NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Revision 1.0: Released to production.

Revision 1.1: Update Ripple injection, Add Type 1 and Type 2.

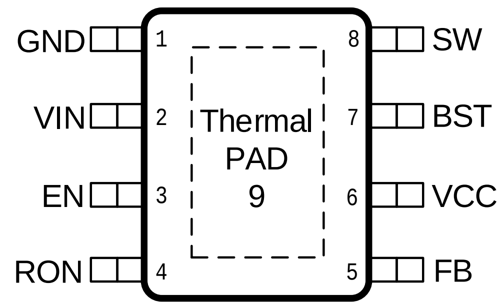
Revision 1.2: Update Equations 10.

Revision 1.3: Update DEVICE ORDER INFORMATION.

SCT2A22STER	Tape & Reel	4000	2A22	8	ESOP-8

Over operating free-air temperature unless otherwise noted(1)

VIN, EN, RON	-0.3	105	V
BOOT	-0.3	110	V
SW	-1	105	V
VCC	-0.3	30	V
BOOT-SW	-0.3	6	V
FB	-0.3	6	V
Operating junction temperature T_J(2)	-40	150	ÁC
Storage temperature TSTG	-65	150	ÁC



(1) Stresses beyond those listed under Absolute Maximum Rating may cause device permanent damage. The device is not guaranteed to function outside of its Recommended Operation Conditions.

(2) The IC includes over temperature protection to protect the device during overload conditions. Junction temperature will exceed 150ÁC when over temperature protection is active. Continuous operation above the specified maximum operating junction temperature will reduce lifetime.

GND	1	Ground
VIN	2	Input supply voltage. Connect a local bypass capacitor from VIN pin to GND pin. Path from VIN pin to high frequency bypass capacitor and GND must be as short as possible.
EN	3	Enable pin to the regulator with internal pull-up current source. a) Float or connect to VIN to enable the converter. b) Pull below 1.22V to disable the converter. c) Resistor divider from VIN to GND connecting EN pin can adjust the input voltage lockout threshold.
RON	4	On-time programming pin. A resistor between this pin and VIN sets the switch ON time.
FB	5	

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VCC	6	Output from the Internal High Voltage Regulator. The internal VCC regulator provides bias supply for the gate drivers and other internal circuitry. A larger than 1.0 εF decoupling capacitor is recommended.
BST	7	Power supply bias for high-side power MOSFET gate sid Power su{ lא פ

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V_{IN}=48V, T_J=-40ÁC~125ÁC, typical value is tested under 25ÁC.

V_{IN}	Operating input voltage		4.5 100	V
V_{CC}	V_{CC} Regulator Output			

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The SCT2A22 is a 4.5V-100V input, 1A output, synchronous buck converter with built-in 530mq high-side and 220mq low-side power MOSFETs. It implements constant on time control to regulate output voltage, providing excellent line and load transient response.

The SCT2A22 operates in Forced PWM mode to achieve low light load ripple and support isolation buck topology. Applying an external diode on VCC pin from converter output, the quiescent current can be decrease.

The SCT2A22 features an internal 4.3ms soft-start time to avoid large inrush current and output voltage overshoot during startup. The switching frequency is programmed by the resistor from V_{IN} pin to R_{ON} pin.

The SCT2A22 has a default input start-up voltage of 4.1V with 220mV hysteresis. The EN pin is a high-voltage pin with a precision threshold that can be used to adjust the input voltage lockout thresholds with two external resistors to meet accurate higher UVLO system requirements. Floating EN pin enables the device with the internal pull-up current to the pin. Connecting EN pin to VIN directly starts up the device automatically.

The SCT2A22 full protection features include the input under-voltage lockout, the output over-voltage protection, over current protection with cycle-by-cycle current limiting, output hard short protection and thermal shutdown protection.

The SCT2A22 employs constant on-time (COT) Mode control providing fast transient with pseudo fixed switching frequency. At the beginning of each switching cycle, since the feedback voltage (VFB) is lower than the internal reference voltage (VREF), the high-side MOSFET (Q1) is turned on during one on-time and the inductor current rises to charge up the output voltage. The on-time is determined by the input voltage and Ron resistor. After the on-time, the Q1 turns off and the low-side MOSFET (Q2) turns on after dead time duration. The inductor current drops and the output capacitors are discharged. When the output voltage decreases and the VFB decreased below the VREF, the Q1 turns on during one on-time after another dead time duration. This repeats on cycle-by-cycle based.

The on time of the SCT2A22 is determined by the R_{ON} resistor and is inversely proportional to the input voltage. The inverse relationship with V_{IN} results in a nearly constant frequency as V_{IN} is varied. The On time can be calculated from Equation 1.

(1)

To set a specific continuous conduction mode switching frequency, the R_{ON} resistor is determined by Equation 2:

(2)

R_{ON} must be selected for a minimum on-time (at maximum VIN) greater than 150 ns for proper operation.

The inductor current is monitored during high-side MOSFET turn on. The SCT2A22 implements over current protection with cycle-by-cycle limiting high-side MOSFET peak current during unexpected overload or output hard short condition.

SCT2A22 also provide a HS current limit off timer for making the IC safer when trigger over current condition. Once trigger HS over current, the present on-time period is immediately terminated, and will force LS turn on a non-resettable off timer for avoiding the inductor current run away. The length of off time is controlled by FB voltage and VIN voltage and could be calculated by the following equation.

(3)

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SCT2A22 adopts Constant-On-Time (COT) control in which the on-time is terminated by an on-timer and the off-time is terminated by the feedback voltage (VFB) falling below the reference voltage (VREF). Therefore, for stable operation, the feedback voltage must decrease monotonically, in phase with the inductor current during the off time. Furthermore, this change in feedback voltage (VFB) during off-time must be larger than any noise component present at the feedback node. A type 3 ripple injection configuration is recommended for minimum output ripple.

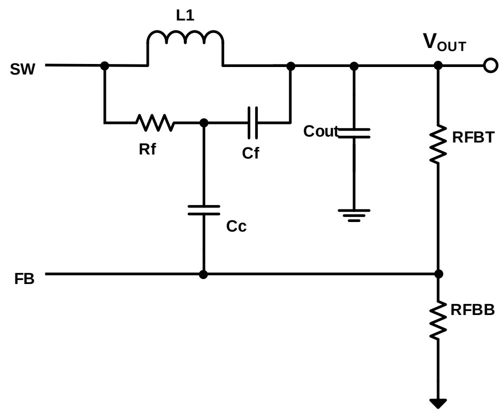

Figure 9. type 3

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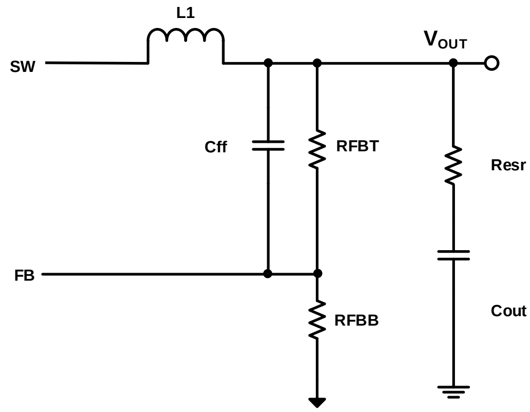

Figure 11. type 2 Ripple Injection Network

The use of Type 1 and Type 2 ripple injection circuits requires consideration of the Resr temperature characteristics of electrolytic capacitors to ensure stable operation over the entire temperature range.

The SCT2A22 contains an internal high voltage linear regulator with a nominal output voltage of 7.5 V. This regulator supplies power to internal circuit blocks including the synchronous FET gate driver and the logic circuits. An external capacitor at rr at

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campngou ts m n

The SCT2A22 is enabled when the VIN pin voltage

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circuit compares the FB pin voltage to the internal reference voltage. When FB voltage exceeds 120% of internal 1.2V reference voltage, the high-side MOSFET turns off to avoid output voltage continue to increase. When the FB pin voltage falls below 115% of the 1.2V reference voltage, the high-side MOSFET can turn on again.

The SCT2A22 protects the device from the damage during excessive heat and power dissipation conditions. Once the junction temperature exceeds 173C, the internal thermal sensor stops power MOSFETs switching. When the junction temperature falls below 148C, the device restarts with internal soft start phase.

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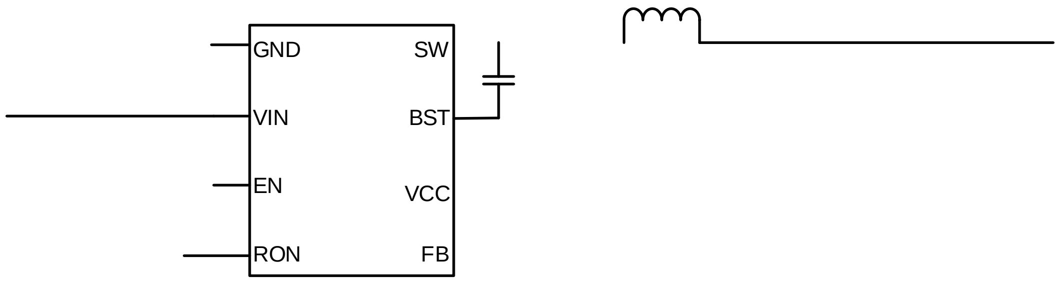

Input Voltage	48V Normal 24V to 100V
Output Voltage	12V
Maximum Output Current	1A
Switching Frequency	300 KHz
Output voltage ripple (peak to peak)	30mV
Transient Response 0.1A to 0.9A load step	æVout = 120mV

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Since the inductor-current ripple increases with the input voltage, so the maximum input voltage in application is always used to calculate the minimum inductance required. Use Equation 18 to calculate the inductance value.

(18)

Where

- L_{MIN} is the minimum inductance required
- f_{sw} is the switching frequency
- V_{OUT} is the output voltage
- $V_{IN(max)}$ is the maximum input voltage
- $I_{OUT(max)}$ is the maximum DC load current
- LIR is coefficient of I_{LPP} to I_{OUT}

The total current flowing through the inductor is the inductor ripple current plus the output current. When selecting an inductor, choose its rated current especially the saturation current larger than its peak operation current and RMS current also not be exceeded. Therefore, the peak switching current of inductor, I_{LPEAK} and I_{LRMS} can be calculated as in equation 19 and equation 20.

(19)

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Vout	L1	COUT	R0	R4	R5	R6	C6	C7
5V	15uH	22uF	82.5K	95K	30K	80.6K	1.5nF	1nF
12V	33uH	22uF	200K	271K	30K	100K	2.2nF	1nF
24V	56uH	22uF	402K	576k	30K	100k	3.3nF	1nF

Vin=48V, Vout=12V, unless otherwise noted

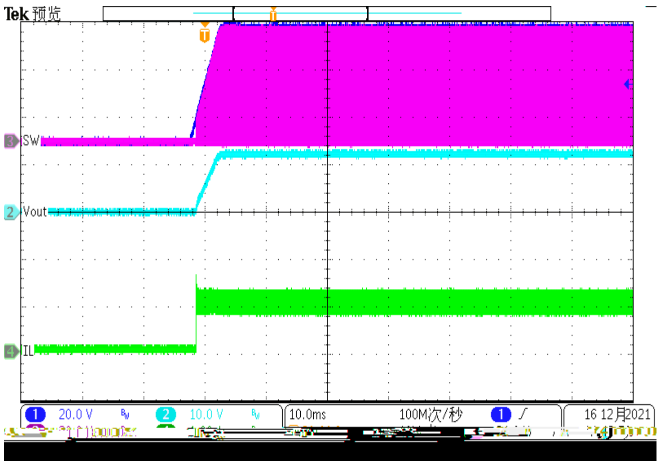

Figure 14. Power up (Iload=1A)

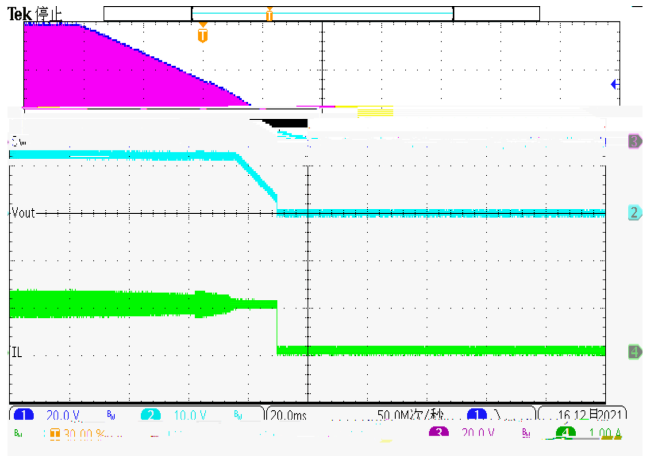

Figure 15. Power down (Iload=1A)

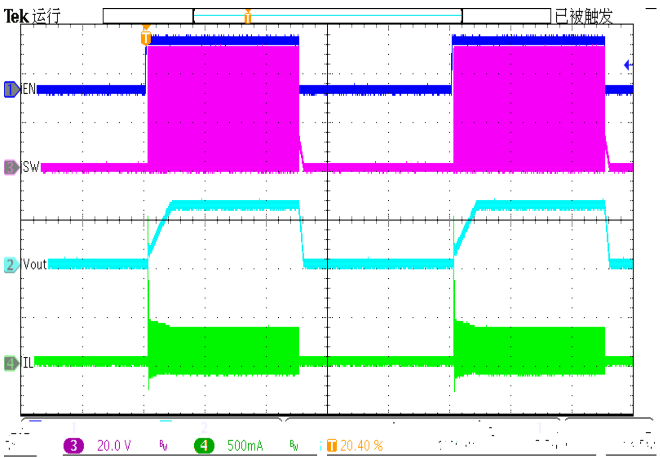

Figure 16. Enable toggle (Iload=0.1A)


Figure 17. Enable toggle (Iload=1A)

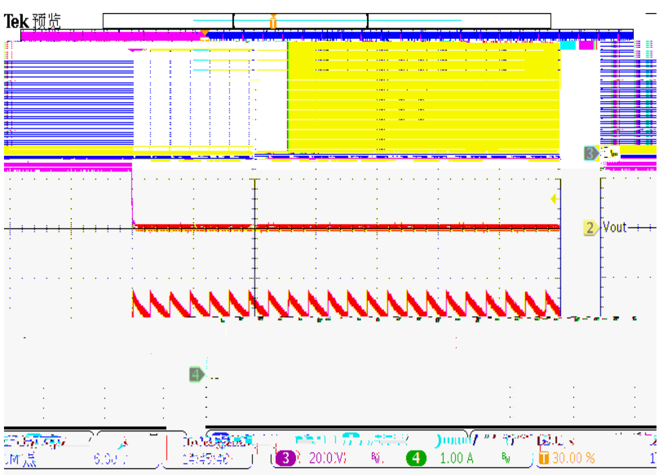

Figure 18. Output Hard Short

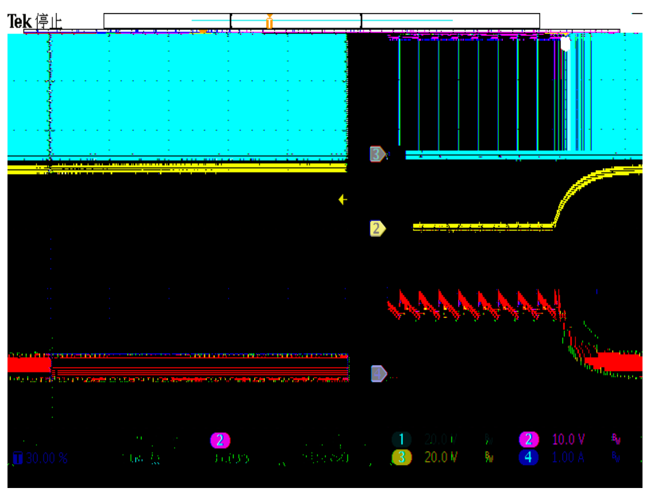

Figure 19. Output Hard Short Release

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(Continued)

Vin=48V, Vout=12V, unless otherwise noted

Figure 20. L oad Transient (0.1A to 0.9A, 1.6A/us)

Figure 21. Load Transient (0.25A to 0.75A,

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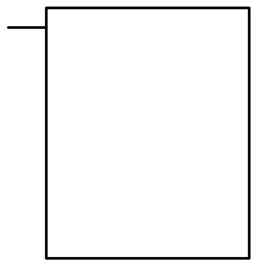

I pĶ t Vo ta e	48 N̄ Ị al36V ĵ o72V
MĶ pĶVo a	12V/5V
Mp xi MĶ tp Curreį	I 1=0.6 Ķ t2=0 5A
Vo a e drop o 1	0.7V
I Ķ cĵ or /Traį Ĵ forml D MTurnĴ Ratio (	L1=68 H /N=2 1:1
Swi chi g FreIJ cĺ	300 KHz

The primary output voltage in an Isolation Buck converter should be no more than one half of the minimum input voltage. For example, at the minimum V_{IN} of 36 V, the primary output voltage (V_{OUT1}) should be no higher than 18V. The isolated output voltage VOUT2 is set by selecting a transformer with a turns ratio (N_1:N_2 =N_{PRI}: N_{SEC}). Using this turns ratio, the required primary output voltage V_{OUT1} is calculated by the following equation:

(25)

The 0.7 V (Vd1) represents the forward voltage drop of the secondary rectifier diode. By setting the primary output voltage V_{OUT1} by selecting the correct feedback resistors, the secondary voltage is regulated at V_{OUT2} nominally. Adjustment of the primary side V_{OUT1} may be required to compensate for voltage errors due to the leakage inductance of the transformer, the resistance of the transformer windings, the diode drop in the power path on the secondary side.

The secondary side rectifier diode must block the maximum input voltage reflected at secondary side switch node. The minimum diode reverse voltage V_{RD1} rating is given below

(26)

A diode with higher reverse voltage rating must be selected in this application. If the input voltage (V_{IN}) has transients above the normal operating maximum input voltage, then the worst-case transient input voltage must be used in calculation while selecting the secondary side rectifier diode.

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Proper PCB layout is a critical for SCT2A22ôs stable and efficient operation. The traces conducting fast switching currents or voltages are easy to interact with stray inductance and parasitic capacitance to generate noise and degrade performance. For better results, follow these guidelines as below:

1. Power grounding scheme is very critical because of carrying power, thermal, and glitch/bouncing noise associated with clock frequency. The thumb of rule is to make ground trace lowest impendence and power are distributed evenly on PCB. Sufficiently placing ground area will optimize thermal and not causing over heat area.

2. Place a low ESR ceramic capacitor as close to VIN pin and the ground as possible to reduce parasitic effect.

3. For operation at full rated load, the top side ground area must provide adequate heat dissipating area. Make sure top switching loop with power have lower impendence of grounding.

4. The power pad should be connected to bottom PCB ground planes using multiple vias directly under the IC. The center thermal pad should always be

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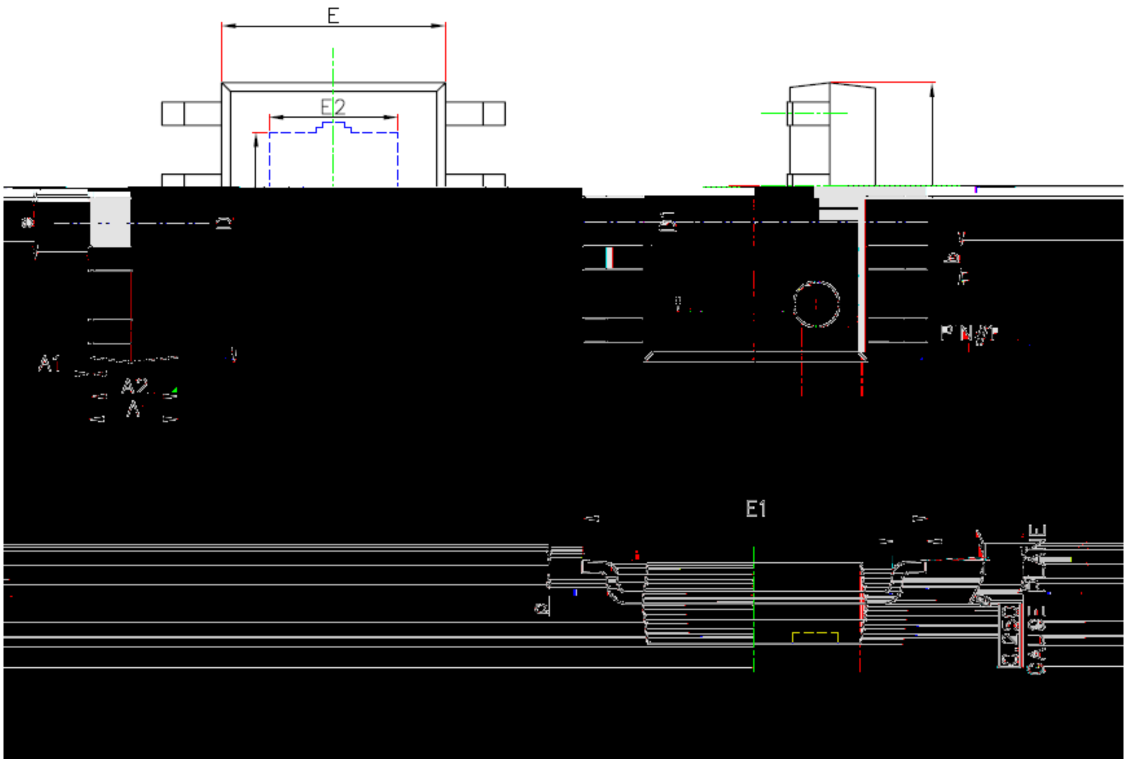

ESOP8(95x130) Package Outline Dimensions

Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min.	Max.	Min.	Max.
A	1.300	1.700	0.051	0.067
A1	0.000	0.100	0.000	0.004
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.201
D1	3.050	3.250	0.120	0.128
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
E2	2.160	2.360	0.085	0.093
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0Á	8Á	0Á	8Á

1. Drawing proposed to be made a JEDEC package outline MO-220 variation.
2. Drawing not to scale.
3. All linear dimensions are in millimeters.
4. Thermal pad shall be soldered on the board.
5. Dimensions of exposed pad on bottom of package do not include mold flash.
6. Contact PCB board fabrication for minimum solder mask web tolerances between the pins.

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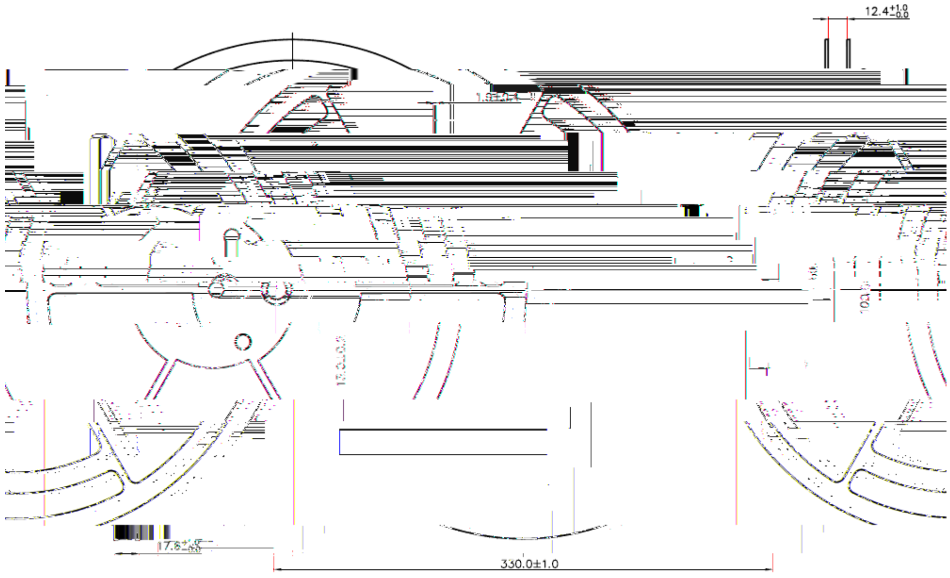
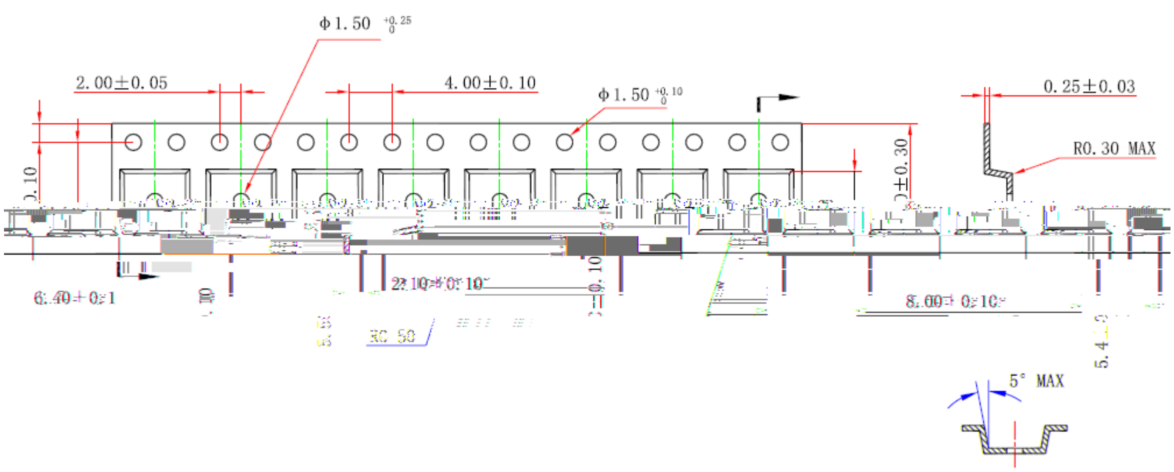

12.4 +1.0 / -0.0
17.6±1.0
330.0±1.0


Φ1.50 +0.25 / 0
2.00±0.05
4.00±0.10
Φ1.50 +0.10 / 0
0.25±0.03
R0.30 MAX
5° MAX