AP2280

SINGLE CHANNEL SLEW RATE CONTROLLED LOAD SWITCH

Features

- Wide input voltage range: 1.5V – 6V
- Low $R_{DS(ON)}$: 80mΩ typical @ 5V
- Turn-on slew rate controlled
- AP2280-1: 100us turn-on rise time
- AP2280-2: 1ms turn-on rise time
- Very low turn-on quiescent current: << 1uA
- Fast load discharge pin
- Temperature range -40ºC to 85°C
- Green Package: SOT25
- SOT25: Available in "Green" Molding Compound (No Br, Sb) (Note 1)

Description

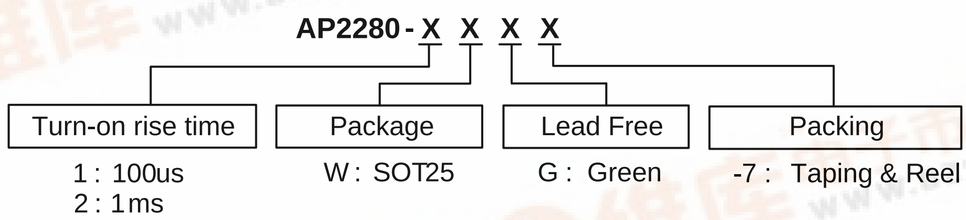
The AP2280 slew rate controlled load switch is a single P-channel MOSFET power switch designed for high-side load-switching or power distribution applications. The MOSFET has a typical $R_{DS(ON)}$ of 80mΩ at 5V, allowing increased load current handling capability with a low forward voltage drop. The turn-on slew rate of the device is controlled internally to reduce turn-on inrush current.

The AP2280 load switch is designed to operate from 1.5V to 6.0V, making it ideal for 1.8V, 2.5V, 3.3V, and 5V systems. The typical quiescent supply current is only 0.004uA, making it ideal for battery powered distribution systems where power consumption is a concern.

Applications

- Smart Phones
- Personal Digital Assistant (PDA)
- Cell Phones
- GPS Navigators
- Bluetooth Headsets
- PMP/MP4
- Notebook and Pocket PC

Ordering Information

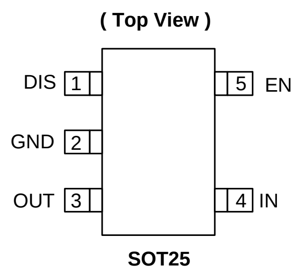


Note: 1. RoHS revision 13.2.2003. Glass and High Temperature Solder Exemptions Applied, see *EU Directive Annex Notes 5 and 7.*

Device	Package Code	Packaging (Note 2)	7" Tape and Reel	
			Quantity	Part Number Suffix
AP2280-1W	W	SOT25	3000/Tape & Reel	-7
AP2280-2W	W	SOT25	3000/Tape & Reel	-7

Note: 2. Pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at http://www.diodes.com/datasheets/ap02001.pdf.

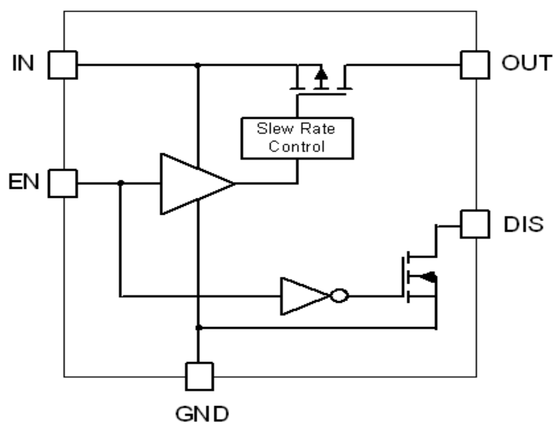
Pin Assignments



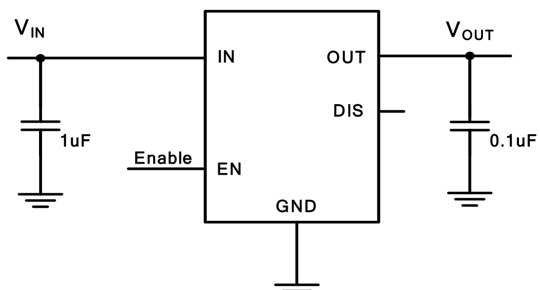
Pin Description

Pin Name	Pin Number	Description
	SOT25	
DIS	1	Discharge pin. If DIS pin is tied to OUT pin externally, the output voltage will be discharged to ground when disabled.
GND	2	Ground.
OUT	3	Voltage output pin. This is the pin to the P-channel MOSFET drain. Bypass to ground through a 0.1uF capacitor.
IN	4	Voltage input pin. This is the pin to the P-channel MOSFET source. Bypass to ground through a 1µF capacitor.
EN	5	Enable input, active high.

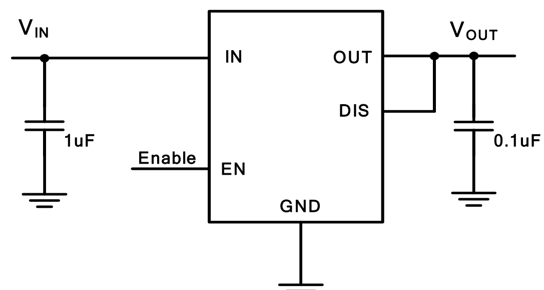
Block Diagram



Typical Application Circuits



For applications without output discharge



For applications with output discharge

Absolute Maximum Ratings

Symbol	Parameter		Ratings	Units
ESD HBM	Human Body Model ESD Protection		4	KV
ESD MM	Machine Model ESD Protection		400	V
V_{IN}	Input Voltage		6.5	V
V_{OUT}	Output Voltage		V_{IN} + 0.3	V
V_{EN}	Enable Voltage		6.5	V
I_{load}	Maximum Continuous Load Current		2	A
$T_{J(max)}$	Maximum Junction Temperature		125	°C
T_{ST}	Storage Temperature Range		-65 ~ 150	°C
P_D	Power Dissipation (Note 3,5)	SOT25	750	mW

Note: 3. Ratings apply to ambient temperature at 25°C.

Recommended Operating Conditions

Symbol	Parameter	Min	Max	Units
V_{IN}	Input voltage	1.5	6.0	V
I_{OUT}	Output Current (Note 4)	0	2.0	A
T_A	Operating Ambient Temperature	-40	85	°C

Note: 4. Maximum output current depends on application conditions. Please refer to the application note section.

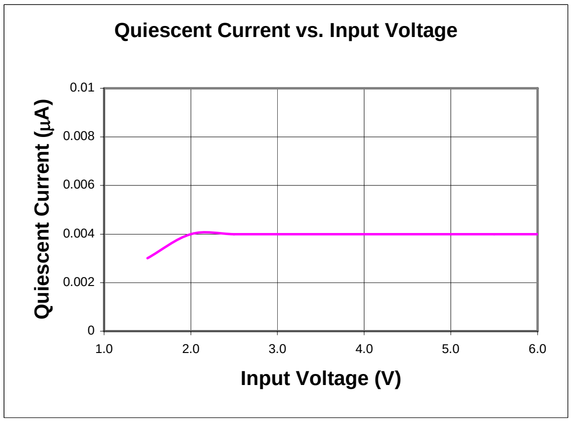
Electrical Characteristics

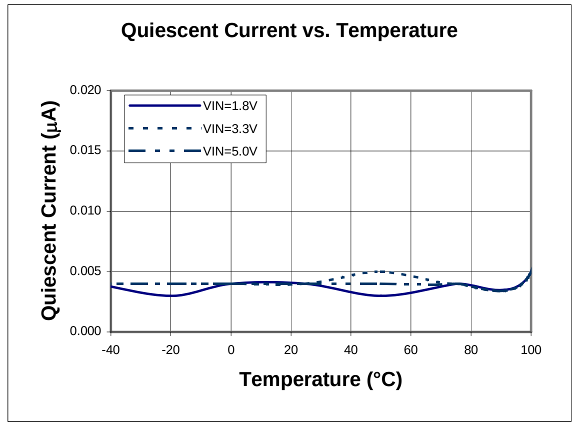
($T_A = 25^oC$, $V_{IN} = V_{EN} = 5.0V$, unless otherwise stated)

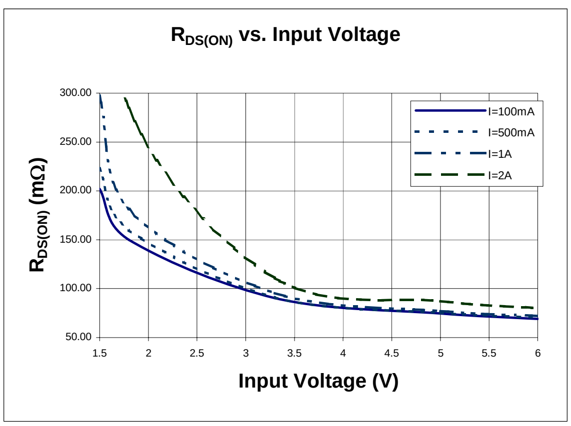
Symbol	Parameters	Test Conditions	Min	Typ.	Max	Unit
I_Q	Input Quiescent Current	$V_{EN} = V_{IN}$, $I_{OUT} = 0$	—	0.004	1	µA
I_{SHDN}	Input Shutdown Current	V_{EN} = 0V, OUT open	—	0.004	1	µA
I_{LEAK}	Input Leakage Current	V_{EN} = 0V, OUT grounded	—	0.01	1	µA
$R_{DS(ON)}$	Switch on-resistance	V_{IN} = 5.0V		80		mΩ
		V_{IN} = 3.3V		92		mΩ
		V_{IN} = 1.8V		150		mΩ
		V_{IN} = 1.5V		200		mΩ
V_{IL}	EN Input Logic Low Voltage	V_{IN} = 1.5V to 6V			0.4	V
V_{IH}	EN Input Logic High Voltage	V_{IN} > 2.7V	2.0			V
		V_{IN} = 1.5V to 2.7V	1.4			V
I_{SINK}	EN Input leakage	V_{EN} = 5V	—		1	µA
$T_{D(ON)}$	Output turn-on delay time	R_{load}=10Ω		1		µS
T_{ON}	Output turn-on rise time	AP2280-1, R_{load} = 10Ω		100	150	µS
		AP2280-2, R_{load} = 10Ω		1000	1500	µS
$T_{D(OFF)}$	Output turn-off delay time	R_{load} = 10Ω		0.4	1	µS
R_{DISCH}	Discharge FET on-resistance	V_{EN} = GND		20	40	Ω
θ_{JA}	Thermal Resistance Junction-to-Ambient	SOT25 (Note 5)		160		^{o}C/W
θ_{JC}	Thermal Resistance Junction-to-Case	SOT25 (Note 5)		38		^{o}C/W

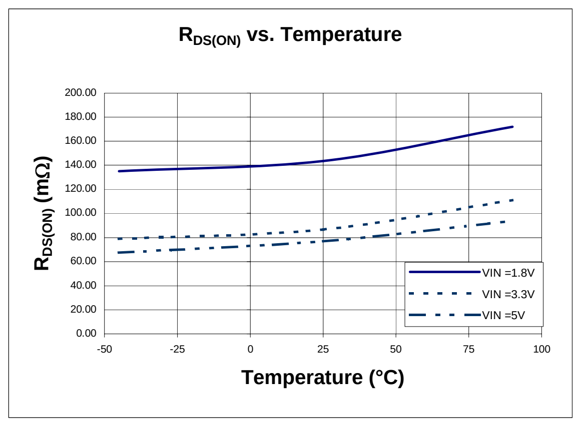
Note: 5. Test condition for SOT25: Device mounted on FR-4 substrate PC board, with minimum recommended pad layout.

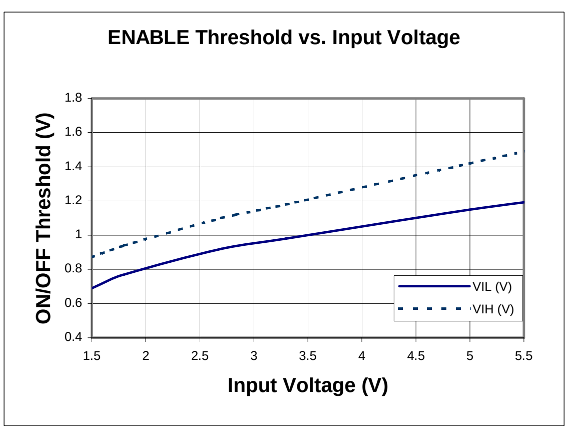
Typical Performance Characteristics

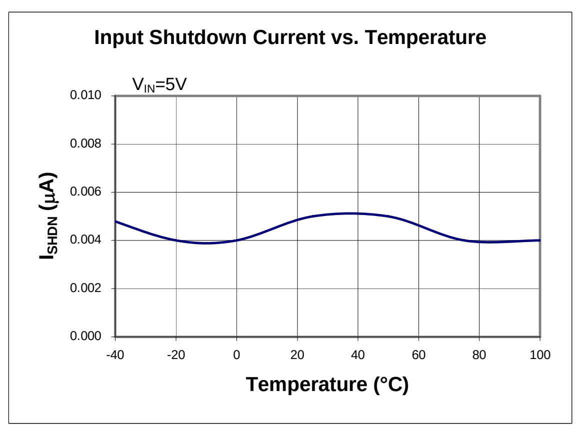






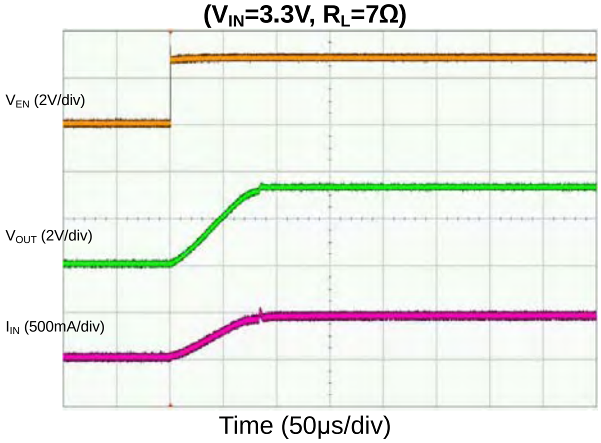




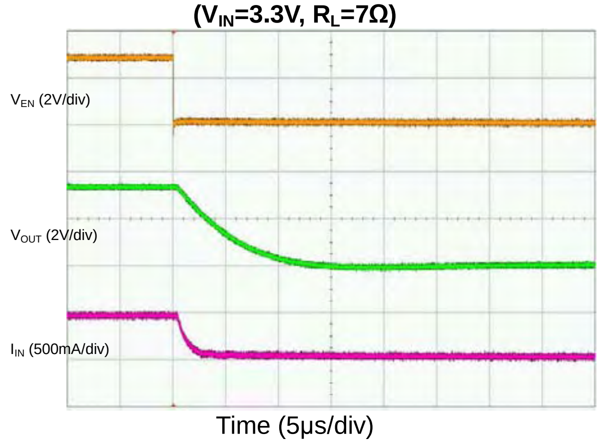


Typical Performance Characteristics (Continued)

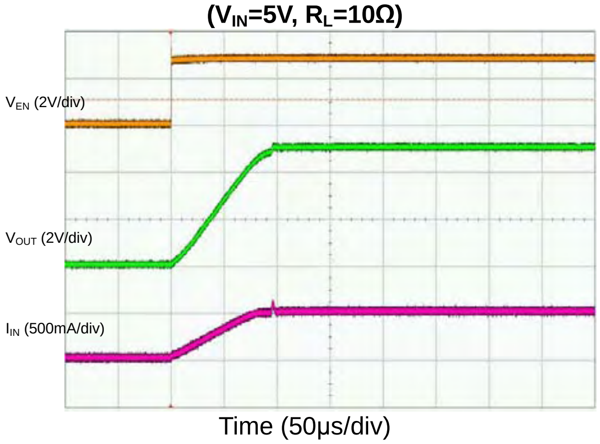
AP2280-1 Turn-On
(V_{IN}=3.3V, R_L=7Ω)



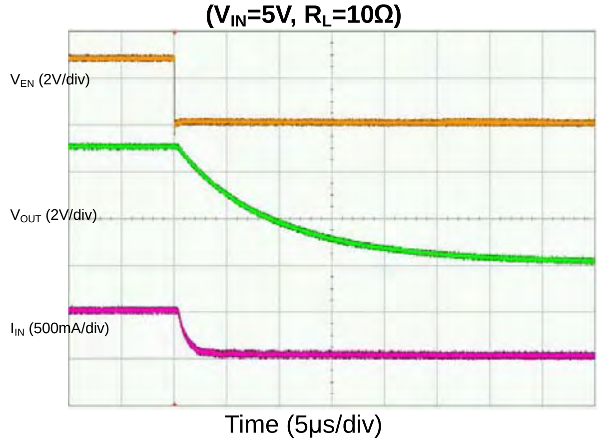
AP2280-1 Turn-Off
(V_{IN}=3.3V, R_L=7Ω)



AP2280-1 Turn-On
(V_{IN}=5V, R_L=10Ω)

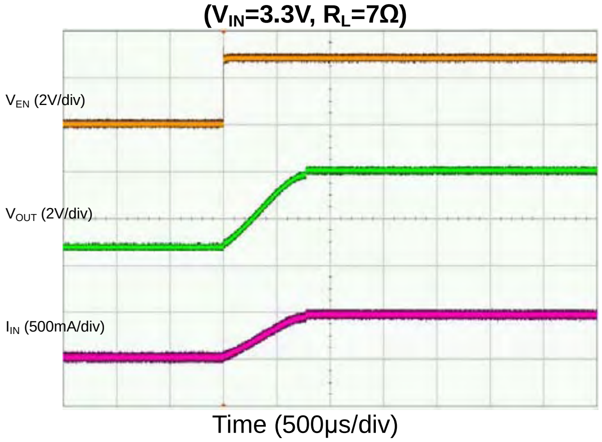


AP2280-1 Turn-Off
(V_{IN}=5V, R_L=10Ω)

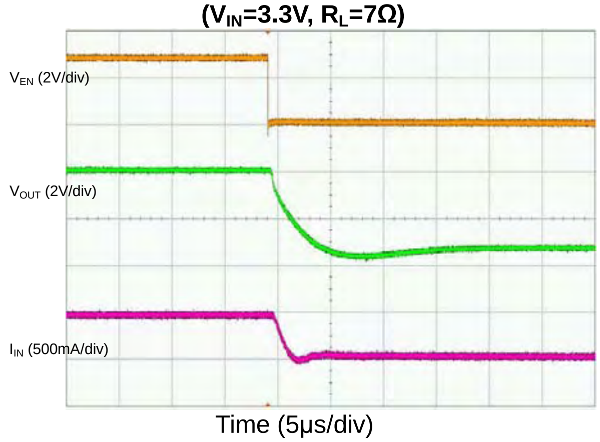


Typical Performance Characteristics (Continued)

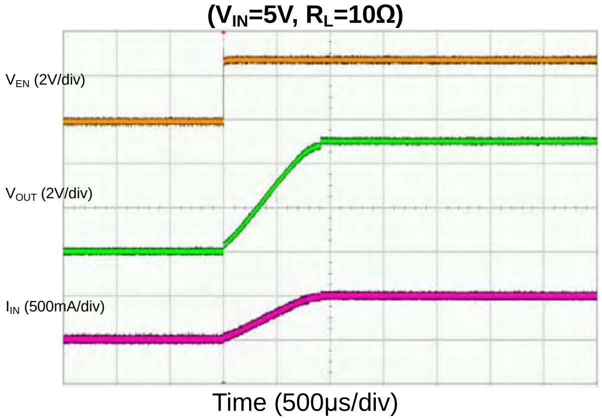
AP2280-2 Turn-On
(V_{IN}=3.3V, R_L=7Ω)



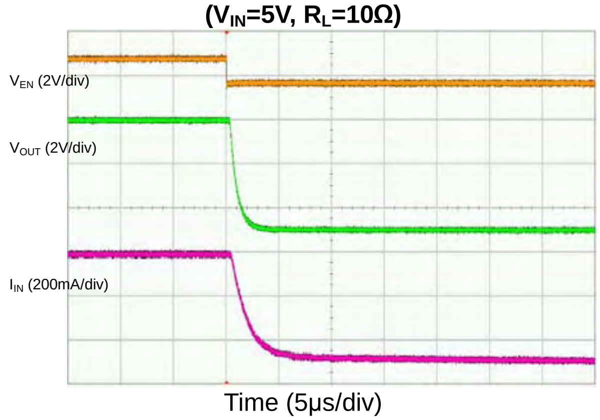
AP2280-2 Turn-Off
(V_{IN}=3.3V, R_L=7Ω)



AP2280-2 Turn-On
(V_{IN}=5V, R_L=10Ω)



AP2280-2 Turn-Off
(V_{IN}=5V, R_L=10Ω)



Application Note

Input Capacitor

A 1μF capacitor is recommended to connect between IN and GND pins to decouple input power supply glitch and noise. The input capacitor has no specific type or ESR (Equivalent Series Resistance) requirement. However, for higher current application, ceramic capacitors are recommended due to their capability to withstand input current surges from low impedance sources, such as batteries in portable applications. This input capacitor must be located as close as possible to the device to assure input stability and less noise. For PCB layout, a wide copper trace is required for both IN and GND.

Output Capacitor

A 0.1μF capacitor is recommended to connect between OUT and GND pins to stabilize and accommodate load transient condition. The output capacitor has no specific type or ESR requirement. The amount of the capacitance may be increased without limit. For PCB layout, the output capacitor must be placed as close as possible to OUT and GND pins, and keep the traces as short as possible.

Enable/Shutdown Operation

The AP2280 is turned on by setting the EN pin high and is turned off by pulling it low. To ensure proper operation, the signal source used to drive the EN pin must be able to swing above and below the specified turn-on/off voltage thresholds listed in the Electrical Characteristics section under V_{IL} and V_{IH}.

Discharge Operation

The AP2280 offers a discharge option that helps to discharge the output when disabled. To use this feature, the DIS pin is connected to the OUT pin externally. If this feature is not used, the DIS pin should be left open.

Power Dissipation

The device power dissipation and proper sizing of the thermal plane is critical to avoid thermal shutdown and ensure reliable operation. Power dissipation of the device depends on input voltage and load conditions and can be calculated by:

$$P_D = I_{OUT}{}^2 x R_{DSON} \qquad \textbf{(1)}$$

However, the maximum power dissipation that can be handled by the device depends on the maximum junction to ambient thermal resistance, maximum ambient temperature, and maximum device junction temperature, which can be approximated by the equation below:

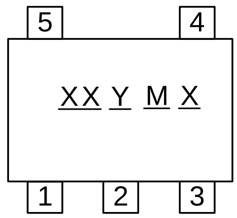
$$P_D(\max@\,T_A) = \frac{(+125°C - T_A)}{\theta_{JA}} \qquad \textbf{(2)}$$

For example at V_{IN} = 5V, the typical R_{DSON} = 80mΩ. For I_{OUT} = 2A, the maximum power dissipation calculated using equation (1) is P_D = 0.32W. Based on θ_{JA} = 160°C/W and equation (2), the calculated junction temperature rise from ambient is approximately 51°C. Since the maximum junction temperature is 125°C, the operating ambient temperature must be kept below 74°C to safely operate the device.

On the other hand, at T_A = 85°C and V_{IN} = 5V, the calculated maximum power dissipation from equation (2) is P_{Dmax} = 0.25W. Hence the safe operating maximum continuous current is 1.77A. For other application conditions, the users should recalculate the device maximum power dissipation based on the operating conditions.

Marking Information

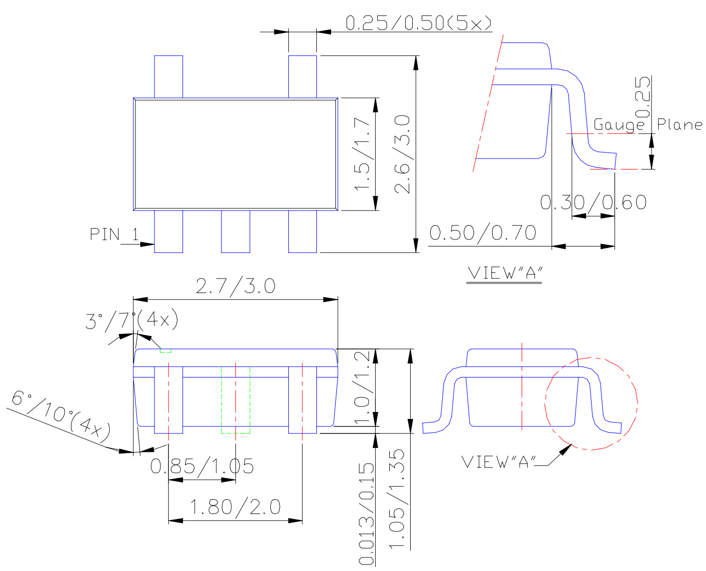
(Top View)



XX : UA : AP2280-1
UB : AP2280-2
Y : Year 0~9
M : Month A~L
X : G : Green

SOT25

Package Information (All Dimensions in mm)



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