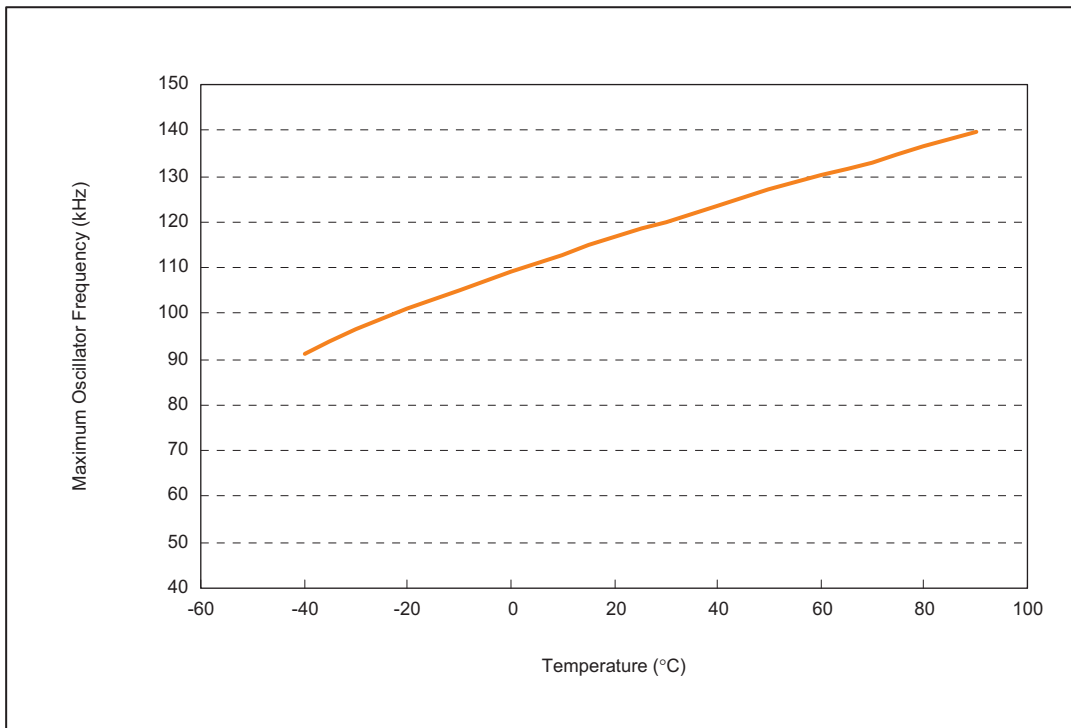
Typical Performance Characteristics
 $L=220\mu\text{H}$, $C=47\mu\text{F}$

HT7730 Efficiency vs. Output Current

L=220 μ H, C=47 μ F



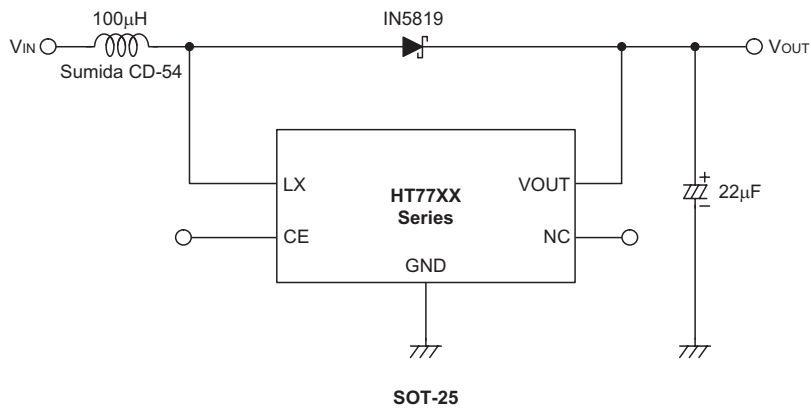
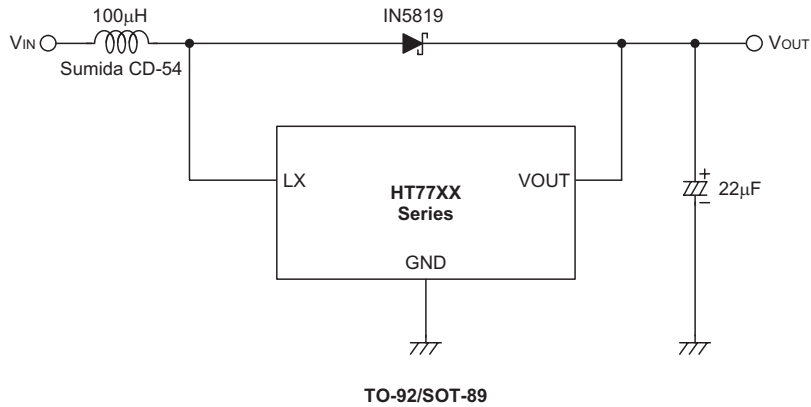
HT7730 Output Voltage vs. Output Current

L=220 μ H, C=47 μ F



HT7730 Maximum Oscillator Frequency vs. Temperature

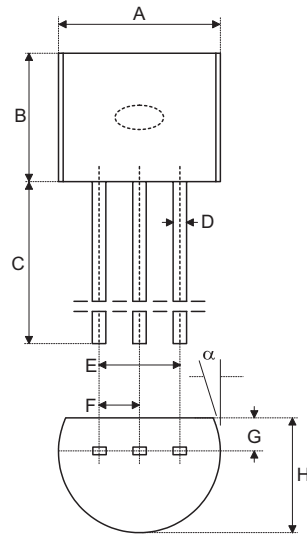
Application Circuits



Note: For the SOT-25 package, when CE is pulled low, the internal blocks of the device, such as the reference band gap, gain block, and all feedback and control circuitry will be switched off. The boost converter's output, VOUT, will be at a value one Schottky diode voltage drop below the input voltage and the LX pin remains in a high impedance condition. The output capacitor and load at VOUT determine the rate at which VOUT decays.

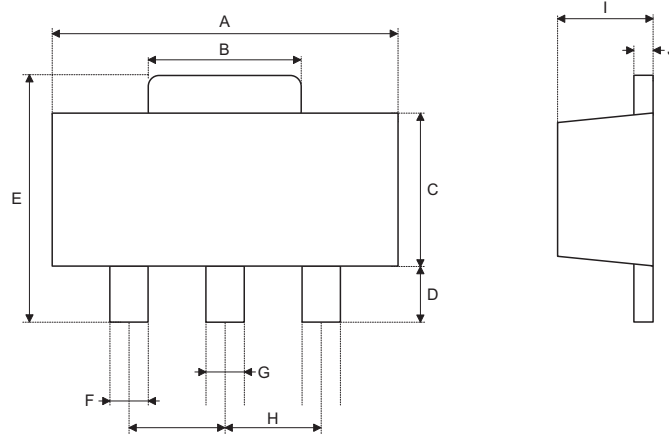
Package Information

3-pin TO-92 Outline Dimensions



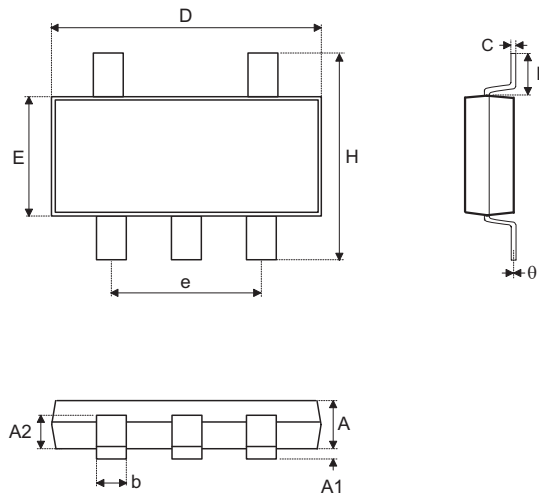
| Symbol | Dimensions in mil | | |
|----------|-------------------|------|------|
| | Min. | Nom. | Max. |
| A | 170 | — | 200 |
| B | 170 | — | 200 |
| C | 500 | — | — |
| D | 11 | — | 20 |
| E | 90 | — | 110 |
| F | 45 | — | 55 |
| G | 45 | — | 65 |
| H | 130 | — | 160 |
| I | 8 | — | 18 |
| α | 4° | — | 6° |

3-pin SOT-89 Outline Dimensions



| Symbol | Dimensions in mil | | |
|--------|-------------------|------|------|
| | Min. | Nom. | Max. |
| A | 173 | — | 181 |
| B | 64 | — | 72 |
| C | 90 | — | 102 |
| D | 35 | — | 47 |
| E | 155 | — | 167 |
| F | 14 | — | 19 |
| G | 17 | — | 22 |
| H | — | 59 | — |
| I | 55 | — | 63 |
| J | 14 | — | 17 |

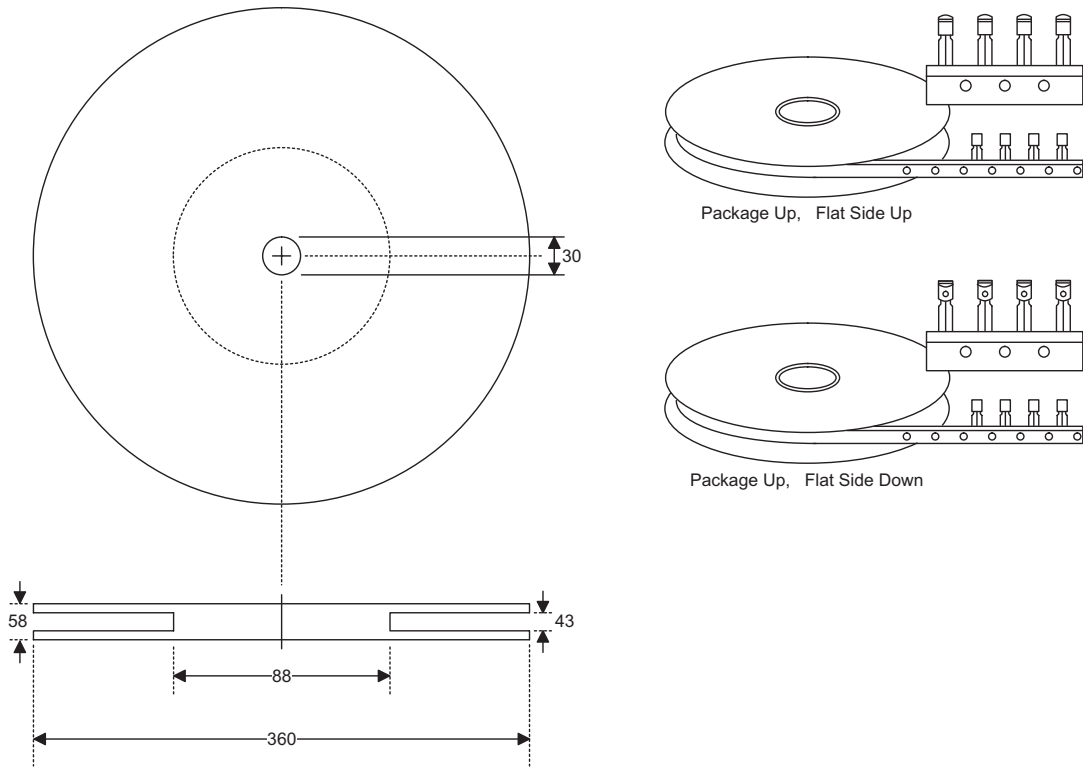
5-pin SOT-25 Outline Dimensions



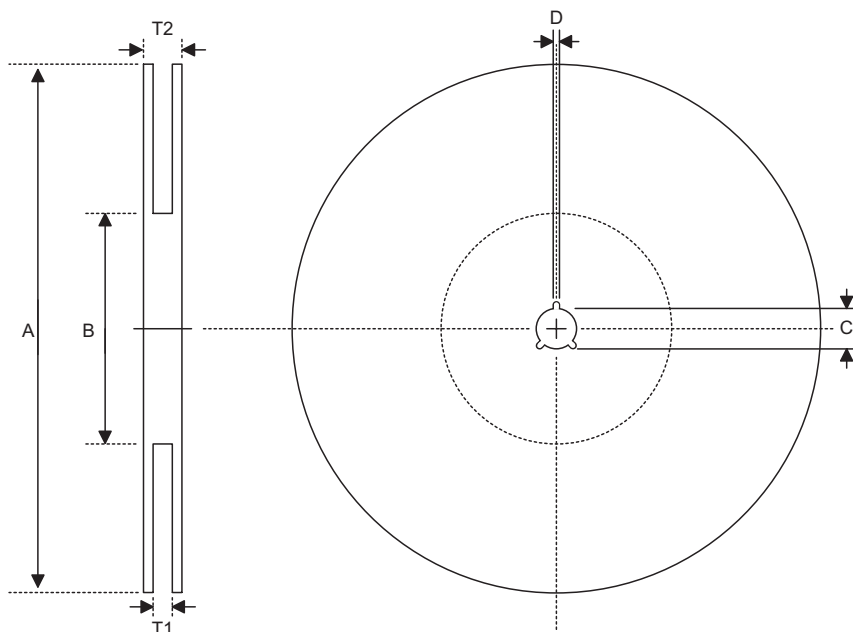
| Symbol | Dimensions in mm | | |
|----------|------------------|------|------|
| | Min. | Nom. | Max. |
| A | 1.00 | — | 1.30 |
| A1 | — | — | 0.10 |
| A2 | 0.70 | — | 0.90 |
| b | 0.35 | — | 0.50 |
| C | 0.10 | — | 0.25 |
| D | 2.70 | — | 3.10 |
| E | 1.40 | — | 1.80 |
| e | — | 1.90 | — |
| H | 2.60 | — | 3 |
| L | 0.37 | — | — |
| θ | 1° | — | 9° |

Product Tape and Reel Specifications

TO-92 Reel Dimensions (Unit: mm)



SOT-89 & SOT-25 Reel Dimensions

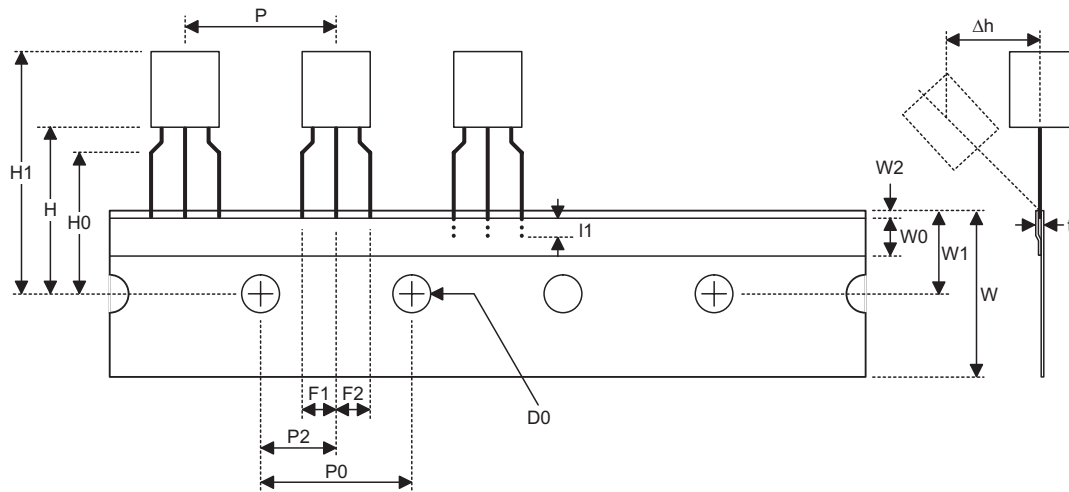


SOT-89

| Symbol | Description | Dimensions in mm |
|--------|-----------------------|------------------|
| A | Reel Outer Diameter | 180±1.0 |
| B | Reel Inner Diameter | 62±1.5 |
| C | Spindle Hole Diameter | 12.75±0.15 |
| D | Key Slit Width | 1.9±0.15 |
| T1 | Space Between Flange | 12.4±0.2 |
| T2 | Reel Thickness | 17-0.4 |

SOT-25

| Symbol | Description | Dimensions in mm |
|--------|-----------------------|------------------|
| A | Reel Outer Diameter | 178±1.0 |
| B | Reel Inner Diameter | 62±1.0 |
| C | Spindle Hole Diameter | 13.0±0.2 |
| D | Key Slit Width | 2.5±0.25 |
| T1 | Space Between Flange | 8.4+1.5 -0.0 |
| T2 | Reel Thickness | 11.4+1.5 |

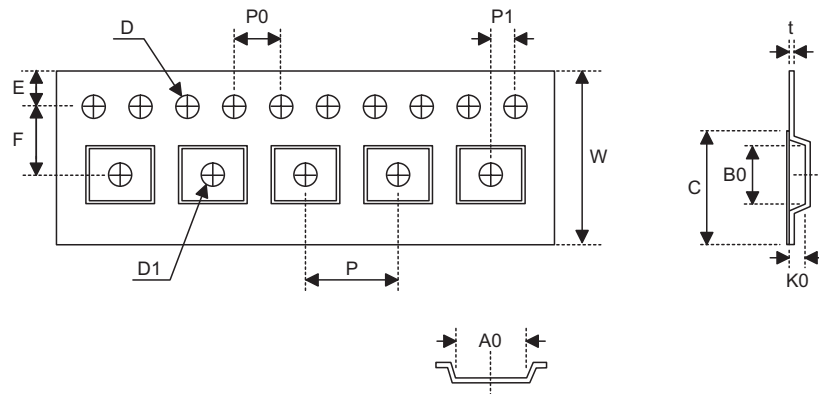
TO-92 Carrier Tape Dimensions

TO-92

| Symbol | Description | Dimensions in mm |
|----------------|---|------------------|
| l1 | Taped Lead Length | (2.5) |
| P | Component Pitch | 12.7±1.0 |
| P ₀ | Perforation Pitch | 12.7±0.3 |
| P ₂ | Component to Perforation (Length Direction) | 6.35±0.4 |
| F ₁ | Lead Spread | 2.5+0.4 -0.1 |
| F ₂ | Lead Spread | 2.5+0.4 -0.1 |
| Δh | Component Alignment | 0±0.1 |
| W | Carrier Tape Width | 18.0+1.0 -0.5 |
| W ₀ | Hold-down Tape Width | 6.0±0.5 |
| W ₁ | Perforation Position | 9.0±0.5 |
| W ₂ | Hold-down Tape Position | (0.5) |
| H ₀ | Lead Clinch Height | 16.0±0.5 |
| H ₁ | Component Height | Less than 24.7 |
| D ₀ | Perforation Diameter | 4.0±0.2 |
| t | Taped Lead Thickness | 0.7±0.2 |
| H | Component Base Height | 19.0±0.5 |

Note: Thickness less than 0.38±0.05mm~0.5mm

P₀ Accumulated pitch tolerance: ±1mm/20pitches.

() Bracketed figures are for reference only.

SOT-89 & SOT-25 Carrier Tape Dimensions

SOT-89

| Symbol | Description | Dimensions in mm |
|--------|--|------------------|
| W | Carrier Tape Width | 12.0+0.3 -0.1 |
| P | Cavity Pitch | 8.0±0.1 |
| E | Perforation Position | 1.75±0.1 |
| F | Cavity to Perforation (Width Direction) | 5.5±0.05 |
| D | Perforation Diameter | 1.5+0.1 |
| D1 | Cavity Hole Diameter | 1.5+0.1 |
| P0 | Perforation Pitch | 4.0±0.1 |
| P1 | Cavity to Perforation (Length Direction) | 2.0±0.10 |
| A0 | Cavity Length | 4.8±0.1 |
| B0 | Cavity Width | 4.5±0.1 |
| K0 | Cavity Depth | 1.8±0.1 |
| t | Carrier Tape Thickness | 0.30±0.013 |
| C | Cover Tape Width | 9.3 |

SOT-25

| Symbol | Description | Dimensions in mm |
|--------|--|------------------|
| W | Carrier Tape Width | 8.0±0.3 |
| P | Cavity Pitch | 4.0 |
| E | Perforation Position | 1.75 |
| F | Cavity to Perforation (Width Direction) | 3.5±0.05 |
| D | Perforation Diameter | 1.5+0.1 |
| D1 | Cavity Hole Diameter | 1.5+0.1 |
| P0 | Perforation Pitch | 4.0 |
| P1 | Cavity to Perforation (Length Direction) | 2.0 |
| A0 | Cavity Length | 3.15 |
| B0 | Cavity Width | 3.2 |
| K0 | Cavity Depth | 1.4 |
| t | Carrier Tape Thickness | 0.20±0.03 |
| C | Cover Tape Width | 5.3 |

Holtek Semiconductor Inc. (Headquarters)

No.3, Creation Rd. II, Science Park, Hsinchu, Taiwan
Tel: 886-3-563-1999
Fax: 886-3-563-1189
<http://www.holtek.com.tw>

Holtek Semiconductor Inc. (Taipei Sales Office)

4F-2, No. 3-2, YuanQu St., Nankang Software Park, Taipei 115, Taiwan
Tel: 886-2-2655-7070
Fax: 886-2-2655-7373
Fax: 886-2-2655-7383 (International sales hotline)

Holtek Semiconductor Inc. (Shanghai Sales Office)

7th Floor, Building 2, No.889, Yi Shan Rd., Shanghai, China 200233
Tel: 021-6485-5560
Fax: 021-6485-0313
<http://www.holtek.com.cn>

Holtek Semiconductor Inc. (Shenzhen Sales Office)

43F, SEG Plaza, Shen Nan Zhong Road, Shenzhen, China 518031
Tel: 0755-8346-5589
Fax: 0755-8346-5590
ISDN: 0755-8346-5591

Holtek Semiconductor Inc. (Beijing Sales Office)

Suite 1721, Jinyu Tower, A129 West Xuan Wu Men Street, Xicheng District, Beijing, China 100031
Tel: 010-6641-0030, 6641-7751, 6641-7752
Fax: 010-6641-0125

Holmate Semiconductor, Inc. (North America Sales Office)

46712 Fremont Blvd., Fremont, CA 94538
Tel: 510-252-9880
Fax: 510-252-9885
<http://www.holmate.com>

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