Fully Integrated Power MOS, 30V OVP, 3A 1~4 Lithium Batteries, Buck–Boost Charger

General Description

IU5180C is a fully integrated buck-boost switch charging management IC used for 1~4 lithium-ion and lithium-polymer batteries, as well as 1~5 lithium iron phosphate batteries. The chip integration includes a 4-switch MOSFET, input and charging current sensing circuits, batteries, and loop compensation for the buck-boost converter. The chip has a charging current capacity of 3A, and the charging current can be flexibly adjusted through external resistors.

The IU5180C has four built-in loops to control the charging process, namely a constant current (CC) loop, a constant voltage (CV) loop, a chip temperature adjustment loop, and an intelligently adjustable charging current to prevent the output of the adapter from collapsing. It is matched with the input adaptive loop of all adapters, and its input adaptive point is flexibly adjustable through an external voltage divider resistor.

IU5180C adjusts the voltage sharing ratio of the external feedback resistor of the battery to obtain different constant voltage charging voltage values, thereby adapting to different sections and specifications of lithium batteries.

Features

- Fully Integrated Switch Mode Buck-Boost Charger
- Operating Voltage 3.6~21V, BAT Terminal withstand Voltage 30V, Integrated High-Voltage Transistor
- Maximum 3A Charging Current, Adjustable External Resistance for Charging Current
- NTC Function
- Input Current Adaptive Function, with Externally Adjustable Adaptive Points
- Support Dual Channel LED Charging Status Indication
- 500KHz Switching Frequency
- Output Overvoltage, Short Circuit Protection
- Integrated 30V OVP Function
- Chip Temperature Adaptive adjustment
- Chip over Temperature Protection
- Good EMI Characteristics

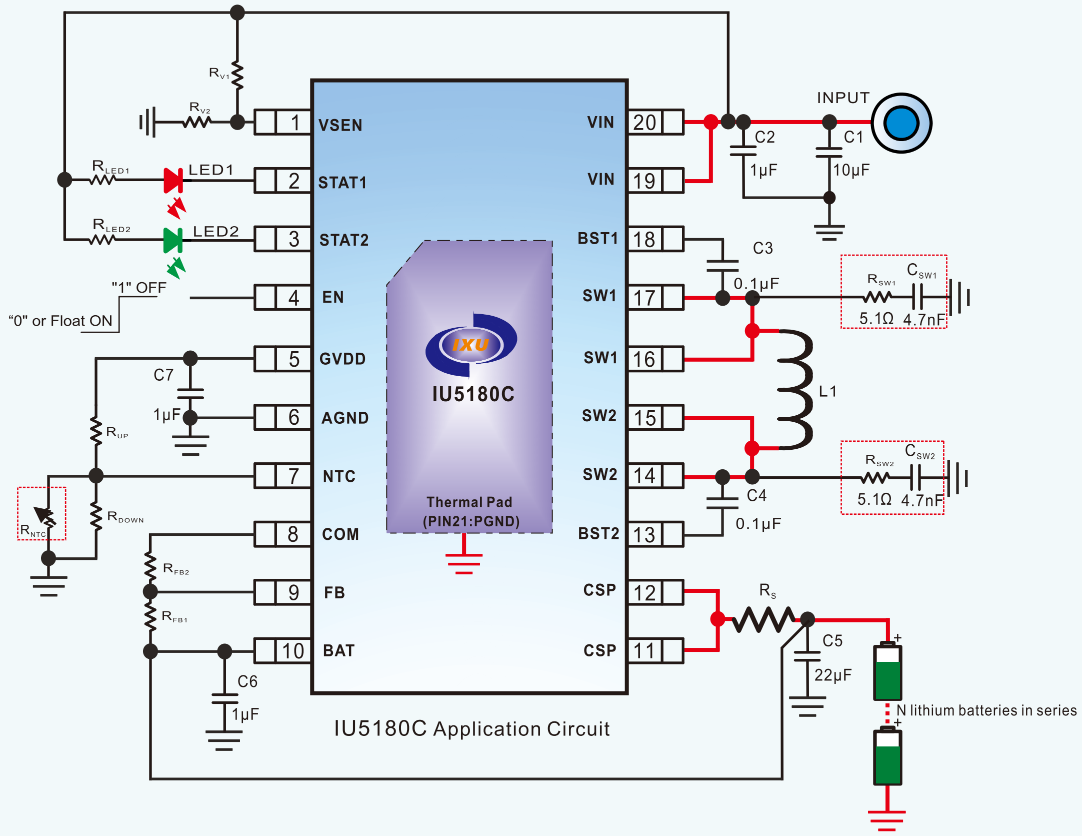
Applications

- Toy
- Walkie-Talkie
- Electronic Cigarette
- Bluetooth Speaker
- Lithium Iron Phosphate Battery Pack
- 4.2V/4.3V/4.35V/4.4V lithium Battery Pack

Package

- TSSOP20-PP

Typical Applications



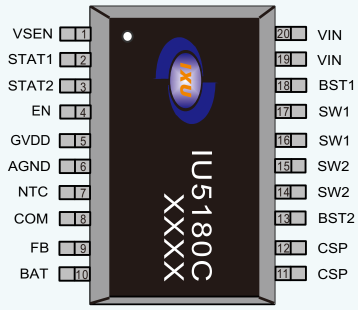
IU5180C Application Circuit

Notes:

(1) The saturation current value of the L1 power inductor must be carefully confirmed and have sufficient margin.
(2) For 1~2 batteries, it is recommended to use a 4.7uH inductor for L1;
for 3~4 batteries, it is recommended to use a 6.8uH inductor for L1.
(3) The power resistor RS is used to set the charging current value and taps should be made close to its two ends.
(4) The BAT tap of the power resistor RS is close to and passes through its sampling capacitor (C5 must be close to the RS resistor port) and is far away from the inductor.
(5) The surface - mount capacitors of other pins should be arranged as close as possible to the chip pins.
(6) The EN pin of the chip is a low voltage pin with an internal 500KΩ pull-down resistor.
(7) In order to reduce peak spikes and optimize EMI, add RC absorbing circuits to SW1 and SW2 respectively.
(8) The battery voltage line connected to the FB pin of the chip can also be sampled by tapping separately from the true anode of the battery to reduce line loss error.
(9) If the chip works in high voltage and high current charging for a long time, its heat dissipation must be optimized and strengthened. Otherwise, the input voltage and charging current should be appropriately reduced for use.
(10) The red solid lines in the figure represent the paths for large current flow.

PIN Configuration and Functions

IU5180C



TSSOP20-PP
TOP VIEW

PIN	NAME	TYPE	DESCRIPTION
1	VSEN	I	VIN voltage detection input adaptive point port
2	STAT1	O	Charging status indicator port 1
3	STAT2	O	Charging status indicator port 2
4	EN	I	Enabling PIN
5	GVDD	P	Internal LDO output terminal
6	AGND	-	Analog ground
7	NTC	I	The input terminal of the thermistor detects the battery temperature through an external thermistor
8	COM	O	Battery voltage detection resistor and internal switch tube connection terminal of the chip
9	FB	I	Battery voltage feedback terminal
10	BAT	P	Battery connection PIN
11,12	CSP	I	Battery charging current detection positive input terminal
13	BST2	P	Output high side power MOSFET gate driver power supply
14,15	SW2	I	Step-up side half bridge switch node
16,17	SW1	I	Step-down side half bridge switch node
18	BST1	P	Input high side power MOSFET gate driver power supply
19,20	VIN	P	Input power supply
Thermal PAD	PGND	-	power ground

Absolute Maximum Ratings [1]

SYMBOL	PARAMETER	VALUE	UNIT
VMAX	VIN, BST1, BST2, SW1, SW2, CSP, BAT, FB, COM, NTC, STAT1, STAT2, VSEN	-0.3~30	V
	GVDD, EN	-0.3~6	V
T_J	Junction operating temperature range	-40~150	℃
T_{STG}	Storage temperature range	-55~150	℃
T_{SDR}	Lead temperature (Soldering, 10 sec.)	260	℃

Recommended Operating Conditions

SYMBOL	PARAMETER	VALUE	UNIT
V_{IN}	Input power supply voltage	3.6~21	V
T_J	Junction operating temperature range	-40~125	℃
T_A	Ambient temperature range	-40~85	℃

Thermal Information [2]

SYMBOL	PARAMETER	VALUE	UNIT
θ_{JA}	Package thermal resistance - chip to environment thermal resistance	36	℃/W
θ_{JC}	Package thermal resistance - chip to Package Surface Thermal Resistance	17	℃/W

Ordering Information

Device	Package Type	Device Marking	Package size	Tape Width	Quantity
IU5180C	TSSOP20L-PP		13”	8mm	5000 units

ESD Ratings

HBM (Human Body Model) -- ±2kV

MM (Machine model) -- ±200V

1. The above parameters are only the limit values of device operation. It is not recommended that the working conditions of the device exceed the limit values. Otherwise, the reliability and life of the device will be affected, and even permanent damage will be caused.
2. Where the PCB board is placed in IU5180C, a heat dissipation design is needed. The heat sink at the bottom of IU5180C is connected with the heat sink area of PCB board.

Electrical Characteristics (VIN=5V , R_S=50mΩ , L=4.7uH , unless otherwise noted)

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
VIN	Supply voltage		3. 6		21	V
VIN_{UVLO}	VIN under voltage lockout threshold	VIN Falling		3.6		V
ΔVIN_{UVLO}	VIN under voltage lockout hysteresis			200		mV
VIN_{OVP}	VIN over voltage protection	VIN Rising		23		V
ΔVIN_{OVP}	VIN over voltage protection hysteresis			1.28		V
I_Q	Input quiescent current	VIN=12V, V_{BAT}=8.4V		0.7		mA
I_{SD}	Input shutdown current	VIN=12V, V_{BAT}=8.4V, V_{EN}=5V		50		μA
I_{BAT}	Battery leakage current	Unplug charger, V_{BAT}=8.4V		6		μA
		Plug charger, V_{EN}=5V VIN>V_{BAT}, V_{BAT}=8.4V		0.5		
		Plug charger, V_{EN}=5V VIN<V_{BAT}, V_{BAT}=8.4V		6		
		Plug charger, R_{FB1}=740KΩ, R_{FB2}=100KΩ VIN>V_{BAT}, V_{BAT}=8.4V		25		
		Plug charger, R_{FB1}=740KΩ, R_{FB2}=100KΩ VIN<V_{BAT}, V_{BAT}=8.4V		640		

Electrical Characteristics (VIN=5V , R_s=50mΩ , L=4.7uH , unless otherwise noted)

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{VSEN}	VSEN pin modulation voltage			1		V
V_{FB}	Feedback voltage modulation threshold		0.99	1	1.01	V
V_{CV}	Terminal battery voltage	K=1+R_{B1}/R_{B2}		K*V_{FB}		V
V_{RCH}	Recharge voltage	V_{BAT} Falling		0.975V_{CV}		V
V_{TRK}	TC charge mode battery voltage threshold	V_{BAT} Rising		0.667V_{CV}		V
V_{SHORT}	Battery short threshold	V_{BAT} Falling		0.25V_{CV}		V
V_{OVPB}	BAT over voltage threshold	V_{BAT} Rising		1.07V_{CV}		V
V_{SENSE}	Maximum current detection voltage			50		mV
I_{CC}	CC charge mode current	R_S=25mΩ	1.8	2	2.2	A
I_{TC}	TC charge mode current			10%		ICC
I_{BF}	Terminate charge current			10%		ICC
V_{cold}	NTC low temperature falling threshold	Percentage of GVDD		70		%
V_{cold_hys}	NTC Low temperature protection hysteresis	Percentage of GVDD		0.83		%
V_{hot}	NTC high temperature rising threshold	Percentage of GVDD		47.5		%
V_{hot_hys}	NTC high temperature protection hysteresis	Percentage of GVDD		1.67		%
V_{GVDD}	GVDD output voltage			5		V

Electrical Characteristics (VIN=5V , R_s=50mΩ , L=4.7uH , unless otherwise noted)

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{ENH}	EN Enable High Level Threshold		1.5			V
V_{ENL}	EN Enable Low Level Threshold				0.4	V
F_{SW}	Maximum switching frequency			500		KHz
TMR_{TC}	Trick charge time limit			2		Hour
$TMR_{CC/CV}$	CC/CV charge time limit			20		Hour
T_{REG}	Thermal regulation threshold			120		℃
T_{SD}	Thermal shutdown temperature			150		℃
ΔT	Thermal shutdown temperature hysteresis			40		℃

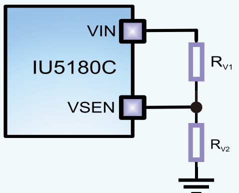
IU5180C Application Points

1. Charge Process

The IU5180C adopts a complete TC/CC/CV charging process. When the voltage of the battery is less than the trickle point, the system charges at 10%*I_{CC} charging current; When the voltage of the battery is greater than the trickle point, the system charges with I_{CC} charging current; When the battery voltage approaches the set float charging voltage, the system enters constant voltage charging, and the charging current continues to decrease. When the charging current is less than 10%* I_{CC}, the system will stop charging; When the battery is fully charged and the battery voltage drops to the set recharge voltage due to self discharge or load consumption, the system will restore the charging state.

2. Adaptive Input Current Limit Function

The IU5180C has a special built-in loop that can automatically adjust the charging current to prevent the input DC power from entering an overdrive state, thereby preventing any improper setting that may cause the adapter to collapse. The input adaptation function of IC determines the lowest value V_{INAJ} to which the power input pin of the chip can be reduced by selecting two resistors, R_{V1} and R_{V2}. When the input reaches this value, the chip will actively reduce the appropriate charging current to adapt to the capacity of the input power supply, thereby avoiding further weakening of the input power supply. The calculation formula is as follows:



$$VIN_{AJ} = \frac{1*(R_{V1}+R_{V2})}{R_{V2}}$$

If the pin is connected to a VIN, this function is disabled; If grounded, charging is prohibited.

3. Protection Function

IU5180C has comprehensive battery charging protection function. When the chip experiences input overvoltage, output overvoltage, or chip overheating, the system charging will be prohibited until the protection state is released; When the battery voltage is below V_{SHORT}, the output short circuit protection function is activated; When the input voltage is lower than the undervoltage protection threshold, all main functional modules of the chip will be turned off to avoid misoperation of the system due to low power supply voltage; In addition, the system has a protection function for charging out of date. If there is a problem with a lithium battery, it will cause the charging time to be too long. When the TC stage charging time is greater than 2 hours or the CC charging time is greater than 20 hours, the charging timeout protection function will be activated and the charging process will be forcibly terminated. Only when the system is powered on again or the battery status changes will the timer be reset.

4. Charging Indication Function

The STAT1 and STAT2 pins of the chip are status indicator pins that output 0 level or high resistance state. If the LED light is not connected, but directly connected to the main control, there must be a pull-up resistor to convert the high resistance state into the exact high level.

(1) Charging process:

The STAT2 port outputs a high resistance state and the LED light is constantly off;

The STAT1 port outputs a low level and the LED light is constantly on.

(2) Charging completed:

The STAT2 port outputs a low level and the LED light is constantly on;

The STAT1 port outputs a high resistance state and the LED light is constantly off.

(3) In cases of battery overvoltage, battery short circuit, NTC port detecting abnormal battery temperature, chip overheating, and charging timeout, the LED lights on both ports flash alternately at a frequency of 1.5Hz.

(4) When the input VIN terminal is under voltage or the chip is in non enable mode, both ports output a high resistance state and the LED lights are all off.

(5) If there is no battery detected after the system is powered on, the two LED lights will alternately flash and then turn off.

5. Charging Current Setting

The constant current charging current can be set through resistance R_S, and the specific calculation formula is as follows:

$$I_{CC} = \frac{50mV}{R_S(m\Omega)}(A)$$

If you need to obtain a charging current of 2A I_{CC}, you only need to select a detection resistor R_S with a resistance value of 25mΩ. Thus, the charging current I_{TC} of the TC stage is determined by the following formula:

$$I_{TC} = 10\% I_{CC} = \frac{5mV}{R_S(m\Omega)}(A)$$

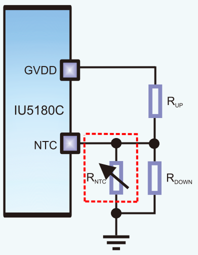
The set constant current charging current will flow through the corresponding R_S resistor. Therefore, it is necessary to select an R_S resistor with sufficient rated power. It should be particularly noted that when the chip works in high voltage and high current charging for a long time, its heat dissipation must be optimized and strengthened. Otherwise, the input voltage and charging current should be appropriately reduced for use.

6. Chip Temperature Adaptive Adjustment Function

The chip is equipped with a temperature adaptive adjustment loop. When the chip is in the charging process, if the temperature rises to 120℃, the temperature control loop begins to work. The charging current gradually decreases, and the chip temperature will decrease accordingly. Finally, the chip temperature will stabilize at the set value, thereby protecting the chip.

7. NTC Resistor Setting

Battery charging supports NTC protection function, and the temperature of the battery is detected through the NTC pin. When NTC detects that the battery temperature is within the set temperature window range, it charges normally; When NTC detects that the battery temperature is below the set low temperature protection point or above the set high temperature protection point, it stops charging and alarms. If the NTC function is not used, the pin must be grounded. The following figure shows the high-temperature reference points and low-temperature reference points set internally through voltage divider resistors, with the low-temperature reference point being GVDD*70% and the high-temperature reference point being GVDD*47.5%. Set the temperature range for normal operation of NTC by selecting appropriate external resistors.



$$\frac{R_{DOWN}//R_{NTC\_Cold}}{R_{UP}+R_{DOWN}//R_{NTC\_Cold}}=70\%$$

$$\frac{R_{DOWN}//R_{NTC\_Hot}}{R_{UP}+R_{DOWN}//R_{NTC\_Hot}}=47.5\%$$

In the above equation, R_{NTC_Cold} is the resistance value corresponding to the NTC resistor at the set low temperature point, and R_{NTC_Hot} is the resistance value corresponding to the NTC resistor at the set high temperature point. Due to the fact that R_{DOWN} and R_{UP} resistors can be independently set for low and high temperature windows, This enables the chip to meet most NTC resistor models, which brings great convenience to applications. The relationship between resistance R_{DOWN}, R_{UP}, and NTC resistance can be given by the following formula based on the above definition:

$$R_{UP}=\frac{90*R_{NTC\_Hot}*R_{NTC\_Cold}}{133*(R_{NTC\_Cold}-R_{NTC\_Hot})}$$

$$R_{DOWN}=\frac{30*R_{NTC\_Hot}*R_{NTC\_Cold}}{19*R_{NTC\_Cold}-49*R_{NTC\_Hot}}$$

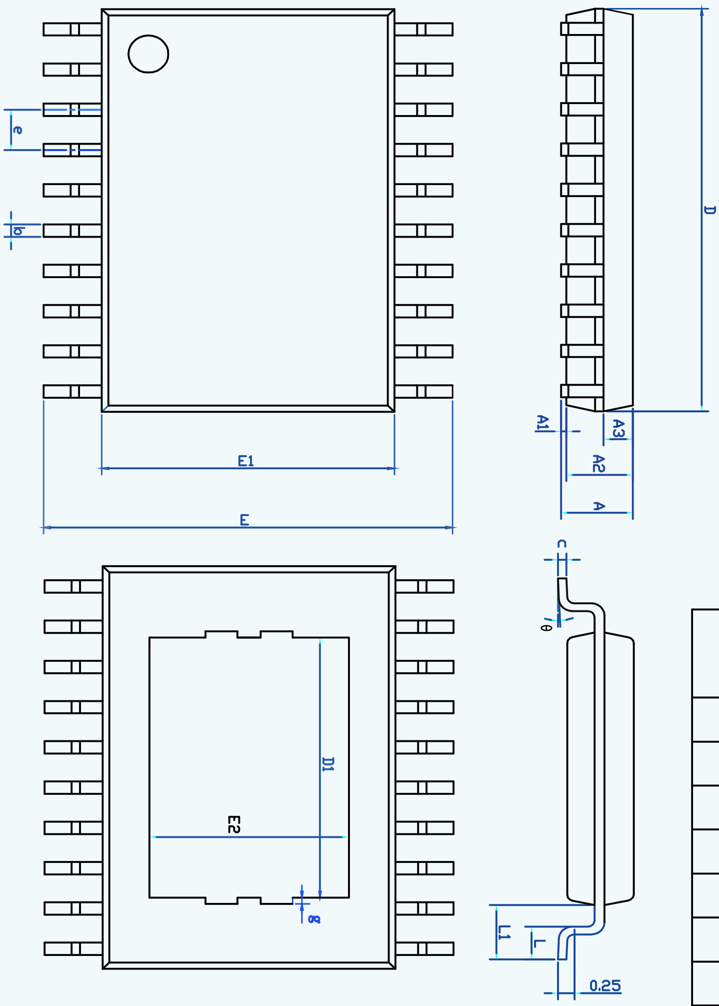
8. Battery Floating Charging Voltage Setting

The internal clamping voltage threshold corresponding to the FB pin of the chip is 1V. Based on this voltage and the two external voltage divider resistors R_{FB1} and R_{FB2}, the float charging voltage value for battery charging can be set. The specific formula is as follows:

$$V_{CV}=\frac{1*(R_{FB1}+R_{FB2})}{R_{FB2}}$$

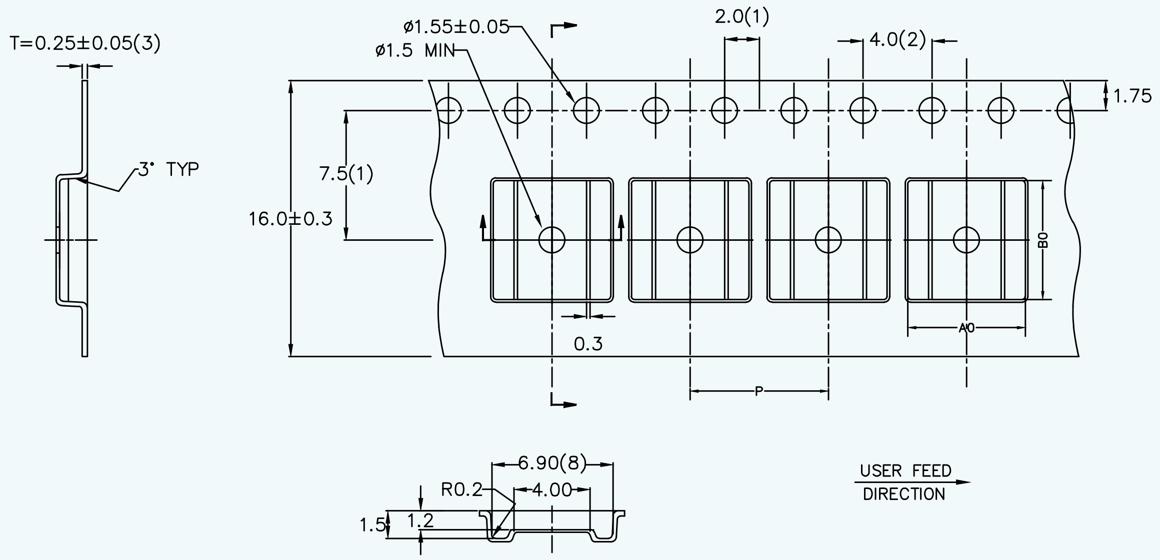
Package Information

IU5180C TSSOP20-PP PACKAGE OUTLINE DIMENSIONS (units:mm)



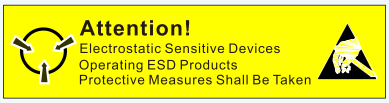
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	——	——	1.20
A1	0.04	0.08	0.12
A2	0.95	1.00	1.05
A3	0.39	0.44	0.49
b	0.20	——	0.29
c	0.13	——	0.18
D	6.40	6.50	6.60
D1	4.10REF		
E	6.30	6.40	6.50
E1	4.30	4.40	4.50
E2	2.90REF		
e	0.65BSC		
L	0.50	0.60	0.70
L1	1.00REF		
θ	0°	——	8°
g	0.10REF		

TAPE AND REEL INFORMATION



A0	B0	K0	P	P0	E	F	D0	P2	T	W
6.65±0.1	6.80±0,1	1.5±0.1	8.0±0.1	4.0±0.1	1.75±0.1	7.5±0.1	1.55±0.05	2.0±0.1	0.25±0.05	16±0.3

NOTES:
1. MEASURED FROM THE CENTERLINE OF SPROCKET HOLE TO CENTERLINE OF THE POCKET HOLE AND FROM THE CENTERLINE OF SPROCKET HOLE TO CENTERLINE OF THE POCKET
2. CUMULATIVE TOLERANCE OF 10 SPROCKET HOLES IS ±0.20
3. THIS THICKNESS IS APPLICABLE AS MEASURED AT THE EDGE OF THE TAPE
4. MATERIAL: CONDUCTIVE POLYSTYRENE
5. DIM IN MM
6. ALLOWABLE CAMBER TO BE 1mm PER 100mm IN LENGTH, NON-CUMULATIVE OVER 250mm
7. UNLESS OTHERWISE SPECIFIED, TOLERANCE ±0.10
8. MEASUREMENT POINT TO BE 0.3 FROM BOTTOM POCKET .
9. SURFACE RESISTIVITY LESS THAN OR EQUAL TO 1.0X10E6 OHMS/SQUARE .



Precautions for MOS Circuit Operation:

Static electricity can be generated in many places. The following precautions can effectively prevent MOS circuit from being damaged due to the sound of electrostatic discharge:

- Operators shall be grounded through anti-static wrist strap.
- The equipment enclosure must be grounded.
- Tools used during assembly must be grounded.
- Conductor packaging or anti-static materials must be used for packaging or transportation.

Declaration:
•Shanghai IXU Micro-electronics Co., Ltd. reserves the right to make changes to the manual without prior notice! Customers should obtain the latest version of the material before use and verify whether the relevant information is complete and up-to-date.
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