

3-Terminal 0.5A Positive Voltage Regulator

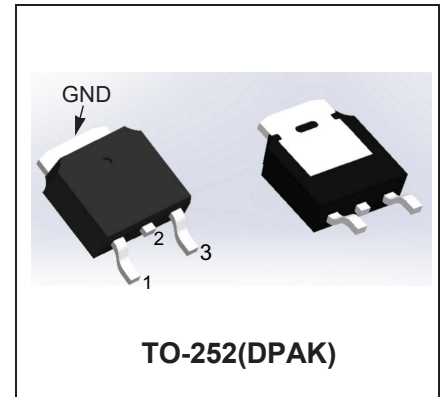
LR78MXXD

Description

The LR78MXXD series of three-terminal positive regulators are available in the TO-252(DPAK) package with several fixed output voltages making it useful in a wide range of applications.

Features

- Output Current up to 0.5A
- Output Voltages of 5, 6, 8, 9,12, 15, 18, 24V
- Thermal Overload Protection
- Short Circuit Protection
- Output Transistor Safe Operating Area (SOA)Protection
- We declare that material of product is compliant with ROHS requirements and Halogen Free.



1. Input 2. GND 3. Output

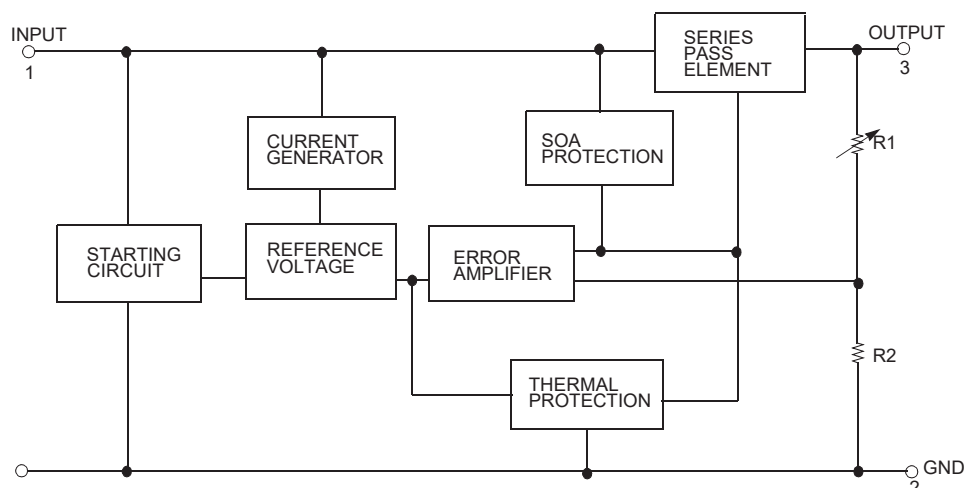
ORDERING INFORMATION

DEVICE	Package	XX Description	Packing Information	MOQ
LR78MXXD	TO-252 (DPAK)	Output Voltage e.g. 12.0V=12 5.0V=05	2500 Units/ Reel	5000

DEVICE MARKING INFORMATION

Marking	First Column Description (e.g L78M05)	Second Column Description (YYWW)
	Device Code L78M05 is the Device Code for LR78M05D	Year and Week Code e.g. "1936" represent "The 36th week of 2019"

BLOCK DIGRAM



Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Input Voltage (for $V_O = 5V$ to $18V$) (for $V_O = 24V$)	V_I V_I	35 40	V V
Thermal Resistance Junction-Case (Note1) TO-252(DAPK) ($T_c = +25^\circ C$)	$R_{\theta JC}$	3.5	$^\circ C/W$
Thermal Resistance Junction-Air (Note1, 2) TO-252(DAPK) ($T_a = +25^\circ C$)	$R_{\theta JA}$	92	$^\circ C/W$
Operating Junction Temperature Range	T_J	$0 \sim +150$	$^\circ C$
Operating Ambient Temperature	T_{OPR}	$-40 \sim +125$	$^\circ C$
Storage Temperature Range	T_{STG}	$-65 \sim +150$	$^\circ C$

Note: 1. Thermal resistance test board size: 30.0mm×25.0mm×1.6mm (FR4); Copper foil: 35um; Standard soldering pad.
2. Assume no ambient airflow

Electrical Characteristics (LR78M05D)

(Refer to the test circuits, $0 \leq T_J \leq +125^\circ C$, $I_O = 350mA$, $V_I = 10V$, unless otherwise specified, $C_I = 0.33\mu F$, $C_O = 0.1\mu F$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_O	$T_J = +25^\circ C$	4.8	5	5.2	V
		$I_O = 5mA$ to $350mA$ $V_I = 7V$ to $20V$	4.75	5	5.25	
Line Regulation (Note3)	ΔV_O	$I_O = 200mA$ $T_J = +25^\circ C$	-	-	100	mV
		$V_I = 7V$ to $25V$ $V_I = 8V$ to $25V$	-	-	50	
Load Regulation (Note3)	ΔV_O	$I_O = 5mA$ to $0.5A$, $T_J = +25^\circ C$	-	-	100	mV
		$I_O = 5mA$ to $200mA$, $T_J = +25^\circ C$	-	-	50	
Quiescent Current	I_Q	$T_J = +25^\circ C$	-	4.0	6.0	mA
Quiescent Current Change	ΔI_Q	$I_O = 5mA$ to $350mA$	-	-	0.5	mA
		$I_O = 200mA$ $V_I = 8V$ to $25V$	-	-	0.8	
Output Voltage Drift	$\Delta V/\Delta T$	$I_O = 5mA$ $T_J = 0$ to $+125^\circ C$	-	0.5	-	mV/ $^\circ C$
Output Noise Voltage	V_N	$f = 10Hz$ to $100kHz$	-	40	-	$\mu V/V_O$
Ripple Rejection	RR	$f = 120Hz$, $I_O = 300mA$ $V_I = 8V$ to $18V$, $T_J = +25^\circ C$	-	80	-	dB
Dropout Voltage	V_D	$T_J = +25^\circ C$, $I_O = 500mA$	-	2	-	V
Short Circuit Current	ISC	$T_J = +25^\circ C$, $V_I = 35V$	-	200	-	mA

Note:

3. Load and line regulation are specified at constant junction temperature. Change in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Electrical Characteristics (LR78M06D) (Continued)

(Refer to the test circuits, $0 \leq T_J \leq +125^\circ\text{C}$, $I_O=350\text{mA}$, $V_I=11\text{V}$, unless otherwise specified, $C_I=0.33\mu\text{F}$, $C_O=0.1\mu\text{F}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_O	$T_J = +25^\circ\text{C}$	5.75	6	6.25	V
		$I_O = 5\text{mA to } 350\text{mA}$ $V_I = 8\text{V to } 21\text{V}$	5.7	6	6.3	
Line Regulation (Note1)	ΔV_O	$I_O = 200\text{mA}$ $T_J = +25^\circ\text{C}$	-	-	120	mV
		$V_I = 8\text{V to } 25\text{V}$ $V_I = 9\text{V to } 25\text{V}$	-	-	60	
Load Regulation (Note1)	ΔV_O	$I_O = 5\text{mA to } 0.5\text{A}$, $T_J = +25^\circ\text{C}$	-	-	120	mV
		$I_O = 5\text{mA to } 200\text{mA}$, $T_J = +25^\circ\text{C}$	-	-	60	
Quiescent Current	I_Q	$T_J = +25^\circ\text{C}$	-	4.0	6.0	mA
Quiescent Current Change	ΔI_Q	$I_O = 5\text{mA to } 350\text{mA}$	-	-	0.5	mA
		$I_O = 200\text{mA}$ $V_I = 9\text{V to } 25\text{V}$	-	-	0.8	
Output Voltage Drift	$\Delta V/\Delta T$	$I_O = 5\text{mA}$ $T_J = 0 \text{ to } +125^\circ\text{C}$	-	0.6	-	mV/ $^\circ\text{C}$
Output Noise Voltage	V_N	$f = 10\text{Hz to } 100\text{kHz}$	-	45	-	$\mu\text{V}/V_O$
Ripple Rejection	RR	$f = 120\text{Hz}$, $I_O = 300\text{mA}$ $V_I = 9\text{V to } 19\text{V}$, $T_J = +25^\circ\text{C}$	-	80	-	dB
Dropout Voltage	V_D	$T_J = +25^\circ\text{C}$, $I_O = 500\text{mA}$	-	2	-	V
Short Circuit Current	I_{SC}	$T_J = +25^\circ\text{C}$, $V_I = 35\text{V}$	-	200	-	mA

Note:

1. Load and line regulation are specified at constant junction temperature. Change in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Electrical Characteristics (LR78M08D) (Continued)

(Refer to the test circuits, $0 \leq T_J \leq +125^\circ\text{C}$, $I_O=350\text{mA}$, $V_I=14\text{V}$, unless otherwise specified, $C_I = 0.33\mu\text{F}$, $C_O=0.1\mu\text{F}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_O	$T_J = +25^\circ\text{C}$	7.7	8	8.3	V
		$I_O = 5\text{mA to } 350\text{mA}$ $V_I = 10.5\text{V to } 23\text{V}$	7.6	8	8.4	
Line Regulation (Note1)	ΔV_O	$I_O = 200\text{mA}$ $T_J = +25^\circ\text{C}$	-	-	160	mV
		$V_I = 10.5\text{V to } 25\text{V}$ $V_I = 11\text{V to } 25\text{V}$	-	-	80	
Load Regulation (Note1)	ΔV_O	$I_O = 5\text{mA to } 0.5\text{A}$, $T_J = +25^\circ\text{C}$	-	-	160	mV
		$I_O = 5\text{mA to } 200\text{mA}$, $T_J = +25^\circ\text{C}$	-	-	80	
Quiescent Current	I_Q	$T_J = +25^\circ\text{C}$	-	4.0	6.0	mA
Quiescent Current Change	ΔI_Q	$I_O = 5\text{mA to } 350\text{mA}$	-	-	0.5	mA
		$I_O = 200\text{mA}$ $V_I = 10.5\text{V to } 25\text{V}$	-	-	0.8	
Output Voltage Drift	RR	$I_O = 5\text{mA}$ $T_J = 0 \text{ to } +125^\circ\text{C}$	-	0.8	-	mV/ $^\circ\text{C}$
Output Noise Voltage	V_N	$f = 10\text{Hz to } 100\text{kHz}$	-	52	-	$\mu\text{V}/V_O$
Ripple Rejection	RR	$f = 120\text{Hz}$, $I_O = 300\text{mA}$ $V_I = 11.5\text{V to } 21.5\text{V}$, $T_J = +25^\circ\text{C}$	-	80	-	dB
Dropout Voltage	V_D	$T_J = +25^\circ\text{C}$, $I_O = 500\text{mA}$	-	2	-	V
Short Circuit Current	I_{SC}	$T_J = +25^\circ\text{C}$, $V_I = 35\text{V}$	-	200	-	mA

Note:

1. Load and line regulation are specified at constant junction temperature. Change in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Electrical Characteristics (LR78M09D) (Continued)

(Refer to the test circuits, $0 \leq T_J \leq +125^\circ\text{C}$, $I_O=350\text{mA}$, $V_I=15\text{V}$, unless otherwise specified, $C_I = 0.33\mu\text{F}$, $C_O=0.1\mu\text{F}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_O	$T_J = +25^\circ\text{C}$	8.65	9	9.35	V
		$I_O = 5\text{mA to } 350\text{mA}$ $V_I = 10.5\text{V to } 23\text{V}$	8.55	9	8.45	
Line Regulation (Note1)	ΔV_O	$I_O = 200\text{mA}$ $T_J = +25^\circ\text{C}$	-	-	180	mV
		$V_I = 10.5\text{V to } 25\text{V}$ $V_I = 11\text{V to } 25\text{V}$	-	-	90	
Load Regulation (Note1)	ΔV_O	$I_O = 5\text{mA to } 0.5\text{A}$, $T_J = +25^\circ\text{C}$	-	-	180	mV
		$I_O = 5\text{mA to } 200\text{mA}$, $T_J = +25^\circ\text{C}$	-	-	90	
Quiescent Current	I_Q	$T_J = +25^\circ\text{C}$	-	4.0	6.0	mA
Quiescent Current Change	ΔI_Q	$I_O = 5\text{mA to } 350\text{mA}$	-	-	0.5	mA
		$I_O = 200\text{mA}$ $V_I = 10.5\text{V to } 25\text{V}$	-	-	0.8	
Output Voltage Drift	RR	$I_O = 5\text{mA}$ $T_J = 0 \text{ to } +125^\circ\text{C}$	-	0.8	-	mV/ $^\circ\text{C}$
Output Noise Voltage	V_N	$f = 10\text{Hz to } 100\text{kHz}$	-	52	-	$\mu\text{V}/V_O$
Ripple Rejection	RR	$f = 120\text{Hz}$, $I_O = 300\text{mA}$ $V_I = 11.5\text{V to } 21.5\text{V}$, $T_J = +25^\circ\text{C}$	-	80	-	dB
Dropout Voltage	V_D	$T_J = +25^\circ\text{C}$, $I_O = 500\text{mA}$	-	2	-	V
Short Circuit Current	ISC	$T_J = +25^\circ\text{C}$, $V_I = 35\text{V}$	-	200	-	mA

Note:

1. Load and line regulation are specified at constant junction temperature. Change in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Electrical Characteristics (LR78M12D) (Continued)

(Refer to the test circuits, $0 \leq T_J \leq +125^\circ\text{C}$, $I_O=350\text{mA}$, $V_I=19\text{V}$, unless otherwise specified, $C_I=0.33\mu\text{F}$, $C_O=0.1\mu\text{F}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_O	$T_J = +25^\circ\text{C}$	11.5	12	12.5	V
		$I_O = 5\text{mA to } 350\text{mA}$ $V_I = 14.5\text{V to } 27\text{V}$	11.4	12	12.6	
Line Regulation (Note1)	ΔV_O	$I_O = 200\text{mA}$ $T_J = +25^\circ\text{C}$	-	-	240	mV
		$V_I = 14.5\text{V to } 30\text{V}$ $V_I = 16\text{V to } 30\text{V}$	-	-	120	
Load Regulation (Note1)	ΔV_O	$I_O = 5\text{mA to } 0.5\text{A}$, $T_J = +25^\circ\text{C}$	-	-	240	mV
		$I_O = 5\text{mA to } 200\text{mA}$, $T_J = +25^\circ\text{C}$	-	-	120	
Quiescent Current	I_Q	$T_J = +25^\circ\text{C}$	-	4.1	6.0	mA
Quiescent Current Change	ΔI_Q	$I_O = 5\text{mA to } 350\text{mA}$	-	-	0.5	mA
		$I_O = 200\text{mA}$ $V_I = 14.5\text{V to } 30\text{V}$	-	-	0.8	
Output Voltage Drift	$\Delta V/\Delta T$	$I_O = 5\text{mA}$ $T_J = 0 \text{ to } +125^\circ\text{C}$	-	1	-	mV/ $^\circ\text{C}$
Output Noise Voltage	V_N	$f = 10\text{Hz to } 100\text{kHz}$	-	75	-	$\mu\text{V}/V_O$
Ripple Rejection	RR	$f = 120\text{Hz}$, $I_O = 300\text{mA}$ $V_I = 15\text{V to } 25\text{V}$, $T_J = +25^\circ\text{C}$	-	80	-	dB
Dropout Voltage	V_D	$T_J = +25^\circ\text{C}$, $I_O = 500\text{mA}$	-	2	-	V
Short Circuit Current	I_{SC}	$T_J = +25^\circ\text{C}$, $V_I = 35\text{V}$	-	200	-	mA

Note:

1. Load and line regulation are specified at constant junction temperature. Change in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Electrical Characteristics (LR78M15D) (Continued)

(Refer to the test circuits, $0 \leq T_J \leq +125^\circ\text{C}$, $I_O=350\text{mA}$, $V_I=23\text{V}$, unless otherwise specified, $C_I=0.33\mu\text{F}$, $C_O=0.1\mu\text{F}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_O	$T_J = +25^\circ\text{C}$	14.4	15	15.6	V
		$I_O = 5\text{mA to } 350\text{mA}$ $V_I = 17.5\text{V to } 30\text{V}$	14.25	15	15.75	
Line Regulation (Note1)	ΔV_O	$I_O = 200\text{mA}$ $T_J = +25^\circ\text{C}$	-	-	300	mV
		$V_I = 17.5\text{V to } 30\text{V}$ $V_I = 20\text{V to } 30\text{V}$	-	-	150	
Load Regulation (Note1)	ΔV_O	$I_O = 5\text{mA to } 0.5\text{A}$, $T_J = +25^\circ\text{C}$	-	-	300	mV
		$I_O = 5\text{mA to } 200\text{mA}$, $T_J = +25^\circ\text{C}$	-	-	150	
Quiescent Current	I_Q	$T_J = +25^\circ\text{C}$	-	4.1	6.0	mA
Quiescent Current Change	ΔI_Q	$I_O = 5\text{mA to } 350\text{mA}$	-	-	0.5	mA
		$I_O = 200\text{mA}$ $V_I = 17.5\text{V to } 30\text{V}$	-	-	0.8	
Output Voltage Drift	$\Delta V/\Delta T$	$I_O = 5\text{mA}$ $T_J = 0 \text{ to } +125^\circ\text{C}$	-	1.2	-	mV/ $^\circ\text{C}$
Output Noise Voltage	V_N	$f = 10\text{Hz to } 100\text{kHz}$	-	100	-	$\mu\text{V}/V_O$
Ripple Rejection	RR	$f = 120\text{Hz}$, $I_O = 300\text{mA}$ $V_I = 18.5\text{V to } 28.5\text{V}$, $T_J = +25^\circ\text{C}$	-	70	-	dB
Dropout Voltage	V_D	$T_J = +25^\circ\text{C}$, $I_O = 500\text{mA}$	-	2	-	V
Short Circuit Current	I_{SC}	$T_J = +25^\circ\text{C}$, $V_I = 35\text{V}$	-	200	-	mA

Note:

1. Load and line regulation are specified at constant junction temperature. Change in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Electrical Characteristics (LR78M18D) (Continued)

(Refer to the test circuits, $0 \leq T_J \leq +125^\circ\text{C}$, $I_O=350\text{mA}$, $V_I=26\text{V}$, unless otherwise specified, $C_I=0.33\mu\text{F}$, $C_O=0.1\mu\text{F}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_O	$T_J = +25^\circ\text{C}$	17.3	18	18.7	V
		$I_O = 5\text{mA to } 350\text{mA}$ $V_I = 20.5\text{V to } 33\text{V}$	17.1	18	18.9	
Line Regulation (Note1)	ΔV_O	$I_O = 200\text{mA}$ $T_J = +25^\circ\text{C}$	-	-	360	mV
		$V_I = 21\text{V to } 33\text{V}$ $V_I = 24\text{V to } 33\text{V}$	-	-	180	
Load Regulation (Note1)	ΔV_O	$I_O = 5\text{mA to } 0.5\text{A}$, $T_J = +25^\circ\text{C}$	-	-	360	mV
		$I_O = 5\text{mA to } 200\text{mA}$, $T_J = +25^\circ\text{C}$	-	-	180	
Quiescent Current	I_Q	$T_J = +25^\circ\text{C}$	-	4.2	6.0	mA
Quiescent Current Change	ΔI_Q	$I_O = 5\text{mA to } 350\text{mA}$	-	-	0.5	mA
		$I_O = 200\text{mA}$ $V_I = 21\text{V to } 33\text{V}$	-	-	0.8	
Output Voltage Drift	$\Delta V/\Delta T$	$I_O = 5\text{mA}$, $T_J = 0 \text{ to } 125^\circ\text{C}$	-	-1.1	-	mV/ $^\circ\text{C}$
Output Noise Voltage	V_N	$f = 10\text{Hz to } 100\text{kHz}$	-	100	-	$\mu\text{V}/V_O$
Ripple Rejection	RR	$f = 120\text{Hz}$, $I_O = 300\text{mA}$, $V_I = 22\text{V to } 32\text{V}$ $T_J = +25^\circ\text{C}$	-	70	-	dB
Dropout Voltage	V_D	$T_J = +25^\circ\text{C}$, $I_O = 500\text{mA}$	-	2	-	V
Short Circuit Current	I_{SC}	$T_J = +25^\circ\text{C}$, $V_I = 35\text{V}$	-	200	-	mA

Note:

1. Load and line regulation are specified at constant junction temperature. Change in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

Electrical Characteristics (LR78M24D) (Continued)

(Refer to the test circuits, $0 \leq T_J \leq +125^\circ\text{C}$, $I_O=350\text{mA}$, $V_I=33\text{V}$, unless otherwise specified, $C_I=0.33\mu\text{F}$, $C_O=0.1\mu\text{F}$)

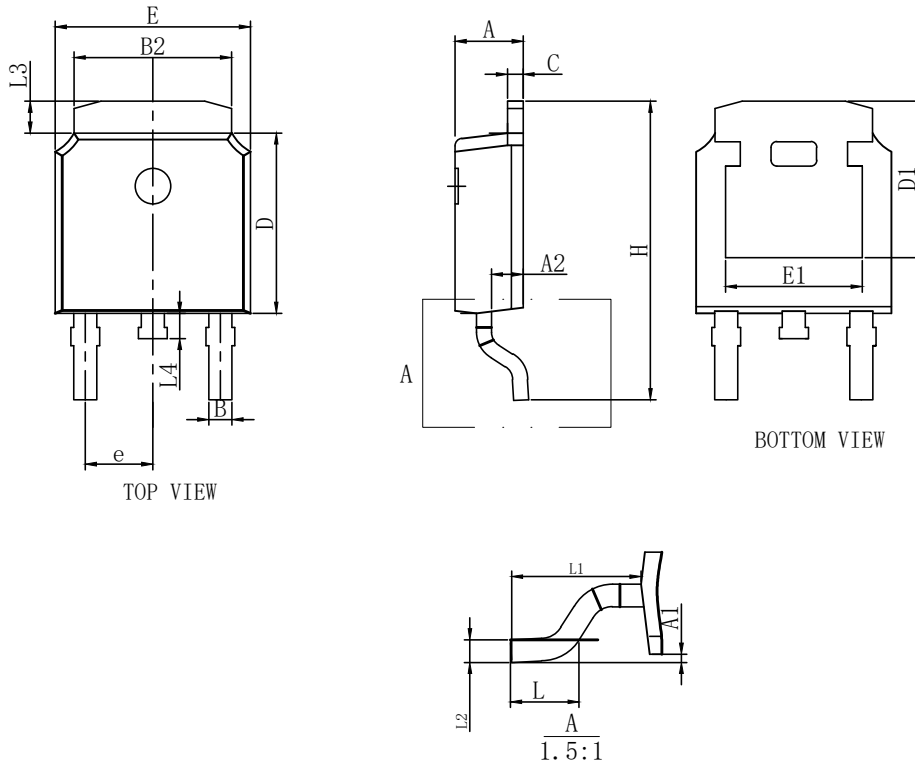
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_O	$T_J = +25^\circ\text{C}$	23	24	25	V
		$I_O = 5\text{mA to } 350\text{mA}$ $V_I = 27\text{V to } 38\text{V}$	22.8	24	25.2	
Line Regulation (Note1)	ΔV_O	$I_O = 200\text{mA}$ $T_J = +25^\circ\text{C}$	-	-	480	mV
		$V_I = 27\text{V to } 38\text{V}$ $V_I = 28\text{V to } 38\text{V}$	-	-	240	
Load Regulation (Note1)	ΔV_O	$I_O = 5\text{mA to } 0.5\text{A}$, $T_J = +25^\circ\text{C}$	-	-	480	mV
		$I_O = 5\text{mA to } 200\text{mA}$, $T_J = +25^\circ\text{C}$	-	-	240	
Quiescent Current	I_Q	$T_J = +25^\circ\text{C}$	-	4.2	6.0	mA
Quiescent Current Change	ΔI_Q	$I_O = 5\text{mA to } 350\text{mA}$	-	-	0.5	mA
		$I_O = 200\text{mA}$ $V_I = 27\text{V to } 38\text{V}$	-	-	0.8	
Output Voltage Drift	$\Delta V/\Delta T$	$I_O = 5\text{mA}$ $T_J = 0 \text{ to } +125^\circ\text{C}$	-	-1.2	-	mV/ $^\circ\text{C}$
Output Noise Voltage	V_N	$f = 10\text{Hz to } 100\text{kHz}$	-	170	-	$\mu\text{V}/V_O$
Ripple Rejection	RR	$f = 120\text{Hz}$, $I_O = 300\text{mA}$ $V_I = 28\text{V to } 38\text{V}$, $T_J = +25^\circ\text{C}$	-	70	-	dB
Dropout Voltage	V_D	$T_J = +25^\circ\text{C}$, $I_O = 500\text{mA}$	-	2	-	V
Short Circuit Current	I_{SC}	$T_J = +25^\circ\text{C}$, $V_I = 35\text{V}$	-	200	-	mA

Note:

1. Load and line regulation are specified at constant junction temperature. Change in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.

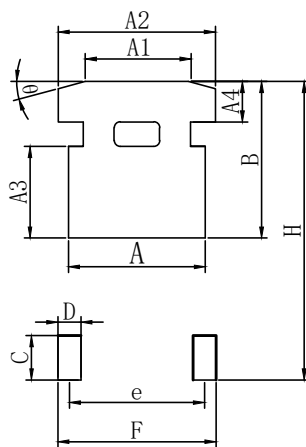
MECHANICAL DIMENSIONS

TO-252 (DPAK)



DIM	MILLIMETERS		
	MIN	NOM	MAX
A	2.15	2.30	2.45
A1	-	-	0.20
A2	0.90	1.07	1.17
B	0.68	0.78	0.88
B2	5.20	5.33	5.46
C	0.49	-	0.58
D	5.90	6.10	6.30
D1	5.30REF		
E	6.40	6.60	6.80
E1	4.63	4.83	5.03
e	2.286BSC		
H	9.85	10.10	10.35
L	1.30	1.50	1.70
L1	2.90REF		
L2	0.51BSC		
L3	0.88	1.08	1.28
L4	0.55	0.80	1.05

RECOMMENDED PCB LAYOUT (Unit: mm)



DIM	MIN(mm)
A	6.03
A1	4.50
A2	6.46
A3	4.10
A4	2.37
B	6.50
C	2.50
D	1.68
e	4.80
H	12.35
F	5.95

MECHANICAL DIMENSIONS

Version	Description	Update by	Update Date
1.9	Update thermal resistance test condition.	Chen S	2023-08-24
1.1	Update operating temperature range.	Chen S	2023-10-27

DISCLAIMER

- Curve guarantee in the specification. The curve of test items with electric parameter is used as quality guarantee. The curve of test items without electric parameter is used as reference only.
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