1.Description

AP5056H is a complete single-chip lithium-ion battery constant current/constant voltage linear power management chip. Its MSOP-8/SOP-8 package and minimal peripheral components are very suitable for portable products, and AP5056H is specifically designed for USB power supply specifications. Based on the internal MOSFET structure, there is no need for external sensing resistors and isolation diodes. When the external ambient temperature is too high or working at high power, thermal feedback can adjust the charging current to reduce the chip temperature. The charging voltage is fixed at 4.2V, and the charging current can be set through an external resistor. When the charging current drops to 1/10 of the set value after reaching the final float voltage, AP5056H will automatically terminate the charging cycle. When the input terminal (adapter or USB power supply) is unplugged, AP5056H automatically enters a low current state, and the battery leakage current will drop below 0.5 μ A. AP5056H can also be set to the shutdown state, reducing the power supply current to 180μA. Other features include: battery temperature monitoring, undervoltage lockout, automatic recharging, and two status pins to display charging and charging termination

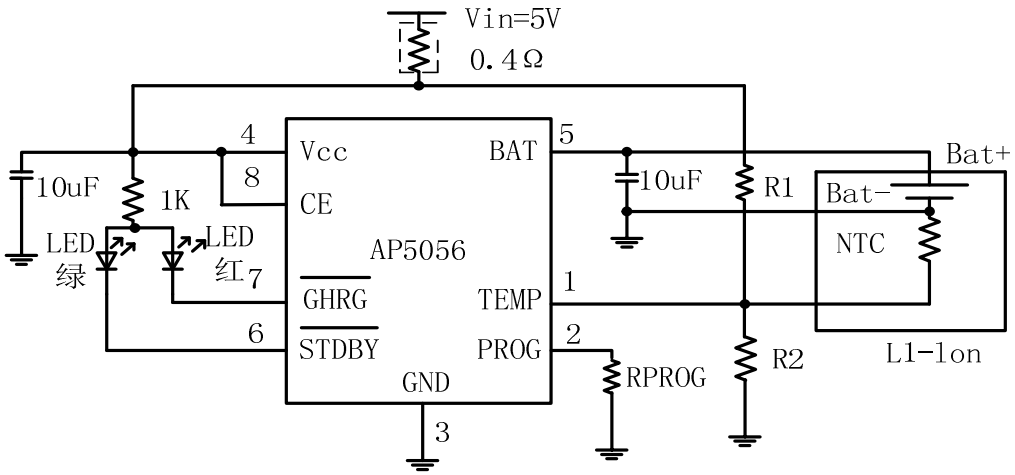
2.Features

- Input voltage up to 30V
- Input overvoltage protection Typ: 6.5V
- Programmable charging current up to 1000mA
- No need for external MOSFETs, sensing resistors, and isolation diodes
- Constant current/constant voltage operation, with thermal regulation function that maximizes charging rate without overheating hazard. Directly manage charging of a single lithium-ion battery from the USB interface
- Pre set charging voltage of 4.2V
- Charging current monitor output for battery level detection
- Automatically recharge
- Charging status dual output, no battery and fault status display
- Terminate charging with 1/10 charging current
- Stop working state current 180μA
- 2.9V trickle charging threshold voltage
- Soft start limits surge current
- Battery temperature detection function

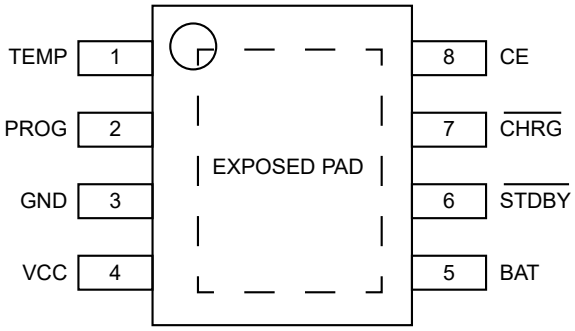
3.Applications

- Cellular Telephones, PDAs, MP3 /MP4 Players
- Charging Docks and Cradles
- Bluetooth、GPS Applications

4.Typical Application Circuit



5.Pinning Information

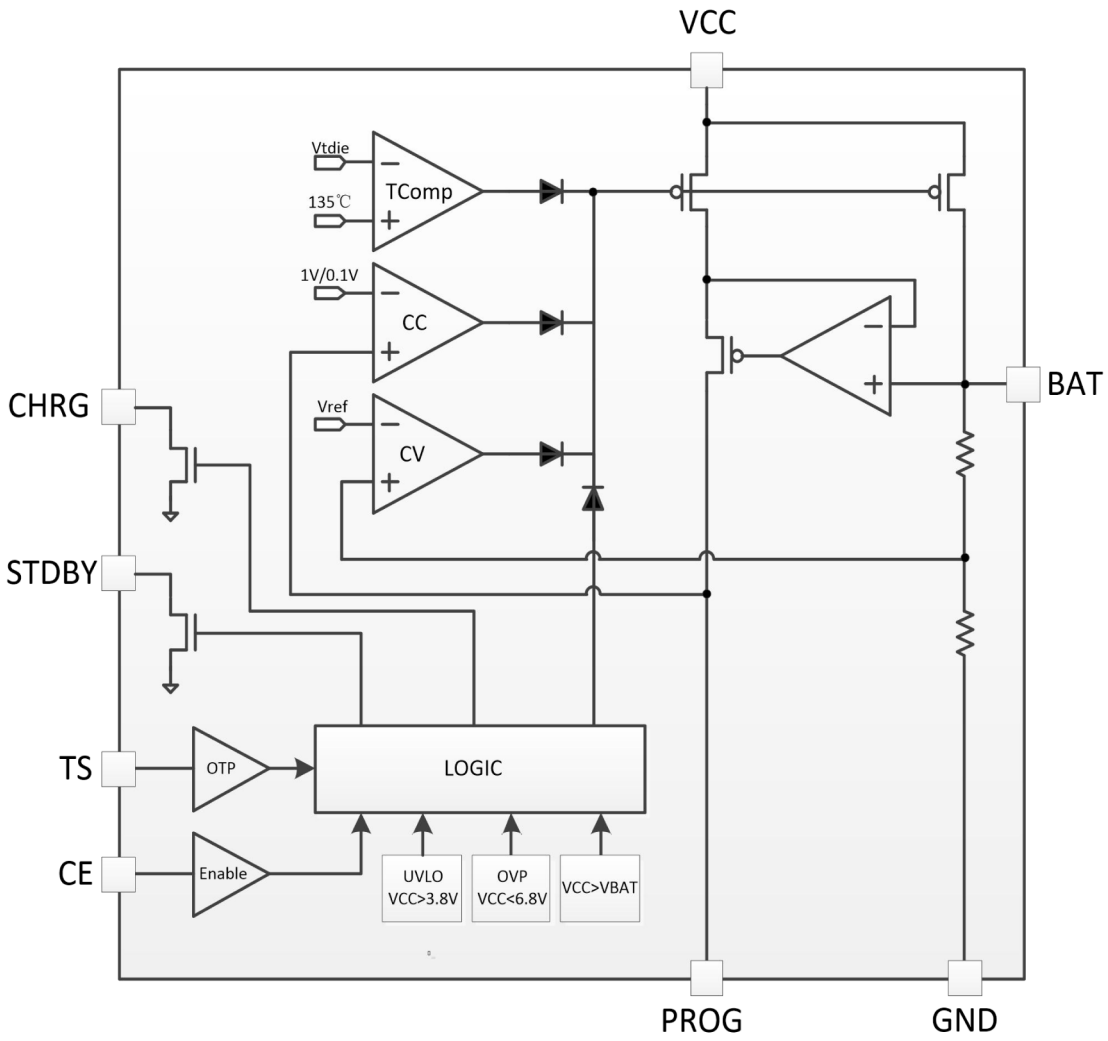


ESOP-8

Pin Descriptions

Pin Number	Pin Name	Pin Number	Pin Name
1	TEMP	5	BAT
2	PROG	6	$\overline{\text{STDBY}}$
3	GND	7	$\overline{\text{CHRG}}$
4	VCC	8	CE

6.Bolbk Diagram



7.Absolute Maximum Ratings

Parameter	Symbol	Ratings	Units
Input Supply Voltage	V_{CC}	V_{SS}-0.3~V_{SS}+30	V
CE Voltage	V_{CE}	V_{SS}-0.3~5.5+0.3	V
PROG pin Voltage	V_{prog}	V_{SS}-0.3~V_{CC}+0.3	V
BAT pin Voltage	V_{bat}	V_{SS}-0.3~8	V
CHAG pin Voltage	V_{chrg}	V_{SS}-0.3~V_{SS}+8	V
BAT pin Current	I_{bat}	1400	mA
PROG pin Current	I_{prog}	1400	μA
Operating Ambient Temperature	T_{opa}	-40 to 85	°C
Storage Temperature	T_{str}	-65 to 125	°C
Lead Temperature (Soldering, 10s)		260	°C

Caution: The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded under any conditions.

8.Electrical Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input supply voltage	V_{CC1}		4.25	20		V
Working voltage	V_{CC2}		4.25		5.5	V
Input voltage OVP	V_{OVP}	V_{CC} Rise	5.6	6.5	7.2	V
OVP Delay	$V_{OVP\ -HYS}$			0.25		V
Input power supply current	I_{CC}	Charging mode , R_{PROG}=2K		350		μA
		Standby mode		150	500	μA
		Shutdown mode (R_{PROG} Not connected, V_{CC}<V_{bat} or V_{CC}<V_{uv})		180		μA
Stable output (float charging) voltage	Vfloat	T_A=25°C, I_{BAT}=40mA	4.16		4.24	V
BAT Pin current	Ibat	R_{PROG}=2k,Current mode	450	500	550	mA
		R_{PROG}=1k,Current mode	900	1000	1150	mA
		standby mode, Vbat=4.3V	0	-2.5	-6	μA
		Shutdown mode		-1	-2.5	μA
		Sleep mode, V_{CC}=0V		-0.05	-0.5	μA
Trickle Charge Current	Itrikl	V_{bat}<V_{trikl}, R_{PROG}=1k	240	300	360	mA
Trickle charging threshold voltage	Vtrikl	R_{PROG}=10K, Vbat Rise	2.78	2.9	3.05	V
Trickle voltage hysteresis voltage	Vtrhys	R_{PROG}=10k	100	180	250	mV
V_{CC} Undervoltage lockout threshold	Vuv	V_{CC} From low to high	3.6	3.8	4.05	V
V_{CC} undervoltage locking hysteresis	Vuvhys		150	200	300	mV
V_{CC} -V_{BAT} Lock threshold voltage	Vasd	V_{CC} From low to high	45	170	400	mV
		V_{CC} From low to low	5	100		mV
C/10Termination current threshold	Iterm	R_{PROG}=1k		100		mA
		R_{PROG}=2k		50		mA
PROG Pin voltage	Vprog	R_{PROG}=1k, Current mode	0.9	1	1.1	V
CHRG Pin output low voltage	Vchrg	Ichrg=5mA		0.3	0.5	V
STDBY Pin output low voltage	Vstdby	Istdby=5mA		0.3	0.5	V

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Battery recharge threshold voltage	ΔVrecg	V_{FLOAT} - V_{RECHRG}	80	160	280	mV
CE High voltage	Vce-h	AP5056H	1.2			V
CE Low voltage	Vce-l	AP5056H			0.8	V
TEMP Pin high-end flip voltage	Vtemp-h			80	82	%V_{CC}
TEMP Pin low-end flip voltage	Vtemp-l		42	45		%V_{CC}
Junction temperature in limited temperature mode	Tlim			145		°C

9.Typical Characteristic

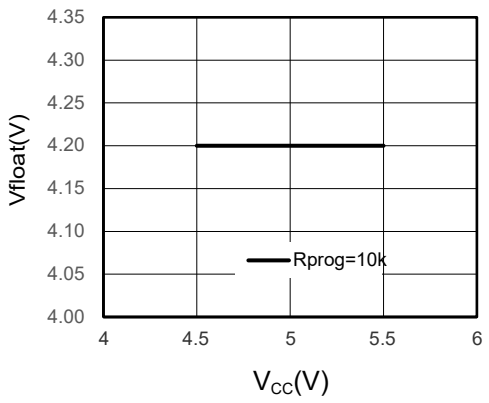


Figure 1: Vfloat vs V_{CC}

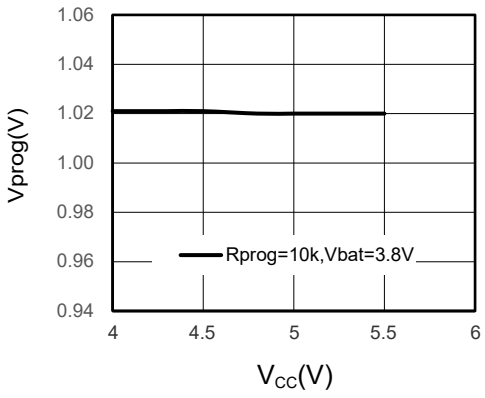


Figure 2: Vprog vs V_{CC}

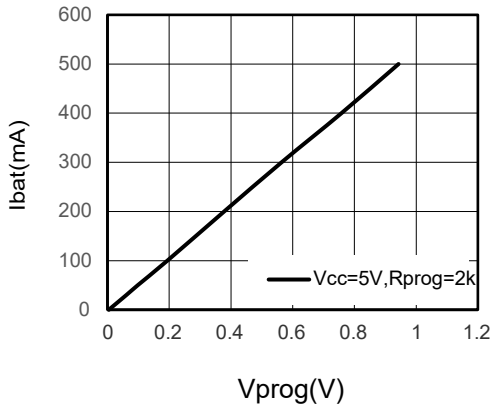


Figure 3: Charge current vs Vprog

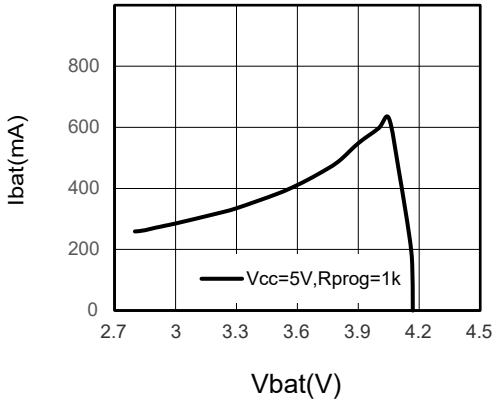


Figure 4: Ibat vs Vbat

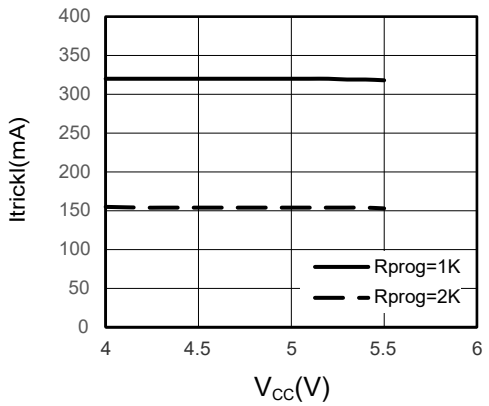


Figure 5: Itrickl vs V_{CC}

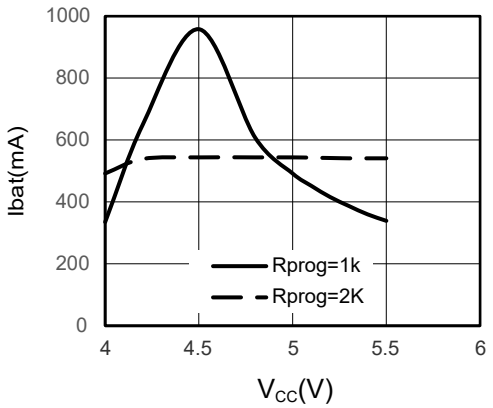


Figure 6: Ibat vs V_{CC}

10.Pin Function

TEMP (Pin 1): Battery temperature detection input. TEMP pin to receive the battery NTC sensor output. If the TEMP pin voltage is less than the input voltage is greater than 45% or 80% of the input voltage means the battery temperature is too low or too high, then the charge has been suspended.
If the TEMP direct access GND, battery temperature detection canceled, the other charged and functioning properly.

PROG (Pin 2): Charging current setting, monitoring, and turn off pins. Connecting a 1% precision external resistor from the ROG pin to the ground terminal can set the charging current. In the pre charging stage, the voltage of this pin is modulated at 0.3V; During the constant current charging phase, the voltage of this pin is fixed at 1V. In all charging modes, the voltage of the pin can be measured to estimate the charging current according to the following formula: IBAT = (VPROG/RPROG) • 1000
The ROG pin can also be used to turn off charging. Disconnecting the programming resistor to ground will allow an internal 3μA current to pull up the voltage of the ROG pin. When it reaches the shutdown threshold voltage of 1.21V, the charger enters shutdown mode, charging stops and the input current drops to 180 μ A. This pin is also clamped at approximately 2.4V. Driving this pin with a voltage exceeding the clamp will result in a pulling current of up to 1.5mA. Reconnecting the RPROG to ground will return the charger to normal operating mode.

GND (Pin 3): Ground.

VCC (Pin 4): Input voltage positive input terminal. Provide charging power supply. The VCC voltage range is 4.25V-20V, and the working range is 4.25V-5.5V. A bypass capacitor with at least 10 μ F should be connected. When the voltage difference between the power supply VCC and the BAT pin is less than 30mV, AP5056H enters shutdown mode and IBAT is less than 2μA.

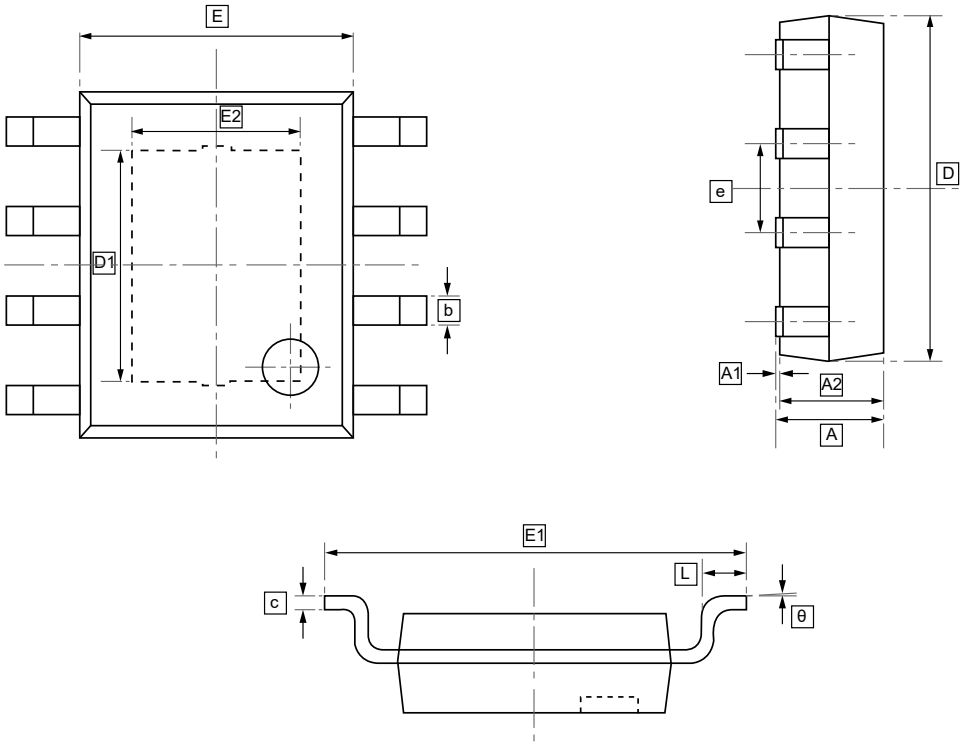
BAT (Pin 5): Battery connection end. Provide battery charging current and adjust the final float charging voltage to 4.2V. Set the float voltage from this pin through an internal precision resistor voltage divider, and disconnect it in turn off mode.

STDBY (Pin 6): Battery charging completion indicator terminal. After the battery is fully charged, STDBY pulls down through the internal switch to indicate that the charging is complete. In addition, the STDBY pin will be in a high impedance state.

CHRG (Pin 7): The charging status indicator terminal for open drain output. When the battery is charging, the CHRG pin is pulled low through the internal N-channel MOSFET, indicating that charging is in progress. Otherwise, the CHRG is in a high resistance state.

CE (Pin 8): The high input level of the chip enables the AP5056H to operate normally. The low input level puts AP5056H in a charging disabled state. The CE pin can be driven by TTL level or CMOS level.

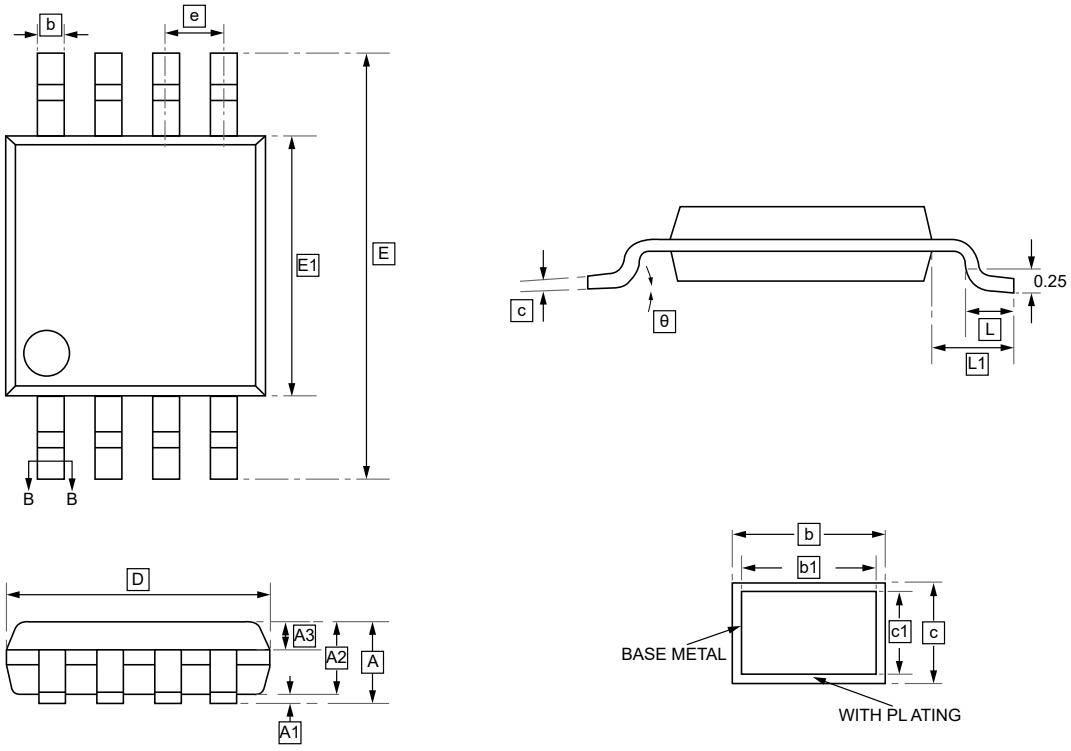
11.1 ESOP-8 Package Outline Dimensions



DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	b	c	D	D1	E	E1	E2	e	L	θ
Min	1.300	0.000	1.350	0.330	0.170	4.700	3.202	3.800	5.800	2.313	1.270	0.400	0°
Max	1.700	0.100	1.550	0.510	0.250	5.100	3.402	4.000	6.200	2.513	BSC	1.270	8°

11.2 MSOP-8 Package Outline Dimensions

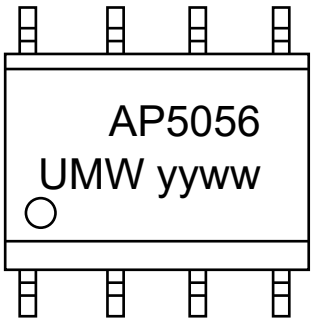


DIMENSIONS (mm are the original dimensions)

Symbol	A	A1	A2	A3	b	b1	c	c1	D	E	E1	e
Min	-	0.05	0.75	0.30	0.28	0.27	0.15	0.14	2.90	4.70	2.90	0.65
Max	1.10	0.15	0.95	0.40	0.36	0.33	0.19	0.16	3.10	5.10	3.10	BSC

Symbol	L	L1	θ
Min	0.40	0.95	0°
Max	0.70	REF	8°

12.Ordering Information



yy: Year Code
ww: Week Code

Order Code	Marking	Package	Base QTY	Delivery Mode
UMW AP5056HSPER	AP5056	ESOP-8	2500	Tape and reel
UMW AP5056HMPERB	AP5056	MSOP-8	4000	Tape and reel

13.Disclaimer

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