

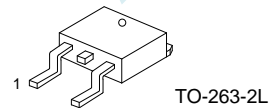
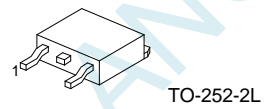
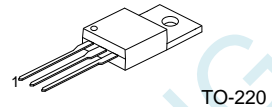
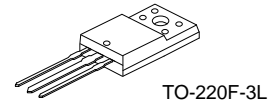
3 TERMINAL 1.5A POSITIVE VOLTAGE REGULATORS

DESCRIPTION

The UTC78XX series of three-terminal positive regulators are available in TO-220 package and with several fixed output voltage, making them useful in a wide range of application. Each type employs internal current limiting, thermal shut-down and safe area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1.5A output current. Although designed as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltage and currents.

FEATURES

- *Output current up to 1.5A
- *5V;6V;8V;9V;10V;12V;15V;18V;24V output voltage available
- *Thermal overload protection
- *Short circuit protection
- *Output transistor SOA protection

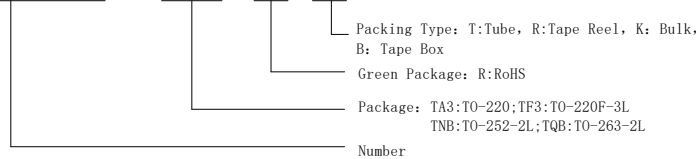


1:INPUT; 2:GND; 3:OUTPUT

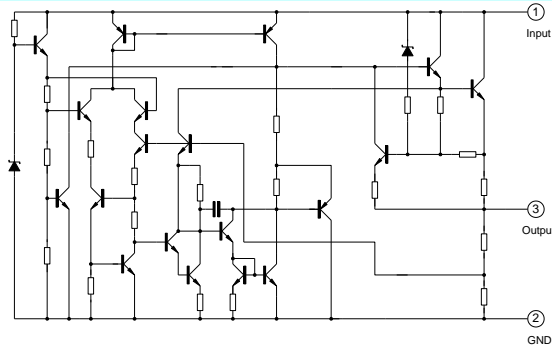
ORDERING INFORMATION

Ordering Number	Package	Print Number	Free	Packing
UTC78XX-TA3-R-T	TO-220	UTC78XX	RoHS	Tube
UTC78XX-TF3-R-T	TO-220F-3L	UTC78XX	RoHS	Tube
UTC78MXX-TNB-R-T	TO-252-2L	UTC78MXX	RoHS	Tube
UTC78MXX-TNB-R-R	TO-252-2L	UTC78MXX	RoHS	Tape Reel
UTC78XX-TQB-R-R	TO-263-2L	UTC78XX	RoHS	Tape Reel

UTC78XX - TA3 - R - T



BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

Characteristic	Symbol	Value	Unit
Input voltage (for Vo=5V to 18V) (for Vo=24V)	Vi	35	V
		40	V
Operating Temperature	Topr	-20 ~ +125	°C
Storage Temperature	Tstg	-65 ~ +150	°C

THERMAL DATA

Characteristic	Symbol	TO-220	TO-220F-3L	TO-252-2L	TO-263-2L	Unit
Thermal resistance junction-cases	RθJC	5	5	12.5	3	°C/W
Thermal resistance junction-air	RθJA	50	60	125	62.5	°C/W

UTC7805 ELECTRICAL CHARACTERISTICS

(Refer to test circuits, 0<Tj<125°C, Io=500mA, Vi=10V, Ci=0.33μF, Co=0.1μF, unless otherwise specified)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Units
Output voltage	Vo	Tj=25°C	4.8	5.0	5.2	V
		5.0mA<Io<1.0A, Po<15W Vi=7.5V to 20V	4.75	5.00	5.25	V
Line regulation	ΔVo	Tj=25°C, Vi=7.5V to 25V	-	4.0	100	mV
		Tj=25°C, Vi=8V to 12V	-	1.6	50	mV
Load regulation	ΔVo	Tj=25°C, Io=5.0mA to 1.5A	-	9	100	mV
		Tj=25°C, Io=250mA to 750mA	-	4	50	mV
Quiescent current	Iq	Tj=25°C	-	5.0	8	mA
Quiescent current change	ΔIq	Io=5mA to 1.0A	-	0.03	0.5	mA
		Vi=8V to 25V	-	0.3	0.8	mA
Output voltage drift	ΔVo/ΔT	Io=5mA	-	0.8	-	mV/°C
Output noise voltage	VN	f=10Hz to 100kHz, Ta=25°C	-	42	-	μV/Vo
Ripple rejection	RR	f=120Hz, Vi=8V to 18V	62	73	-	dB
Dropout voltage	Vo	Io=1.0A, Tj=25°C	-	2	-	V
Output resistance	Ro	f=1kHz	-	15	-	mΩ
Short circuit current	Isc	Vi=35V, Ta=25°C	-	250	-	mA
peak current	Ipk	Tj=25°C	-	2.2	-	A

UTC7806 ELECTRICAL CHARACTERISTICS

(Refer to test circuits, $0 < T_j < 125^\circ\text{C}$, $I_o = 500\text{mA}$, $V_i = 11\text{V}$, $C_i = 0.33\mu\text{F}$, $C_o = 0.1\mu\text{F}$, unless otherwise specified)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Units
Output voltage	V_o	$T_j = 25^\circ\text{C}$	5.75	6.00	6.25	V
		$5.0\text{mA} < I_o < 1.0\text{A}$, $P_o < 15\text{W}$ $V_i = 8.5\text{V}$ to 21V	5.7	6.0	6.3	V
Line regulation	ΔV_o	$T_j = 25^\circ\text{C}$, $V_i = 8.5\text{V}$ to 25V	-	5	120	mV
		$T_j = 25^\circ\text{C}$, $V_i = 9\text{V}$ to 13V	-	1.5	60	mV
Load regulation	ΔV_o	$T_j = 25^\circ\text{C}$, $I_o = 5.0\text{mA}$ to 1.5A	-	9	130	mV
		$T_j = 25^\circ\text{C}$, $I_o = 250\text{mA}$ to 750mA	-	3	60	mV
Quiescent current	I_q	$T_j = 25^\circ\text{C}$	-	5.0	8	mA
Quiescent current change	ΔI_q	$I_o = 5\text{mA}$ to 1.0A	-	-	0.5	mA
		$V_i = 9\text{V}$ to 25V	-	-	0.8	mA
Output voltage drift	$\Delta V_o / \Delta T$	$I_o = 5\text{mA}$	-	0.8	-	mV/ $^\circ\text{C}$
Output noise voltage	V_N	$f = 10\text{Hz}$ to 100kHz , $T_a = 25^\circ\text{C}$	-	45	-	$\mu\text{V}/V_o$
Ripple rejection	RR	$f = 120\text{Hz}$, $V_i = 9\text{V}$ to 19V	59	75	-	dB
Dropout voltage	V_o	$I_o = 1.0\text{A}$, $T_j = 25^\circ\text{C}$	-	2	-	V
Output resistance	R_o	$f = 1\text{kHz}$	-	19	-	$\text{m}\Omega$
Short circuit current	I_{sc}	$V_i = 35\text{V}$, $T_a = 25^\circ\text{C}$	-	250	-	mA
peak current	I_{pk}	$T_j = 25^\circ\text{C}$	-	2.2	-	A

UTC7808 ELECTRICAL CHARACTERISTICS

(Refer to test circuits, $0 < T_j < 125^\circ\text{C}$, $I_o = 500\text{mA}$, $V_i = 14\text{V}$, $C_i = 0.33\mu\text{F}$, $C_o = 0.1\mu\text{F}$, unless otherwise specified)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Units
Output voltage	V_o	$T_j = 25^\circ\text{C}$	7.7	8.0	8.3	V
		$5.0\text{mA} < I_o < 1.0\text{A}$, $P_o < 15\text{W}$ $V_i = 11\text{V}$ to 23V	7.6	8.0	8.4	V
Line regulation	ΔV_o	$T_j = 25^\circ\text{C}$, $V_i = 10.5\text{V}$ to 25V	-	5.0	160	mV
		$T_j = 25^\circ\text{C}$, $V_i = 11\text{V}$ to 17V	-	2.0	80	mV
Load regulation	ΔV_o	$T_j = 25^\circ\text{C}$, $I_o = 5.0\text{mA}$ to 1.5A	-	10	160	mV
		$T_j = 25^\circ\text{C}$, $I_o = 250\text{mA}$ to 750mA	-	5.0	80	mV
Quiescent current	I_q	$T_j = 25^\circ\text{C}$	-	5.0	8	mA
Quiescent current change	ΔI_q	$I_o = 5\text{mA}$ to 1.0A	-	0.05	0.5	mA
		$V_i = 11\text{V}$ to 25V	-	0.5	1.0	mA
Output voltage drift	$\Delta V_o / \Delta T$	$I_o = 5\text{mA}$	-	0.8	-	mV/ $^\circ\text{C}$
Output noise voltage	V_N	$f = 10\text{Hz}$ to 100kHz , $T_a = 25^\circ\text{C}$	-	52	-	$\mu\text{V}/V_o$
Ripple rejection	RR	$f = 120\text{Hz}$, $V_i = 11.5\text{V}$ to 21.5V	56	73	-	dB
Dropout voltage	V_o	$I_o = 1.0\text{A}$, $T_j = 25^\circ\text{C}$	-	2	-	V
Output resistance	R_o	$f = 1\text{kHz}$	-	17	-	$\text{m}\Omega$
Short circuit current	I_{sc}	$V_i = 35\text{V}$, $T_a = 25^\circ\text{C}$	-	250	-	mA
peak current	I_{pk}	$T_j = 25^\circ\text{C}$	-	2.2	-	A

UTC7809 ELECTRICAL CHARACTERISTICS

(Refer to test circuits, $0 < T_j < 125^\circ\text{C}$, $I_o = 500\text{mA}$, $V_i = 15\text{V}$, $C_i = 0.33\mu\text{F}$, $C_o = 0.1\mu\text{F}$, unless otherwise specified)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Units
Output voltage	V_o	$T_j = 25^\circ\text{C}$	8.65	9.00	9.35	V
		$5.0\text{mA} < I_o < 1.0\text{A}, P_o < 15\text{W}$ $V_i = 11.5\text{V to } 24\text{V}$	8.6	9.0	9.4	V
Line regulation	ΔV_o	$T_j = 25^\circ\text{C}, V_i = 11.5\text{V to } 25\text{V}$	-	6	180	mV
		$T_j = 25^\circ\text{C}, V_i = 12\text{V to } 25\text{V}$	-	2	90	mV
Load regulation	ΔV_o	$T_j = 25^\circ\text{C}, I_o = 5.0\text{mA to } 1.5\text{A}$	-	12	180	mV
		$T_j = 25^\circ\text{C}, I_o = 250\text{mA to } 750\text{mA}$	-	4	90	mV
Quiescent current	I_Q	$T_j = 25^\circ\text{C}$	-	5.0	8	mA
Quiescent current change	ΔI_Q	$I_o = 5\text{mA to } 1.0\text{A}$	-	-	0.5	mA
		$V_i = 12\text{V to } 26\text{V}$	-	-	0.8	mA
Output voltage drift	$\Delta V_o / \Delta T$	$I_o = 5\text{mA}$	-	1	-	mV/ $^\circ\text{C}$
Output noise voltage	V_N	$f = 10\text{Hz to } 100\text{kHz}, T_a = 25^\circ\text{C}$	-	58	-	$\mu\text{V}/V_o$
Ripple rejection	RR	$f = 120\text{Hz}, V_i = 13\text{V to } 23\text{V}$	56	71	-	dB
Dropout voltage	V_o	$I_o = 1.0\text{A}, T_j = 25^\circ\text{C}$	-	2	-	V
Output resistance	R_o	$f = 1\text{kHz}$	-	15	-	$\text{m}\Omega$
Short circuit current	I_{sc}	$V_i = 35\text{V}, T_a = 25^\circ\text{C}$	-	250	-	mA
peak current	I_{pk}	$T_j = 25^\circ\text{C}$	-	2.2	-	A

UTC7810 ELECTRICAL CHARACTERISTICS

(Refer to test circuits, $0 < T_j < 125^\circ\text{C}$, $I_o = 500\text{mA}$, $V_i = 16\text{V}$, $C_i = 0.33\mu\text{F}$, $C_o = 0.1\mu\text{F}$, unless otherwise specified)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Units
Output voltage	V_o	$T_j = 25^\circ\text{C}$	9.6	10	10.4	V
		$5.0\text{mA} < I_o < 1.0\text{A}, P_o < 15\text{W}$ $V_i = 12.5\text{V to } 25\text{V}$	9.5	10	10.5	V
Line regulation	ΔV_o	$T_j = 25^\circ\text{C}, V_i = 12.5\text{V to } 25\text{V}$	-	10	200	mV
		$T_j = 25^\circ\text{C}, V_i = 13\text{V to } 20\text{V}$	-	3	100	mV
Load regulation	ΔV_o	$T_j = 25^\circ\text{C}, I_o = 5.0\text{mA to } 1.5\text{A}$	-	12	200	mV
		$T_j = 25^\circ\text{C}, I_o = 250\text{mA to } 750\text{mA}$	-	4	100	mV
Quiescent current	I_Q	$T_j = 25^\circ\text{C}$	-	5.0	8	mA
Quiescent current change	ΔI_Q	$I_o = 5\text{mA to } 1.0\text{A}$	-	-	0.5	mA
		$V_i = 13\text{V to } 29\text{V}$	-	-	0.8	mA
Output voltage drift	$\Delta V_o / \Delta T$	$I_o = 5\text{mA}$	-	1	-	mV/ $^\circ\text{C}$
Output noise voltage	V_N	$f = 10\text{Hz to } 100\text{kHz}, T_a = 25^\circ\text{C}$	-	58	-	$\mu\text{V}/V_o$
Ripple rejection	RR	$f = 120\text{Hz}, V_i = 14\text{V to } 24\text{V}$	56	71	-	dB
Dropout voltage	V_o	$I_o = 1.0\text{A}, T_j = 25^\circ\text{C}$	-	2	-	V
Output resistance	R_o	$f = 1\text{kHz}$	-	17	-	$\text{m}\Omega$
Short circuit current	I_{sc}	$V_i = 35\text{V}, T_a = 25^\circ\text{C}$	-	250	-	mA
peak current	I_{pk}	$T_j = 25^\circ\text{C}$	-	2.2	-	A

UTC7812 ELECTRICAL CHARACTERISTICS

(Refer to test circuits, $0 < T_j < 125^\circ\text{C}$, $I_o = 500\text{mA}$, $V_i = 19\text{V}$, $C_i = 0.33\mu\text{F}$, $C_o = 0.1\mu\text{F}$, unless otherwise specified)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Units
Output voltage	V_o	$T_j = 25^\circ\text{C}$	11.5	12.0	12.5	V
		$5.0\text{mA} < I_o < 1.0\text{A}$, $P_o < 15\text{W}$ $V_i = 14.5\text{V}$ to 27V	11.4	12	12.6	V
Line regulation	ΔV_o	$T_j = 25^\circ\text{C}$, $V_i = 14.5\text{V}$ to 30V	-	10	240	mV
		$T_j = 25^\circ\text{C}$, $V_i = 16\text{V}$ to 22V	-	3	120	mV
Load regulation	ΔV_o	$T_j = 25^\circ\text{C}$, $I_o = 5.0\text{mA}$ to 1.5A	-	11	240	mV
		$T_j = 25^\circ\text{C}$, $I_o = 250\text{mA}$ to 750mA	-	5.0	120	mV
Quiescent current	I_Q	$T_j = 25^\circ\text{C}$	-	5.1	8	mA
Quiescent current change	ΔI_Q	$I_o = 5\text{mA}$ to 1.0A	-	-	0.5	mA
		$V_i = 15\text{V}$ to 30V	-	-	0.8	mA
Output voltage drift	$\Delta V_o / \Delta T$	$I_o = 5\text{mA}$	-	1	-	mV/ $^\circ\text{C}$
Output noise voltage	V_N	$f = 10\text{Hz}$ to 100kHz , $T_a = 25^\circ\text{C}$	-	76	-	$\mu\text{V}/V_o$
Ripple rejection	RR	$f = 120\text{Hz}$, $V_i = 15\text{V}$ to 25V	55	71	-	dB
Dropout voltage	V_o	$I_o = 1.0\text{A}$, $T_j = 25^\circ\text{C}$	-	2	-	V
Output resistance	R_o	$f = 1\text{kHz}$	-	18	-	$\text{m}\Omega$
Short circuit current	I_{sc}	$V_i = 35\text{V}$, $T_a = 25^\circ\text{C}$	-	250	-	mA
peak current	I_{pk}	$T_j = 25^\circ\text{C}$	-	2.2	-	A

UTC7815 ELECTRICAL CHARACTERISTICS

(Refer to test circuits, $0 < T_j < 125^\circ\text{C}$, $I_o = 500\text{mA}$, $V_i = 23\text{V}$, $C_i = 0.33\mu\text{F}$, $C_o = 0.1\mu\text{F}$, unless otherwise specified)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Units
Output voltage	V_o	$T_j = 25^\circ\text{C}$	14.4	15.0	15.6	V
		$5.0\text{mA} < I_o < 1.0\text{A}$, $P_o < 15\text{W}$ $V_i = 17.5\text{V}$ to 30V	14.25	15	15.75	V
Line regulation	ΔV_o	$T_j = 25^\circ\text{C}$, $V_i = 17.5\text{V}$ to 30V	-	11	300	mV
		$T_j = 25^\circ\text{C}$, $V_i = 20\text{V}$ to 26V	-	3	150	mV
Load regulation	ΔV_o	$T_j = 25^\circ\text{C}$, $I_o = 5.0\text{mA}$ to 1.5A	-	12	300	mV
		$T_j = 25^\circ\text{C}$, $I_o = 250\text{mA}$ to 750mA	-	4	150	mV
Quiescent current	I_Q	$T_j = 25^\circ\text{C}$	-	5.2	8	mA
Quiescent current change	ΔI_Q	$I_o = 5\text{mA}$ to 1.0A	-	-	0.5	mA
		$V_i = 18\text{V}$ to 30.5V	-	-	0.8	mA
Output voltage drift	$\Delta V_o / \Delta T$	$I_o = 5\text{mA}$	-	1	-	mV/ $^\circ\text{C}$
Output noise voltage	V_N	$f = 10\text{Hz}$ to 100kHz , $T_a = 25^\circ\text{C}$	-	90	-	$\mu\text{V}/V_o$
Ripple rejection	RR	$f = 120\text{Hz}$, $V_i = 18.5\text{V}$ to 28.5V	54	70	-	dB
Dropout voltage	V_o	$I_o = 1.0\text{A}$, $T_j = 25^\circ\text{C}$	-	2	-	V
Output resistance	R_o	$f = 1\text{kHz}$	-	19	-	$\text{m}\Omega$
Short circuit current	I_{sc}	$V_i = 35\text{V}$, $T_a = 25^\circ\text{C}$	-	250	-	mA
peak current	I_{pk}	$T_j = 25^\circ\text{C}$	-	2.2	-	A

UTC7818 ELECTRICAL CHARACTERISTICS

(Refer to test circuits, $0 < T_j < 125^\circ\text{C}$, $I_o = 500\text{mA}$, $V_i = 26\text{V}$, $C_i = 0.33\mu\text{F}$, $C_o = 0.1\mu\text{F}$, unless otherwise specified)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Units
Output voltage	V_o	$T_j = 25^\circ\text{C}$	17.3	18.0	18.7	V
		$5.0\text{mA} < I_o < 1.0\text{A}$, $P_o < 15\text{W}$ $V_i = 21\text{V}$ to 33V	17.1	18	18.9	V
Line regulation	ΔV_o	$T_j = 25^\circ\text{C}$, $V_i = 21\text{V}$ to 33V	-	15	360	mV
		$T_j = 25^\circ\text{C}$, $V_i = 24\text{V}$ to 30V	-	5	180	mV
Load regulation	ΔV_o	$T_j = 25^\circ\text{C}$, $I_o = 5.0\text{mA}$ to 1.5A	-	15	360	mV
		$T_j = 25^\circ\text{C}$, $I_o = 250\text{mA}$ to 750mA	-	5.0	180	mV
Quiescent current	I_Q	$T_j = 25^\circ\text{C}$	-	5.2	8	mA
Quiescent current change	ΔI_Q	$I_o = 5\text{mA}$ to 1.0A	-	-	0.5	mA
		$V_i = 21\text{V}$ to 32V	-	-	0.8	mA
Output voltage drift	$\Delta V_o / \Delta T$	$I_o = 5\text{mA}$	-	1	-	mV/ $^\circ\text{C}$
Output noise voltage	V_N	$f = 10\text{Hz}$ to 100kHz , $T_a = 25^\circ\text{C}$	-	110	-	$\mu\text{V}/V_o$
Ripple rejection	RR	$f = 120\text{Hz}$, $V_i = 22\text{V}$ to 32V	53	69	-	dB
Dropout voltage	V_o	$I_o = 1.0\text{A}$, $T_j = 25^\circ\text{C}$	-	2	-	V
Output resistance	R_o	$f = 1\text{kHz}$	-	22	-	$\text{m}\Omega$
Short circuit current	I_{sc}	$V_i = 35\text{V}$, $T_a = 25^\circ\text{C}$	-	250	-	mA
peak current	I_{pk}	$T_j = 25^\circ\text{C}$	-	2.2	-	A

UTC7824 ELECTRICAL CHARACTERISTICS

(Refer to test circuits, $0 < T_j < 125^\circ\text{C}$, $I_o = 500\text{mA}$, $V_i = 33\text{V}$, $C_i = 0.33\mu\text{F}$, $C_o = 0.1\mu\text{F}$, unless otherwise specified)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Units
Output voltage	V_o	$T_j = 25^\circ\text{C}$	23	24	25	V
		$5.0\text{mA} < I_o < 1.0\text{A}$, $P_o < 15\text{W}$ $V_i = 27\text{V}$ to 38V	22.8	24	25.2	V
Line regulation	ΔV_o	$T_j = 25^\circ\text{C}$, $V_i = 27\text{V}$ to 38V	-	17	480	mV
		$T_j = 25^\circ\text{C}$, $V_i = 30\text{V}$ to 36V	-	6	240	mV
Load regulation	ΔV_o	$T_j = 25^\circ\text{C}$, $I_o = 5.0\text{mA}$ to 1.5A	-	15	480	mV
		$T_j = 25^\circ\text{C}$, $I_o = 250\text{mA}$ to 750mA	-	5.0	240	mV
Quiescent current	I_Q	$T_j = 25^\circ\text{C}$	-	5.2	8	mA
Quiescent current change	ΔI_Q	$I_o = 5\text{mA}$ to 1.0A	-	-	0.5	mA
		$V_i = 27\text{V}$ to 38V	-	-	0.8	mA
Output voltage drift	$\Delta V_o / \Delta T$	$I_o = 5\text{mA}$	-	1.5	-	mV/ $^\circ\text{C}$
Output noise voltage	V_N	$f = 10\text{Hz}$ to 100kHz , $T_a = 25^\circ\text{C}$	-	160	-	$\mu\text{V}/V_o$
Ripple rejection	RR	$f = 120\text{Hz}$, $V_i = 28\text{V}$ to 38V	50	67	-	dB
Dropout voltage	V_o	$I_o = 1.0\text{A}$, $T_j = 25^\circ\text{C}$	-	2	-	V
Output resistance	R_o	$f = 1\text{kHz}$	-	28	-	$\text{m}\Omega$
Short circuit current	I_{sc}	$V_i = 35\text{V}$, $T_a = 25^\circ\text{C}$	-	250	-	mA
peak current	I_{pk}	$T_j = 25^\circ\text{C}$	-	2.2	-	A

TEST CIRCUITS

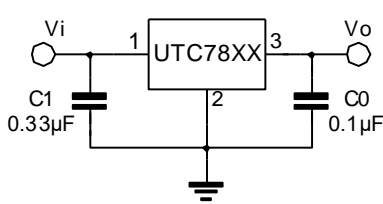


FIG.1 DC PARAMETERS

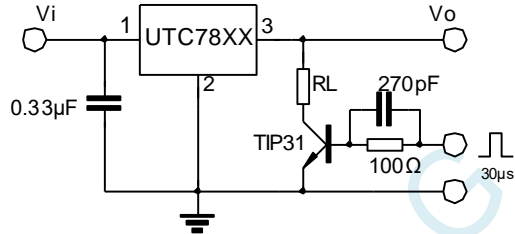


FIG.2 LOAD REGULATION

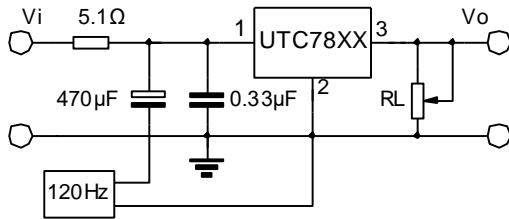


FIG.3 RIPPLE REJECTION

APPLICATION CIRCUITS

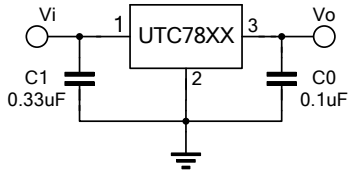


Fig.4 Fixed output regulator

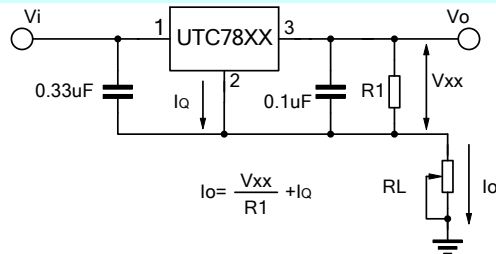


Fig.5 Constant current regulator

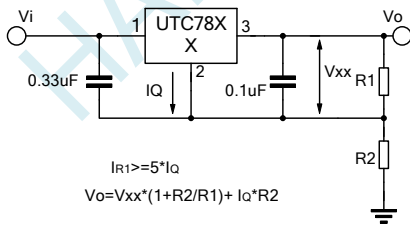


Fig.6 Circuit for increasing Regulator output voltage

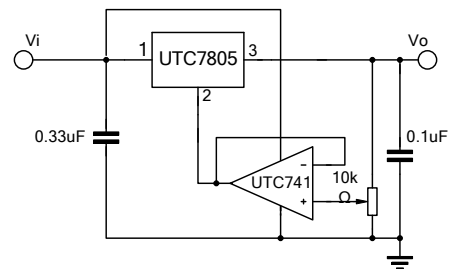


Fig.7 Adjustable output

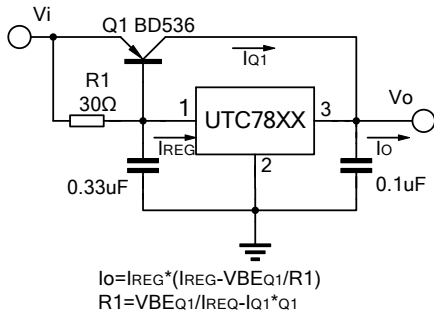


Fig.8 High current with voltage regulator

$$I_o = I_{REG} * (I_{REG} - V_{BEQ1} / R1)$$

$$R1 = V_{BEQ1} / (I_{REG} - I_{q1} * Q1)$$

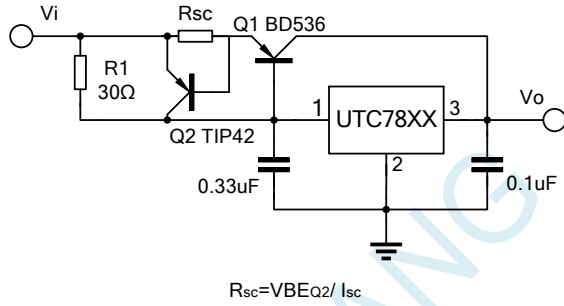


Fig.9 High output current short circuit protection

$$R_{sc} = V_{BEQ2} / I_{sc}$$

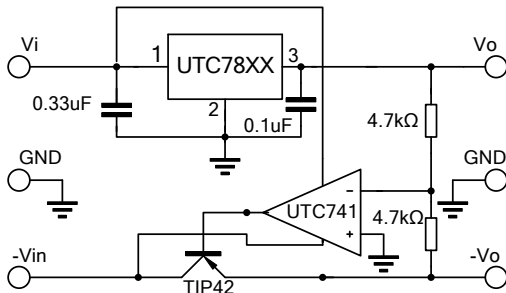


Fig.10 Tracking voltage regulator

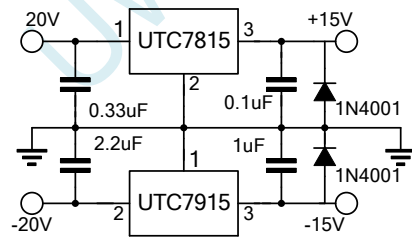


Fig.11 Split power supply(±15V,1A)

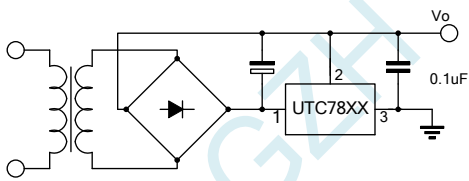


Fig.12 Negative output voltage circuit

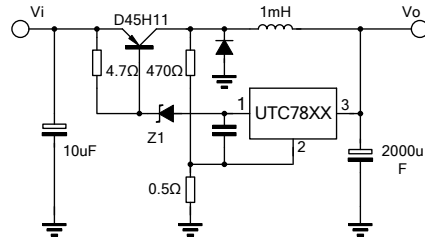
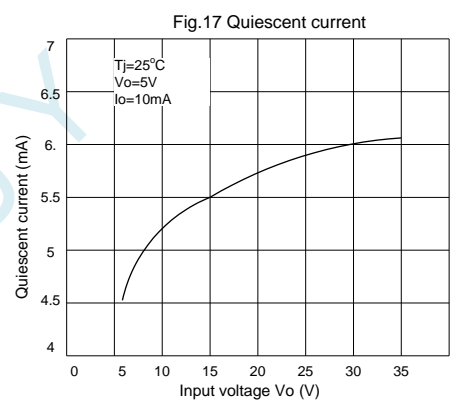
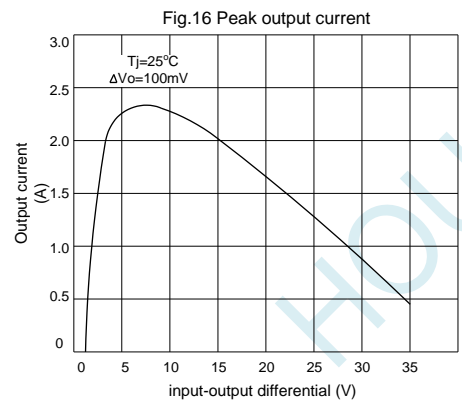
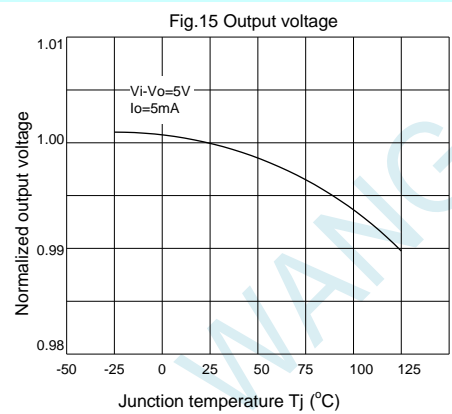
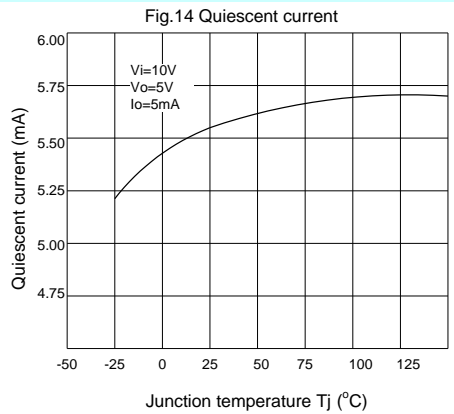
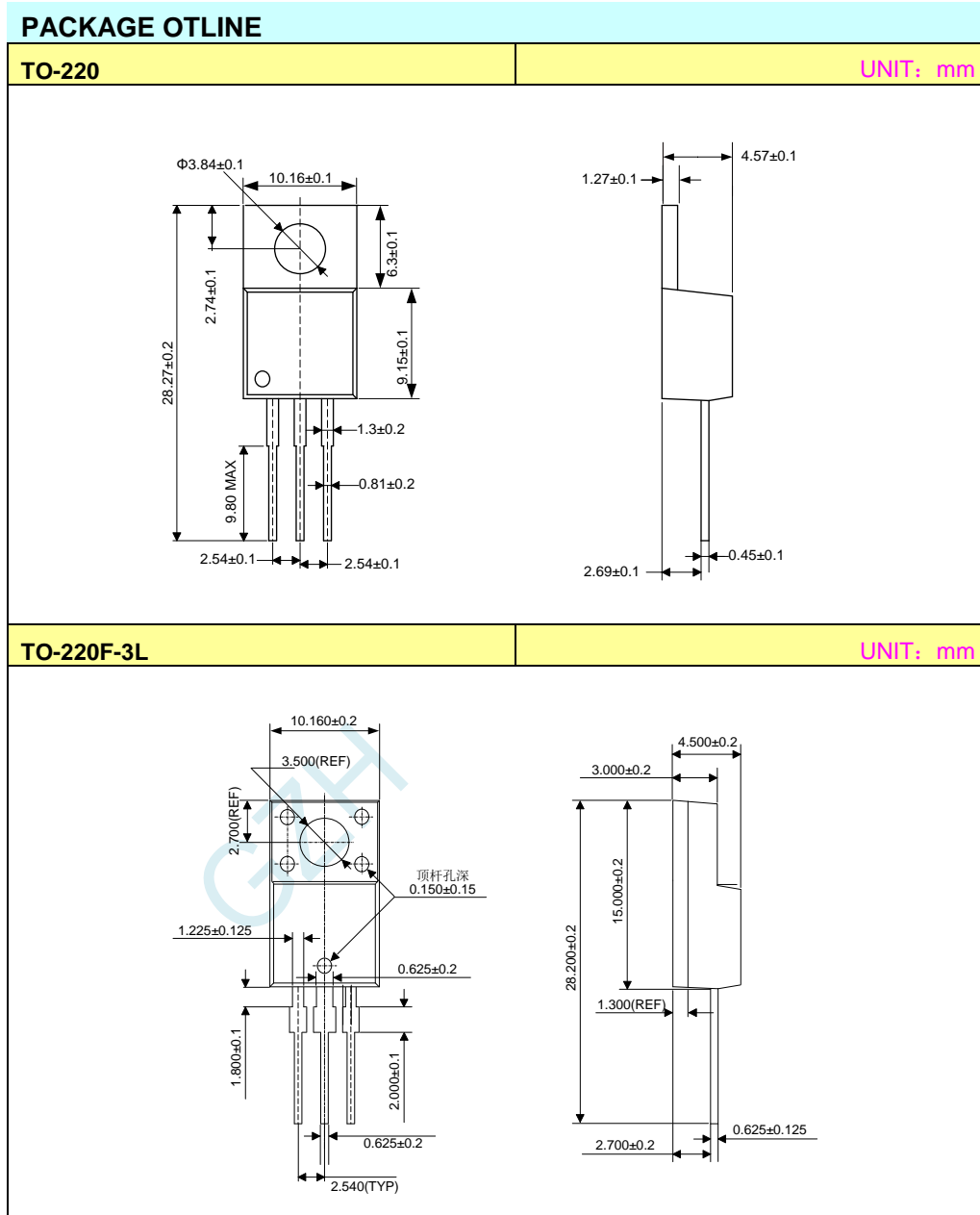
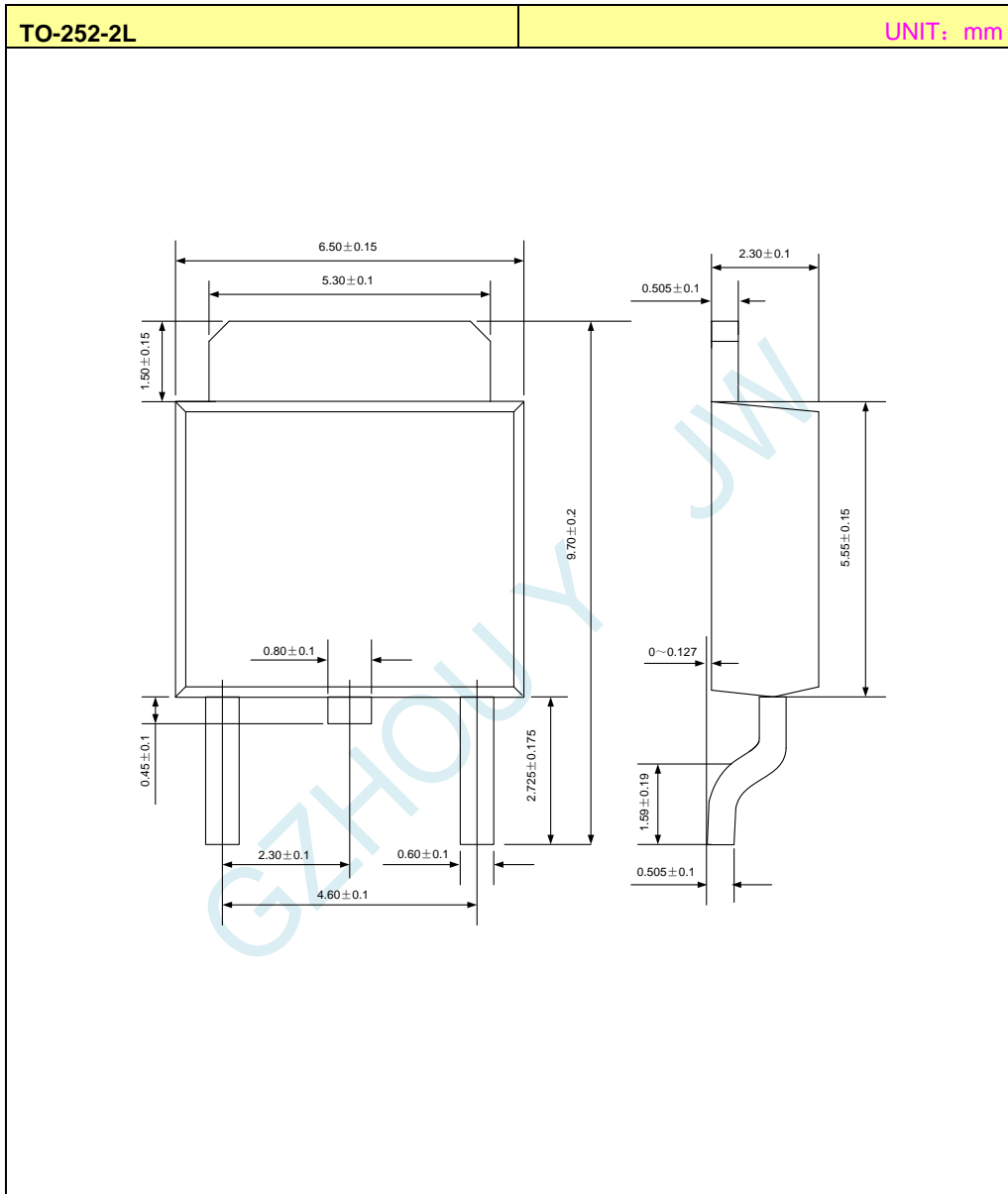


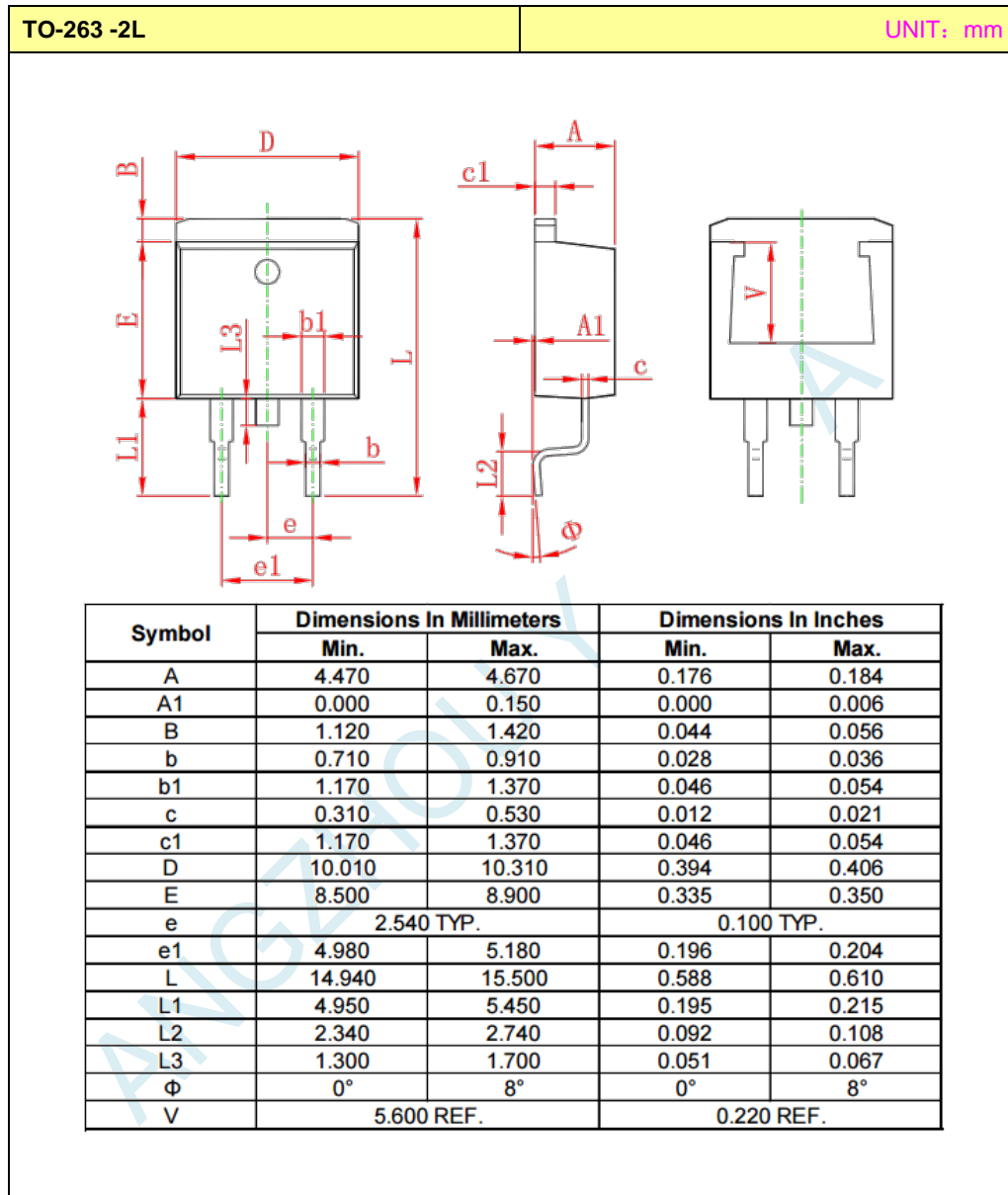
Fig.13 switching regulator

TYPICAL PERFORMANCE CHARACTERISTICS









ELECTROSTATIC DISCHARGE CAUTION



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage handling to prevent electrostatic damage to the device.