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April 2015

KA78XXE / KA78XXAE

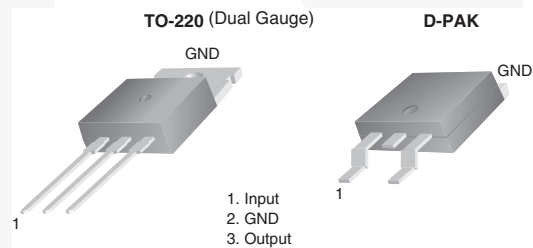
3-Terminal 1 A Positive Voltage Regulator

Features

- Output Current up to 1 A
- Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24 V
- Thermal Overload Protection
- Short-Circuit Protection
- Output Transistor Safe Operating Area Protection

Description

The KA78XXE / KA78XXAE series of three-terminal positive regulators is available in the TO-220 / D-PAK package with several fixed-output voltages, making them useful in a wide range of applications. Each type employs internal current limiting, thermal shut-down, and safe operating area. If adequate heat sinking is provided, they can deliver over 1 A output current. Although designed primarily as fixed-voltage regulators, these devices can be used with external components for adjustable voltages and currents.



Block Diagram

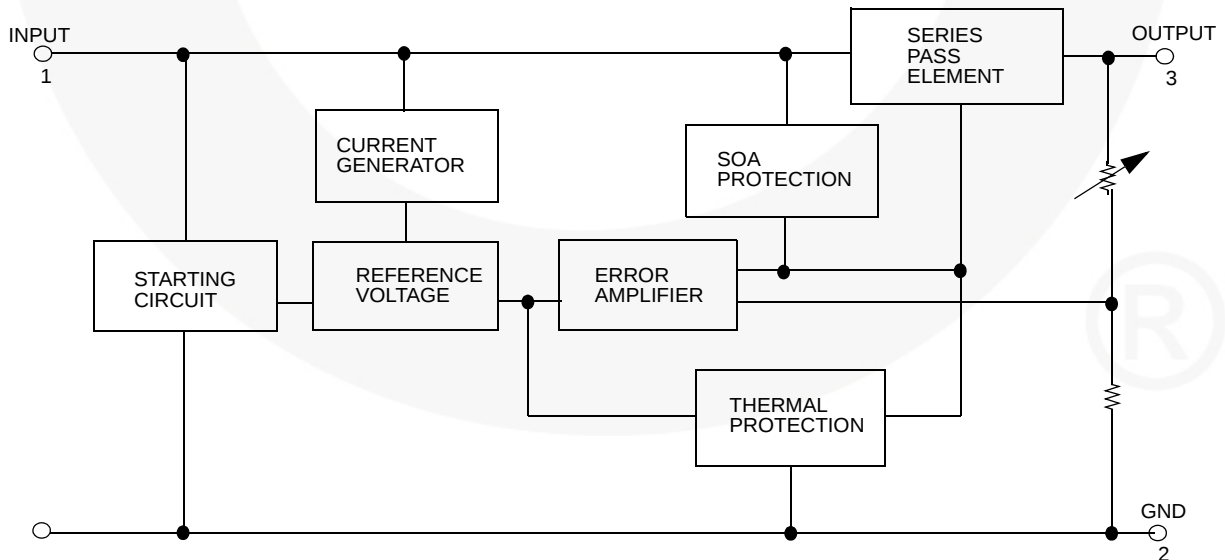


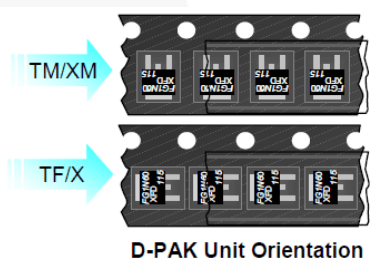
Figure 1. Block Diagram

Ordering Information

Product Number	Output Voltage Tolerance ⁽¹⁾	Package	Operating Temperature	Parking Method
KA7805ETU	±4%	TO-220 (Dual Gauge)	-40°C to +125°C	Rail
KA7806ETU				
KA7808ETU				
KA7809ETU				
KA7810ETU				
KA7812ETU				
KA7815ETU				
KA7818ETU				
KA7824ETU				
KA7805ERTF				
KA7805ERTM	±2%	D-PAK ⁽²⁾	0°C to +125°C	Tape and Reel
KA7808ERTM				
KA7809ERTM				
KA7812ERTM				
KA7805AETU				
KA7809AETU				
KA7810AETU				
KA7812AETU				
KA7815AETU				
KA7824AETU				

Notes:

1. Above output voltage tolerance is available at 25°C.
2. Refer to below figure for TM / TF Suffix for DPAK.



D-PAK Unit Orientation

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. Values are at $T_A = 25^\circ\text{C}$ unless otherwise noted.

Symbol	Parameter		Value	Unit
V_I	Input Voltage	$V_O = 5\text{ V to }18\text{ V}$	35	V
		$V_O = 24\text{ V}$	40	V
$R_{\theta JC}$	Thermal Resistance Junction-Case (TO-220)		5	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance Junction-Air (TO-220)		65	$^\circ\text{C/W}$
T_{OPR}	Operating Temperature Range	KA78XXE / KA78XXER	-40 to +125	$^\circ\text{C}$
		KA78XXAE	0 to +125	
T_{STG}	Storage Temperature Range		-65 to +150	$^\circ\text{C}$

Electrical Characteristics (KA7805E / KA7805ER)

Refer to test circuit, $-40^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$, $I_O = 500 \text{ mA}$, $V_I = 10 \text{ V}$, $C_I = 0.33 \mu\text{F}$, $C_O = 0.1 \mu\text{F}$, unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	$T_J = +25^{\circ}\text{C}$	4.80	5.00	5.20	V
		$5.0 \text{ mA} \leq I_O \leq 1.0 \text{ A}$, $P_O \leq 15 \text{ W}$, $V_I = 7 \text{ V to } 20 \text{ V}$	4.75	5.00	5.25	
Regline	Line Regulation ⁽³⁾	$T_J = +25^{\circ}\text{C}$	$V_I = 7 \text{ V to } 25 \text{ V}$	4.0	100.0	mV
			$V_I = 8 \text{ V to } 12 \text{ V}$	1.6	50.0	
Regload	Load Regulation ⁽³⁾	$T_J = +25^{\circ}\text{C}$	$I_O = 5.0 \text{ mA to } 1.5 \text{ A}$	9	100	mV
			$I_O = 250 \text{ mA to } 750 \text{ mA}$	4	50	
I_Q	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5	8	mA
ΔI_Q	Quiescent Current Change	$I_O = 5 \text{ mA to } 1.0 \text{ A}$		0.03	0.50	mA
		$V_I = 7 \text{ V to } 25 \text{ V}$		0.30	1.30	
$\Delta V_O / \Delta T$	Output Voltage Drift ⁽⁴⁾	$I_O = 5 \text{ mA}$		-0.8		mV/ $^{\circ}\text{C}$
V_N	Output Noise Voltage	$f = 10 \text{ Hz to } 100 \text{ kHz}$, $T_A = +25^{\circ}\text{C}$		42		μV
RR	Ripple Rejection ⁽⁴⁾	$f = 120 \text{ Hz}$, $V_I = 8 \text{ V to } 18 \text{ V}$		62	73	dB
V_{Drop}	Dropout Voltage	$I_O = 1 \text{ A}$, $T_J = +25^{\circ}\text{C}$		2		V
R_O	Output Resistance ⁽⁴⁾	$f = 1 \text{ kHz}$		15		m Ω
I_{SC}	Short-Circuit Current	$V_I = 35 \text{ V}$, $T_A = +25^{\circ}\text{C}$		230		mA
I_{PK}	Peak Current ⁽⁴⁾	$T_J = +25^{\circ}\text{C}$		2.2		A

Notes:

3. Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.
4. These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (KA7806E)

Refer to test circuit, $-40^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$, $I_O = 500\text{ mA}$, $V_I = 11\text{ V}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$, unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	$T_J = +25^{\circ}\text{C}$	5.75	6.00	6.25	V
		$5.0\text{ mA} \leq I_O \leq 1.0\text{ A}$, $P_O \leq 15\text{ W}$, $V_I = 8.0\text{ V to } 21\text{ V}$	5.70	6.00	6.30	
Regline	Line Regulation ⁽⁵⁾	$T_J = +25^{\circ}\text{C}$	$V_I = 8\text{ V to } 25\text{ V}$	5.0	120.0	mV
			$V_I = 9\text{ V to } 13\text{ V}$	1.5	60.0	
Regload	Load Regulation ⁽⁵⁾	$T_J = +25^{\circ}\text{C}$	$I_O = 5\text{ mA to } 1.5\text{ A}$	9	120	mV
			$I_O = 250\text{ mA to } 750\text{ mA}$	3	60	
I_Q	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5	8	mA
ΔI_Q	Quiescent Current Change	$I_O = 5\text{ mA to } 1\text{ A}$			0.5	mA
		$V_I = 8\text{ V to } 25\text{ V}$			1.3	
$\Delta V_O / \Delta T$	Output Voltage Drift ⁽⁶⁾	$I_O = 5\text{ mA}$		-0.8		mV/ $^{\circ}\text{C}$
V_N	Output Noise Voltage	$f = 10\text{ Hz to } 100\text{ kHz}$, $T_A = +25^{\circ}\text{C}$		45		μV
RR	Ripple Rejection ⁽⁶⁾	$f = 120\text{ Hz}$, $V_I = 9\text{ V to } 19\text{ V}$	59	75		dB
V_{Drop}	Dropout Voltage	$I_O = 1\text{ A}$, $T_J = +25^{\circ}\text{C}$		2		V
R_O	Output Resistance ⁽⁶⁾	$f = 1\text{ kHz}$		19		m Ω
I_{SC}	Short-Circuit Current	$V_I = 35\text{ V}$, $T_A = +25^{\circ}\text{C}$		250		mA
I_{PK}	Peak Current ⁽⁶⁾	$T_J = +25^{\circ}\text{C}$		2.2		A

Notes:

5. Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.
6. These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (KA7808E / KA7808ER)

Refer to test circuit, $-40^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$, $I_O = 500\text{ mA}$, $V_I = 14\text{ V}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$, unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	$T_J = +25^{\circ}\text{C}$	7.7	8.0	8.3	V
		$5.0\text{ mA} \leq I_O \leq 1.0\text{ A}$, $P_O \leq 15\text{ W}$, $V_I = 10.5\text{ V to } 23\text{ V}$	7.6	8.0	8.4	
Regline	Line Regulation ⁽⁷⁾	$T_J = +25^{\circ}\text{C}$	$V_I = 10.5\text{ V to } 25\text{ V}$	5	160	mV
			$V_I = 11.5\text{ V to } 17\text{ V}$	2	80	
Regload	Load Regulation ⁽⁷⁾	$T_J = +25^{\circ}\text{C}$	$I_O = 5.0\text{ mA to } 1.5\text{ A}$	10	160	mV
			$I_O = 250\text{ mA to } 750\text{ mA}$	5	80	
I_Q	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5	8	mA
ΔI_Q	Quiescent Current Change	$I_O = 5\text{ mA to } 1.0\text{ A}$		0.05	0.50	mA
		$V_I = 10.5\text{ V to } 25\text{ V}$		0.50	1.00	
$\Delta V_O / \Delta T$	Output Voltage Drift ⁽⁸⁾	$I_O = 5\text{ mA}$		-0.8		mV/ $^{\circ}\text{C}$
V_N	Output Noise Voltage	$f = 10\text{ Hz to } 100\text{ kHz}$, $T_A = +25^{\circ}\text{C}$		52		μV
RR	Ripple Rejection ⁽⁸⁾	$f = 120\text{ Hz}$, $V_I = 11.5\text{ V to } 21.5\text{ V}$	56	73		dB
V_{Drop}	Dropout Voltage	$I_O = 1\text{ A}$, $T_J = +25^{\circ}\text{C}$		2		V
R_O	Output Resistance ⁽⁸⁾	$f = 1\text{ kHz}$		17		m Ω
I_{SC}	Short-Circuit Current	$V_I = 35\text{ V}$, $T_A = +25^{\circ}\text{C}$		230		mA
I_{PK}	Peak Current ⁽⁸⁾	$T_J = +25^{\circ}\text{C}$		2.2		A

Notes:

7. Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.
8. These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (KA7809E / KA7809ER)

Refer to test circuit, $-40^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$, $I_O = 500\text{ mA}$, $V_I = 15\text{ V}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$, unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	$T_J = +25^{\circ}\text{C}$	8.65	9.00	9.35	V
		$5.0\text{ mA} \leq I_O \leq 1.0\text{ A}$, $P_O \leq 15\text{ W}$, $V_I = 11.5\text{ V to } 24\text{ V}$	8.60	9.00	9.40	
Regline	Line Regulation ⁽⁹⁾	$T_J = +25^{\circ}\text{C}$	$V_I = 11.5\text{ V to } 25\text{ V}$	6	180	mV
			$V_I = 12\text{ V to } 17\text{ V}$	2	90	
Regload	Load Regulation ⁽⁹⁾	$T_J = +25^{\circ}\text{C}$	$I_O = 5\text{ mA to } 1.5\text{ A}$	12	180	mV
			$I_O = 250\text{ mA to } 750\text{ mA}$	4	90	
I_Q	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5	8	mA
ΔI_Q	Quiescent Current Change	$I_O = 5\text{ mA to } 1.0\text{ A}$			0.5	mA
		$V_I = 11.5\text{ V to } 26\text{ V}$			1.3	
$\Delta V_O / \Delta T$	Output Voltage Drift ⁽¹⁰⁾	$I_O = 5\text{ mA}$		-1		mV/ $^{\circ}\text{C}$
V_N	Output Noise Voltage	$f = 10\text{ Hz to } 100\text{ kHz}$, $T_A = +25^{\circ}\text{C}$		58		μV
RR	Ripple Rejection ⁽¹⁰⁾	$f = 120\text{ Hz}$, $V_I = 13\text{ V to } 23\text{ V}$	56	71		dB
V_{Drop}	Dropout Voltage	$I_O = 1\text{ A}$, $T_J = +25^{\circ}\text{C}$		2		V
R_O	Output Resistance ⁽¹⁰⁾	$f = 1\text{ kHz}$		17		m Ω
I_{SC}	Short-Circuit Current	$V_I = 35\text{ V}$, $T_A = +25^{\circ}\text{C}$		250		mA
I_{PK}	Peak Current ⁽¹⁰⁾	$T_J = +25^{\circ}\text{C}$		2.2		A

Notes:

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

10. These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (KA7810E)

Refer to test circuit, $-40^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$, $I_O = 500\text{ mA}$, $V_I = 16\text{ V}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$, unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	$T_J = +25^{\circ}\text{C}$	9.6	10.0	10.4	V
		$5.0\text{ mA} \leq I_O \leq 1.0\text{ A}$, $P_O \leq 15\text{ W}$, $V_I = 12.5\text{ V to } 25\text{ V}$	9.5	10.0	10.5	
Regline	Line Regulation ⁽¹¹⁾	$T_J = +25^{\circ}\text{C}$	$V_I = 12.5\text{ V to } 25\text{ V}$	10	200	mV
			$V_I = 13\text{ V to } 25\text{ V}$	3	100	
Regload	Load Regulation ⁽¹¹⁾	$T_J = +25^{\circ}\text{C}$	$I_O = 5\text{ mA to } 1.5\text{ A}$	12	200	mV
			$I_O = 250\text{ mA to } 750\text{ mA}$	4	400	
I_Q	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5.1	8.0	mA
ΔI_Q	Quiescent Current Change	$I_O = 5\text{ mA to } 1.0\text{ A}$			0.5	mA
		$V_I = 12.5\text{ V to } 29\text{ V}$			1.0	
$\Delta V_O / \Delta T$	Output Voltage Drift ⁽¹²⁾	$I_O = 5\text{ mA}$		-1		mV/ $^{\circ}\text{C}$
V_N	Output Noise Voltage	$f = 10\text{ Hz to } 100\text{ kHz}$, $T_A = +25^{\circ}\text{C}$		58		μV
RR	Ripple Rejection ⁽¹²⁾	$f = 120\text{ Hz}$, $V_I = 13\text{ V to } 23\text{ V}$	56	71		dB
V_{Drop}	Dropout Voltage	$I_O = 1\text{ A}$, $T_J = +25^{\circ}\text{C}$		2		V
R_O	Output Resistance ⁽¹²⁾	$f = 1\text{ kHz}$		17		m Ω
I_{SC}	Short-Circuit Current	$V_I = 35\text{ V}$, $T_A = +25^{\circ}\text{C}$		250		mA
I_{PK}	Peak Current ⁽¹²⁾	$T_J = +25^{\circ}\text{C}$		2.2		A

Notes:

11. Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.
12. These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (KA7812E / KA7812ER)

Refer to test circuit, $-40^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$, $I_O = 500\text{ mA}$, $V_I = 19\text{ V}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$, unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	$T_J = +25^{\circ}\text{C}$	11.5	12.0	12.5	V
		$5.0\text{ mA} \leq I_O \leq 1.0\text{ A}$, $P_O \leq 15\text{ W}$, $V_I = 14.5\text{ V to } 27\text{ V}$	11.4	12.0	12.6	
Regline	Line Regulation ⁽¹³⁾	$T_J = +25^{\circ}\text{C}$	$V_I = 14.5\text{ V to } 30\text{ V}$	10	240	mV
			$V_I = 16\text{ V to } 22\text{ V}$	3	120	
Regload	Load Regulation ⁽¹³⁾	$T_J = +25^{\circ}\text{C}$	$I_O = 5\text{ mA to } 1.5\text{ A}$	11	240	mV
			$I_O = 250\text{ mA to } 750\text{ mA}$	5	120	
I_Q	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5.1	8.0	mA
ΔI_Q	Quiescent Current Change	$I_O = 5\text{ mA to } 1.0\text{ A}$		0.1	0.5	mA
		$V_I = 14.5\text{ V to } 30\text{ V}$		0.5	1.0	
$\Delta V_O / \Delta T$	Output Voltage Drift ⁽¹⁴⁾	$I_O = 5\text{ mA}$		-1		mV/ $^{\circ}\text{C}$
V_N	Output Noise Voltage	$f = 10\text{ Hz to } 100\text{ kHz}$, $T_A = +25^{\circ}\text{C}$		76		μV
RR	Ripple Rejection ⁽¹⁴⁾	$f = 120\text{ Hz}$, $V_I = 15\text{ V to } 25\text{ V}$	55	71		dB
V_{Drop}	Dropout Voltage	$I_O = 1\text{ A}$, $T_J = +25^{\circ}\text{C}$		2		V
R_O	Output Resistance ⁽¹⁴⁾	$f = 1\text{ kHz}$		18		m Ω
I_{SC}	Short-Circuit Current	$V_I = 35\text{ V}$, $T_A = +25^{\circ}\text{C}$		230		mA
I_{PK}	Peak Current ⁽¹⁴⁾	$T_J = +25^{\circ}\text{C}$		2.2		A

Notes:

13. Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.
14. These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (KA7815E)

Refer to test circuit, $-40^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$, $I_O = 500\text{ mA}$, $V_I = 23\text{ V}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$, unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	$T_J = +25^{\circ}\text{C}$	14.40	15.00	15.60	V
		$5.0\text{ mA} \leq I_O \leq 1.0\text{ A}$, $P_O \leq 15\text{ W}$, $V_I = 17.5\text{ V to } 30\text{ V}$	14.25	15.00	15.75	
Regline	Line Regulation ⁽¹⁵⁾	$T_J = +25^{\circ}\text{C}$	$V_I = 17.5\text{ V to } 30\text{ V}$	11	300	mV
			$V_I = 20\text{ V to } 26\text{ V}$	3	150	
Regload	Load Regulation ⁽¹⁵⁾	$T_J = +25^{\circ}\text{C}$	$I_O = 5\text{ mA to } 1.5\text{ A}$	12	300	mV
			$I_O = 250\text{ mA to } 750\text{ mA}$	4	150	
I_Q	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5.2	8.0	mA
ΔI_Q	Quiescent Current Change	$I_O = 5\text{ mA to } 1.0\text{ A}$			0.5	mA
		$V_I = 17.5\text{ V to } 30\text{ V}$			1.0	
$\Delta V_O / \Delta T$	Output Voltage Drift ⁽¹⁶⁾	$I_O = 5\text{ mA}$		-1		mV/ $^{\circ}\text{C}$
V_N	Output Noise Voltage	$f = 10\text{ Hz to } 100\text{ kHz}$, $T_A = +25^{\circ}\text{C}$		90		μV
RR	Ripple Rejection ⁽¹⁶⁾	$f = 120\text{ Hz}$, $V_I = 18.5\text{ V to } 28.5\text{ V}$	54	70		dB
V_{Drop}	Dropout Voltage	$I_O = 1\text{ A}$, $T_J = +25^{\circ}\text{C}$		2		V
R_O	Output Resistance ⁽¹⁶⁾	$f = 1\text{ kHz}$		19		m Ω
I_{SC}	Short-Circuit Current	$V_I = 35\text{ V}$, $T_A = +25^{\circ}\text{C}$		250		mA
I_{PK}	Peak Current ⁽¹⁶⁾	$T_J = +25^{\circ}\text{C}$		2.2		A

Notes:

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

16. These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (KA7818E)

Refer to test circuit, $-40^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$, $I_O = 500\text{ mA}$, $V_I = 27\text{ V}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$, unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	$T_J = +25^{\circ}\text{C}$	17.3	18.0	18.7	V
		$5.0\text{ mA} \leq I_O \leq 1.0\text{ A}$, $P_O \leq 15\text{ W}$, $V_I = 21\text{ V to } 33\text{ V}$	17.1	18.0	18.9	
Regline	Line Regulation ⁽¹⁷⁾	$T_J = +25^{\circ}\text{C}$	$V_I = 21\text{ V to } 33\text{ V}$	15	360	mV
			$V_I = 24\text{ V to } 30\text{ V}$	5	180	
Regload	Load Regulation ⁽¹⁷⁾	$T_J = +25^{\circ}\text{C}$	$I_O = 5\text{ mA to } 1.5\text{ A}$	15	360	mV
			$I_O = 250\text{ mA to } 750\text{ mA}$	5	180	
I_Q	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5.2	8.0	mA
ΔI_Q	Quiescent Current Change	$I_O = 5\text{ mA to } 1.0\text{ A}$			0.5	mA
		$V_I = 21\text{ V to } 33\text{ V}$			1.0	
$\Delta V_O / \Delta T$	Output Voltage Drift ⁽¹⁸⁾	$I_O = 5\text{ mA}$		-1		mV/ $^{\circ}\text{C}$
V_N	Output Noise Voltage	$f = 10\text{ Hz to } 100\text{ kHz}$, $T_A = +25^{\circ}\text{C}$		110		μV
RR	Ripple Rejection ⁽¹⁸⁾	$f = 120\text{ Hz}$, $V_I = 22\text{ V to } 32\text{ V}$	53	69		dB
V_{Drop}	Dropout Voltage	$I_O = 1\text{ A}$, $T_J = +25^{\circ}\text{C}$		2		V
R_O	Output Resistance ⁽¹⁸⁾	$f = 1\text{ kHz}$		22		m Ω
I_{SC}	Short-Circuit Current	$V_I = 35\text{ V}$, $T_A = +25^{\circ}\text{C}$		250		mA
I_{PK}	Peak Current ⁽¹⁸⁾	$T_J = +25^{\circ}\text{C}$		2.2		A

Notes:

17. Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.
18. These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (KA7824E)

Refer to test circuit, $-40^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$, $I_O = 500\text{ mA}$, $V_I = 33\text{ V}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$, unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	$T_J = +25^{\circ}\text{C}$	23.00	24.00	25.00	V
		$5.0\text{ mA} \leq I_O \leq 1.0\text{ A}$, $P_O \leq 15\text{ W}$, $V_I = 27\text{ V to } 38\text{ V}$	22.80	24.00	25.25	
Regline	Line Regulation ⁽¹⁹⁾	$T_J = +25^{\circ}\text{C}$		17	480	mV
		$V_I = 30\text{ V to } 36\text{ V}$		6	240	
Regload	Load Regulation ⁽¹⁹⁾	$T_J = +25^{\circ}\text{C}$		15	480	mV
		$I_O = 250\text{ mA to } 750\text{ mA}$		5	240	
I_Q	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5.2	8.0	mA
ΔI_Q	Quiescent Current Change	$I_O = 5\text{ mA to } 1.0\text{ A}$		0.1	0.5	mA
		$V_I = 27\text{ V to } 38\text{ V}$		0.5	1.0	
$\Delta V_O / \Delta T$	Output Voltage Drift ⁽²⁰⁾	$I_O = 5\text{ mA}$		-1.5		mV/ $^{\circ}\text{C}$
V_N	Output Noise Voltage	$f = 10\text{ Hz to } 100\text{ kHz}$, $T_A = +25^{\circ}\text{C}$		120		μV
RR	Ripple Rejection ⁽²⁰⁾	$f = 120\text{ Hz}$, $V_I = 28\text{ V to } 38\text{ V}$	50	67		dB
V_{Drop}	Dropout Voltage	$I_O = 1\text{ A}$, $T_J = +25^{\circ}\text{C}$		2		V
R_O	Output Resistance ⁽²⁰⁾	$f = 1\text{ kHz}$		28		m Ω
I_{SC}	Short-Circuit Current	$V_I = 35\text{ V}$, $T_A = +25^{\circ}\text{C}$		230		mA
I_{PK}	Peak Current ⁽²⁰⁾	$T_J = +25^{\circ}\text{C}$		2.2		A

Notes:

19. Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty is used.
20. These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (KA7805AE)

Refer to the test circuit, $0^{\circ}\text{C} < T_J < +125^{\circ}\text{C}$, $I_O = 1\text{ A}$, $V_I = 10\text{ V}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$, unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	$T_J = +25^{\circ}\text{C}$	4.9	5.0	5.1	V
		$I_O = 5\text{ mA to }1\text{ A}$, $P_O \leq 15\text{ W}$, $V_I = 7.5\text{ V to }20\text{ V}$	4.8	5.0	5.2	
Regline	Line Regulation ⁽²¹⁾	$V_I = 7.5\text{ V to }25\text{ V}$, $I_O = 500\text{ mA}$		5.0	50.0	mV
		$V_I = 8\text{ V to }12\text{ V}$		3.0	50.0	
		$T_J = +25^{\circ}\text{C}$	$V_I = 7.3\text{ V to }20\text{ V}$	5.0	50.0	
			$V_I = 8\text{ V to }12\text{ V}$	1.5	25.0	
Regload	Load Regulation ⁽²¹⁾	$T_J = +25^{\circ}\text{C}$, $I_O = 5\text{ mA to }1.5\text{ A}$		9	100	mV
		$I_O = 5\text{ mA to }1\text{ A}$		9	100	
		$I_O = 250\text{ mA to }750\text{ mA}$		4	50	
I_Q	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5	6	mA
ΔI_Q	Quiescent Current Change	$I_O = 5\text{ mA to }1\text{ A}$			0.5	mA
		$V_I = 8\text{ V to }25\text{ V}$, $I_O = 500\text{ mA}$			0.8	
		$V_I = 7.5\text{ V to }20\text{ V}$, $T_J = +25^{\circ}\text{C}$			0.8	
$\Delta V/\Delta T$	Output Voltage Drift ⁽²²⁾	$I_O = 5\text{ mA}$		-0.8		mV/ $^{\circ}\text{C}$
V_N	Output Noise Voltage	$f = 10\text{ Hz to }100\text{ kHz}$, $T_A = +25^{\circ}\text{C}$		42		μV
RR	Ripple Rejection ⁽²²⁾	$f = 120\text{ Hz}$, $I_O = 500\text{ mA}$, $V_I = 8\text{ V to }18\text{ V}$		68		dB
V_{Drop}	Dropout Voltage	$I_O = 1\text{ A}$, $T_J = +25^{\circ}\text{C}$		2		V
R_O	Output Resistance ⁽²²⁾	$f = 1\text{ kHz}$		17		$\text{m}\Omega$
I_{SC}	Short-Circuit Current	$V_I = 35\text{ V}$, $T_A = +25^{\circ}\text{C}$		250		mA
I_{PK}	Peak Current ⁽²²⁾	$T_J = +25^{\circ}\text{C}$		2.2		A

Notes:

21. 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.

22. These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (KA7809AE)

Refer to the test circuit, $0^{\circ}\text{C} < T_J < +125^{\circ}\text{C}$, $I_O = 1\text{ A}$, $V_I = 15\text{ V}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$, unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	$T_J = +25^{\circ}\text{C}$	8.82	9.00	9.18	V
		$I_O = 5\text{ mA to }1\text{ A}$, $P_O \leq 15\text{ W}$, $V_I = 11.2\text{ V to }24\text{ V}$	8.65	9.00	9.35	
Regline	Line Regulation ⁽²³⁾	$V_I = 11.7\text{ V to }25\text{ V}$, $I_O = 500\text{ mA}$		6	90	mV
		$V_I = 12.5\text{ V to }19\text{ V}$		4	45	
		$T_J = +25^{\circ}\text{C}$	$V_I = 11.5\text{ V to }24\text{ V}$	6	90	
			$V_I = 12.5\text{ V to }19\text{ V}$	2	45	
Regload	Load Regulation ⁽²³⁾	$T_J = +25^{\circ}\text{C}$, $I_O = 5\text{ mA to }1.0\text{ A}$		12	100	mV
		$I_O = 5\text{ mA to }1.0\text{ A}$		12	100	
		$I_O = 250\text{ mA to }750\text{ mA}$		5	50	
I_Q	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5	6	mA
ΔI_Q	Quiescent Current Change	$V_I = 11.7\text{ V to }25\text{ V}$, $T_J = +25^{\circ}\text{C}$			0.8	mA
		$V_I = 12\text{ V to }25\text{ V}$, $I_O = 500\text{ mA}$			0.8	
		$I_O = 5\text{ mA to }1.0\text{ A}$			0.5	
$\Delta V/\Delta T$	Output Voltage Drift ⁽²⁴⁾	$I_O = 5\text{ mA}$		-1		mV/ $^{\circ}\text{C}$
V_N	Output Noise Voltage	$f = 10\text{ Hz to }100\text{ kHz}$, $T_A = +25^{\circ}\text{C}$		58		μV
RR	Ripple Rejection ⁽²⁴⁾	$f = 120\text{ Hz}$, $I_O = 500\text{ mA}$, $V_I = 12\text{ V to }22\text{ V}$		62		dB
V_{Drop}	Dropout Voltage	$I_O = 1\text{ A}$, $T_J = +25^{\circ}\text{C}$		2		V
R_O	Output Resistance ⁽²⁴⁾	$f = 1\text{ kHz}$		17		m Ω
I_{SC}	Short-Circuit Current	$V_I = 35\text{ V}$, $T_A = +25^{\circ}\text{C}$		250		mA
I_{PK}	Peak Current ⁽²⁴⁾	$T_J = +25^{\circ}\text{C}$		2.2		A

Notes:

23. 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.

24. These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (KA7810AE)

Refer to the test circuit, $0^{\circ}\text{C} < T_J < +125^{\circ}\text{C}$, $I_O = 1\text{ A}$, $V_I = 16\text{ V}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$, unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	$T_J = +25^{\circ}\text{C}$	9.8	10.0	10.2	V
		$I_O = 5\text{ mA to }1\text{ A}$, $P_O \leq 15\text{ W}$, $V_I = 12.8\text{ V to }25\text{ V}$	9.6	10.0	10.4	
Regline	Line Regulation ⁽²⁵⁾	$V_I = 12.8\text{ V to }26\text{ V}$, $I_O = 500\text{ mA}$		8	100	mV
		$V_I = 13\text{ V to }20\text{ V}$		4	50	
		$T_J = +25^{\circ}\text{C}$		8	100	
				3	50	
Regload	Load Regulation ⁽²⁵⁾	$T_J = +25^{\circ}\text{C}$, $I_O = 5\text{ mA to }1.5\text{ A}$		12	100	mV
		$I_O = 5\text{ mA to }1\text{ mA}$		12	100	
		$I_O = 250\text{ mA to }750\text{ mA}$		5	50	
I_Q	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5	6	mA
ΔI_Q	Quiescent Current Change	$I_O = 5\text{ mA to }1.0\text{ A}$			0.5	mA
		$V_I = 12.8\text{ V to }25\text{ V}$, $I_O = 500\text{ mA}$			0.8	
		$V_I = 13\text{ V to }26\text{ V}$, $T_J = +25^{\circ}\text{C}$			0.5	
$\Delta V/\Delta T$	Output Voltage Drift ⁽²⁶⁾	$I_O = 5\text{ mA}$		-1		mV/ $^{\circ}\text{C}$
V_N	Output Noise Voltage	$f = 10\text{ Hz to }100\text{ kHz}$, $T_A = +25^{\circ}\text{C}$		58		μV
RR	Ripple Rejection ⁽²⁶⁾	$f = 120\text{ Hz}$, $I_O = 500\text{ mA}$, $V_I = 14\text{ V to }24\text{ V}$		62		dB
V_{Drop}	Dropout Voltage	$I_O = 1\text{ A}$, $T_J = +25^{\circ}\text{C}$		2		V
R_O	Output Resistance ⁽²⁶⁾	$f = 1\text{ kHz}$		17		m Ω
I_{SC}	Short-Circuit Current	$V_I = 35\text{ V}$, $T_A = +25^{\circ}\text{C}$		250		mA
I_{PK}	Peak Current ⁽²⁶⁾	$T_J = +25^{\circ}\text{C}$		2.2		A

Notes:

25. 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.

26. These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (KA7812AE)

Refer to the test circuit, $0^{\circ}\text{C} < T_J < +125^{\circ}\text{C}$, $I_O = 1\text{ A}$, $V_I = 19\text{ V}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$, unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	$T_J = +25^{\circ}\text{C}$	11.75	12.00	12.25	V
		$I_O = 5\text{ mA to }1\text{ A}$, $P_O \leq 15\text{ W}$, $V_I = 14.8\text{ V to }27\text{ V}$	11.50	12.00	12.50	
Regline	Line Regulation ⁽²⁷⁾	$V_I = 14.8\text{ V to }30\text{ V}$, $I_O = 500\text{ mA}$		10	120	mV
		$V_I = 16\text{ V to }22\text{ V}$		4	120	
		$T_J = +25^{\circ}\text{C}$	$V_I = 14.5\text{ V to }27\text{ V}$	10	120	
			$V_I = 16\text{ V to }22\text{ V}$	3	60	
Regload	Load Regulation ⁽²⁷⁾	$T_J = +25^{\circ}\text{C}$, $I_O = 5\text{ mA to }1.5\text{ A}$		12	100	mV
		$I_O = 5\text{ mA to }1.0\text{ A}$		12	100	
		$I_O = 250\text{ mA to }750\text{ mA}$		5	50	
I_Q	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5.1	6.0	mA
ΔI_Q	Quiescent Current Change	$V_I = 15\text{ V to }30\text{ V}$, $T_J = +25^{\circ}\text{C}$			0.8	mA
		$V_I = 14\text{ V to }27\text{ V}$, $I_O = 500\text{ mA}$			0.8	
		$I_O = 5\text{ mA to }1.0\text{ A}$			0.5	
$\Delta V/\Delta T$	Output Voltage Drift ⁽²⁸⁾	$I_O = 5\text{ mA}$		-1		mV/ $^{\circ}\text{C}$
V_N	Output Noise Voltage	$f = 10\text{ Hz to }100\text{ kHz}$, $T_A = +25^{\circ}\text{C}$		76		μV
RR	Ripple Rejection ⁽²⁸⁾	$f = 120\text{ Hz}$, $I_O = 500\text{ mA}$, $V_I = 14\text{ V to }24\text{ V}$		60		dB
V_{Drop}	Dropout Voltage	$I_O = 1\text{ A}$, $T_J = +25^{\circ}\text{C}$		2		V
R_O	Output Resistance ⁽²⁸⁾	$f = 1\text{ kHz}$		18		m Ω
I_{SC}	Short-Circuit Current	$V_I = 35\text{ V}$, $T_A = +25^{\circ}\text{C}$		250		mA
I_{PK}	Peak Current ⁽²⁸⁾	$T_J = +25^{\circ}\text{C}$		2.2		A

Notes:

27. 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.

28. These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (KA7815AE)

Refer to the test circuit, $0^{\circ}\text{C} < T_J < +125^{\circ}\text{C}$, $I_O = 1\text{ A}$, $V_I = 23\text{ V}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$, unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	$T_J = +25^{\circ}\text{C}$	14.7	15.0	15.3	V
		$I_O = 5\text{ mA to }1\text{ A}$, $P_O \leq 15\text{ W}$, $V_I = 17.7\text{ V to }30\text{ V}$	14.4	15.0	15.6	
Regline	Line Regulation ⁽²⁹⁾	$V_I = 17.9\text{ V to }30\text{ V}$, $I_O = 500\text{ mA}$		10	150	mV
		$V_I = 20\text{ V to }26\text{ V}$		5	150	
		$T_J = +25^{\circ}\text{C}$	$V_I = 17.5\text{ V to }30\text{ V}$	11	150	
			$V_I = 20\text{ V to }26\text{ V}$	3	75	
Regload	Load Regulation ⁽²⁹⁾	$T_J = +25^{\circ}\text{C}$, $I_O = 5\text{ mA to }1.5\text{ A}$		12	100	mV
		$I_O = 5\text{ mA to }1.0\text{ A}$		12	100	
		$I_O = 250\text{ mA to }750\text{ mA}$		5	50	
I_Q	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5.2	6.0	mA
ΔI_Q	Quiescent Current Change	$V_I = 17.5\text{ V to }30\text{ V}$, $T_J = +25^{\circ}\text{C}$			0.8	mA
		$V_I = 17.5\text{ V to }30\text{ V}$, $I_O = 500\text{ mA}$			0.8	
		$I_O = 5\text{ mA to }1.0\text{ A}$			0.5	
$\Delta V/\Delta T$	Output Voltage Drift ⁽³⁰⁾	$I_O = 5\text{ mA}$		-1		mV/ $^{\circ}\text{C}$
V_N	Output Noise Voltage	$f = 10\text{ Hz to }100\text{ kHz}$, $T_A = +25^{\circ}\text{C}$		90		μV
RR	Ripple Rejection ⁽³⁰⁾	$f = 120\text{ Hz}$, $I_O = 500\text{ mA}$, $V_I = 18.5\text{ V to }28.5\text{ V}$		58		dB
V_{Drop}	Dropout Voltage	$I_O = 1\text{ A}$, $T_J = +25^{\circ}\text{C}$		2		V
R_O	Output Resistance ⁽³⁰⁾	$f = 1\text{ kHz}$		19		m Ω
I_{SC}	Short-Circuit Current	$V_I = 35\text{ V}$, $T_A = +25^{\circ}\text{C}$		250		mA
I_{PK}	Peak Current ⁽³⁰⁾	$T_J = +25^{\circ}\text{C}$		2.2		A

Notes:

29. 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.

30. These parameters, although guaranteed, are not 100% tested in production.

Electrical Characteristics (KA7824AE)

Refer to the test circuit, $0^{\circ}\text{C} < T_J < +125^{\circ}\text{C}$, $I_O = 1\text{ A}$, $V_I = 33\text{ V}$, $C_I = 0.33\text{ }\mu\text{F}$, $C_O = 0.1\text{ }\mu\text{F}$, unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	$T_J = +25^{\circ}\text{C}$	23.5	24.0	24.5	V
		$I_O = 5\text{ mA to }1\text{ A}$, $P_O \leq 15\text{ W}$, $V_I = 27.3\text{ V to }38\text{ V}$	23.0	24.0	25.0	
Regline	Line Regulation ⁽³¹⁾	$V_I = 27\text{ V to }38\text{ V}$, $I_O = 500\text{ mA}$		18	240	mV
		$V_I = 21\text{ V to }33\text{ V}$		6	240	
		$T_J = +25^{\circ}\text{C}$	$V_I = 26.7\text{ V to }38\text{ V}$	18	240	
			$V_I = 30\text{ V to }36\text{ V}$	6	120	
Regload	Load Regulation ⁽³¹⁾	$T_J = +25^{\circ}\text{C}$, $I_O = 5\text{ mA to }1.5\text{ A}$		15	100	mV
		$I_O = 5\text{ mA to }1.0\text{ A}$		15	100	
		$I_O = 250\text{ mA to }750\text{ mA}$		7	50	
I_Q	Quiescent Current	$T_J = +25^{\circ}\text{C}$		5.2	6.0	mA
ΔI_Q	Quiescent Current Change	$V_I = 27.3\text{ V to }38\text{ V}$, $T_J = +25^{\circ}\text{C}$			0.8	mA
		$V_I = 27.3\text{ V to }38\text{ V}$, $I_O = 500\text{ mA}$			0.8	
		$I_O = 5\text{ mA to }1.0\text{ A}$			0.5	
$\Delta V/\Delta T$	Output Voltage Drift ⁽³²⁾	$I_O = 5\text{ mA}$		-1.5		mV/ $^{\circ}\text{C}$
V_N	Output Noise Voltage	$f = 10\text{ Hz to }100\text{ kHz}$, $T_A = +25^{\circ}\text{C}$		120		μV
RR	Ripple Rejection ⁽³²⁾	$f = 120\text{ Hz}$, $I_O = 500\text{ mA}$, $V_I = 28\text{ V to }38\text{ V}$		54		dB
V_{Drop}	Dropout Voltage	$I_O = 1\text{ A}$, $T_J = +25^{\circ}\text{C}$		2		V
R_O	Output Resistance ⁽³²⁾	$f = 1\text{ kHz}$		20		m Ω
I_{SC}	Short-Circuit Current	$V_I = 35\text{ V}$, $T_A = +25^{\circ}\text{C}$		250		mA
I_{PK}	Peak Current ⁽³²⁾	$T_J = +25^{\circ}\text{C}$		2.2		A

Notes:

31. 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.

32. These parameters, although guaranteed, are not 100% tested in production.

Typical Performance Characteristics

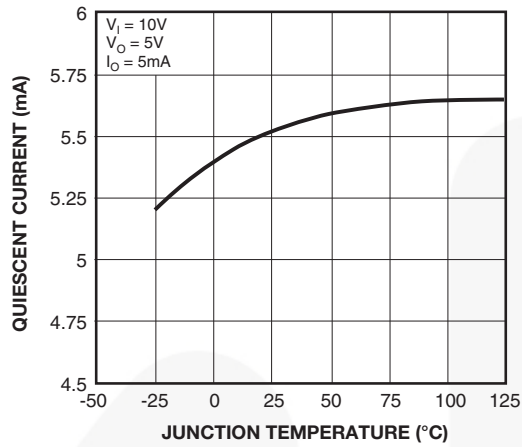


Figure 2. Quiescent Current

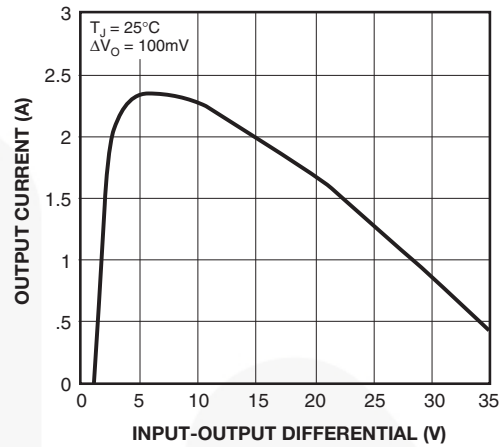


Figure 3. Peak Output Current

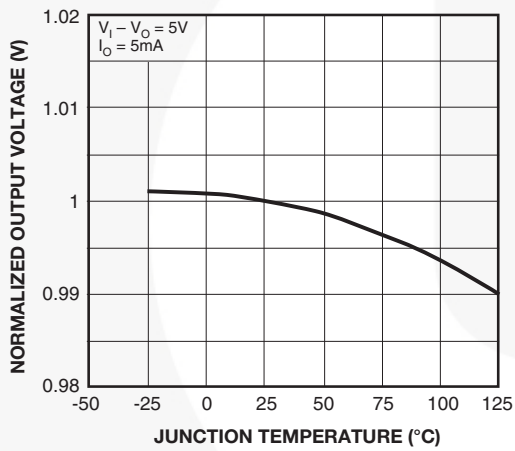


Figure 4. Output Voltage

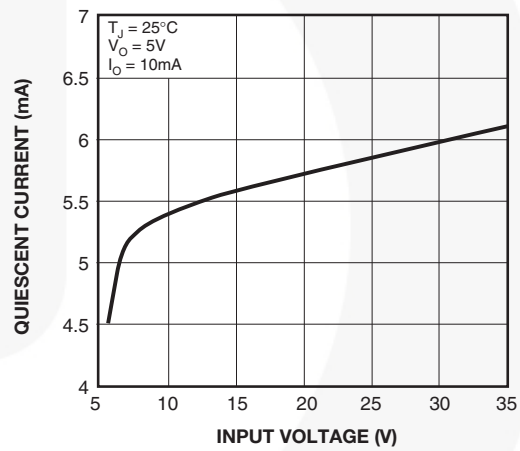


Figure 5. Quiescent Current

Typical Applications

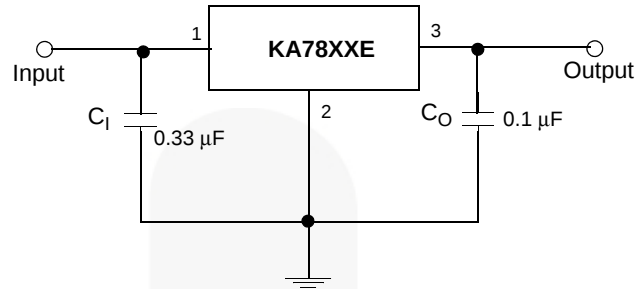


Figure 6. DC Parameters

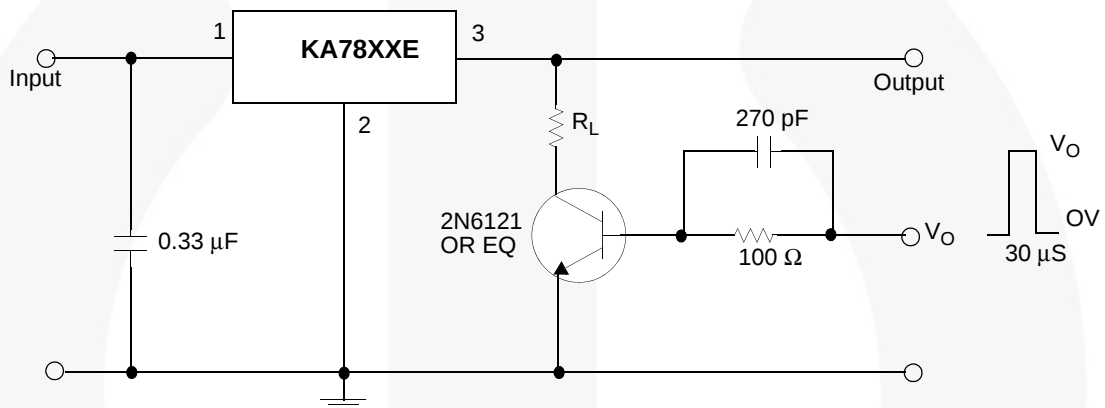


Figure 7. Load Regulation

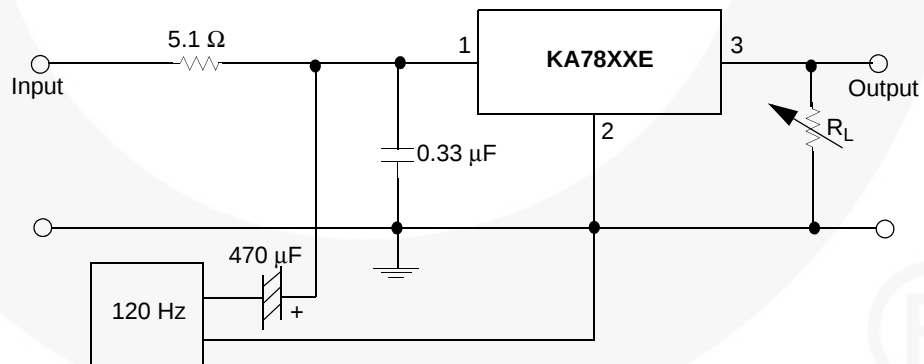


Figure 8. Ripple Rejection

Typical Applications (Continued)

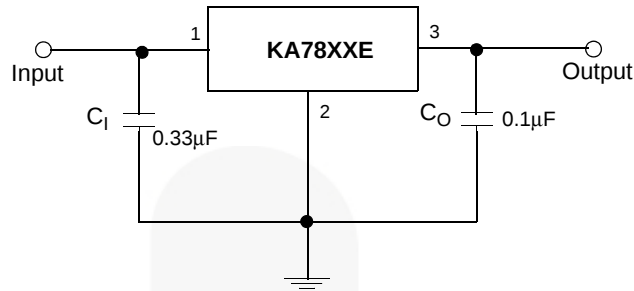


Figure 9. Fixed Output Regulator

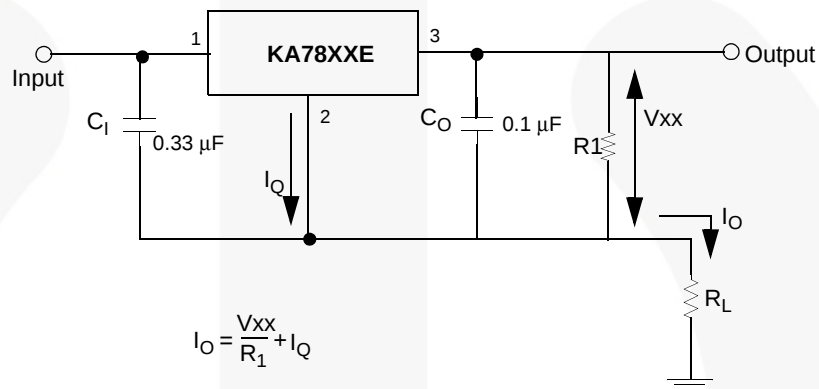
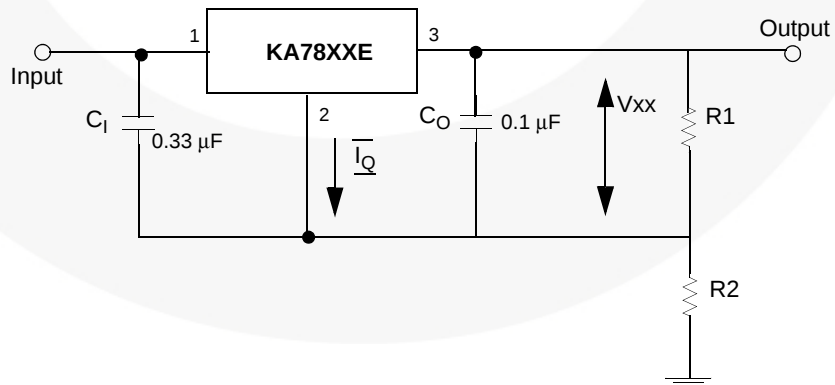


Figure 10. Constant Current Regulator

Notes:

33. To specify an output voltage, substitute voltage value for "XX". A common ground is required between the input and the output voltage. The input voltage must remain typically 2.0 V above the output voltage even during the low point on the input ripple voltage.
34. C_1 is required if regulator is located an appreciable distance from power supply filter.
35. C_0 improves stability and transient response.

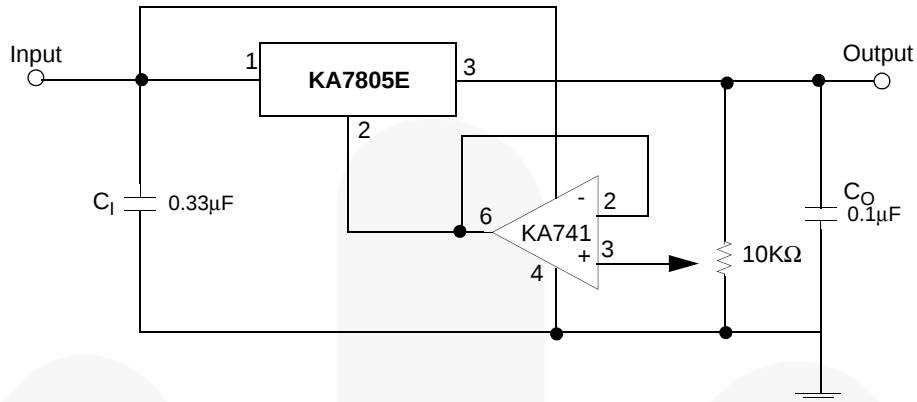


$$I_{R1} \geq 5I_Q$$

$$V_O = V_{XX}(1 + R_2/R_1) + I_Q R_2$$

Figure 11. Circuit for Increasing Output Voltage

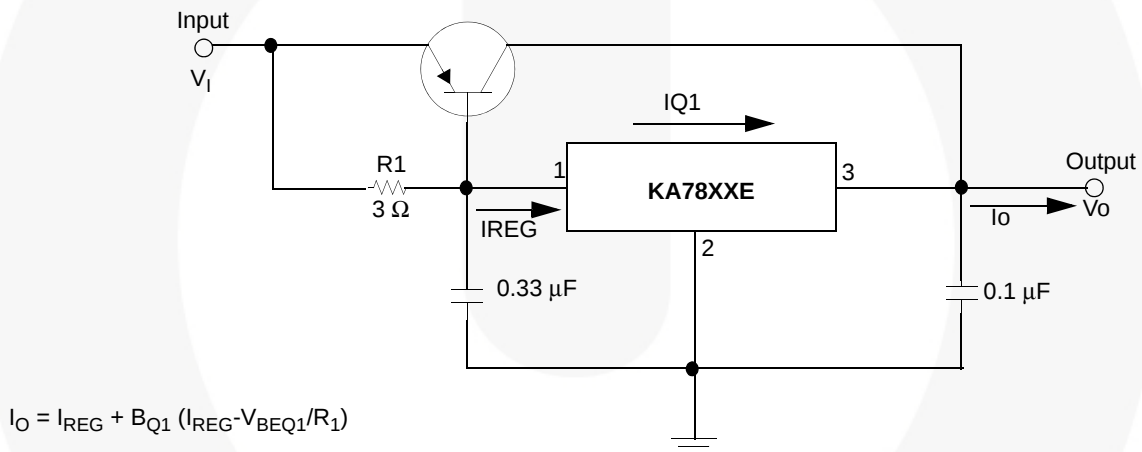
Typical Applications (Continued)



$$I_{R1} \geq 5 I_Q$$

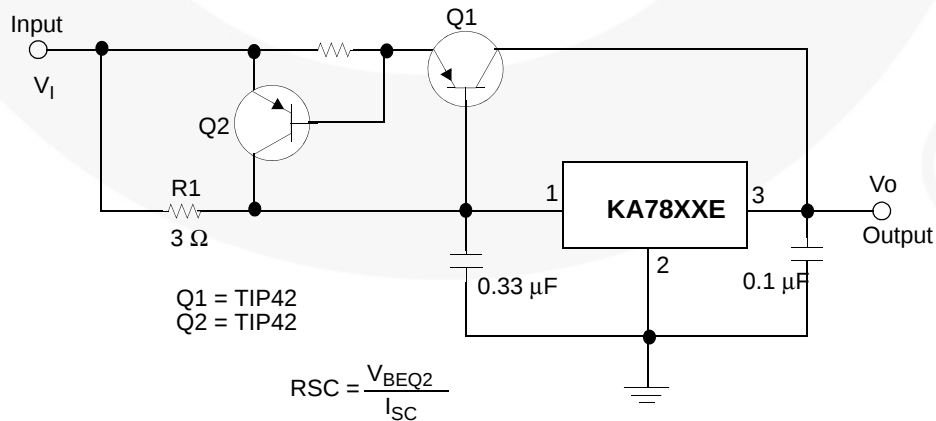
$$V_O = V_{XX}(1 + R_2/R_1) + I_Q R_2$$

Figure 12. Adjustable Output Regulator (7 V to 30 V)



$$I_O = I_{REG} + B_{Q1} (I_{REG} - V_{BEQ1}/R_1)$$

Figure 13. High-Current Voltage Regulator



$$R_{SC} = \frac{V_{BEQ2}}{I_{SC}}$$

Figure 14. High Output Current with Short-Circuit Protection

Typical Applications (Continued)

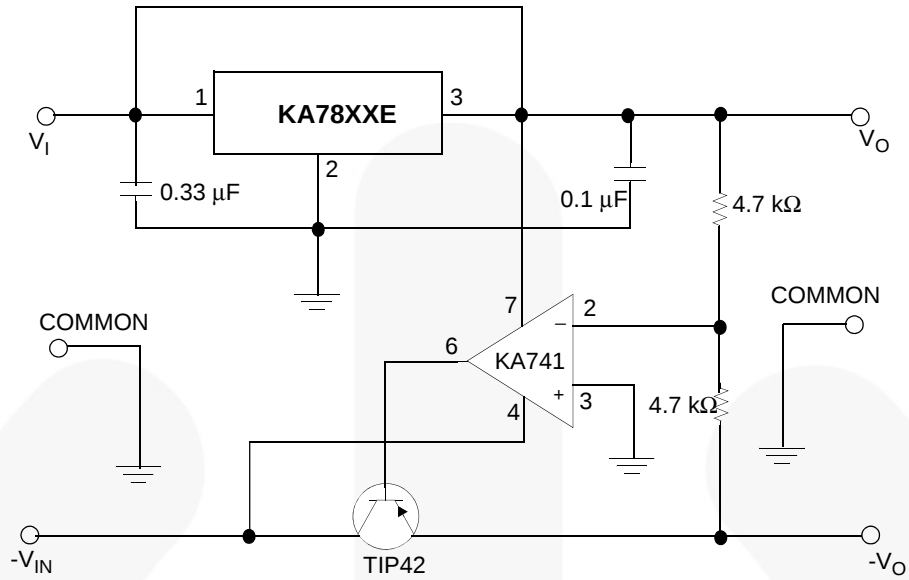


Figure 15. Tracking Voltage Regulator

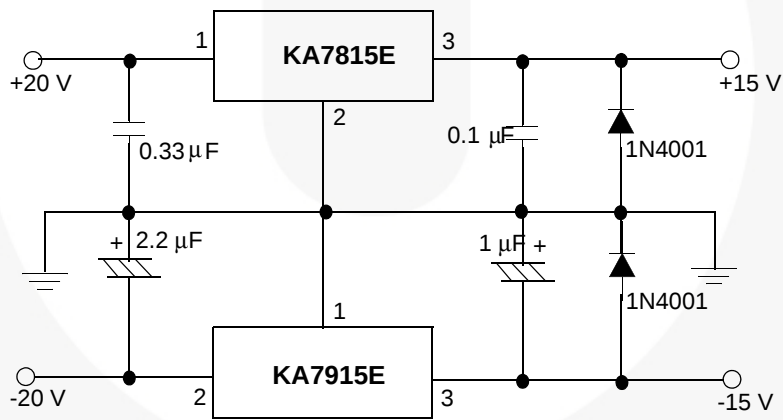


Figure 16. Split-Power Supply (± 15 V - 1 A)

Typical Applications (Continued)

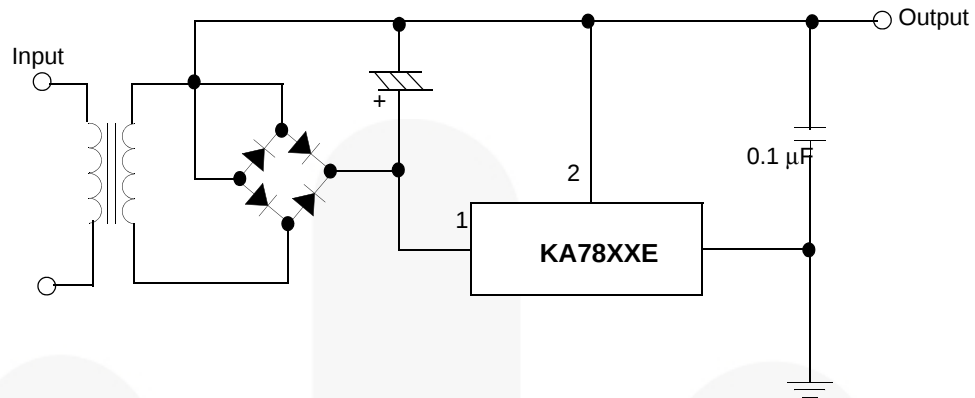


Figure 17. Negative Output Voltage Circuit

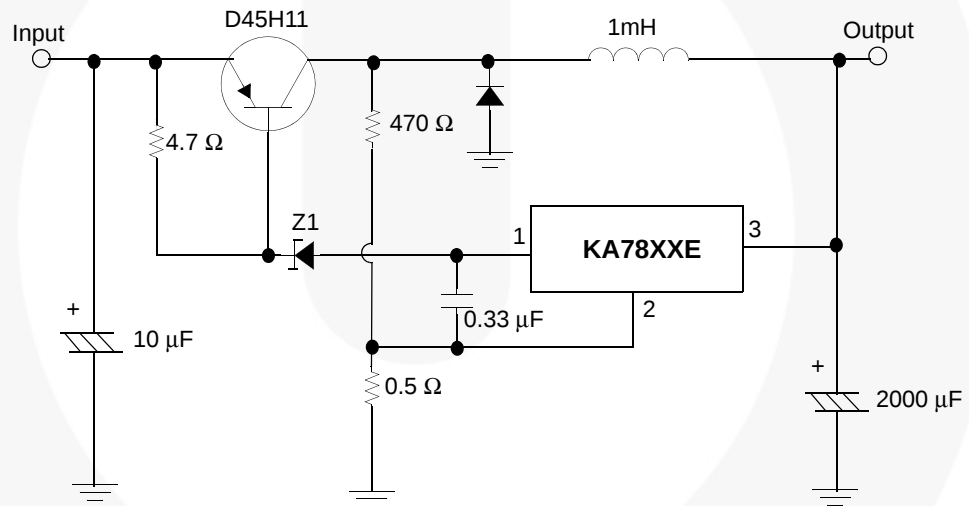


Figure 18. Switching Regulator

Physical Dimensions

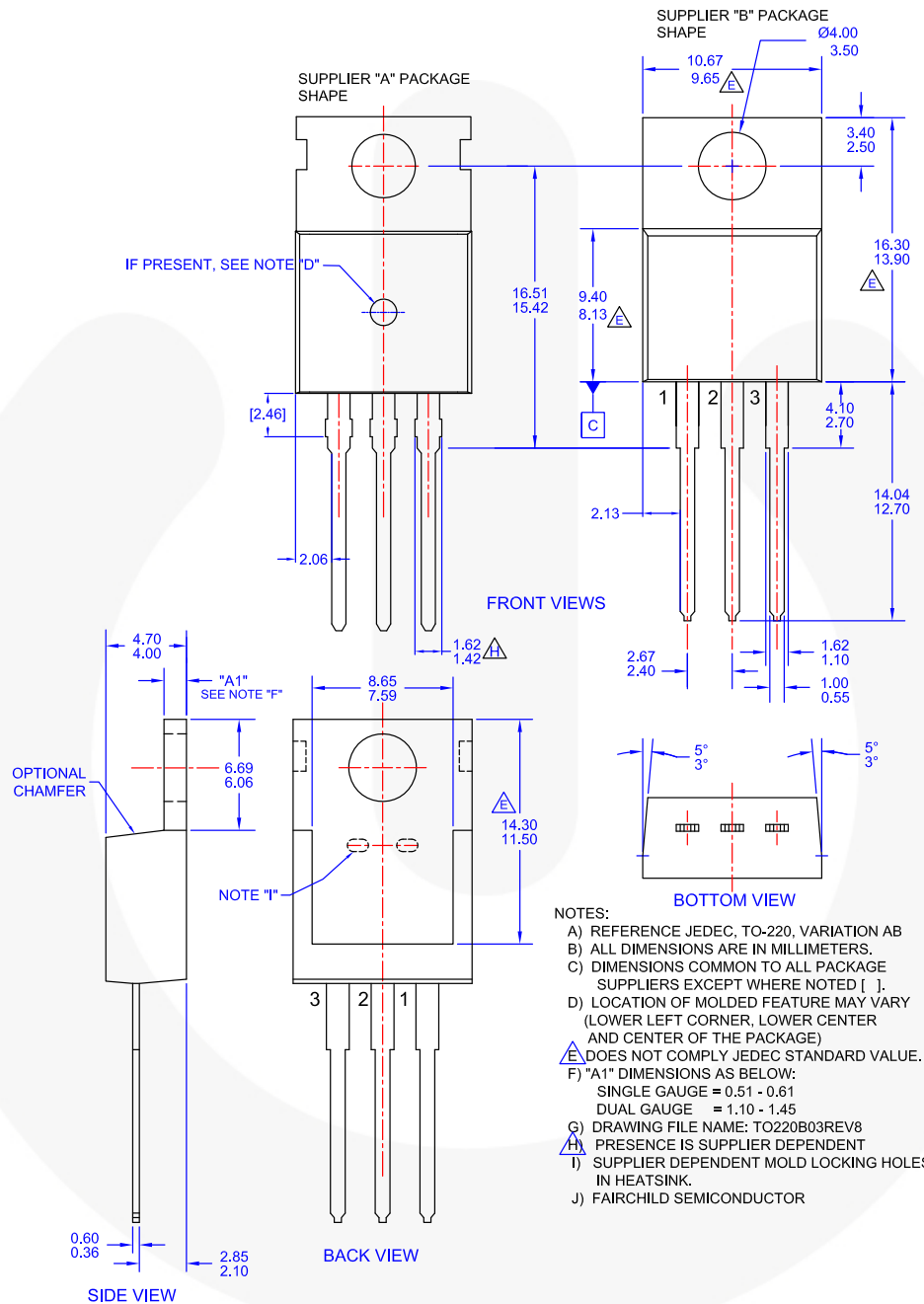


Figure 19. TO-220, MOLDED, 3-LEAD, NON-JEDEC, VARIATION AB (DUAL GAUGE)



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