# UMW TP321/358

General Purpose, 1MHz, Micro-Power CMOS Op-Amps

## 1.Description

UMW TP321/358 are general purpose single, dual and quad CMOS op-amps with low offset, high frequency response, low power, low supply voltage, and rail-to-rail inputs and outputs.

The UMW TP321/358 are unity gain stable with a constant 1MHz gain-bandwidth product, 1V/μs slew rate while consuming only 45μA of supply current per amplifier. The rail-to-rail input and output characteristics allow the full power-supply voltage to be used for signal range.

This combination of features makes the UMW TP321/358 superior and cost-effective among RRIO CMOS opamps. The TP321/358 are ideal choices for battery-powered applications because they minimize errors due to power supply voltage variations over the lifetime of the battery and maintain high CMRR even for a rail-to-rail input op-amp.

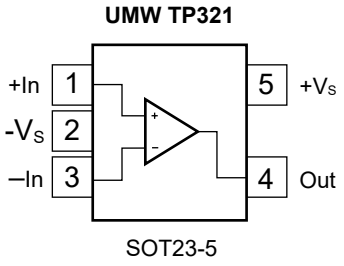
## 2.Features

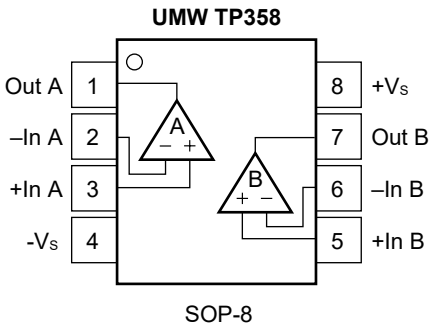
- General Purpose, Low Cost
- Gain Bandwidth Product: 1MHz
- Low Quiescent Current: 45μA/Amplifier
- Offset Voltage: 5.0mV Maximum
- Offset Voltage Temperature Drift: 2uV/°C
- Input Bias Current: 10pA
- CMRR/PSRR: 90dB
- Unity Gain Stable
- Rail-to-Rail Input and Output
- No Phase Reversal for Overdriven Inputs
- Supply Voltage Ran ge: 2.1V to 6.0V
- Operati on Range: -40° C to 125° C
- ESD Rating :
- 8kV - HBM, 2kV - CDM and 500V - MM
- Popular Type Package

## 3.Applications

- Audio Output
- Battery and Power Supply Control
- Smoke/Gas/Environment Sensors
- Medical Equipment
- Portable Instruments and Mobile Device
- Active Filters
- Piezo Electrical Transducer Amplifier
- Sensor Interface
- ASIC Input or Output Amplifier

## 4.Pinning information




## 5.Absolute Maximum Ratings (1)

| Parameter | Value |
|---|---|
| Supply Voltage, V+ to V- | 6.6V |
| Input Voltage | $V^-$ – 0.1 to $V^+$ + 0.1 |
| Input Current: +IN, –IN, SHDN (2) | ±10mA |
| Output Current: OUT | ±40mA |
| Output Short-Circuit Duration (3) | Indefinite |
| Operating Temperature Range | -40°C to 125°C |
| Maximum Junction Temperature | 150°C |
| Storage Temperature Range | -65°C to 150°C |
| Lead Temperature (Soldering, 10 sec) | 260°C |

Note:

(1): Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

(2): The inputs are protected by ESD protection diodes to each power supply. If the input extends more than 300mV beyond the power supply, the input current should be limited to less than 10mA.

(3): A heat sink may be required to keep the junction temperature below the absolute maximum. This depends on the power supply voltage and how many amplifiers are shorted. Thermal resistance varies with the amount of PC board metal connected to the package. The specified values are for short traces connected to the leads.

## 6.Electrical Characteristics

The denotes the specifications which apply over the full operating temperature range, otherwise specifications are at $T_A$=27°C. $V_{SUPPLY}$=5V, $V_{CM}$=$V_{OUT}$=$V_{SUPPLY}$/2, $R_L$=100KΩ, $C_L$=100pF.

| Parameter | Symbol | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| Input Offset Voltage | $V_{OS}$ | $V_{CM}$=$V_{SUPPLY}$/2 | -5 | ±0.8 | 5 | mV |
| Input Offset Voltage Drift | $V_{OS}$TC | | | 2 | | μV/°C |
| Input Bias Current | $I_B$ | | | 10 | | pA |
| Input Offset Current | $I_{OS}$ | | | 1 | | pA |
| Input Voltage Noise Density | $e_n$ | f=1kHz | | 45 | | nV/√Hz |
| | | f=10kHz | | 29 | | nV/√Hz |
| Input Resistance | $R_{IN}$ | | >100 | | | GΩ |
| Input Capacitance | $C_{IN}$ | Differential | | 1.5 | | pF |
| | | Common Mode | | 3 | | pF |
| Common Mode Rejection Ratio | CMRR | $V_{CM}$=0.1V 4.9V | 80 | 90 | | dB |
| Common-mode input Voltage Range | $V_{CM}$ | | -0.1 | | 5.1 | V |
| Power Supply Rejection Ratio | PSRR | | 80 | 90 | | dB |
| Open-Loop Large Signal Gain | $A_{VOL}$ | $V_{OUT}$=2.5V, $R_{LOAD}$=100kΩ | 80 | 97 | | dB |
| | | $V_{OUT}$=0.1V to 4.9V, $R_{LOAD}$=100kΩ | 72 | 95 | | dB |
| Output Swing from Supply Rail | $V_{OL}$ | $R_{LOAD}$=100kΩ | | 5 | | mV |
| Output Short-Circuit Current | $I_{SC}$ | Sink or source current | | 40 | | mA |
| Quiescent Current per Amplifier | $I_Q$ | | | 45 | 87 | μA |
| Phase Margin | PM | $R_{LOAD}$=100kΩ, $C_{LOAD}$=100pF | | 63 | | ° |
| Gain Margin | GM | $R_{LOAD}$=100kΩ, $C_{LOAD}$=100pF | | -15 | | dB |
| Gain-Bandwidth Product | GBWP | f=1kHz | | 1 | | MHz |

| Parameter | Symbol | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| Settling Time, 1.5V to 3.5V | ts | 0.1% | | 2.3 | | μs |
| Unity Gain | | 0.01% | | 2.8 | | μs |
| Settling Time, 2.45V to 2.55V | | 0.1% | | 0.33 | | μs |
| Unity Gain | | 0.01% | | 0.38 | | μs |
| Slew Rate | SR | $A_V$=1, $V_{OUT}$=1.5V to 3.5V<br>$C_{LOAD}$=100pF, $R_{LOAD}$=100kΩ | | 1 | | V/μs |
| Total Harmonic Distortion and | THD+N | f=1kHz,$A_V$=1,$R_L$=100kΩ,$V_{OUT}$=2$V_{PP}$ | | -105 | | dB |
| Noise | | f=10kHz,$A_V$=1,$R_L$=100kΩ,$V_{OUT}$=2$V_{PP}$ | | -90 | | dB |

## 7.1 Typical characteristic

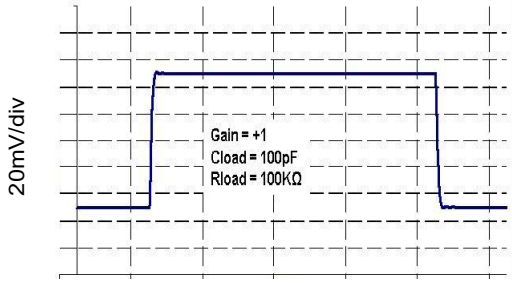



Figure 1: Small-Signal Step Response, 100mV Step

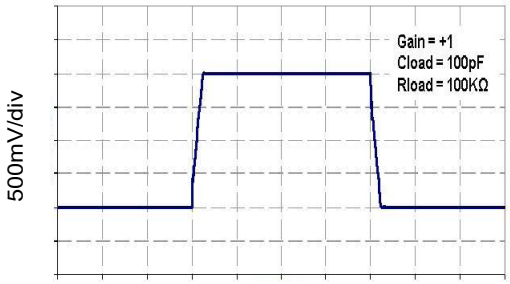



Figure 2: Large-Signal Step Response, 2V Step

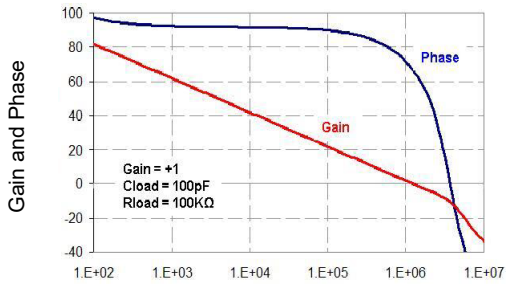



Figure 3: Open-Loop Gain and Phase

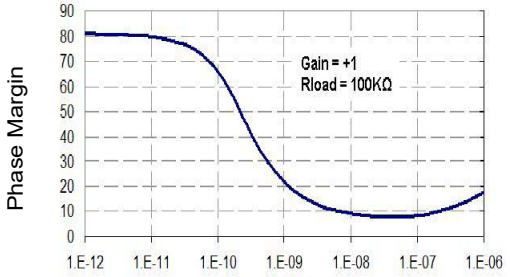



Figure 4: Phase Margin vs. $C_{LOAD}$ (Stable for Any $C_{LOAD}$)

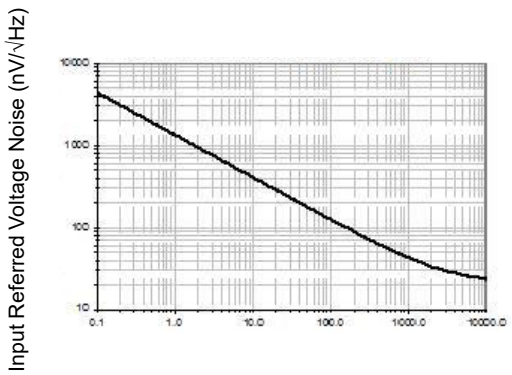



Figure 5: Input Voltage Noise Spectral Density

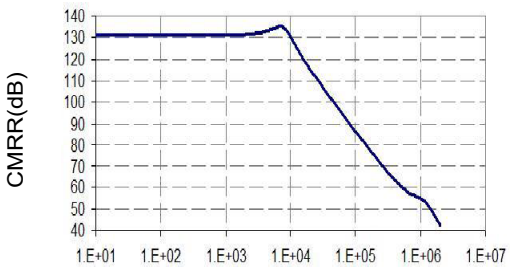
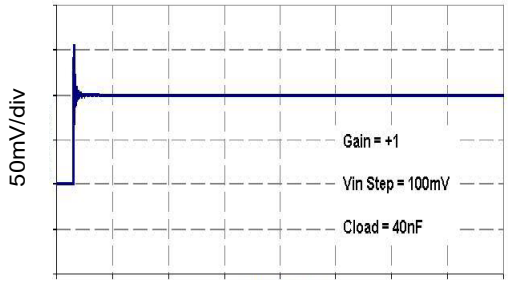


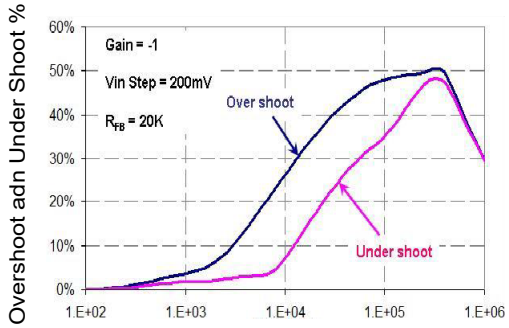

Figure 6: Common-Mode Rejection Ratio

## 7.2 Typical characteristic



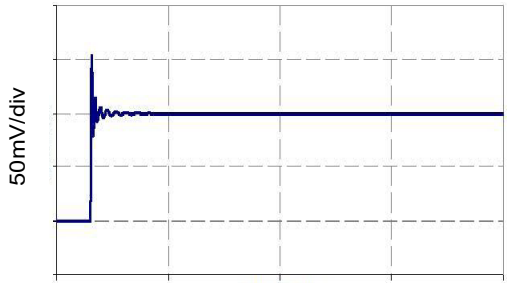

0.1mSec/div

Figure 7: Over-Shoot Voltage, $C_{LOAD}$=40nF, Gain=+1



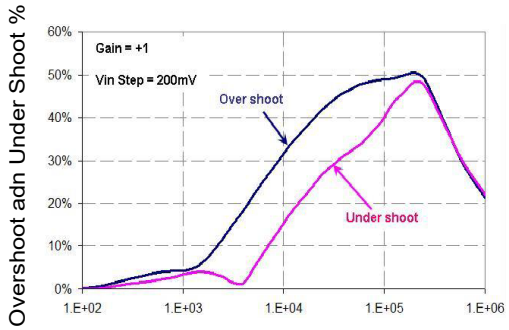

$C_{load}$ (pF)

Figure 8: Over-Shoot % vs. $C_{LOAD}$, Gain -1, RFB=20kΩ



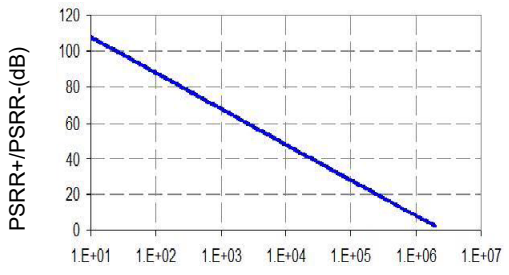

Frequency (Hz)

Figure 9: Over-Shoot Voltage, $C_{LOAD}$=40nF, Gain=-1
RFB=100kΩ



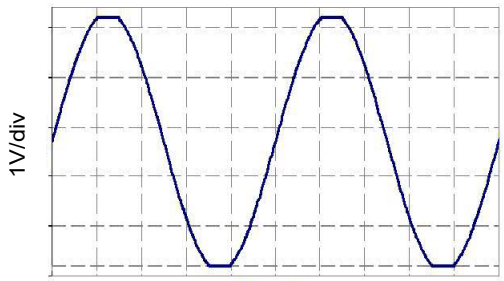

Load Capacitance (pF)

Figure 10: Small-Signal Over-Shoot % vs. $C_{LOAD}$
Gain = +1




Frequency (Hz)

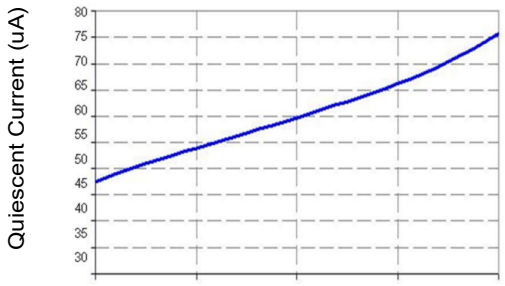
Figure 11: Power-Supply Rejection Ratio




0.2msec/div

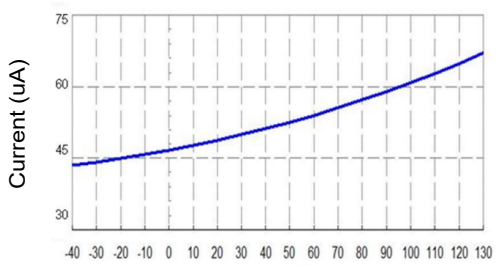
Figure 12: $V_{IN}$=-0.2V to 5.7V, No Phase Reversal

## 7.3 Typical characteristic



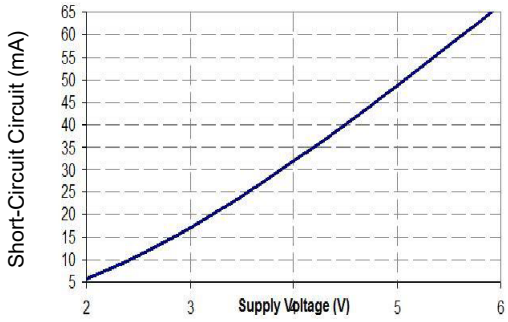

Supply Voltage (V)

Figure 13: Quiescent Supply Current vs. Supply Voltage



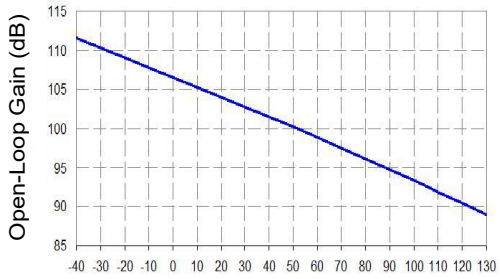

Temperature (°C)

Figure 14: Quiescent Supply Current vs. Temperature



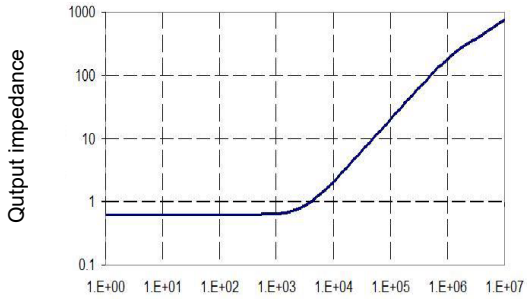

Supply Voltage (V)

Figure 15: Short-Circuit Current vs. Supply Voltage




Temperature (°C)

Figure 16: Open-Loop Gain vs. Temperature




Frequency (Hz)

Figure 17: Closed-Loop Output Impedance vs. Frequency

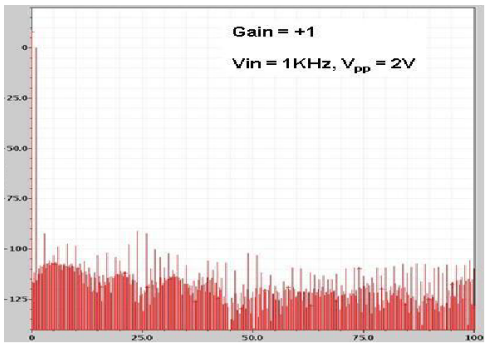



Figure 18: THD+Noise, Gain=+1, $V_{IN}$=1kHz, $V_{PP}$=2V

## 7.4 Typical characteristic

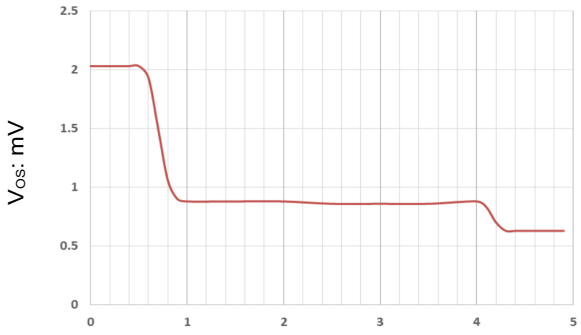
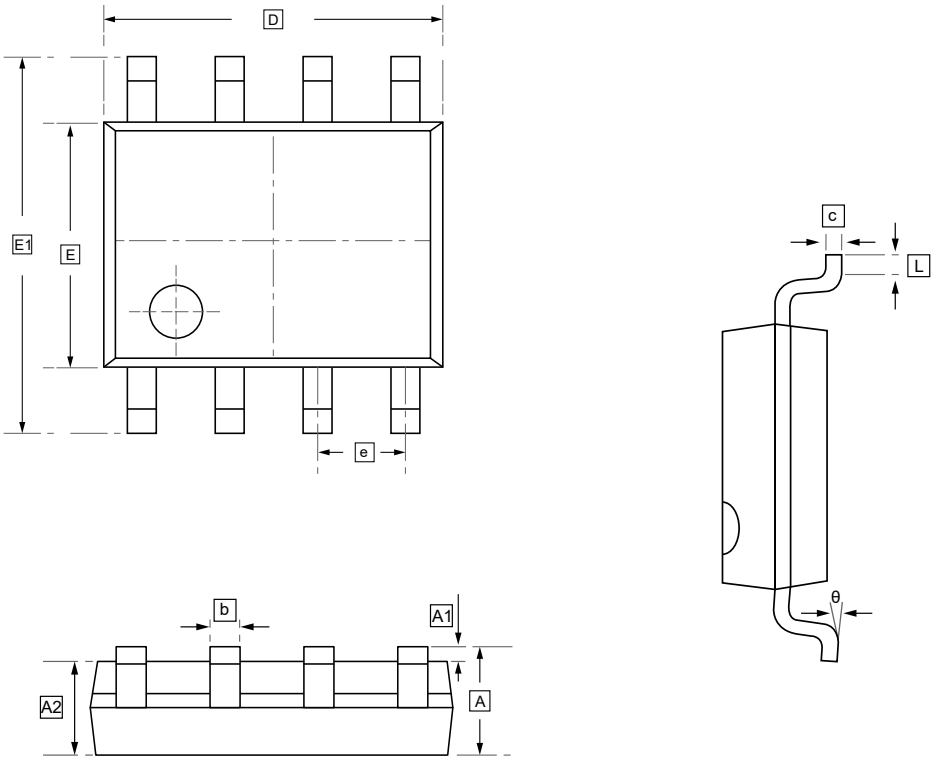



Figure 19: $V_{OS}$ vs. Common Mode Input Voltage

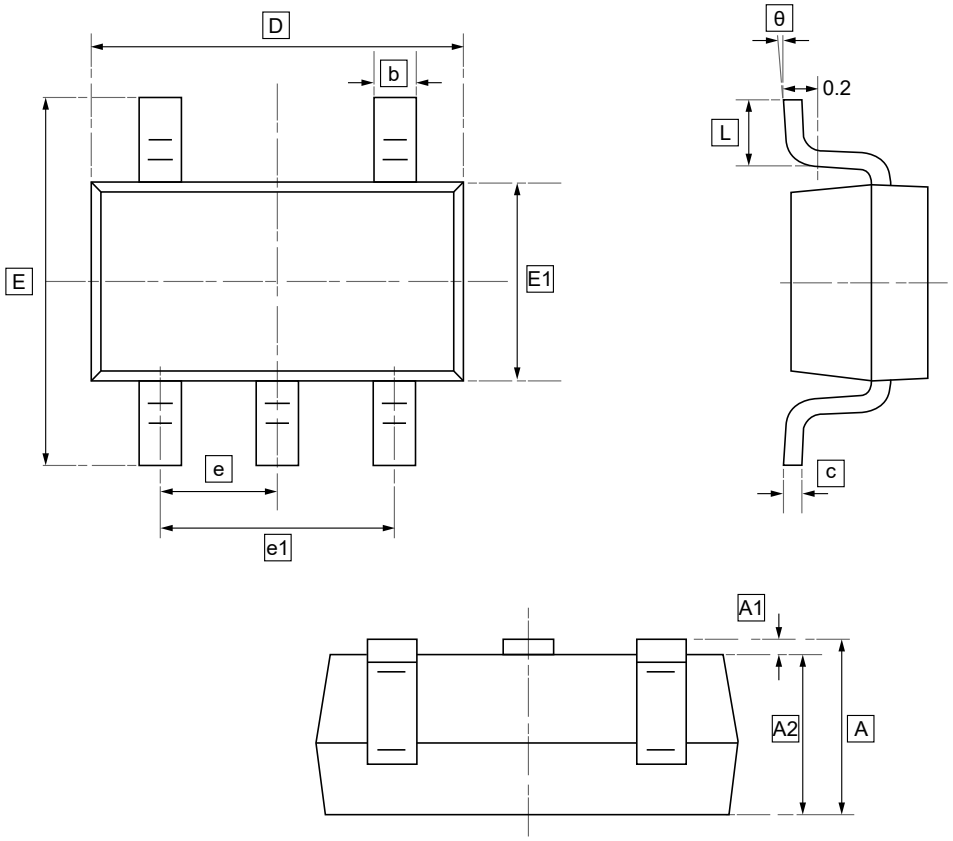
## 8.1 SOP-8 Package Outline Dimensions




**DIMENSIONS (mm are the original dimensions)**

| Symbol | A | A1 | A2 | b | c | D | E | E1 | e | L | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Min** | 1.350 | 0.000 | 1.350 | 0.330 | 0.170 | 4.700 | 3.800 | 5.800 | 1.270 | 0.400 | 0° |
| **Max** | 1.750 | 0.100 | 1.550 | 0.510 | 0.250 | 5.100 | 4.000 | 6.200 | BSC | 1.270 | 8° |

## 8.2 SOT23-5 Package Outline Dimensions

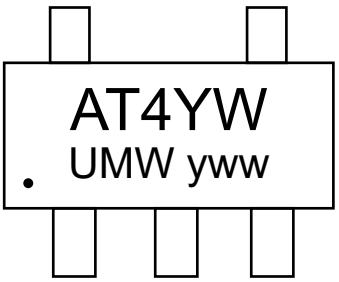



**DIMENSIONS (mm are the original dimensions)**

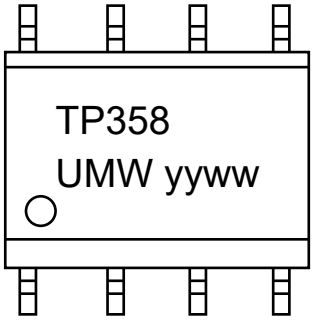
| Symbol | A | A1 | A2 | b | c | D | E1 | E | e | e1 | L | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Min** | 1.050 | 0.000 | 1.050 | 0.300 | 0.100 | 2.820 | 1.500 | 2.650 | 0.950 | 1.800 | 0.300 | 0° |
| **Max** | 1.250 | 0.100 | 1.150 | 0.500 | 0.200 | 3.020 | 1.700 | 2.950 | BSC | 2.000 | 0.600 | 8° |

## 9.Ordering information

SOT23-5




SOP-8




y: Year Code
yy: Year Code
ww: Week Code

| Order Code | Marking | Package | Base QTY | Delivery Mode |
|---|---|---|---|---|
| UMW TP358-SR | TP358 | SOP-8 | 2500 | Tape and reel |
| UMW TP321-TR | AT4YW | SOT23-5 | 3000 | Tape and reel |

## 10.Disclaimer

UMW reserves the right to make changes to all products, specifications. Customers should obtain the latest version of product documentation and verify the completeness and currency of the information before placing an order.

When applying our products, please do not exceed the maximum rated values, as this may affect the reliability of the entire system. Under certain conditions, any semiconductor product may experience faults or failures. Buyers are responsible for adhering to safety standards and implementing safety measures during system design, prototyping, and manufacturing when using our products to prevent potential failure risks that could lead to personal injury or property damage.

Unless explicitly stated in writing, UMW products are not intended for use in medical, life-saving, or life-sustaining applications, nor for any other applications where product failure could result in personal injury or death. If customers use or sell the product for such applications without explicit authorization, they assume all associated risks.

When reselling, applying, or exporting, please comply with export control laws and regulations of China, the United States, the United Kingdom, the European Union, and other relevant countries, regions, and international organizations.

This document and any actions by UMW do not grant any intellectual property rights, whether express or implied, by estoppel or otherwise. The product names and marks mentioned herein may be trademarks of their respective owners.