芯北电 CHIPNORTH

CN8502MXXX

10V/500mA、0.8uA Ultra-Low Power, High-precision linear regulator

1 Description

The CN8502M is a CMOS-based linear regulator featuring ultra-low quiescent current and a low dropout voltage. With a quiescent current of approximately 0.8 μA, it incorporates built-in output short-circuit protection and thermal shutdown protection, and is available in an SOT89-3 package.

2 Features

- Ultra-low quiescent current: 0.8 μA (VIN = 10 V)
- Input voltage range: 2.5 V–10 V
- Output voltage range: 1.8 V–5 V (0.1 V steps)
- High accuracy: ±2%
- Maximum output current: 500 mA
- Output discharge
- Output short-circuit protection
- Over-temperature protection

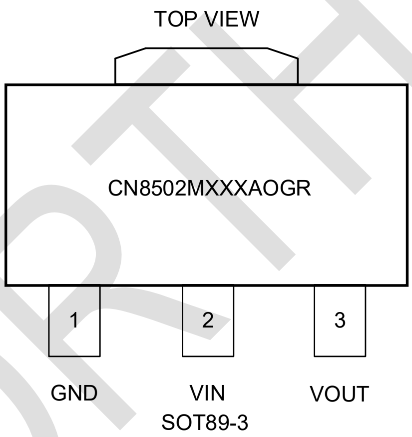
3 Applications

- Mobile phones
- Battery-powered devices
- Wireless phones, wireless communication devices
- Cameras and camcorders
- Portable audio-visual equipment
- Handheld computers
- Smart electricity/water/gas meters
- Industrial instruments

4 Ordering information

Product Number	Package	Quantity/Tape
CN8502MXXXAOGR	SOT89-3	1000/tape

5 Pinout



6 Marking

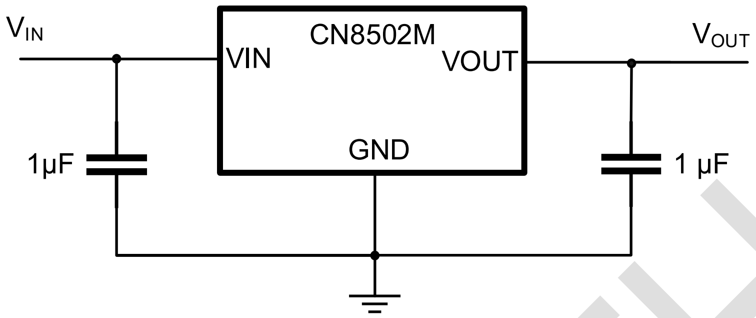
Product Number	Marking
CN8502MXXXAOGR	02MXXXA YYWW

Note: YY/Y=Year WW/W=Week. 8502MXXX=Product Name，XXX= Output Voltage

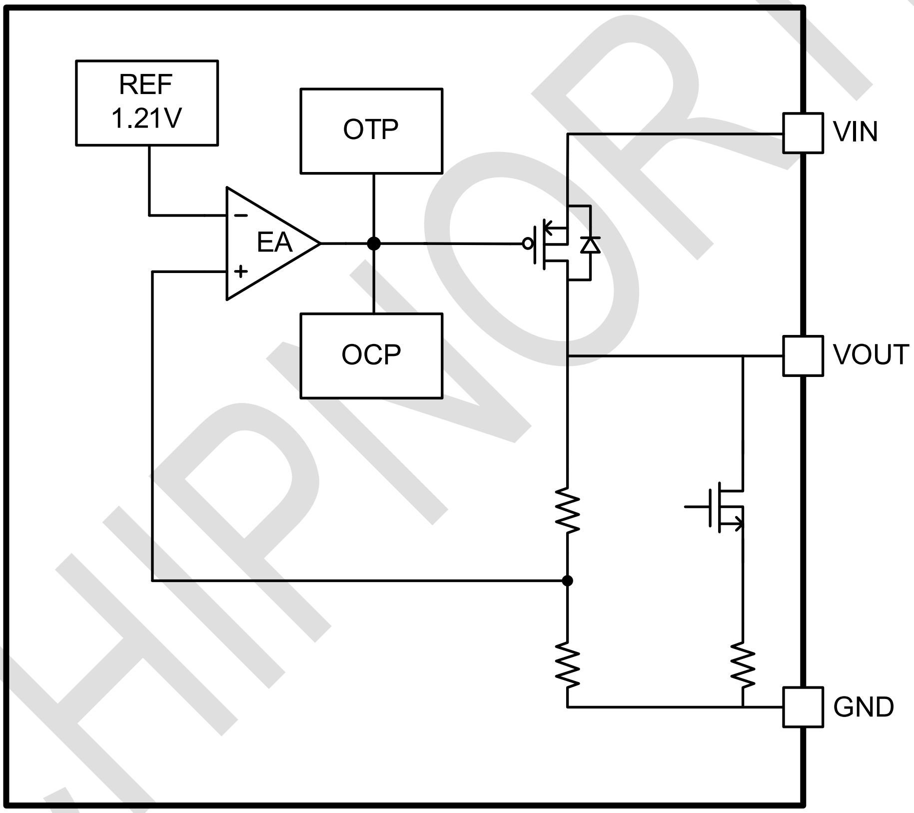
Green (RoHS & HF): CHIPNORTH defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your CHIPNORTH representative directly.

Moisture sensitivity level(MSL):3

7 Typical Application



8 Block Diagram



9 Pin Descriptions

CN8502MXXXAOGR SOT89-3	Pin Name	Descriptions
1	GND	GND
2	VIN	Voltage Input Pin
3	VOUT	Voltage Output Pin

10 Specifications

10.1 Absolute Maximum Ratings

Parameter	Symbol	Value	Units
VIN Pin Voltage	V_{IN}	12	V
VOUT Pin Voltage	V_{OUT}	-0.3 ~ 7	V
Soldering Temperature	T_{LEAD}	260(soldering，10s)	°C
Storage Temperature Range	T_{STG}	-55 ~ 150	°C

Note：Operation beyond the absolute maximum ratings may damage the device. The absolute maximum ratings do not imply that the device will function properly under these conditions or under any other conditions outside the recommended operating conditions. If the device is used beyond the recommended operating conditions but within the absolute maximum ratings, it may not function properly, which could affect its reliability, functionality, and performance, and shorten its service life.

10.2 ESD Ratings

Discharge mode	Standard	Value	Units
HBM	ESDA/JEDEC JS-001-2017	±4000	V
CDM	ESDA/JEDEC JS-002-2018	±2000	V

10.3 Recommended Operating Range

Parameter	Symbol	Min.	Max.	Units
Input Voltage Range	V_{IN}	V_{OUT}+1	10	V
Output Voltage Range	V_{OUT}	1.8	5.0	V
Ambient Temperature	T_A	-40	105	°C
Atmosphere Pressure	p	63	106	kPa
Output Current	I_{OUT}	0	500	mA
Input Capacitor	C_{IN}	1		μF
Output Capacitor	C_{OUT}	1		μF

10.4 Thermal Information

Parameter		CN8502M [SOT89-3]	Units
$R_{\theta JA}$	Thermal resistance from the junction to the environment	127	°C/W

10.5 Electrical Characteristics

CN8502M050AOGR

Test conditions: $V_{IN}=V_{OUT}+1V$，$C_{IN}=1\mu F$，$C_{OUT}=1\mu F$，$T_A=25°C$，unless otherwise specified.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input Voltage Range	V_{IN}		$V_{OUT}+1$		10	V
Output Voltage	V_{OUT}	$I_{OUT}=1mA$	4.9	5	5.1	V
Maximum Output Current	I_{OUTMAX}	$V_{IN}=V_{OUT}+1V$	500			mA
Load Regulation	ΔV_{LOAD}	$1mA \leq I_{OUT} \leq 500mA$		15	23	mV
Dropout Voltage	V_{DROP}	$I_{OUT}=100mA$		100	203	mV
Quiescent Current	I_Q	$V_{IN}=6V$		0.5	1	μA
Line Regulation	ΔV_{LINE}	$I_{OUT}=10mA$ $\Delta V_{OUT}+1V \leq \Delta V_{IN} \leq 10V$		5	15	mV
Short-Circuit Current	I_{SHORT}	$V_{IN}=V_{OUT}+1V$，$V_{OUT}=0V$		50		mA
Current Limit	I_{limit}	$V_{OUT}=V_{OUT(E)}$ X 0.95 $V_{IN}=V_{OUT}+2V$	500	800		mA
Thermal Protection Threshold	OTP			160		°C
Thermal Protection Hysteresis	OTP_HYS			30		°C
Output Voltage Temperature Coefficient	TC_{VOUT}	$V_{IN}=6V$，$T_A=-40°C \sim 105°C$， $I_{OUT}=1mA$		20		ppm/°C

CN8502M040AOGR

Test conditions: V_{IN}=V_{OUT}+1V, C_{IN}=1μF, C_{OUT}=1μF, T_A=25°C, unless otherwise specified.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input Voltage Range	V_{IN}		V_{OUT}+1		10	V
Output Voltage	V_{OUT}	I_{OUT}=1mA	3.92	4	4.08	V
Maximum Output Current	I_{OUTMAX}	V_{IN}=V_{OUT}+1V	500			mA
Load Regulation	ΔV_{LOAD}	1mA≤I_{OUT}≤500mA		10	23	mV
Dropout Voltage	V_{DROP}	I_{OUT}=100mA		110	203	mV
Quiescent Current	I_Q	V_{IN}=5V		0.5	0.8	μA
Line Regulation	ΔV_{LINE}	I_{OUT}=10mA ΔV_{OUT}+1V≤ΔV_{IN}≤10V		5	15	mV
Short-Circuit Current	I_{SHORT}	V_{IN}=V_{OUT}+1V, V_{OUT}=0V		50		mA
Current Limit	I_{limit}	V_{OUT}=$V_{OUT(E)}$ X 0.95 V_{IN}=V_{OUT} +2V	500	800		mA
Thermal Protection Threshold	OTP			160		°C
Thermal Protection Hysteresis	OTP_HYS			30		°C
Output Voltage Temperature Coefficient	TC_{VOUT}	V_{IN}=5V, T_A=-40°C ~105°C, I_{OUT}=1mA		20		ppm/°C

CN8502M033AOGR

Test conditions: $V_{IN}=V_{OUT}+1V$，$C_{IN}=1\mu F$，$C_{OUT}=1\mu F$，$T_A=25°C$，unless otherwise specified.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input Voltage Range	V_{IN}		$V_{OUT}+1$		10	V
Output Voltage	V_{OUT}	$I_{OUT}=1mA$	3.234	3.3	3.366	V
Maximum Output Current	I_{OUTMAX}	$V_{IN}=V_{OUT}+1V$	500			mA
Load Regulation	ΔV_{LOAD}	$1mA \le I_{OUT} \le 500mA$		10	23	mV
Dropout Voltage	V_{DROP}	$I_{OUT}=100mA$		120	203	mV
Quiescent Current	I_Q	$V_{IN}=5V$		0.5	0.8	μA
Line Regulation	ΔV_{LINE}	$I_{OUT}=10mA$ $\Delta V_{OUT}+1V \le \Delta V_{IN} \le 10V$		5	15	mV
Short-Circuit Current	I_{SHORT}	$V_{IN}=V_{OUT}+1V$，$V_{OUT}=0V$		50		mA
Current Limit	I_{limit}	$V_{OUT}=V_{OUT(E)}$ X 0.95 $V_{IN}=V_{OUT}+2V$	500	800		mA
Thermal Protection Threshold	OTP			160		°C
Thermal Protection Hysteresis	OTP_HYS			30		°C
Output Voltage Temperature Coefficient	TC_{VOUT}	$V_{IN}=4.3V$，$T_A=-40°C$ ~105°C， $I_{OUT}=1mA$		20		ppm/°C

Note：

*1. $V_{OUT(E)}$: Output voltage at $V_{IN} = V_{OUT} + 1V$，$I_{OUT} = 1mA$.

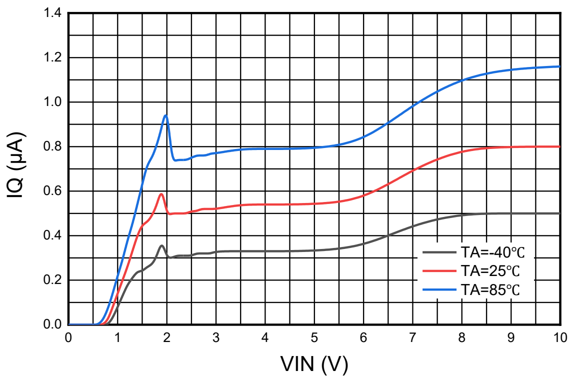
*2. $V_{DROP}=V_{IN}-(V_{OUT\_REG}*0.98)$，$V_{OUT\_REG}$ is Output voltage at $V_{IN}=V_{OUT}+1.0V$ and $I_{OUT}=100mA$. V_{IN} is the input voltage, as the input voltage gradually decreases, the output voltage drops to 98% of V_{OUT_REG}.

*3. I_{LIMIT}: Output current at $V_{IN} = V_{OUT} + 1V$ and $V_{OUT} = 0.95$ X $V_{OUT(E)}$.

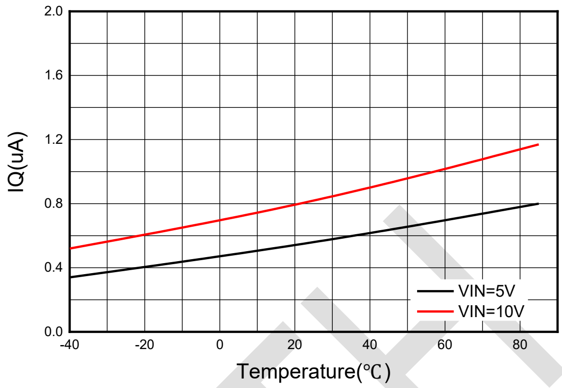
10.6 Characteristics Curve

Test conditions: $V_{IN}=V_{OUT}+1V$, $C_{IN}=1\mu F$, $C_{OUT}=1\mu F$, $T_A=25°C$, unless otherwise specified.

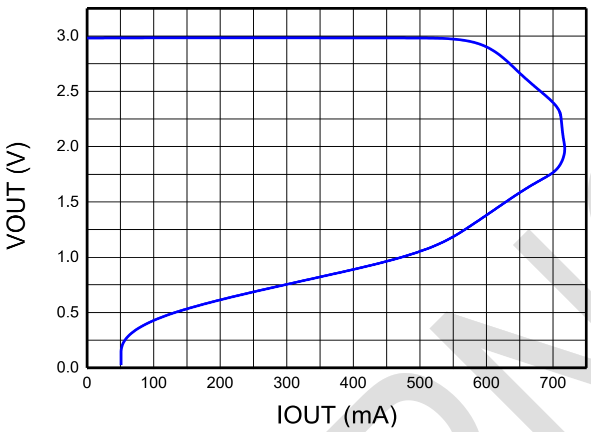
Quiescent Current VS Input Voltage



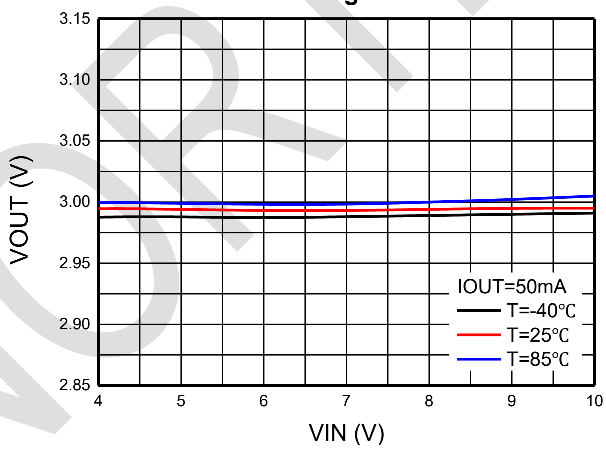
IQ VS Temperature



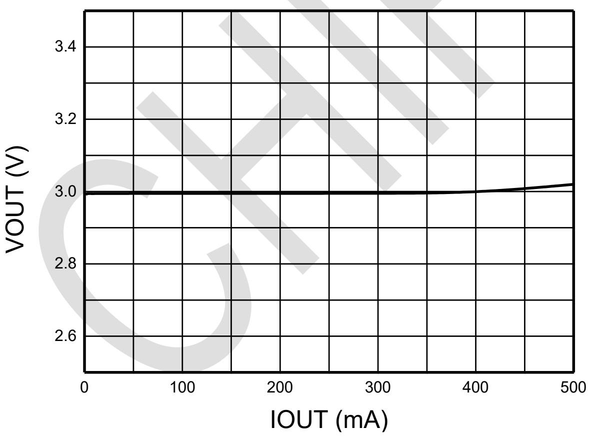
Foladback Current Limit



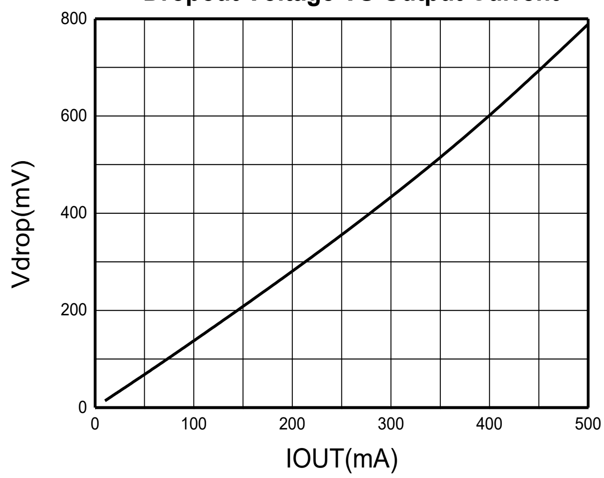
Line Regulation

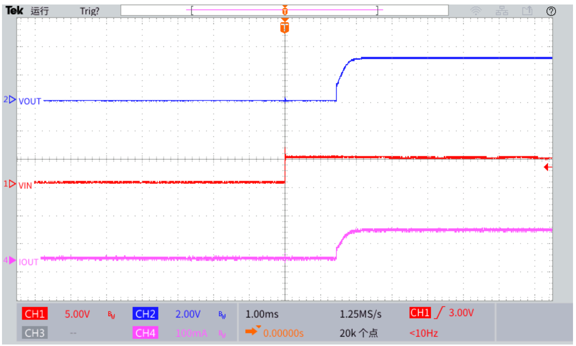


Load Regulation

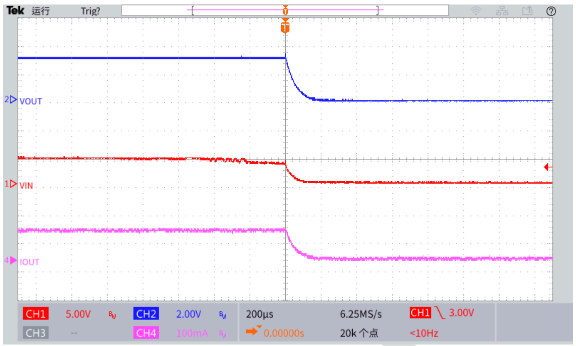


Dropout Voltage VS Output Current

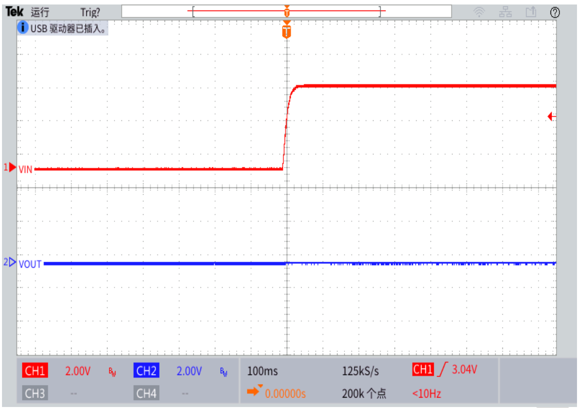




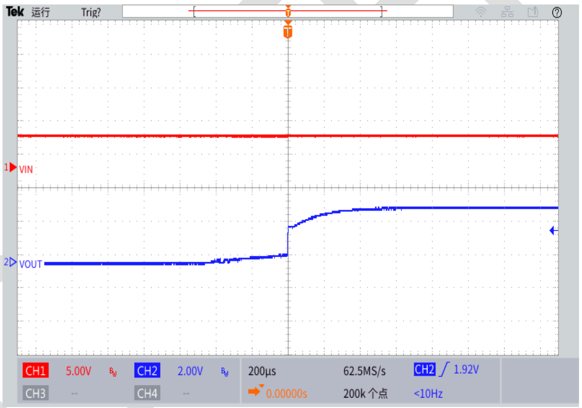
VIN Power On



VIN Power Off



Short-circuit Protection



Short-Circuit Protection Recovery

11 Application Information

CN8502M is a low-dropout linear regulator fabricated with CMOS process, with a maximum input voltage of 10 V. The device offers a series of fixed output voltages ranging from 1.8 V to 5.0 V, featuring an output current capacity of 500 mA, and integrates short-circuit, over-current and thermal shutdown protection functions.

11.1 Over-current protection (current-limiting type)

The CN8502M integrates a current-limiting protection circuit. When the output current exceeds the current limit value, the output voltage drops.

11.2 Short-circuit protection (current-limiting type)

When the output is shorted to ground, the output current will be limited to a typical value of 50 mA, and the output voltage will automatically recover after the fault is removed.

11.3 Output voltage tracking mode

Under normal regulation conditions, the CN8502M requires the input voltage VIN to be at least 1 V higher than the set output voltage, to ensure the internal error amplifier has sufficient headroom to maintain a constant output voltage. When $V_{IN} - V_{OUT}$ is less than the dropout voltage, the regulator automatically enters the output voltage tracking mode. In this mode, the internal power transistor is fully turned on and the feedback loop saturates. The output voltage is no longer controlled by the reference voltage and is approximately equal to the input voltage.

$$V_{OUT} \approx V_{IN} - I_{OUT} * R_{DSON}$$

Since the on-resistance R_{DSON} of the power transistor is very small, we can approximate $V_{OUT} \approx V_{IN}$.
This tracking feature supplies the maximum available voltage to the subsequent circuits under input undervoltage conditions, preventing sudden output collapse or power transistor overload caused by forced operation of the regulation loop. Meanwhile, the chip's internal short-circuit, over-current and thermal protection remain functional in this mode to safeguard the device under abnormal conditions.
When the input voltage rises back above V_{OUT} + $V_{dropout}$, the error amplifier regains adequate supply headroom. The regulator smoothly exits tracking mode and automatically resumes precise regulation of the output voltage. It should be noted that in tracking mode, the power transistor operates in the linear region with zero loop gain, resulting in slightly worse output ripple and load regulation performance compared to normal regulation. This is an abnormal operating region and shall not be used for continuous operation.

11.4 Thermal protection

The CN8502M integrates an internal thermal protection circuit to limit the total power consumption of the chip and prevent damage caused by excessive junction temperature. When the chip junction temperature exceeds the preset safety threshold of 160°C, the thermal protection circuit activates and turns off the power transistor to cool down the device. The power transistor will turn back on after the junction temperature drops by approximately 30°C, which may result in pulsed output waveforms under continuous overload conditions.

11.5 Operating Range and Power Dissipation

The maximum power dissipation of CN8502M is determined by package thermal resistance, PCB copper area, ambient temperature and ventilation. Its internal power dissipation can be calculated via the formula below:

$$P_D = (V_{IN} - V_{OUT}) * I_{OUT} + V_{IN} * I_Q$$

where I_Q stands for quiescent current. The maximum allowable power dissipation is:

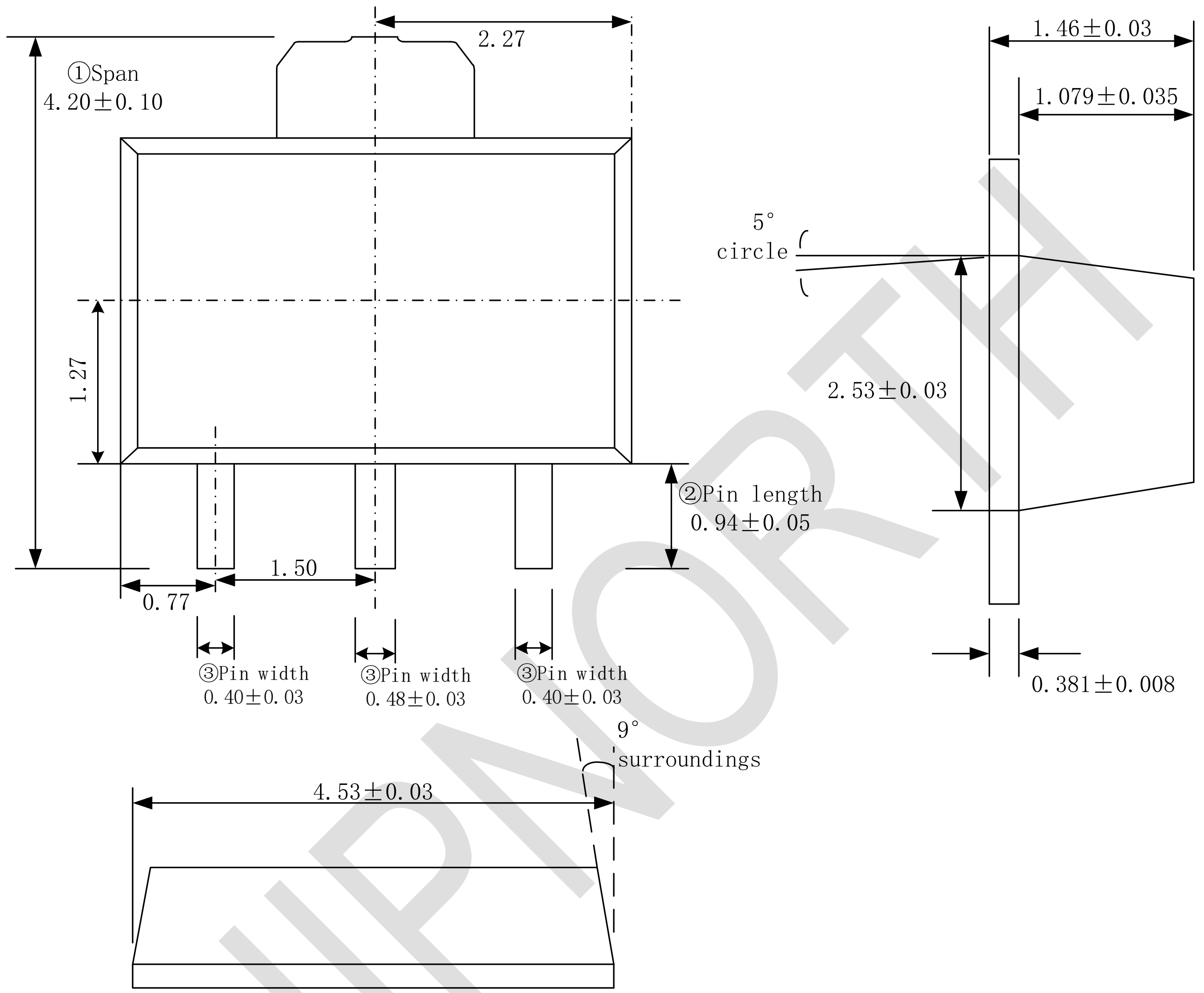
$$P_{D(MAX)} = \frac{T_{J(MAX)} - T_A}{\Theta_{JA}}$$

where $T_{J(MAX)}$ is maximum junction temperature, T_A ambient temperature, θ_{JA} junction-to-ambient thermal resistance.
As CN8502M supports up to 10 V input voltage, pay close attention to power dissipation for large voltage drop and high current applications to ensure $P_D \leq P_{D(MAX)}$.

12 Package Information

SOT89-3

Unit：mm



13 Important Statement

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14 Revision History

Date	Version Number	Revision Notes
2026/08/04	R1.0	Official Release
2026/08/14	R1.1	Updated application