Description

The TP10 series are CMOS dual, and quad RRIO op-amps with low offset, low power and stable high frequency response. with 6MHz bandwidth, 4.5V/µs slew rate and low distortion while drawing only 600µA of quiescent current per amplifier. The input common-mode voltage range extends 300mV beyond V− and V+, and the outputs swing rail-to-rail. The TP10 family can be used as plug-in replacements for many commercially available op-amps to reduce power and improve input/output range and performance.

The combination of features makes the TP10 ideal choices for motor control and portable audio amplification, sound ports, and other consumer Audio. The TP10 Op-amp is very stable, and it is capable of driving heavy capacitive loads such as those found in LCDs. The ability to swing rail-to-rail at the inputs and outputs enables designers to buffer CMOS DACs, ASICs, or other wide output swing devices in single-supply systems.

Features

- Supply Voltage: 2.7V to 5.5V
- Low Supply Current: 600µA per channel
- Rail to Rail Input and Output
- Bandwidth: 6 MHz
- Slew Rate: 4.5V/µs
- Excellent EMI Suppress Performance
- Offset Voltage: ±3mV Maximum
- Offset Voltage Temperature Drift: 1 µV/°C
- Low Noise: 19 nV/√Hz at 1kHz
- High Output Capability: 100mA
- −40°C to 125°C Operation Temperature Range

Applications

- E-Bike
- Motor Control
- Portable Audio

Pin Configuration

TP10-2
SOP-8

Out A	1	8	+ Vs
− In A	2	7	Out B
+ In A	3	6	− In B
− Vs	4	5	+ In B

TP10-4
SOP-14/TSSOP-14

Out A	1	14	Out D
− In A	2	13	− In D
+ In A	3	12	+ In D
+ Vs	4	11	− Vs
+ In B	5	10	+ In C
− In B	6	9	− In C
Out B	7	8	Out C
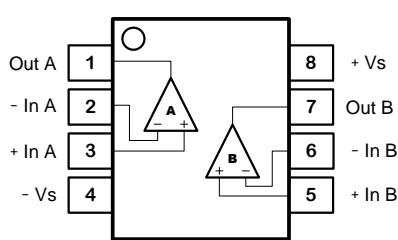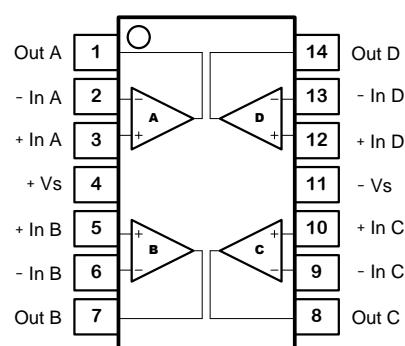
Absolute Maximum Ratings

Parameters	Rating
Supply Voltage, $(+V_S) - (-V_S)$	7 V
Input Voltage	$(-V_S) - 0.3$ to $(+V_S) + 0.3$
Differential Input Voltage	±7V
Input Current: +IN, –IN [Note 2]	±10mA
Output Short-Circuit Duration [Note 3]	Infinite
Maximum Junction Temperature	150°C
Operating Temperature Range	–40 to 125°C
Storage Temperature Range	–65 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.

Note 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.

Note 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.

ESD Rating

Symbol	Parameter	Condition	Minimum Level	Unit
HBM	Human Body Model ESD	MIL-STD-883H Method 3015.8	8	kV
CDM	Charged Device Model ESD	JEDEC-EIA/JESD22-C101E	2	kV

Electrical Characteristics

All test condition is V$_S$ = 5V, T$_A$ = 25°C, R$_L$ = 2kΩ, C$_L$ =100pF, unless otherwise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V$_S$	Supply Voltage Range		2.7		5.5	V
I$_Q$	Quiescent Current per Amplifier			600	900	µA
PSRR	Power Supply Rejection Ratio	V$_S$ = 2.7V to 5.5V	70	95		dB
V$_{OS}$	Input Offset Voltage	V$_{CM}$ = 0V to 3V	-3		3	mV
V$_{OS}$ TC	Input Offset Voltage Drift	T$_A$ = -40°C to 125°C		2		µV/°C
I$_B$	Input Bias Current	T$_A$ = 25 °C		1		pA
		T$_A$ = 85 °C		25		pA
I$_{OS}$	Input Offset Current			1		pA
C$_{IN}$	Input Capacitance	Differential Mode		10		pF
		Common Mode		10		pF
Av	Open-loop Voltage Gain	R$_{LOAD}$ = 10kΩ	80	100		dB
V$_{CMR}$	Common-mode Input Voltage Range		(V-) - 0.1		(V+) + 0.1	V
CMRR	Common Mode Rejection Ratio	V$_{CM}$ = 0V to 3V	70	100		dB
Xtalk	Channel Separation	f = 1kHz, RL = 2kΩ		110		dB
V$_{OH}$, V$_{OL}$	Maximum Output Voltage Swing	R$_{LOAD}$ = 10kΩ		5	15	mV
I$_{SC}$	Output Short-Circuit Current			100		mA
I$_O$	Output Current	1V Output Drop Voltage		50		mA
GBW	Gain-Bandwidth Product			6		MHz
SR	Slew Rate	A$_V$ = 1, V$_{OUT}$ = 1.5V to 3.5V, C$_{LOAD}$ = 60pF, R$_{LOAD}$ = 1kΩ		4.5		V/µs
t$_S$	Settling Time, 0.1%	AV = 1, 2V Step, C$_{LOAD}$ = 60pF, R$_{LOAD}$ = 1kΩ		0.8		µs
	Settling Time, 0.01%			1		µs
PM	Phase Margin	R$_{LOAD}$ = 1kΩ, C$_{LOAD}$ = 60pF		60		°
GM	Gain Margin	R$_{LOAD}$ = 1kΩ, C$_{LOAD}$ = 60pF		15		dB
E$_N$	Input Voltage Noise	f = 0.1Hz to 10Hz		8		µV$_{PP}$
e$_N$	Input Voltage Noise Density	f = 1kHz		19		nV/√Hz
i$_N$	Input Current Noise	f = 1kHz		2		fA/√Hz
THD+N	Total Harmonic Distortion and Noise	f = 1kHz, AV =1, RL = 2kΩ, VOUT = 1Vp-p		0.003		%

Typical Performance Characteristics

V_S = 5V, V_{CM} = 2.5V, RL = Open, unless otherwise specified.
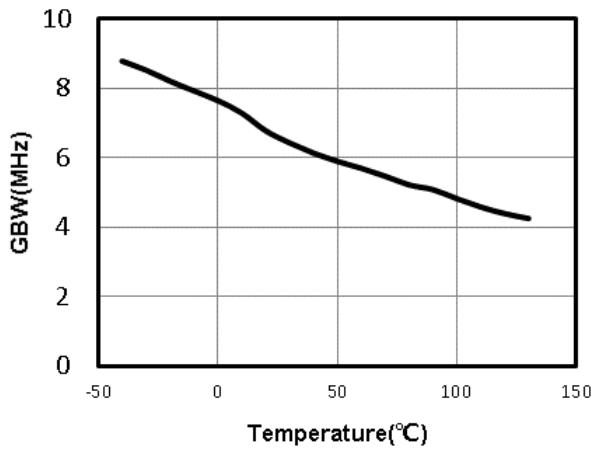
Figure 1. Unity Gain Bandwidth vs. Temperature
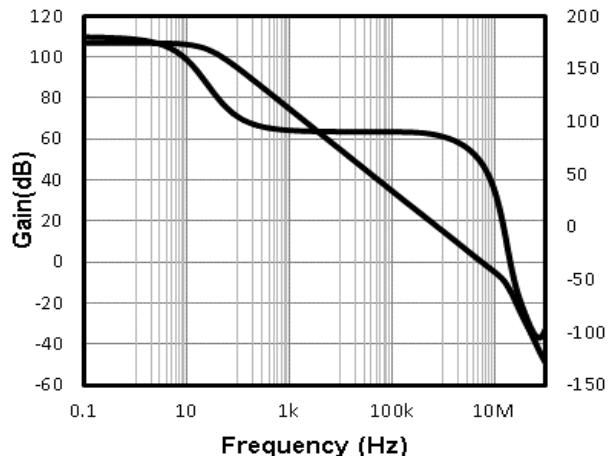
Figure 2. Open-Loop Gain and Phase
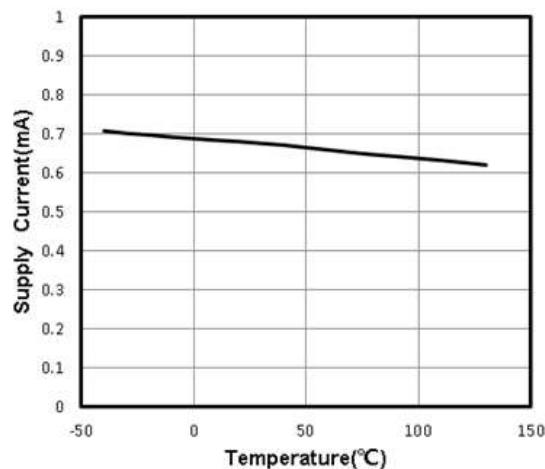
Figure 3. Supply Current vs. Temperature
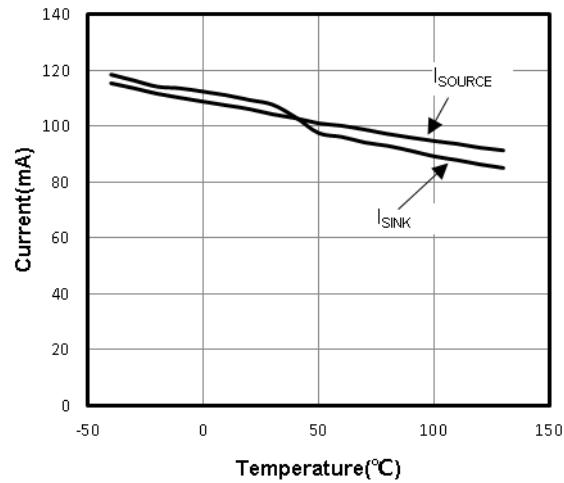
Figure 4. Short Circuit Current vs. Temperature
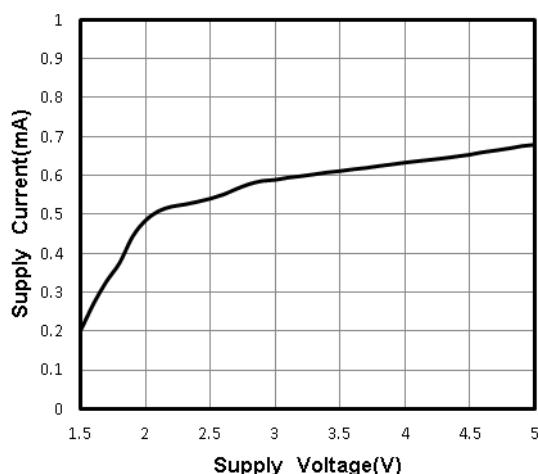
Figure 5. Quiescent Current vs. Supply Voltage
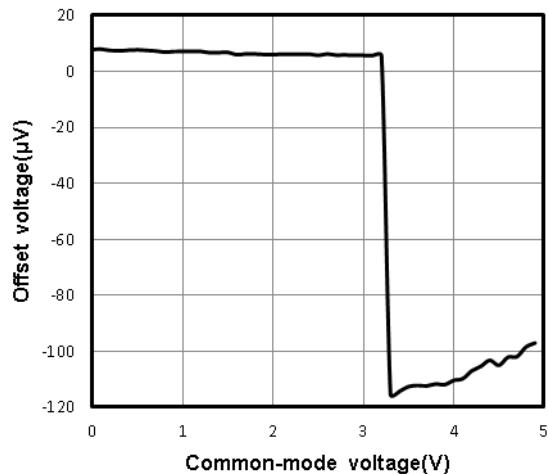
Figure 6. Offset Voltage vs. Common-Mode Voltage
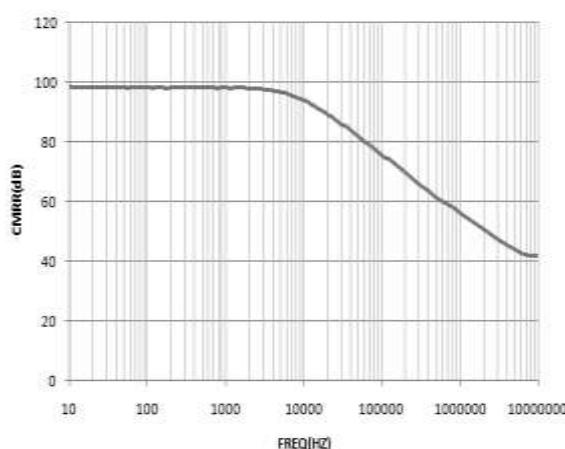
Figure 7. CMRR vs. Frequency
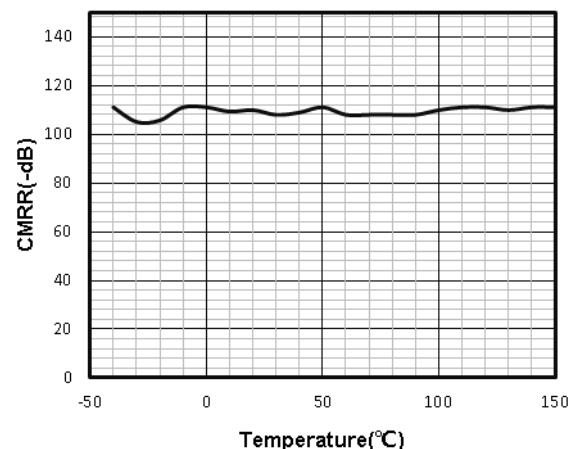
Figure 8. CMRR vs. Temperature
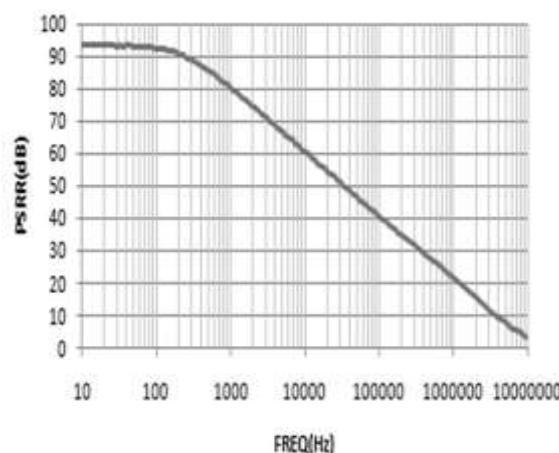
Figure 9. Power-Supply Rejection Ratio
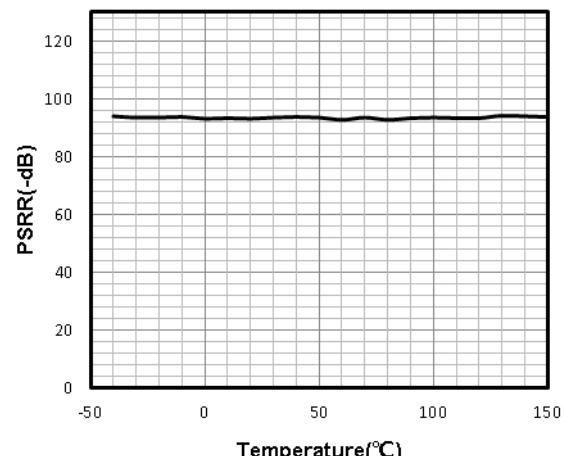
Figure 10. PSRR vs. Temperature
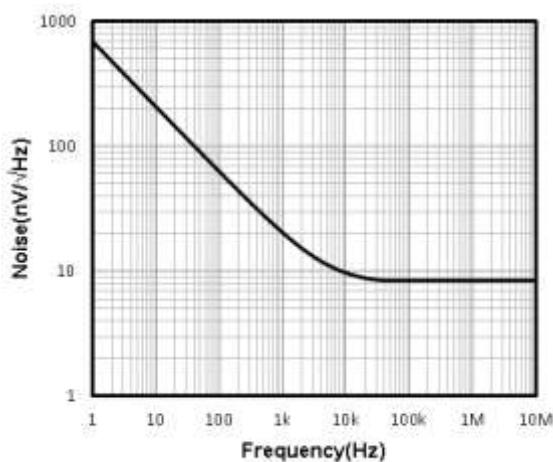
Figure 11. Input Voltage Noise Spectral Density
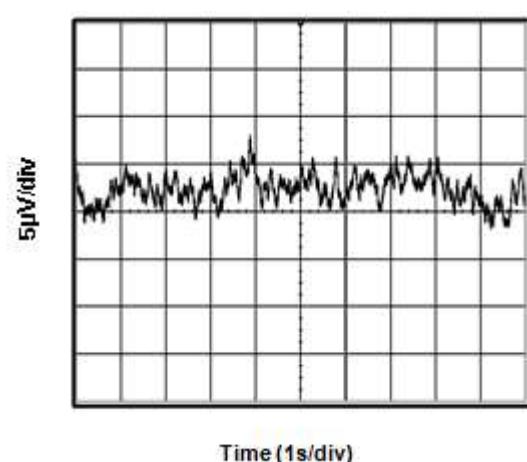
Figure 12. 0.1 Hz to 10 Hz Input Voltage Noise
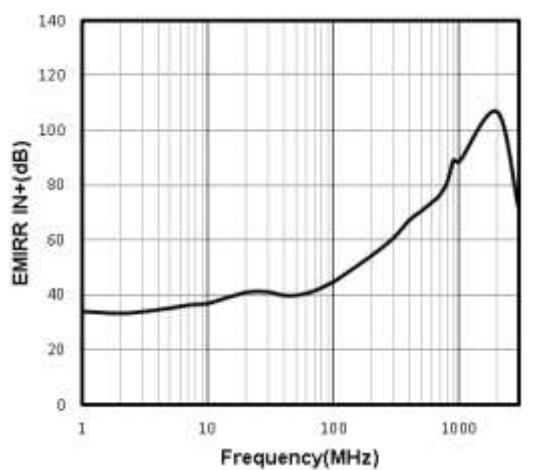
Figure 13. EMIRR IN+ vs. Frequency
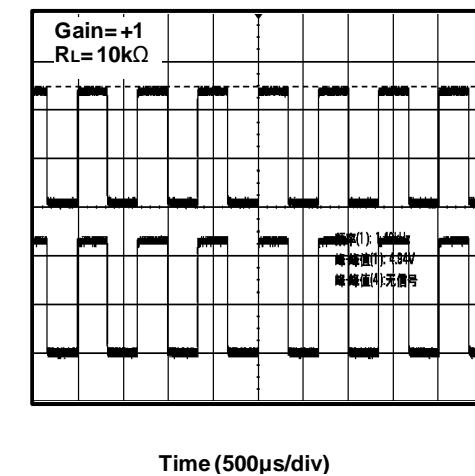
Figure 14. Large-Scale Step Response
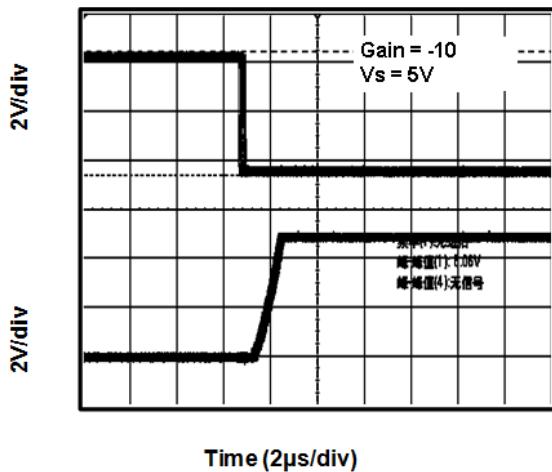
Figure 15. Negative Over-Voltage Recovery
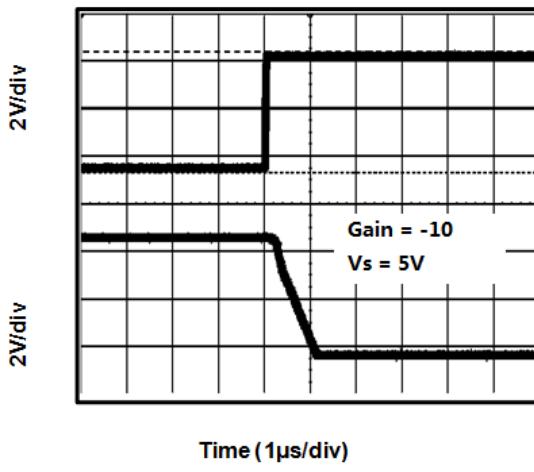

Figure 16. Positive Over-Voltage Recovery
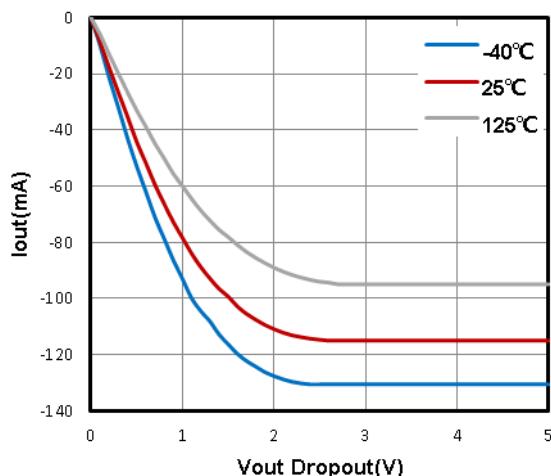
Figure 17. Negative Output Swing vs. Load Current
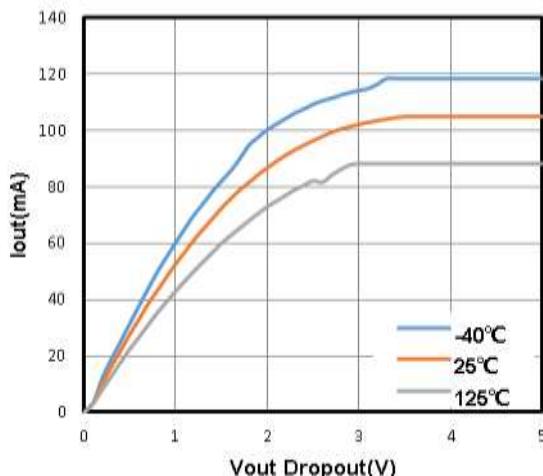
Figure 18. Positive Output Swing vs. Load Current

Package Dimension

SOP-8
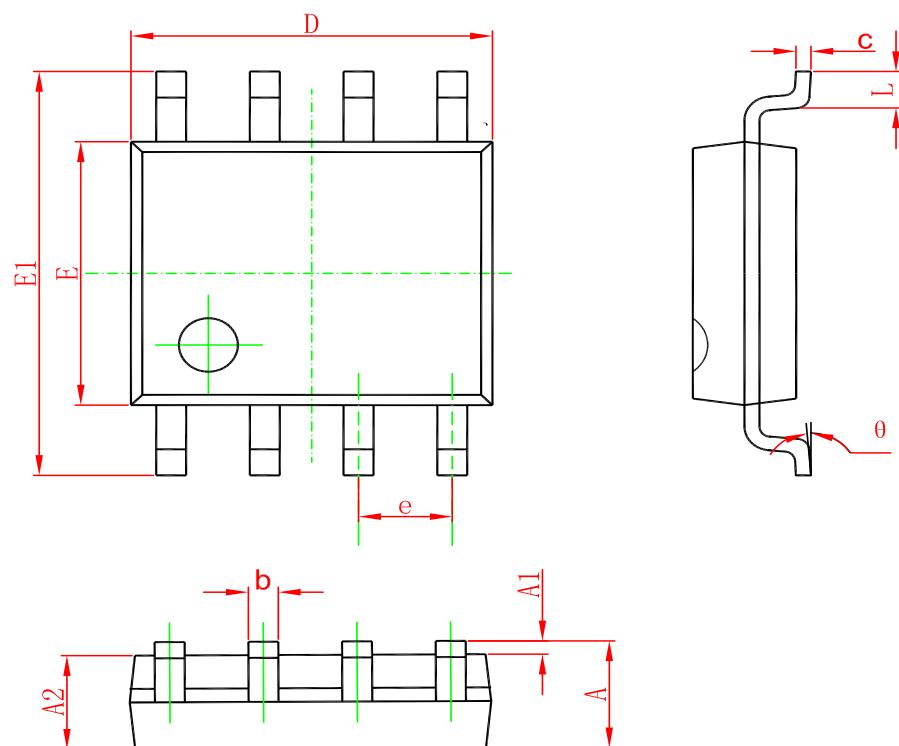
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

SOP-14
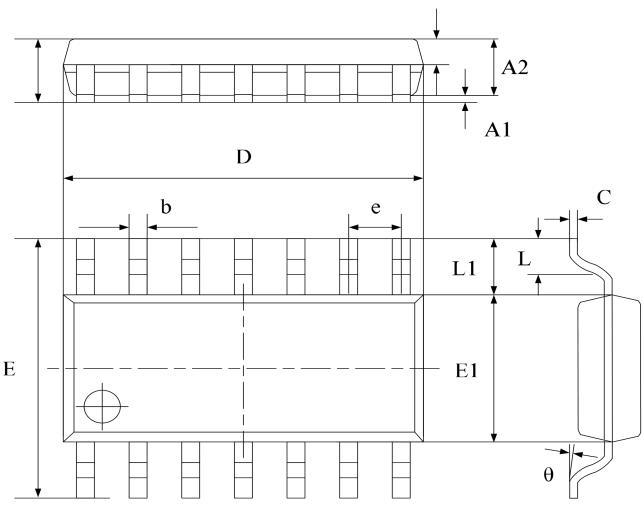
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.450	1.850	0.059	0.076
A1	0.100	0.300	0.004	0.012
A2	1.350	1.550	0.055	0.063
A3	0.550	0.750	0.022	0.031
b	0.406typ.		0.017typ.	
C	0.203typ.		0.008typ.	
D	8.630	8.830	0.352	0.360
E	5.840	6.240	0.238	0.255
E1	3.850	4.050	0.157	0.165
e	1.270 typ.		0.050 typ.	
L1	1.040 ref.		0.041 ref.	
L	0.350	0.750	0.014	0.031
θ	2°	8°	2°	8°

TSSOP-14
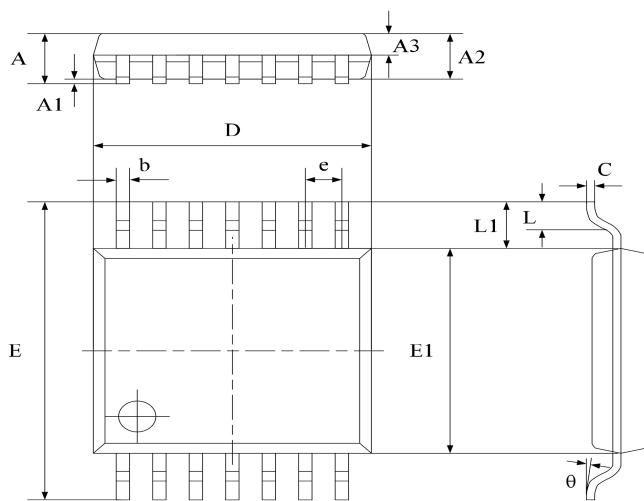
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	-	1.200	-	0.0472
A1	0.050	0.150	0.002	0.006
A2	0.900	1.050	0.037	0.043
A3	0.390	0.490	0.016	0.020
b	0.200	0.290	0.008	0.012
C	0.130	0.180	0.005	0.007
D	4.860	5.060	0.198	0.207
E	6.200	6.600	0.253	0.269
E1	4.300	4.500	0.176	0.184
e	0.650 typ.		0.0256 typ.	
L1	1.000 ref.		0.0393 ref.	
L	0.450	0.750	0.018	0.031
θ	0°	8°	0°	8°

Ordering information

Order code	Package	Baseqty	Deliverymode	Marking
UMW TP10-2-SR	SOP-8	2500	Tape and reel	T102
UMW TP10-4-SR	SOP-14	2500	Tape and reel	T104
UMW TP10-4-TR	TSSOP-14	4000	Tape and reel	T104

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