

CAT7105

2.0A High Efficiency Step-Down DC/DC Converter

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2.0A High Efficiency Step-Down DC/DC Converter

Features

- ◆ High Efficiency up to 95%
- ◆ 4.75V to 23V Wide Input Voltage Range
- ◆ Output Adjustable from 1.23 to 21V
- ◆ 2.0A Output Current
- ◆ 380kHz constant Frequency Operation
- ◆ Current Mode Operation
- ◆ Over-temperature Protected
- ◆ Over Current Protection
- ◆ Under Voltage Lockout
- ◆ 25 μ A Shutdown Current
- ◆ SOP8 Package
- ◆ RoHS Compliant (100% Green available)

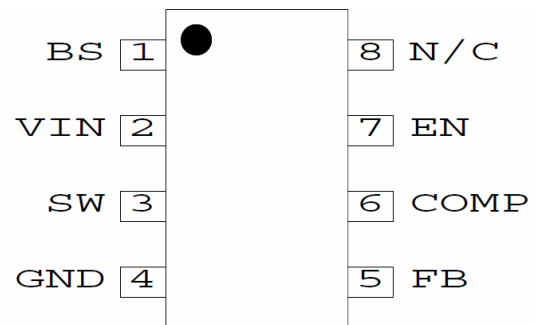
General Description

The CAT7105 is a high efficiency and high output current step-down DC/DC converter that integrates a low resistance high side NMOS. Including on the substrate with the listed features are a high performance voltage error amplifier that provides tight voltage regulation accuracy under transient conditions; an under voltage lockout circuit to prevent start up until the input voltage reaches 4.75V; an internally set soft start circuit to limit inrush currents; and other features include an over current protection and thermal shutdown. The CAT7105 is available in a 8 pin SOIC package.

Application

Set-Top-Box, DVD, LCD Displays
 Battery Charger and High Power LED Power Supply
 Distributed Power System
 Data comm. xDSL CPE

Pin Configuration



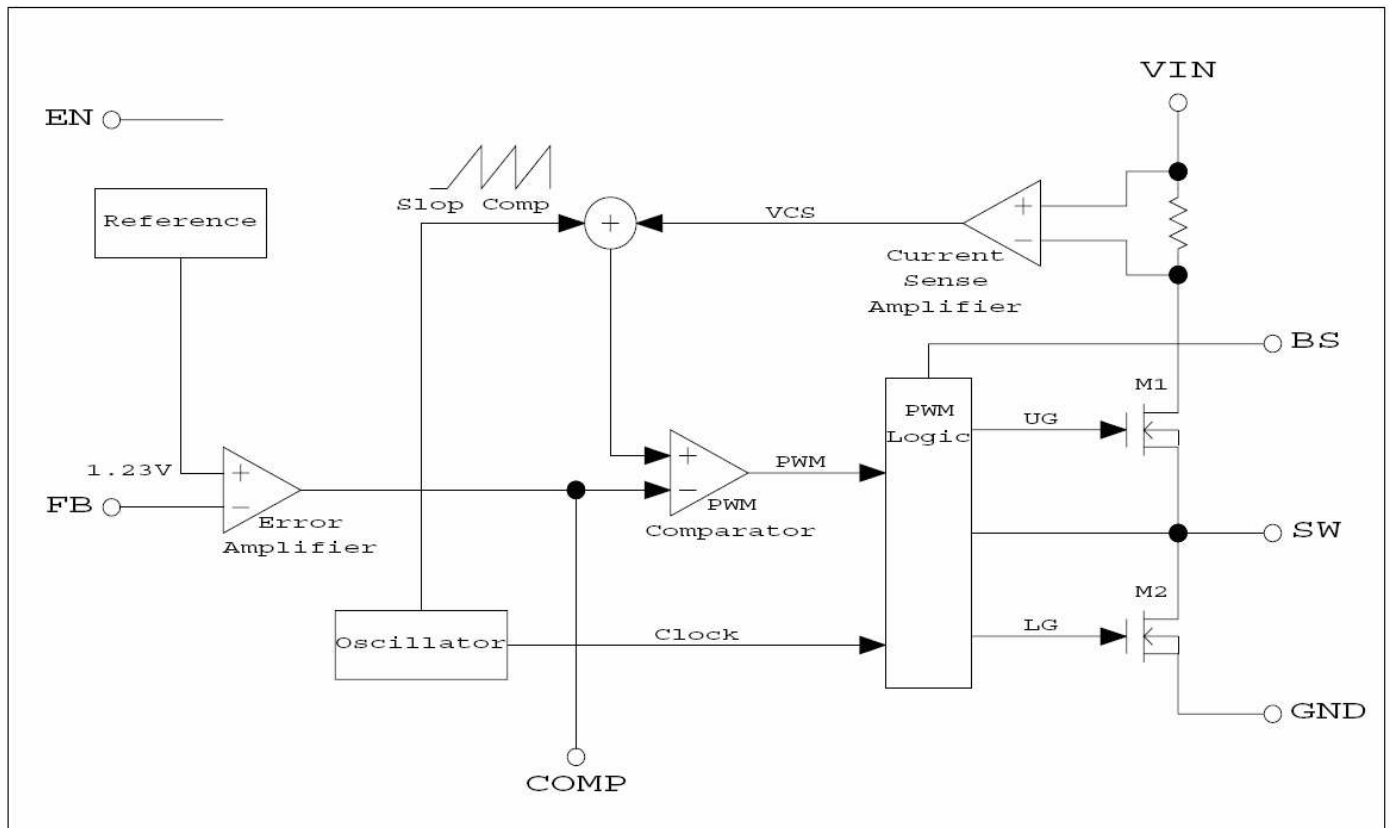
Ordering Information

| Part Number | Package | Ship |
|-------------|----------------|-------------------|
| CAT7105CA | 8L SOP (Green) | 2500/ Tape & Reel |

Pin Description

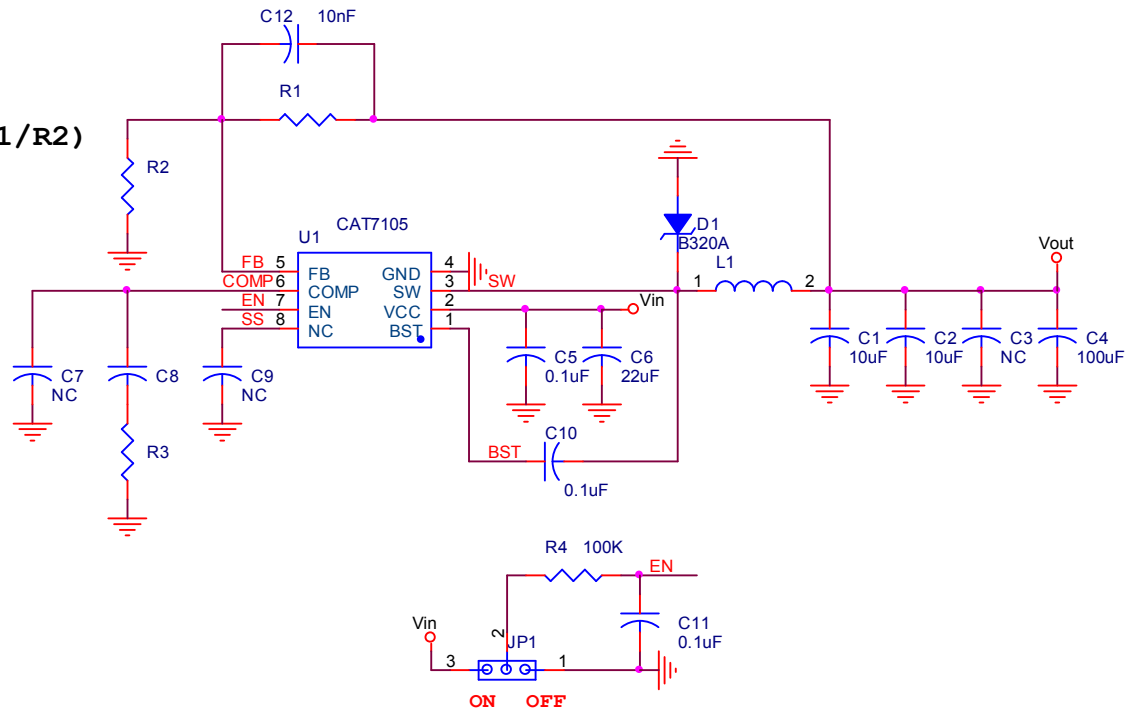
| Pin | Symbol | Description |
|-----|--------|---|
| 1 | BS | High Side Gate Drive Boost Input. A capacitor must be connected from SW to BS. This capacitor boosts the gate drive to the internal NMOS above VIN to fully turn it ON. |
| 2 | VIN | Power Supply Pin. The input voltage for the power supply is connected to Pin2. |
| 3 | SW | Power Switch Output. This is the output of a power MOSFET switch connected directly to the input voltage. |
| 4 | GND | Ground Pin. This is the ground reference connection for all components in the power supply. |
| 5 | FB | Voltage Feedback Pin. This is the input to an error amplifier, which drives the PWM controller. It's necessary to connect this pin to the actual output of power supply to set the DC output voltage. |
| 6 | COMP | Compensation Pin. This pin is used to compensate the regulation control loop. Connect a series RC network from COMP pin to GND pin to compensate the regulation control loop. |
| 7 | EN | Enable Pin. This input provides an electrical ON/OFF control of the power Supply. |
| 8 | NC | No Connection |

Function Block Diagram



Typical Application

$V_{in}=4.75V\sim 23V$
 $V_{out}=1.23V * (1+R1/R2)$



*note: The recommended applications shall be customer design-in orientation to fit each customers demand. Based on the nature of customers demand-oriented, please contact CAT or agent for design support service.

| | R1 | R2 | R3 | C8 | L1 |
|------------|-------|-----|------|-----|-------|
| V out=5V | 68K | 22K | 15K | 2nF | 15uH |
| V out=3.3V | 16.8K | 10K | 10K | 2nF | 6uH |
| V out=1.8V | 4.7K | 10K | 5.6K | 1nF | 4.7uH |

Absolute Maximum Ratings

Input Supply Voltage GND - 0.3V to +23V
 SW Voltage - 0.3 to VIN+0.3V
 Other Pins - 0.3V to +6V
 Boost Voltage Vsw-0.3V to Vsw+6V
 SW Peak Current 3.0 A

ESD Classification Class 2
 Junction Temperature Range 150°C
 Operating Temperature -20°C to 85°C
 Storage Temperature Range -65°C to 150°C
 Lead Temperature (Soldering 10s) 260°C

*note: The IC has a protection circuit against static electricity. Do not apply high static electricity or high voltage that exceeds the performance of the protection circuit to the IC.

Electrical Characteristic

(Recommended Operating Conditions, Unless Otherwise Noted; VIN = 12V; TA = 25 °C)

| Parameter | Test Conditions | Min | Typ. | Max | Unit |
|--|---------------------------------|------|------|------|------|
| Supply Voltage | | 4.75 | | 23 | V |
| Shutdown Supply Current | VEN = 0V | | 25 | 50 | µA |
| Regulated Feedback Voltage | $4.75V \leq V_{IN} \leq 23V$ | 1.19 | 1.23 | 1.26 | V |
| Error Amplifier Trans conductance | $\Delta I_{COMP} = \pm 10\mu A$ | 500 | 800 | 1120 | µA/V |
| Current sense to COMP Trans conductance | | | 3.8 | | A/V |
| Current Limit | | | 3.0 | | A |
| SW Leakage Current | VEN = 0V, VSW = 0V | | | 10 | µA |
| High Side On Resistance | | | 0.25 | | Ω |
| Low Side On Resistance | I | | 10 | | Ω |
| Oscillation frequency | | 320 | 380 | 440 | KHz |
| Short Circuit Oscillation Frequency | VFB=0V | | 40 | | KHz |
| Maximum Duty Cycle | VFB=1.0V | | 90 | | % |
| Minimum Duty Cycle | VFB=1.5V | | | 0 | % |
| Under Voltage Lockout Threshold | VIN Rising | 3.9 | 4.1 | 4.3 | V |
| Under Voltage Lockout Threshold Hysteresis | | | 200 | | mV |
| Thermal Shutdown Threshold | | | 160 | | °C |
| EN High Level | | 2.6 | | | V |
| EN Low Level | | | | 0.9 | V |
| EN Input Current | VEN = 0V | 1.1 | 1.8 | 2.5 | µA |

Function Description

The CAT7105 is a constant frequency current mode PWM step-down converter. It regulates input voltages from 4.75V to 23V down to an output voltage as low as 1.23V, and is able to supply up to 2A of load current.

Oscillator Frequency

Slope compensated current mode PWM control provides stable switching and cycle-by-cycle current limit for superior load and line response and protection of the internal main switch and synchronous rectifier. The CAT7105 switches at a constant frequency (380 KHz) and regulates the output voltage. During each cycle the PWM comparator modulates the power transferred to the load by changing the inductor peak current based on the feedback error voltage. During normal operation, the main switch is turned on for a certain time to ramp the inductor current at each rising edge of the internal oscillator, and switched off when the peak inductor current is above the error voltage. When the main switch is off, the low side MOS will be turned on immediately and stay on until either the next cycle starts.

Short Circuit Protection

The CAT7105 has short circuit protection. When the output is shorted to ground, the oscillator frequency is reduced to prevent the inductor current from increasing beyond the N MOS current limit. The NMOS current limit is also reduced to lower the short circuit current. The frequency and current limit will return to the normal values once the short circuit condition is removed and the feedback voltage reaches 1.23V.

Maximum Load current

The CAT7105 can operate down to 4.75V input voltage; however the maximum load current decreases at lower input due to large IR drop on the main switch and low side switch. The slope compensation signal reduces the peak inductor current as a function of the duty cycle to prevent sub-harmonic oscillations at duty cycles greater than 50%.

Enable

The EN pin provides electrical on/off control of the regulator. Once the EN pin voltage exceeds the threshold voltage, the regulator starts operation and the internal slow start begins to ramp. If the EN pin voltage is pulled below the threshold, the regulator stops switching and the internal slow start resets. Connecting the pin to ground or to any voltage less than 0.9V will disable the regulator and activate the shutdown mode.

Under Voltage Lockout

The CAT7105 incorporates an under voltage lockout circuit to keep the device disable when VIN is below the UVLO start threshold. During power up, internal circuit are held inactive until VIN exceeds the UVLO start threshold voltage. Once the VULO start threshold voltage is reached, device start-up begins. The device operates until VIN fall below the UVLO stop threshold voltage. The typical hysteretic in the UVLO comparator is 200mV.

Boost Capacitor

Connect a 0.01 μ F low ESR ceramic capacitor between the BS pin and SW pin. This capacitor

provides the gate drive voltage for the high side MOSFET.

Thermal Shutdown

The CAT7105 protects itself from overheating with an internal thermal shutdown circuit. If the junction temperature exceeds the thermal shutdown threshold, the voltage reference is grounded and high side MOSFET is turned off.

Compensation

The system stability is controlled through COMP pin. It will present a general design procedure to help insure a stable and operational circuit. The design in this data sheet is optimized for particular requirements. If different conversions are requires, some of the components may need to be changed to ensure stability. The power components and their effects will be determined first, and then the compensation components will be chosen to produce stability.

Output Voltage

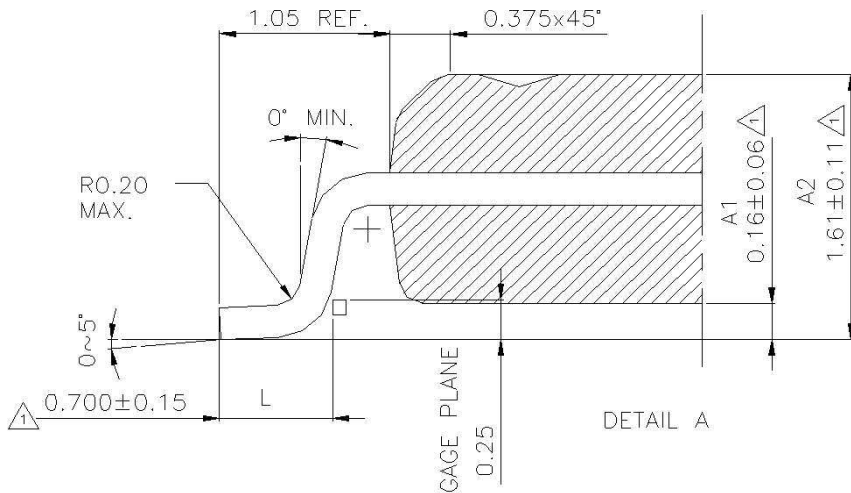
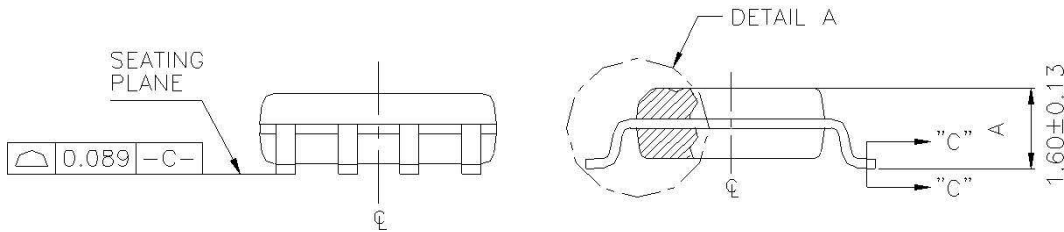
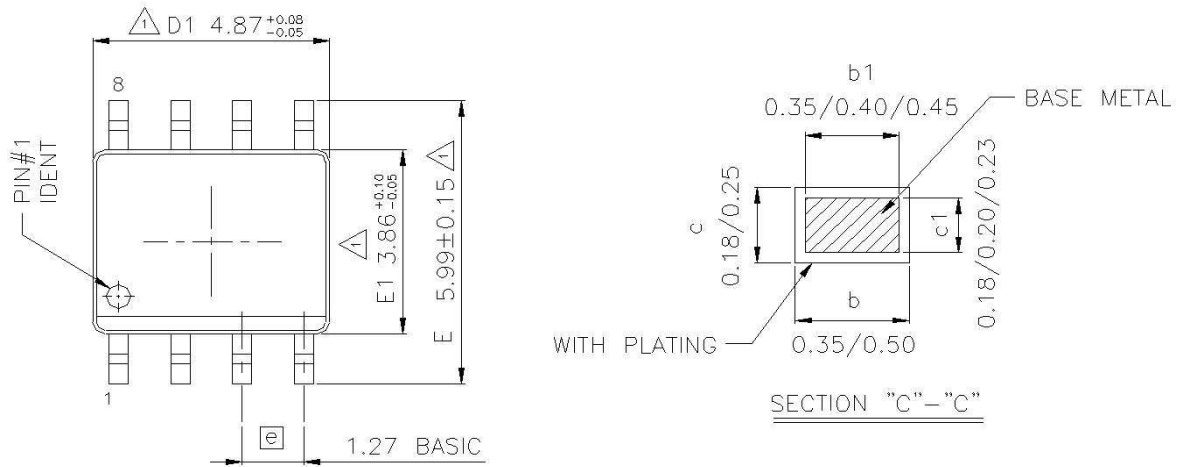
The output voltage is set using the FB pin and a resistor divider connected to the output as shown in Figure1. The FB pin voltage is 1.23V, so the ratio of the feedback resistors sets the output voltage according to the following equation:

$$V_{FB} = V_{OUT} * R2 / (R1 + R2)$$

Thus the output voltage is:

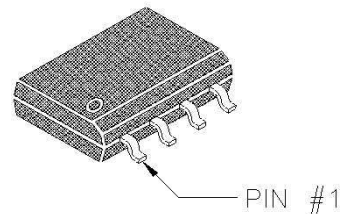
$$V_{OUT} = 1.23 * (R1 + R2) / R2$$

Package Dimensions



NOTES:

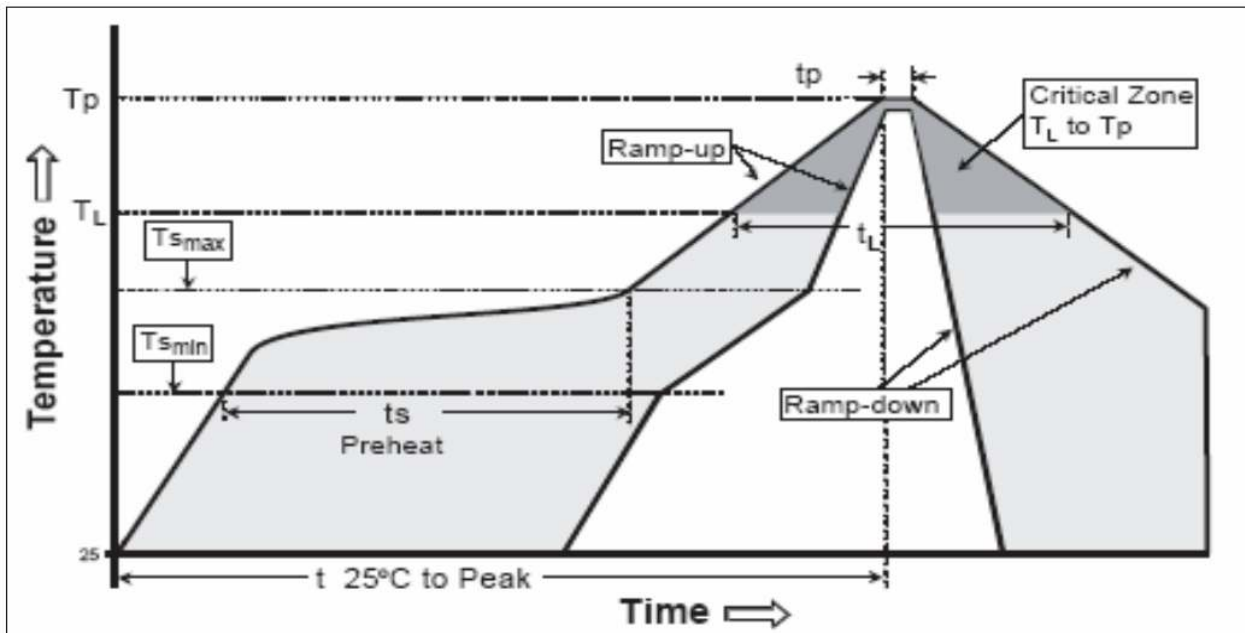
1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (MM).
2. DIMENSION D1 & E1 DOES NOT INCLUDE MOLD PROTRUSION.
3. COPLANARITY OF ALL LEADS SHALL BE (BEFORE TEST) 0.089 MAX. FROM THE SEATING PLANE, UNLESS OTHERWISE SPECIFIED.



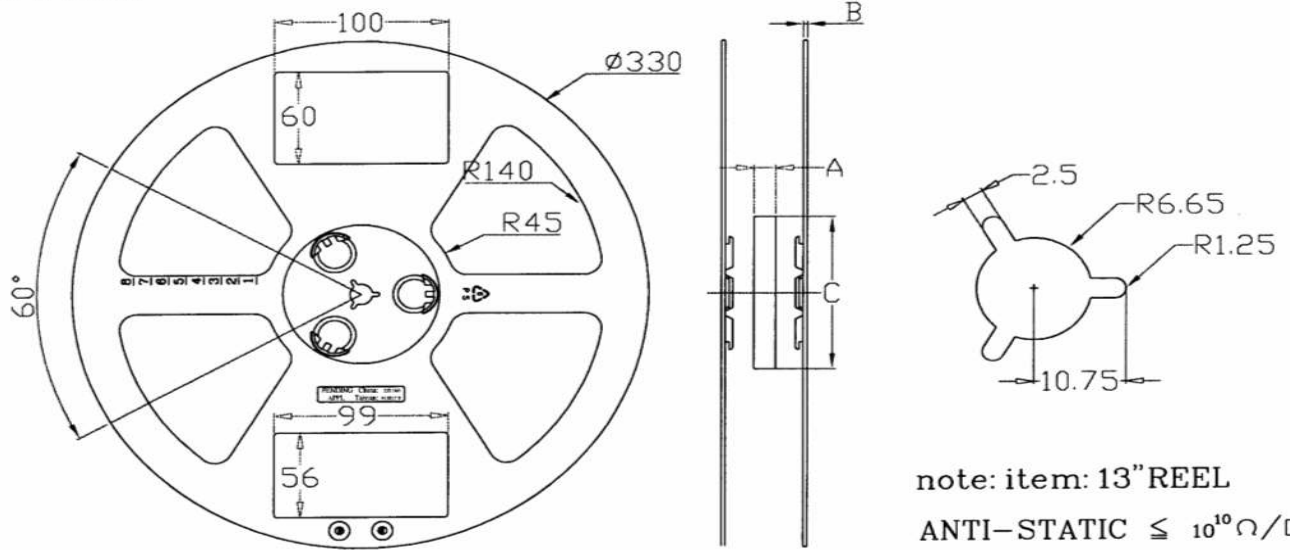
Classification Reflow Profiles

| Reflow Profile | Green Assembly |
|--|-----------------|
| Average Ramp-Up Rate ($T_{s_{max}}$ to T_p) | 3°C/second max. |
| Preheat | |
| -Temperature Min($T_{s_{min}}$) | 150°C |
| -Temperature Max($T_{s_{max}}$) | 200°C |
| -Time($t_{s_{min}}$ to $t_{s_{max}}$) | 60-180 seconds |
| Time maintained above: | |
| -Temperature(T_L) | 217°C |
| -Time(t_L) | 60-150 seconds |
| Peak Temperature(T_p) | 260 +0/-5 °C |
| Time within 5 °C of actual Peak Temperature(t_p) | 20-40 seconds |
| Ramp-Down Rate | 6°C/second max. |
| Time 25°C to Peak Temperature | 8 minutes max. |

Note: All Temperature refer to topside of the package, measured on the package body surface.



Reel Outline



note: item: 13" REEL
 ANTI-STATIC $\leq 10^{10} \Omega/\square$
 material: P.S

| SPEC | 12 | 16 | 24 | 32 | 44 | 56 | 72 |
|------------------------------|------|------|------|------|------|-----|-----|
| DIM A $+1.5$ -0.5 | 12.5 | 16.5 | 24.5 | 32.5 | 44.5 | 57 | 73 |
| DIM B ± 0.2 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 |
| DIM C ± 1.5 | 99 | 99 | 99 | 99 | 99 | 99 | 99 |

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