

LM117QML 3-Terminal Adjustable Regulator

Check for Samples: [LM117QML](#), [LM117QML-SP](#)

FEATURES

- Available with Radiation Ensured
 - High Dose Rate 100 krad(Si)
 - ELDRS Free 100 krad(Si)
- Specified max. 0.3% Load Regulation (LM117)
- Specified 0.5A or 1.5A Output Current
- Adjustable Output Down to 1.2V
- Current Limit Constant with Temperature
- 80 dB Ripple Rejection
- Output is Short-Circuit Protected

DESCRIPTION

The LM117 series of adjustable 3-terminal positive voltage regulators is capable of supplying either 0.5A or 1.5A over a 1.2V to 37V output range. They are exceptionally easy to use and require only two external resistors to set the output voltage. Further, both line and load regulation are better than standard fixed regulators.

In addition to higher performance than fixed regulators, the LM117 series offers full overload protection available only in IC's. Included on the chip are current limit, thermal overload protection and safe area protection. All overload protection circuitry remains fully functional even if the adjustment terminal is disconnected.

Normally, no capacitors are needed unless the device is situated more than 6 inches from the input filter capacitors in which case an input bypass is needed. An optional output capacitor can be added to improve transient response. The adjustment terminal can be bypassed to achieve very high ripple rejection ratios which are difficult to achieve with standard 3-terminal regulators.

Besides replacing fixed regulators, the LM117 is useful in a wide variety of other applications. Since the regulator is "floating" and sees only the input-to-output differential voltage, supplies of several hundred volts can be regulated as long as the maximum input to output differential is not exceeded, i.e., avoid short-circuiting the output.

Also, it makes an especially simple adjustable switching regulator, a programmable output regulator, or by connecting a fixed resistor between the adjustment pin and output, the LM117 can be used as a precision current regulator. Supplies with electronic shutdown can be achieved by clamping the adjustment terminal to ground which programs the output to 1.2V where most loads draw little current.

For the negative complement, see LM137 series data sheet.



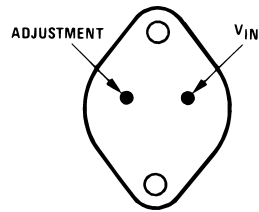
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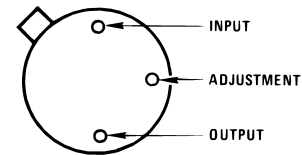
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CONNECTION DIAGRAMS



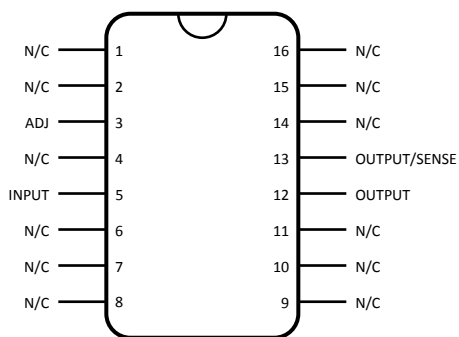
CASE IS OUTPUT

**Figure 1. 2-Pin TO Metal Can Package
Bottom View
See K Package**



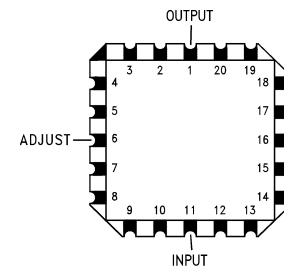
CASE IS OUTPUT

**Figure 2. 3-Pin PFM Metal Can Package
Bottom View
See NDT0003A Package**



For the Ceramic SOIC device to function properly, the "Output" and "Output/Sense" pins must be connected on the users printed circuit board.

**Figure 3. 16-Pin CFP
Top View**

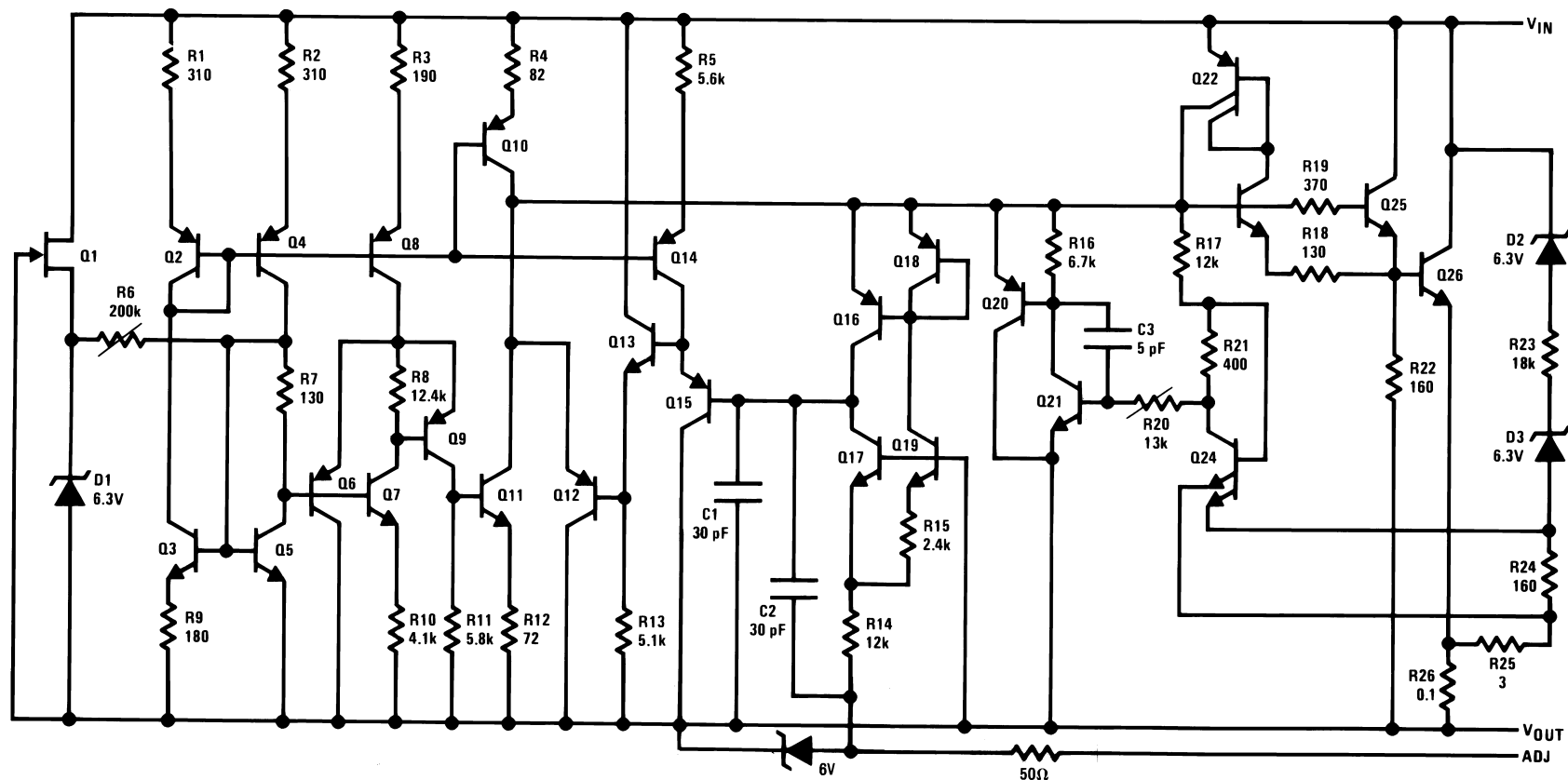


**Figure 4. 20-Pin LCCC
Top View
See NAJ0020A Package**

Table 1. LM117 Series Packages

Part Number Suffix	Package	Design Load Current
K	TO	1.5A
H	PFM	0.5A
WG, GW	CFP	0.5A
E	LCCC	0.5A

Schematic Diagram





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

Absolute Maximum Ratings⁽¹⁾

Power Dissipation ⁽²⁾			Internally Limited
Input-Output Voltage Differential			+40V, -0.3V
Storage Temperature			-65°C ≤ T _A ≤ +150°C
Maximum Junction Temperature (T _{Jmax})			+150°C
Lead Temperature Metal Package			300°C
Thermal Resistance	θ _{JA}	T0 Still Air	39°C/W
		T0 500LF/Min Air flow	14°C/W
		PFM Still Air	186°C/W
		PFM 500LF/Min Air flow	64°C/W
		CFP "WG" (device 03, 05) Still Air	115°C/W
		CFP "WG" (device 03, 05) 500LF/Min Air flow	66°C/W
		CFP "GW" (device 06, 07) Still Air	130°C/W
		CFP "GW" (device 06, 07) 500LF/Min Air flow	80°C/W
		LCCC Still Air	88°C/W
		LCCC 500LF/Min Air flow	62°C/W
	θ _{JC}	T0	1.9°C/W
		PFM Metal Can	21°C/W
		CFP "WG" (device 03, 05) ⁽³⁾	3.4°C/W
		CFP "GW" (device 06, 07)	7°C/W
		LCCC	12°C/W
Package Weight		PFM Metal Can	960mg
		CFP "WG" (device 03, 05)	365mg
		CFP "GW" (device 06, 07)	410mg
ESD Tolerance ⁽⁴⁾			3KV

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not ensure specific performance limits. For ensured specifications and test conditions, see the Electrical Characteristics. The ensured specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.
- (2) The maximum power dissipation must be derated at elevated temperatures and is dictated by T_{Jmax} (maximum junction temperature), θ_{JA} (package junction to ambient thermal resistance), and T_A (ambient temperature). The maximum allowable power dissipation at any temperature is P_{Dmax} = (T_{Jmax} - T_A)/θ_{JA} or the number given in the Absolute Maximum Ratings, whichever is lower. "Although power dissipation is internally limited, these specifications are applicable for power dissipations of 2W for the PFM, LCCC, and CFP packages, and 20W for the TO package."
- (3) The package material for these devices allows much improved heat transfer over our standard ceramic packages. In order to take full advantage of this improved heat transfer, heat sinking must be provided between the package base (directly beneath the die), and either metal traces on, or thermal vias through, the printed circuit board. Without this additional heat sinking, device power dissipation must be calculated using θ_{JA}, rather than θ_{JC}, thermal resistance. It must not be assumed that the device leads will provide substantial heat transfer out the package, since the thermal resistance of the leadframe material is very poor, relative to the material of the package base. The stated θ_{JC} thermal resistance is for the package material only, and does not account for the additional thermal resistance between the package base and the printed circuit board. The user must determine the value of the additional thermal resistance and must combine this with the stated value for the package, to calculate the total allowed power dissipation for the device.
- (4) Human body model, 100 pF discharged through a 1.5 kΩ resistor.

Recommended Operating Conditions

Operating Temperature Range	-55°C ≤ T _A ≤ +125°C
Input Voltage Range	4.25V to 41.25V

Table 2. Quality Conformance Inspection

MIL-STD-883, Method 5005 - Group A		
Subgroup	Description	Temp (°C)
1	Static tests at	+25
2	Static tests at	+125
3	Static tests at	-55
4	Dynamic tests at	+25
5	Dynamic tests at	+125
6	Dynamic tests at	-55
7	Functional tests at	+25
8A	Functional tests at	+125
8B	Functional tests at	-55
9	Switching tests at	+25
10	Switching tests at	+125
11	Switching tests at	-55
12	Settling time at	+25
13	Settling time at	+125
14	Settling time at	-55

LM117H & LM117WG Electrical Characteristics

DC Parameters

The following conditions apply, unless otherwise specified. $V_{Diff} = (V_I - V_O)$, $I_L = 8mA$

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
I_{Adj}	Adjustment Pin Current	$V_{Diff} = 3V$			100	μA	1
		$V_{Diff} = 3.3V$			100	μA	2, 3
		$V_{Diff} = 40V$			100	μA	1, 2, 3
I_Q	Minimum Load Current	$V_{Diff} = 3V$, $V_O = 1.7V$			5.0	mA	1
		$V_{Diff} = 3.3V$, $V_O = 1.7V$			5.0	mA	2, 3
		$V_{Diff} = 40V$, $V_O = 1.7V$			5.0	mA	1, 2, 3
V_{Ref}	Reference Voltage	$V_{Diff} = 3V$		1.2	1.3	V	1
		$V_{Diff} = 3.3V$		1.2	1.3	V	2, 3
		$V_{Diff} = 40V$		1.2	1.3	V	1, 2, 3
V_{RLine}	Line Regulation	$3V \leq V_{Diff} \leq 40V$, $V_O = 1.2V$		-8.9	8.9	mV	1
		$3.3V \leq V_{Diff} \leq 40V$, $V_O = 1.2V$		-22.2	22.2	mV	2, 3
V_{RLoad}	Load Regulation	$V_{Diff} = 3V$, $I_L = 10mA$ to 500mA		-15	15	mV	1
		$V_{Diff} = 3.3V$, $I_L = 10mA$ to 500mA		-15	15	mV	2, 3
		$V_{Diff} = 40V$, $I_L = 10mA$ to 150mA		-15	15	mV	1
		$V_{Diff} = 40V$, $I_L = 10mA$ to 100mA		-15	15	mV	2, 3
$\Delta I_{Adj} / Load$	Adjustment Current Change	$V_{Diff} = 3V$, $I_L = 10mA$ to 500mA		-5.0	5.0	μA	1
		$V_{Diff} = 3.3V$, $I_L = 10mA$ to 500mA		-5.0	5.0	μA	2, 3
		$V_{Diff} = 40V$, $I_L = 10mA$ to 150mA		-5.0	5.0	μA	1
		$V_{Diff} = 40V$, $I_L = 10mA$ to 100mA		-5.0	5.0	μA	2, 3

LM117H & LM117WG Electrical Characteristics

DC Parameters (continued)

The following conditions apply, unless otherwise specified. $V_{Diff} = (V_I - V_O)$, $I_L = 8mA$

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
ΔI_{Adj} / Line	Adjustment Current Change	$3V \leq V_{Diff} \leq 40V$		-5.0	5.0	μA	1
		$3.3V \leq V_{Diff} \leq 40V$		-5.0	5.0	μA	2, 3
I_{OS}	Short Circuit Current	$V_{Diff} = 10V$		0.45	1.6	A	1
θ_R	Thermal Regulation	$T_A = 25^\circ C$, $t = 20mS$, $V_{Diff} = 40V$, $I_L = 150mA$		-6.0	6.0	mV	1
I_{CL}	Current Limit	$V_{Diff} \leq 15V$	See ⁽¹⁾	0.5		A	1, 2, 3
		$V_{Diff} = 40V$	See ⁽¹⁾	0.15		A	1

(1) Specified parameter, not tested.

LM117H & LM117WG Electrical Characteristics

AC Parameters

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
RR	Ripple Rejection	$V_I = +6.25V$, $V_O = V_{Ref}$, $f = 120Hz$, $e_i = 1V_{RMS}$, $I_L = 125mA$	See ⁽¹⁾	66		dB	4, 5, 6

(1) Tested @ 25°C; specified, but not tested @ 125°C & -55°C

LM117K Electrical Characteristics

DC Parameters

The following conditions apply, unless otherwise specified. $V_{Diff} = (V_I - V_O)$, $I_L = 10mA$

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
I_{Adj}	Adjustment Pin Current	$V_{Diff} = 3V$			100	μA	1
		$V_{Diff} = 3.3V$			100	μA	2, 3
		$V_{Diff} = 40V$			100	μA	1, 2, 3
I_Q	Minimum Load Current	$V_{Diff} = 3V$, $V_O = 1.7V$			5.0	mA	1
		$V_{Diff} = 3.3V$, $V_O = 1.7V$			5.0	mA	2, 3
		$V_{Diff} = 40V$, $V_O = 1.7V$			5.0	mA	1, 2, 3
V_{Ref}	Reference Voltage	$V_{Diff} = 3V$		1.2	1.3	V	1
		$V_{Diff} = 3.3V$		1.2	1.3	V	2, 3
		$V_{Diff} = 40V$		1.2	1.3	V	1, 2, 3
V_{RLine}	Line Regulation	$3V \leq V_{Diff} \leq 40V$, $V_O = 1.2V$		-8.9	8.9	mV	1
		$3.3V \leq V_{Diff} \leq 40V$, $V_O = 1.2V$		-22.2	22.2	mV	2, 3
V_{RLoad}	Load Regulation	$V_{Diff} = 3V$, $I_L = 10mA$ to 1.5A		-15	15	mV	1
		$V_{Diff} = 3.3V$, $I_L = 10mA$ to 1.5A		-15	15	mV	2, 3
		$V_{Diff} = 40V$, $I_L = 10mA$ to 300mA		-15	15	mV	1
		$V_{Diff} = 40V$, $I_L = 10mA$ to 195mA		-15	15	mV	2, 3

LM117K Electrical Characteristics

DC Parameters (continued)

The following conditions apply, unless otherwise specified. $V_{Diff} = (V_I - V_O)$, $I_L = 10mA$

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
$\Delta I_{Adj} / \text{Load}$	Adjustment Current Change	$V_{Diff} = 3V$, $I_L = 10mA$ to 1.5A		-5.0	5.0	μA	1
		$V_{Diff} = 3.3V$, $I_L = 10mA$ to 1.5A		-5.0	5.0	μA	2, 3
		$V_{Diff} = 40V$, $I_L = 10mA$ to 300mA		-5.0	5.0	μA	1
		$V_{Diff} = 40V$, $I_L = 10mA$ to 195mA		-5.0	5.0	μA	2, 3
$\Delta I_{Adj} / \text{Line}$	Adjustment Current Change	$3V \leq V_{Diff} \leq 40V$		-5.0	5.0	μA	1
		$3.3V \leq V_{Diff} \leq 40V$		-5.0	5.0	μA	2, 3
I_{OS}	Short Circuit Current	$V_{Diff} = 10V$		1.6	3.4	A	1
θ_R	Thermal Regulation	$T_A = 25^\circ C$, $t = 20mS$, $V_{Diff} = 40V$, $I_L = 300mA$		-10.5	10.5	mV	1
I_{CL}	Current Limit	$V_{Diff} \leq 15V$	See ⁽¹⁾	1.5		A	1, 2, 3
		$V_{Diff} = 40V$	See ⁽¹⁾	0.3		A	1

(1) Specified parameter, not tested.

LM117K Electrical Characteristics

AC Parameters

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
RR	Ripple Rejection	$V_I = +6.25V$, $V_O = V_{Ref}$, $f = 120Hz$, $e_i = 1V_{RMS}$, $I_L = 0.5A$	See ⁽¹⁾	66		dB	4, 5, 6

(1) Tested @ 25°C; specified, but not tested @ 125°C & -55°C

LM117E Electrical Characteristics

DC Parameters

The following conditions apply, unless otherwise specified. $V_{Diff} = (V_I - V_O)$, $I_L = 8mA$, $P_D \leq 1.5W$

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
I_{Adj}	Adjustment Pin Current	$V_{Diff} = 3V$			100	μA	1
		$V_{Diff} = 3.3V$			100	μA	2, 3
		$V_{Diff} = 40V$			100	μA	1, 2, 3
I_Q	Minimum Load Current	$V_{Diff} = 3V$, $V_O = 1.7V$			5.0	mA	1
		$V_{Diff} = 3.3V$, $V_O = 1.7V$			5.0	mA	2, 3
		$V_{Diff} = 40V$, $V_O = 1.7V$			5.0	mA	1, 2, 3
V_{Ref}	Reference Voltage	$V_{Diff} = 3V$		1.2	1.3	V	1
		$V_{Diff} = 3.3V$		1.2	1.3	V	2, 3
		$V_{Diff} = 40V$		1.2	1.3	V	1, 2, 3
V_{RLine}	Line Regulation	$3V \leq V_{Diff} \leq 40V$, $V_O = 1.2V$		-8.9	8.9	mV	1
		$3.3V \leq V_{Diff} \leq 40V$, $V_O = 1.2V$		-22.2	22.2	mV	2, 3

LM117E Electrical Characteristics

DC Parameters (continued)

The following conditions apply, unless otherwise specified. $V_{Diff} = (V_I - V_O)$, $I_L = 8\text{mA}$, $P_D \leq 1.5\text{W}$

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
V_{RLoad}	Load Regulation	$V_{Diff} = 3\text{V}$, $I_L = 10\text{mA}$ to 100mA		-15	15	mV	1
		$V_{Diff} = 3.3\text{V}$, $I_L = 10\text{mA}$ to 100mA		-15	15	mV	2, 3
		$V_{Diff} = 40\text{V}$, $I_L = 10\text{mA}$ to 100mA		-15	15	mV	1,2
				-25	25	mV	3
		$V_{Diff} = 3\text{V}$, $I_L = 10\text{mA}$ to 500mA		-15	15	mV	1
		$V_{Diff} = 3.3\text{V}$, $I_L = 10\text{mA}$ to 500mA		-15	15	mV	2, 3
$\Delta I_{Adj} / \text{Load}$	Adjustment Current Change	$V_{Diff} = 3\text{V}$, $I_L = 10\text{mA}$ to 500mA		-5.0	5.0	μA	1
		$V_{Diff} = 3.3\text{V}$, $I_L = 10\text{mA}$ to 500mA		-5.0	5.0	μA	2, 3
		$V_{Diff} = 40\text{V}$, $I_L = 10\text{mA}$ to 100mA		-5.0	5.0	μA	1, 2, 3
$\Delta I_{Adj} / \text{Line}$	Adjustment Current Change	$3\text{V} \leq V_{Diff} \leq 40\text{V}$		-5.0	5.0	μA	1
		$3.3\text{V} \leq V_{Diff} \leq 40\text{V}$		-5.0	5.0	μA	2, 3
I_{OS}	Short Circuit Current	$V_{Diff} = 10\text{V}$		0.45	1.6	A	1
θ_R	Thermal Regulation	$T_A = 25^\circ\text{C}$, $t = 20\text{mS}$, $V_{Diff} = 40\text{V}$, $I_L = 75\text{mA}$		-6.0	6.0	mV	1
I_{CL}	Current Limit	$V_{Diff} \leq 15\text{V}$	See ⁽¹⁾	0.5		A	1, 2, 3
		$V_{Diff} = 40\text{V}$	See ⁽¹⁾	0.15		A	1

(1) Specified parameter, not tested.

LM117E Electrical Characteristics

AC Parameters

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
RR	Ripple Rejection	$V_I = +6.25\text{V}$, $V_O = V_{Ref}$, $f = 120\text{Hz}$, $e_i = 1V_{RMS}$, $I_L = 100\text{mA}$, $C_{Adj} = 10\mu\text{f}$	See ⁽¹⁾	66		dB	4, 5, 6

(1) Tested @ 25°C ; specified, but not tested @ 125°C & -55°C

LM117H & LM117WG RH Electrical Characteristics
DC Parameters⁽¹⁾⁽²⁾

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
V_O	Output Voltage	$V_I = 4.25V, I_L = -5mA$		1.2	1.3	V	1, 2, 3
		$V_I = 4.25V, I_L = -500mA$		1.2	1.3	V	1, 2, 3
		$V_I = 41.25V, I_L = -5mA$		1.2	1.3	V	1, 2, 3
		$V_I = 41.25V, I_L = -50mA$		1.2	1.3	V	1, 2, 3
V_{RLine}	Line Regulation	$4.25V \leq V_I \leq 41.25V, I_L = -5mA$		-9.0	9.0	mV	1
				-23	23	mV	2,3
V_{RLoad}	Load Regulation	$V_I = 6.25V, -500mA \leq I_L \leq -5mA$		-12	12	mV	1, 2, 3
		$V_I = 41.25V, -50mA \leq I_L \leq -5mA$		-12	12	mV	1, 2, 3
V_{RTh}	Thermal Regulation	$V_I = 14.6V, I_L = -500mA$		-12	12	mV	1
I_{Adj}	Adjust Pin Current	$V_I = 4.25V, I_L = -5mA$		-100	-15	μA	1, 2, 3
		$V_I = 41.25V, I_L = -5mA$		-100	-15	μA	1, 2, 3
$\Delta I_{Adj}/Line$	Adjust Pin Current Change	$4.25V \leq V_I \leq 41.25V, I_L = -5mA$		-5.0	5.0	μA	1, 2, 3
$\Delta I_{Adj}/Load$	Adjust Pin Current Change	$V_I = 6.25V, -500mA \leq I_L \leq -5mA$		-5.0	5.0	μA	1, 2, 3
I_Q	Minimum Load Current	$V_I = 4.25V, \text{Forced } V_O = 1.4V$		-3.0	-0.5	mA	1, 2, 3
		$V_I = 14.25V, \text{Forced } V_O = 1.4V$		-3.0	-0.5	mA	1, 2, 3
		$V_I = 41.25V, \text{Forced } V_O = 1.4V$		-5.0	-1.0	mA	1, 2, 3
I_{OS}	Output Short Circuit Current	$V_I = 4.25V$		-1.8	-0.5	A	1, 2, 3
		$V_I = 40V$		-0.5	-0.05	A	1, 2, 3
$V_O (Recov)$	Output Voltage Recovery	$V_I = 4.25V, R_L = 2.5\Omega, C_L = 20\mu F$		1.2	1.3	V	1, 2, 3
		$V_I = 40V, R_L = 250\Omega$		1.2	1.3	V	1, 2, 3
V_O	Output Voltage	$V_I = 6.25V, I_L = -5mA$	See ⁽³⁾	1.2	1.3	V	2
V_{Start}	Voltage Start-Up	$V_I = 4.25V, R_L = 2.5\Omega, C_L = 20\mu F, I_L = -500mA$		1.2	1.3	V	1, 2, 3

- (1) Pre and post irradiation limits are identical to those listed under AC and DC electrical characteristics except as listed in the "Post Radiation Limits" table. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are ensured only for the conditions as specified in Mil-Std-883, Method 1019.5, Condition A.
- (2) Low dose rate testing has been performed on a wafer-by-wafer basis, per test method 1019 condition D of MIL-STD-883, with no enhanced low dose rate sensitivity (ELDRS) effect.
- (3) Tested @ $T_A = 125^\circ C$, correlated to $T_A = 150^\circ C$

LM117H & LM117WG RH Electrical Characteristics
AC Parameters⁽¹⁾⁽²⁾

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub - groups
V_{NO}	Output Noise Voltage	$V_I = 6.25V$, $I_L = -50mA$			120	μV_{RMS}	7
$\Delta V_O / \Delta V_I$	Line Transient Response	$V_I = 6.25V$, $\Delta V_I = 3V$, $I_L = -10mA$			6.0	mV/V	7
$\Delta V_O / \Delta I_L$	Load Transient Response	$V_I = 6.25V$, $\Delta I_L = -200mA$, $I_L = -50mA$			0.6	mV/mA	7
$\Delta V_I / \Delta V_O$	Ripple Rejection	$V_I = 6.25V$, $I_L = -125mA$, $E_I = 1V_{RMS}$ at $f = 2400Hz$		65		dB	4

- (1) Pre and post irradiation limits are identical to those listed under AC and DC electrical characteristics except as listed in the "Post Radiation Limits" table. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are ensured only for the conditions as specified in Mil-Std-883, Method 1019.5, Condition A.
- (2) Low dose rate testing has been performed on a wafer-by-wafer basis, per test method 1019 condition D of MIL-STD-883, with no enhanced low dose rate sensitivity (ELDRS) effect.

LM117H & LM117WG RH Electrical Characteristics
DC Drift Parameters

The following conditions apply, unless otherwise specified.

Deltas performed on QMLV devices at Group B, Subgroup 5, only.

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub - groups
V_O	Output Voltage	$V_I = 4.25V$, $I_L = -5mA$		-0.01	0.01	V	1
		$V_I = 4.25V$, $I_L = -500mA$		-0.01	0.01	V	1
		$V_I = 41.25V$, $I_L = -5mA$		-0.01	0.01	V	1
		$V_I = 41.25V$, $I_L = -50mA$		-0.01	0.01	V	1
V_{RLine}	Line Regulation	$4.25V \leq V_I \leq 41.25V$, $I_L = -5mA$		-4.0	4.0	mV	1
I_{Adj}	Adjust Pin Current	$V_I = 4.25V$, $I_L = -5mA$		-10	10	μA	1
		$V_I = 41.25V$, $I_L = -5mA$		-10	10	μA	1
V_O (Recov)	Output Voltage Recovery	$V_I = 4.25V$, $R_L = 2.5\Omega$, $C_L = 20\mu f$		-0.01	0.01	V	1
		$V_I = 40V$, $R_L = 250\Omega$		-0.01	0.01	V	1

**LM117H & LM117WG RH Electrical Characteristics
AC/DC Post Radiation Limits @ +25°C⁽¹⁾⁽²⁾**

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
V _O	Output Voltage	V _I = 4.25V, I _L = -5mA		1.2	1.35 0	V	1
		V _I = 4.25V, I _L = -500mA		1.2	1.35 0	V	1
		V _I = 41.25V, I _L = -5mA		1.2	1.35 0	V	1
		V _I = 41.25V, I _L = -50mA		1.2	1.35 0	V	1
V _{RLine}	Line Regulation	4.25V ≤ V _I ≤ 41.25V, I _L = -5mA		-25	25	mV	1
ΔV _I / ΔV _O	Ripple Rejection	V _I = 6.25V, I _L = -125mA E _I = 1V _{RMS} at f = 2400Hz		60		dB	4
V _O (Recov)	Output Voltage Recovery	V _I = 4.25V, R _L = 2.5Ω, C _L = 20μf		1.20	1.35 0	V	1
		V _I = 40V, R _L = 250Ω		1.20	1.35 0	V	1

- (1) Pre and post irradiation limits are identical to those listed under AC and DC electrical characteristics except as listed in the "Post Radiation Limits" table. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are ensured only for the conditions as specified in Mil-Std-883, Method 1019.5, Condition A.
- (2) Low dose rate testing has been performed on a wafer-by-wafer basis, per test method 1019 condition D of MIL-STD-883, with no enhanced low dose rate sensitivity (ELDRS) effect.

LM117K RH Electrical Characteristics
DC Parameters⁽¹⁾

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
V _O	Output Voltage	V _I = 4.25V, I _L = -5mA		1.2	1.3	V	1, 2, 3
		V _I = 4.25V, I _L = -1.5A		1.2	1.3	V	1, 2, 3
		V _I = 41.25V, I _L = -5mA		1.2	1.3	V	1, 2, 3
		V _I = 41.25V, I _L = -200mA		1.2	1.3	V	1, 2, 3
V _{RLine}	Line Regulation	4.25V ≤ V _I ≤ 41.25V, I _L = -5mA		-9.0	9.0	mV	1
				-23	23	mV	2,3
V _{RLoad}	Load Regulation	V _I = 6.25V, -1.5A ≤ I _L ≤ -5mA		-3.5	3.5	mV	1
				-12	12	mV	2, 3
		V _I = 41.25V, -200mA ≤ I _L ≤ -5mA		-3.5	3.5	mV	1
				-12	12	mV	2, 3
V _{RTh}	Thermal Regulation	V _I = 14.6V, I _L = -1.5A		-12	12	mV	1
I _{Adj}	Adjust Pin Current	V _I = 4.25V, I _L = -5mA		-100	-15	μA	1, 2, 3
		V _I = 41.25V, I _L = -5mA		-100	-15	μA	1, 2, 3
ΔI _{Adj} / Line	Adjust Pin Current Change	4.25V ≤ V _I ≤ 41.25V, I _L = -5mA		-5.0	5.0	μA	1, 2, 3
ΔI _{Adj} / Load	Adjust Pin Current Change	V _I = 6.25V, -1.5A ≤ I _L ≤ -5mA		-5.0	5.0	μA	1, 2, 3
I _Q	Minimum Load Current	V _I = 4.25V, Forced V _O = 1.4V		-3.0	-0.2	mA	1, 2, 3
		V _I = 14.25V, Forced V _O = 1.4V		-3.0	-0.2	mA	1, 2, 3
		V _I = 41.25V, Forced V _O = 1.4V		-5.0	-0.2	mA	1, 2, 3
I _{OS}	Output Short Circuit Current	V _I = 4.25V		-3.5	-1.5	A	1, 2, 3
		V _I = 40V		-1.0	-0.18	A	1, 2, 3
V _O (Recov)	Output Voltage Recovery	V _I = 4.25V, R _L = 0.833Ω, C _L = 20μF		1.2	1.3	V	1, 2, 3
		V _I = 40V, R _L = 250Ω		1.2	1.3	V	1, 2, 3
V _O	Output Voltage	V _I = 6.25V, I _L = -5mA	See ⁽²⁾	1.2	1.3	V	2
V _{Start}	Voltage Start-Up	V _I = 4.25V, R _L = 0.833Ω, C _L = 20μF, I _L = -1.5A		1.2	1.3	V	1, 2, 3

(1) Pre and post irradiation limits are identical to those listed under AC and DC electrical characteristics except as listed in the "Post Radiation Limits" table. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are ensured only for the conditions as specified in Mil-Std-883, Method 1019.5, Condition A.

(2) Tested @ T_A = 125°C, correlated to T_A = 150°C

LM117K RH Electrical Characteristics

AC Parameters⁽¹⁾

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
V_{NO}	Output Noise Voltage	$V_I = 6.25V$, $I_L = -100mA$			120	μV_{RMS}	7
$\Delta V_O / \Delta V_I$	Line Transient Response	$V_I = 6.25V$, $\Delta V_I = 3V$, $I_L = -10mA$	See ⁽²⁾		18	mV	7
$\Delta V_O / \Delta I_L$	Load Transient Response	$V_I = 6.25V$, $\Delta I_L = -400mA$, $I_L = -100mA$	See ⁽³⁾		120	mV	7
$\Delta V_I / \Delta V_O$	Ripple Rejection	$V_I = 6.25V$, $I_L = -500mA$, $E_I = 1V_{RMS}$ at $f = 2400Hz$		65		dB	4

- (1) Pre and post irradiation limits are identical to those listed under AC and DC electrical characteristics except as listed in the "Post Radiation Limits" table. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are ensured only for the conditions as specified in Mil-Std-883, Method 1019.5, Condition A.
- (2) SMD limit of 6mV/V is equivalent to 18mV
- (3) SMD limit of 0.3mV/V is equivalent to 120mV

LM117K RH Electrical Characteristics

DC Drift Parameters

The following conditions apply, unless otherwise specified.
Deltas performed on QMLV devices at Group B, Subgroup 5, only.

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
V_O	Output Voltage	$V_I = 4.25V$, $I_L = -5mA$		-0.01	0.01	V	1
		$V_I = 4.25V$, $I_L = -1.5A$		-0.01	0.01	V	1
		$V_I = 41.25V$, $I_L = -5mA$		-0.01	0.01	V	1
		$V_I = 41.25V$, $I_L = -200mA$		-0.01	0.01	V	1
V_{RLine}	Line Regulation	$4.25V \leq V_I \leq 41.25V$, $I_L = -5mA$		-4.0	4.0	mV	1
I_{Adj}	Adjust Pin Current	$V_I = 4.25V$, $I_L = -5mA$		-10	10	μA	1
		$V_I = 41.25V$, $I_L = -5mA$		-10	10	μA	1
V_O (Recov)	Output Voltage Recovery	$V_I = 4.25V$, $R_L = 0.833\Omega$, $C_L = 20\mu S$		-0.01	0.01	V	1
		$V_I = 40V$, $R_L = 250\Omega$		-0.01	0.01	V	1

LM117K RH Electrical Characteristics
AC/DC Post Radiation Limits @ +25°C⁽¹⁾

Symbol	Parameter	Conditions	Notes	Min	Max	Unit	Sub-groups
V _O	Output Voltage	V _I = 4.25V, I _L = -5mA		1.2	1.35 0	V	1
		V _I = 4.25V, I _L = -1.5A		1.2	1.35 0	V	1
		V _I = 41.25V, I _L = -5mA		1.2	1.35 0	V	1
		V _I = 41.25V, I _L = -200mA		1.2	1.35 0	V	1
V _{RLine}	Line Regulation	4.25V ≤ V _I ≤ 41.25V, I _L = -5mA		-25	25	mV	1
V _{RLoad}	Load Regulation	V _I = 6.25V, -1.5A ≤ I _L ≤ -5mA		-7.0	7.0	mV	1
		V _I = 41.25V, -200mA ≤ I _L ≤ -5mA		-7.0	7.0	mV	1
ΔV _I / ΔV _O	Ripple Rejection	V _I = 6.25V, I _L = -500mA E _I = 1V _{RMS} at f = 2400Hz		60		dB	4
V _O (Recov)	Output Voltage Recovery	V _I = 4.25V, R _L = 0.833Ω, C _L = 20μS		1.20	1.35 0	V	1
		V _I = 40V, R _L = 250Ω		1.20	1.35 0	V	1

- (1) Pre and post irradiation limits are identical to those listed under AC and DC electrical characteristics except as listed in the "Post Radiation Limits" table. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are ensured only for the conditions as specified in Mil-Std-883, Method 1019.5, Condition A.

Typical Performance Characteristics

Output Capacitor = 0 μ F unless otherwise noted

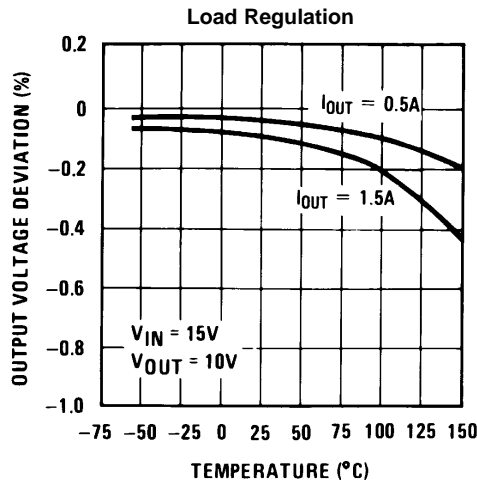


Figure 5.

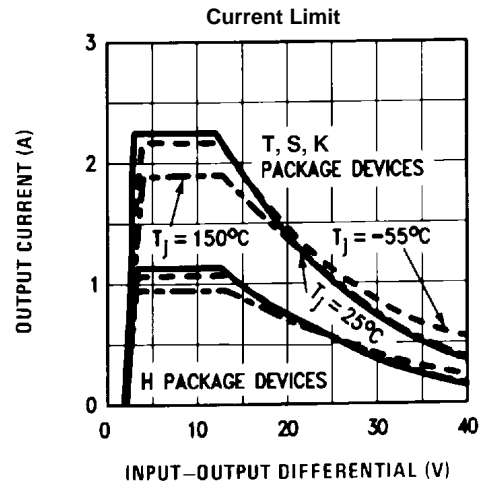


Figure 6.

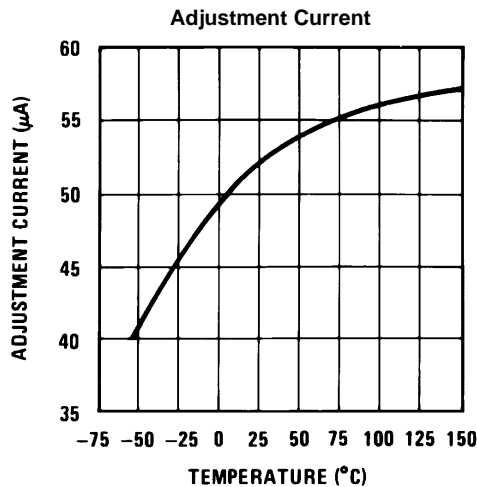


Figure 7.

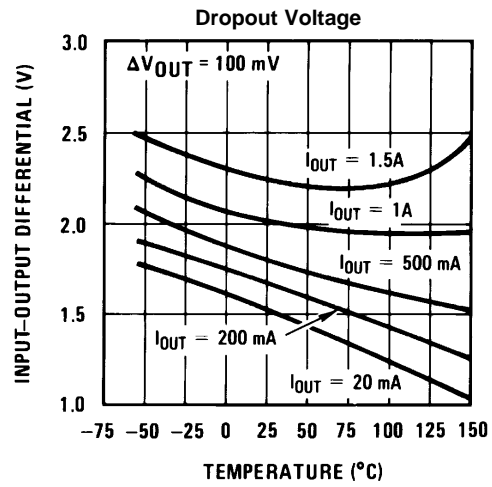


Figure 8.

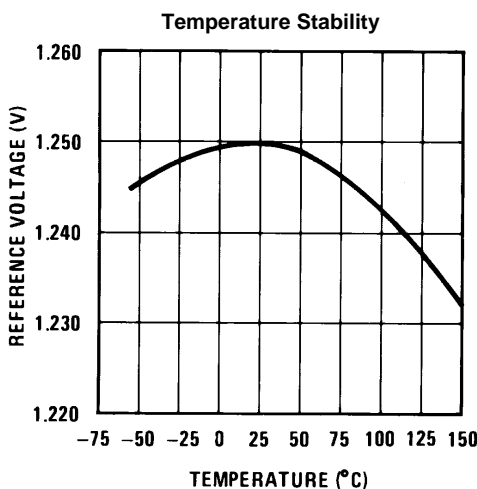


Figure 9.

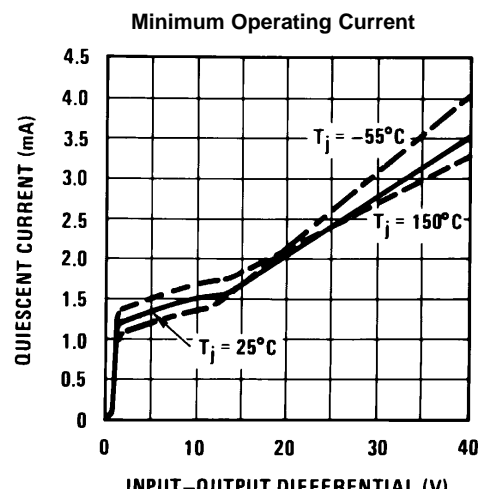


Figure 10.

Typical Performance Characteristics (continued)

Output Capacitor = 0 μ F unless otherwise noted

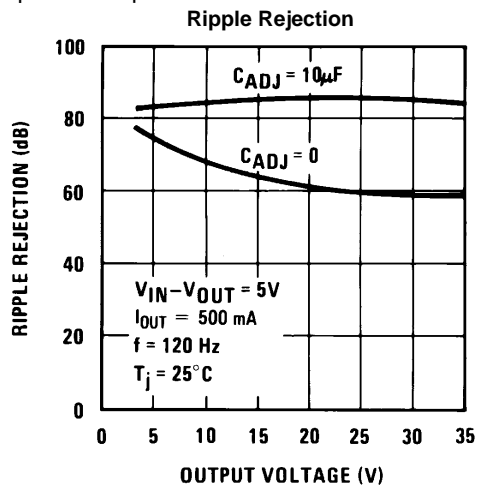


Figure 11.

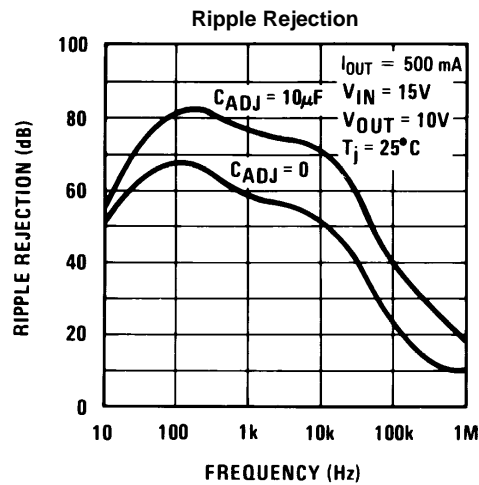


Figure 12.

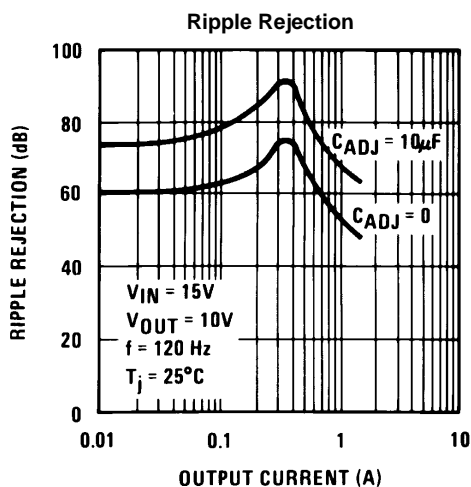


Figure 13.

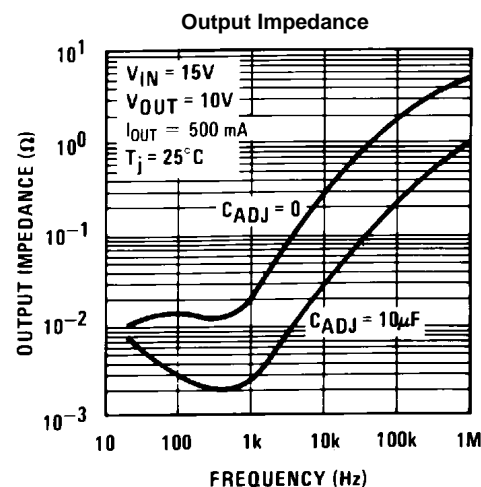


Figure 14.

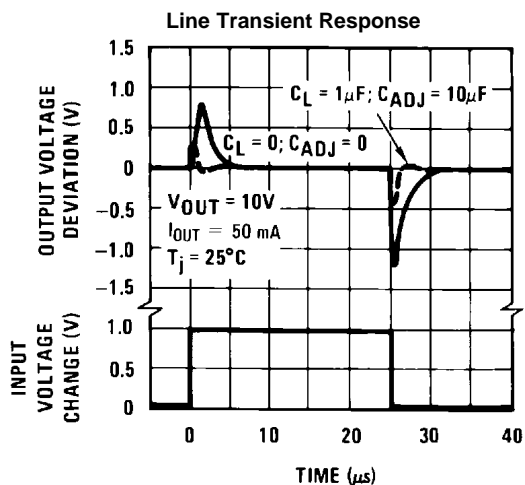


Figure 15.

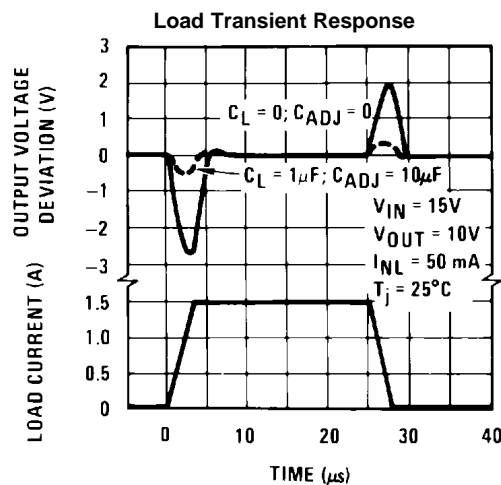
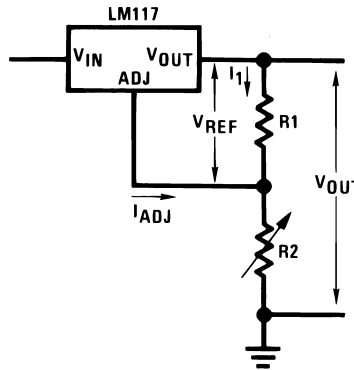


Figure 16.

APPLICATION HINTS

In operation, the LM117 develops a nominal 1.25V reference voltage, V_{REF} , between the output and adjustment terminal. The reference voltage is impressed across program resistor $R1$ and, since the voltage is constant, a constant current I_1 then flows through the output set resistor $R2$, giving an output voltage of

$$V_{OUT} = V_{REF} \left(1 + \frac{R2}{R1} \right) + I_{ADJ}R2 \quad (1)$$



Since the 100µA current from the adjustment terminal represents an error term, the LM117 was designed to minimize I_{ADJ} and make it very constant with line and load changes. To do this, all quiescent operating current is returned to the output establishing a minimum load current requirement. If there is insufficient load on the output, the output will rise.

EXTERNAL CAPACITORS

An input bypass capacitor is recommended. A 0.1µF disc or 1µF solid tantalum on the input is suitable input bypassing for almost all applications. The device is more sensitive to the absence of input bypassing when adjustment or output capacitors are used but the above values will eliminate the possibility of problems.

The adjustment terminal can be bypassed to ground on the LM117 to improve ripple rejection. This bypass capacitor prevents ripple from being amplified as the output voltage is increased. With a 10µF bypass capacitor 80dB ripple rejection is obtainable at any output level. Increases over 10µF do not appreciably improve the ripple rejection at frequencies above 120Hz. If the bypass capacitor is used, it is sometimes necessary to include protection diodes to prevent the capacitor from discharging through internal low current paths and damaging the device.

In general, the best type of capacitors to use is solid tantalum. Solid tantalum capacitors have low impedance even at high frequencies. Depending upon capacitor construction, it takes about 25µF in aluminum electrolytic to equal 1µF solid tantalum at high frequencies. Ceramic capacitors are also good at high frequencies; but some types have a large decrease in capacitance at frequencies around 0.5MHz. For this reason, 0.01µF disc may seem to work better than a 0.1µF disc as a bypass.

Although the LM117 is stable with no output capacitors, like any feedback circuit, certain values of external capacitance can cause excessive ringing. This occurs with values between 500 pF and 5000 pF. A 1µF solid tantalum (or 25µF aluminum electrolytic) on the output swamps this effect and insures stability. Any increase of the load capacitance larger than 10µF will merely improve the loop stability and output impedance.

LOAD REGULATION

The LM117 is capable of providing extremely good load regulation but a few precautions are needed to obtain maximum performance. The current set resistor connected between the adjustment terminal and the output terminal (usually 240Ω) should be tied directly to the output (case) of the regulator rather than near the load. This eliminates line drops from appearing effectively in series with the reference and degrading regulation. For example, a 15V regulator with 0.05Ω resistance between the regulator and load will have a load regulation due to line resistance of $0.05\Omega \times I_L$. If the set resistor is connected near the load the effective line resistance will be $0.05\Omega (1 + R2/R1)$ or in this case, 11.5 times worse.

Figure 17 shows the effect of resistance between the regulator and 240Ω set resistor.

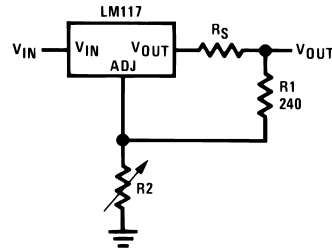


Figure 17. Regulator with Line Resistance in Output Lead

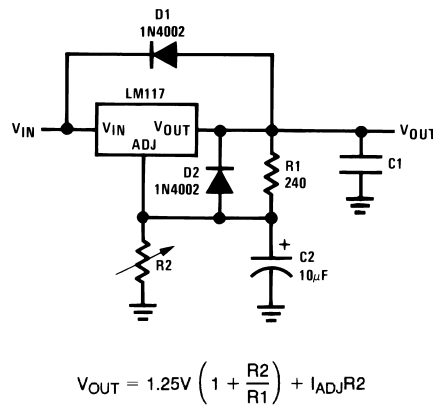
With the TO package, it is easy to minimize the resistance from the case to the set resistor, by using two separate leads to the case. However, with the PFM package, care should be taken to minimize the wire length of the output lead. The ground of R2 can be returned near the ground of the load to provide remote ground sensing and improve load regulation.

PROTECTION DIODES

When external capacitors are used with *any* IC regulator it is sometimes necessary to add protection diodes to prevent the capacitors from discharging through low current points into the regulator. Most 10μF capacitors have low enough internal series resistance to deliver 20A spikes when shorted. Although the surge is short, there is enough energy to damage parts of the IC.

When an output capacitor is connected to a regulator and the input is shorted, the output capacitor will discharge into the output of the regulator. The discharge current depends on the value of the capacitor, the output voltage of the regulator, and the rate of decrease of V_{IN} . In the LM117, this discharge path is through a large junction that is able to sustain 15A surge with no problem. This is not true of other types of positive regulators. For output capacitors of 25μF or less, there is no need to use diodes.

The bypass capacitor on the adjustment terminal can discharge through a low current junction. Discharge occurs when *either* the input or output is shorted. Internal to the LM117 is a 50Ω resistor which limits the peak discharge current. No protection is needed for output voltages of 25V or less and 10μF capacitance. [Figure 18](#) shows an LM117 with protection diodes included for use with outputs greater than 25V and high values of output capacitance.



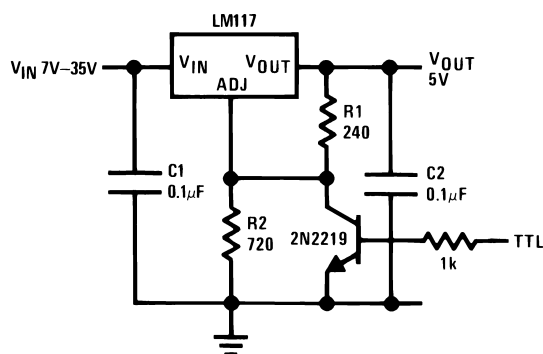
D1 protects against C1
D2 protects against C2

Figure 18. Regulator with Protection Diodes

When a value for $\theta_{(H-A)}$ is found using the equation shown, *a heatsink must be selected that has a value that is less than or equal to this number.*

$\theta_{(H-A)}$ is specified numerically by the heatsink manufacturer in the catalog, or shown in a curve that plots temperature rise vs power dissipation for the heatsink.

Typical Applications



*Min. output $\approx 1.2V$

Figure 19. 5V Logic Regulator with Electronic Shutdown*

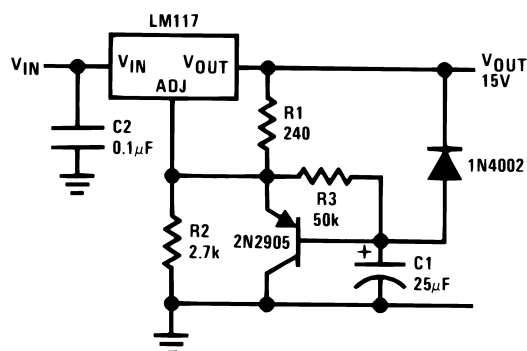
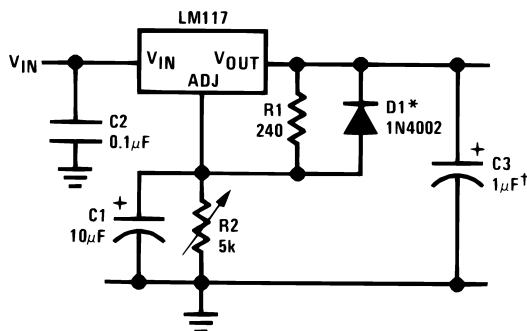


Figure 20. Slow Turn-On 15V Regulator



†Solid tantalum

*Discharges C1 if output is shorted to ground

Figure 21. Adjustable Regulator with Improved Ripple Rejection

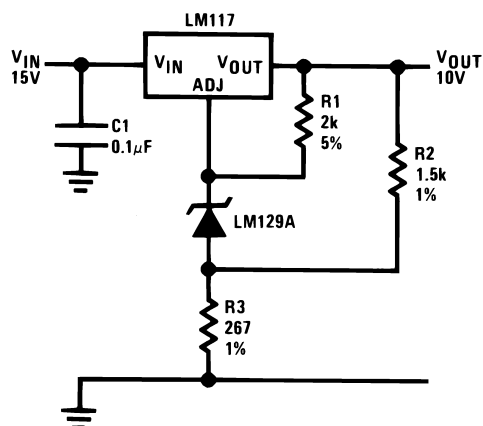
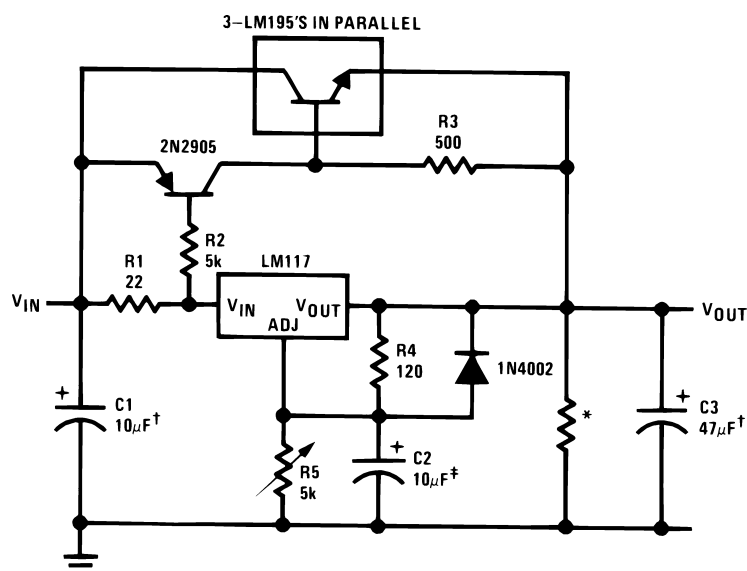


Figure 22. High Stability 10V Regulator

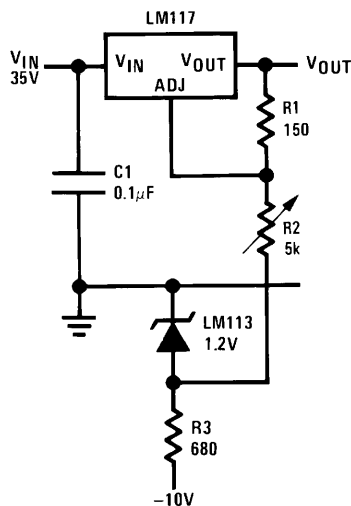


‡Optional—improves ripple rejection

†Solid tantalum

*Minimum load current = 30 mA

Figure 23. High Current Adjustable Regulator



Full output current not available at high input-output voltages

Figure 24. 0 to 30V Regulator

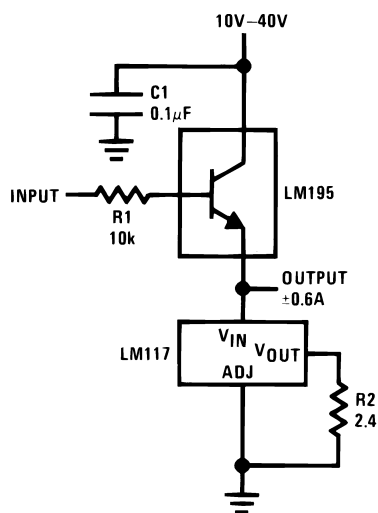
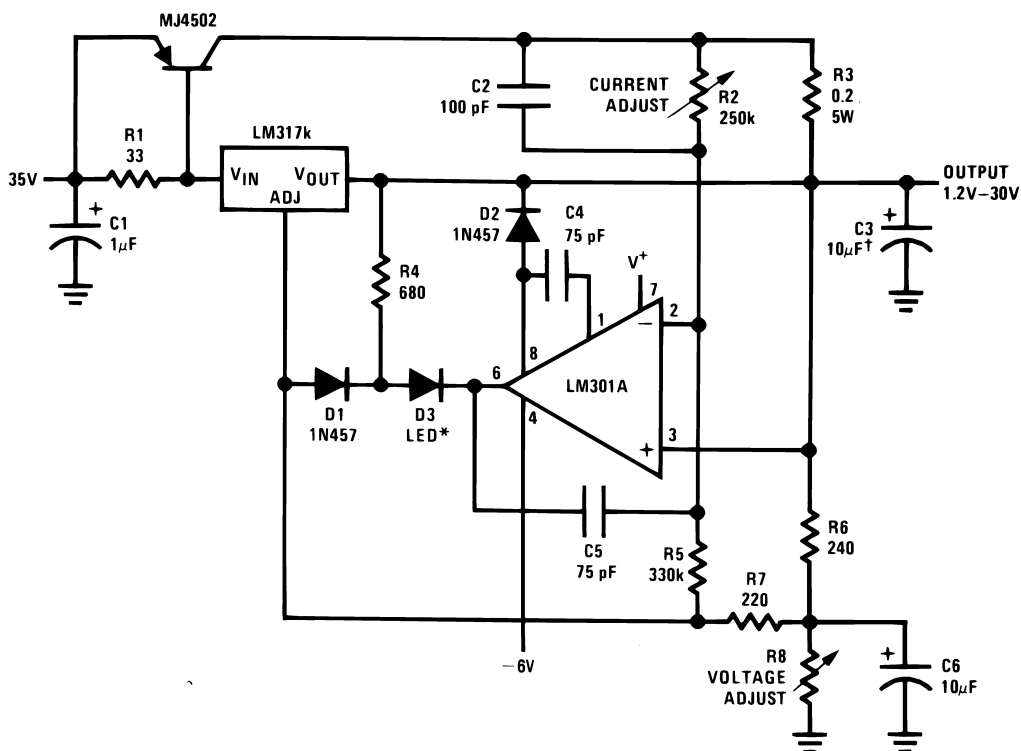


Figure 25. Power Follower



†Solid tantalum

*Lights in constant current mode

Figure 26. 5A Constant Voltage/Constant Current Regulator

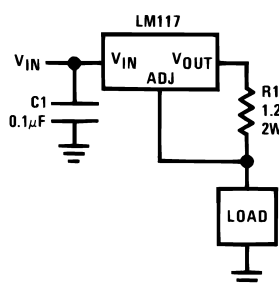
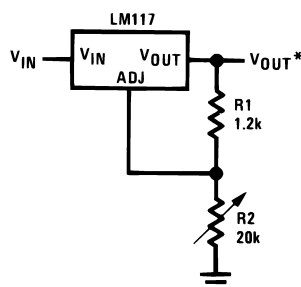


Figure 27. 1A Current Regulator



*Minimum load current $\cong 4$ mA

Figure 28. 1.2V–20V Regulator with Minimum Program Current

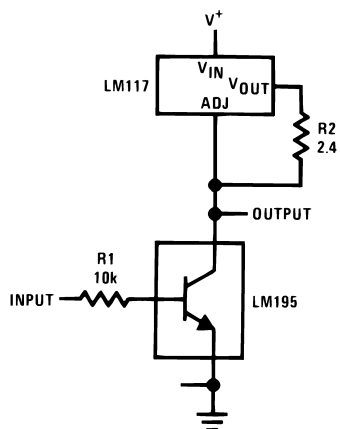
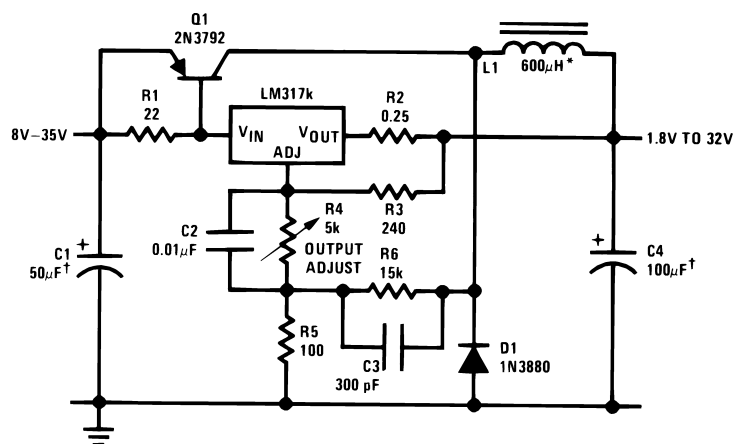


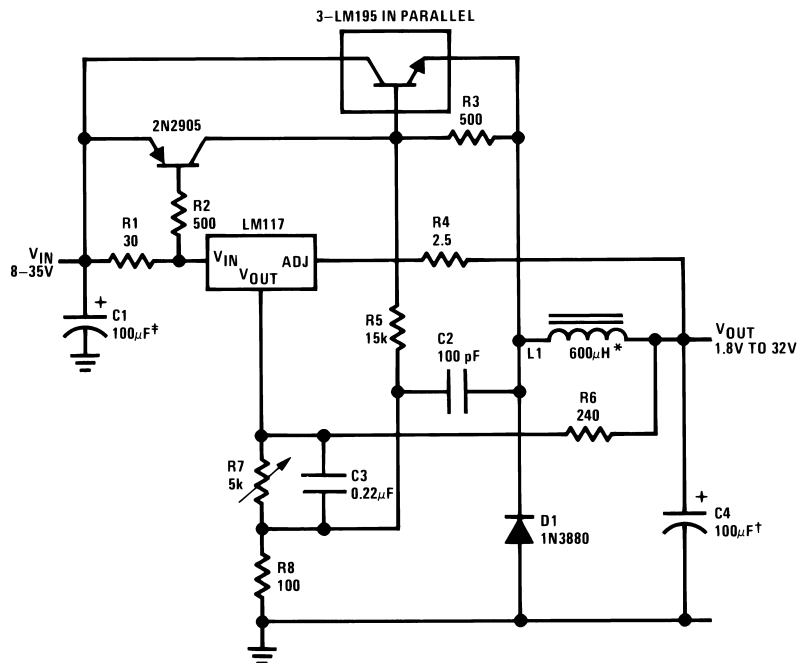
Figure 29. High Gain Amplifier



†Solid tantalum

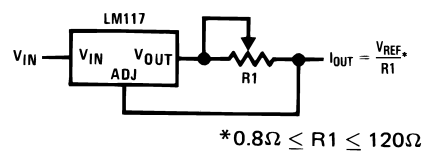
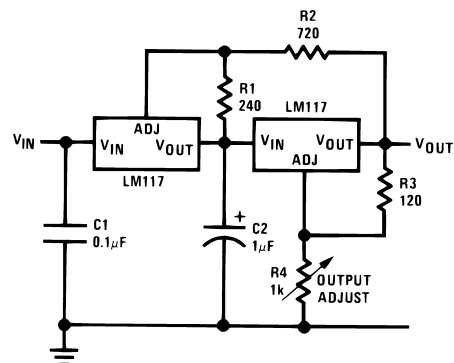
*Core—Arnold A-254168-2 60 turns

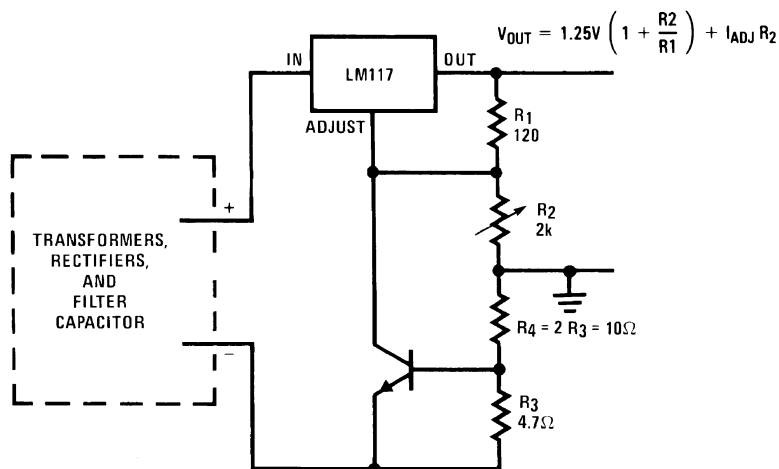
Figure 30. Low Cost 3A Switching Regulator



†Solid tantalum

*Core—Arnold A-254168-2 60 turns

Figure 31. 4A Switching Regulator with Overload Protection**Figure 32. Precision Current Limiter****Figure 33. Tracking Preregulator**

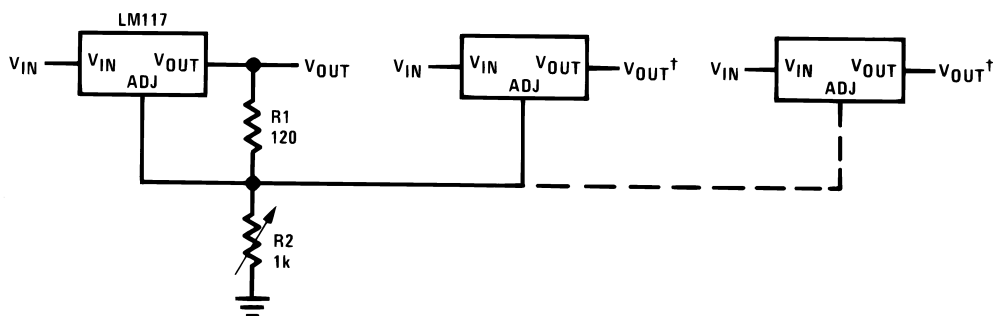


— Short circuit current is approximately $\frac{600 \text{ mV}}{R_3}$, or 120 mA

(Compared to LM117's higher current limit)

—At 50 mA output only $\frac{3}{4}$ volt of drop occurs in R_3 and R_4

Figure 34. Current Limited Voltage Regulator



*All outputs within $\pm 100 \text{ mV}$

†Minimum load—10 mA

Figure 35. Adjusting Multiple On-Card Regulators with Single Control*

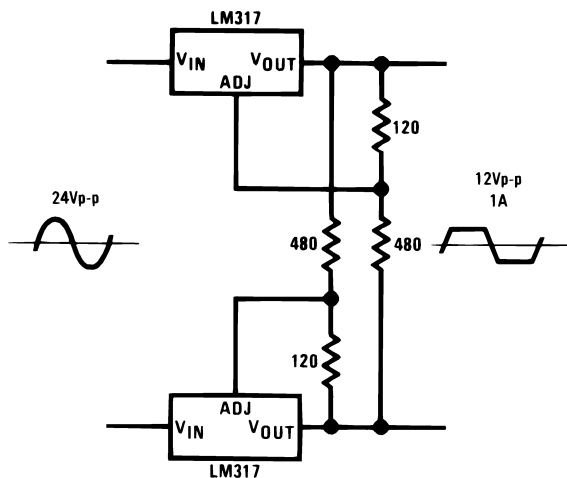
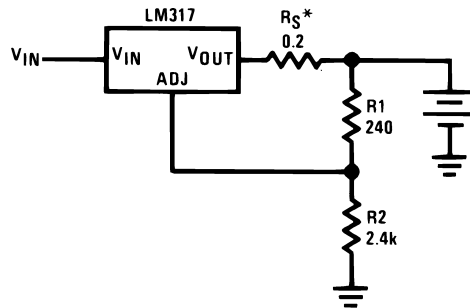


Figure 36. AC Voltage Regulator



$$*R_S \text{—sets output impedance of charger: } Z_{OUT} = R_S \left(1 + \frac{R_2}{R_1} \right)$$

Use of R_S allows low charging rates with fully charged battery.

Figure 37. 12V Battery Charger

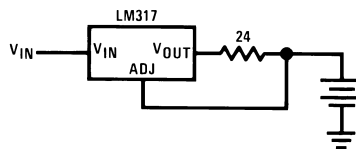


Figure 38. 50mA Constant Current Battery Charger

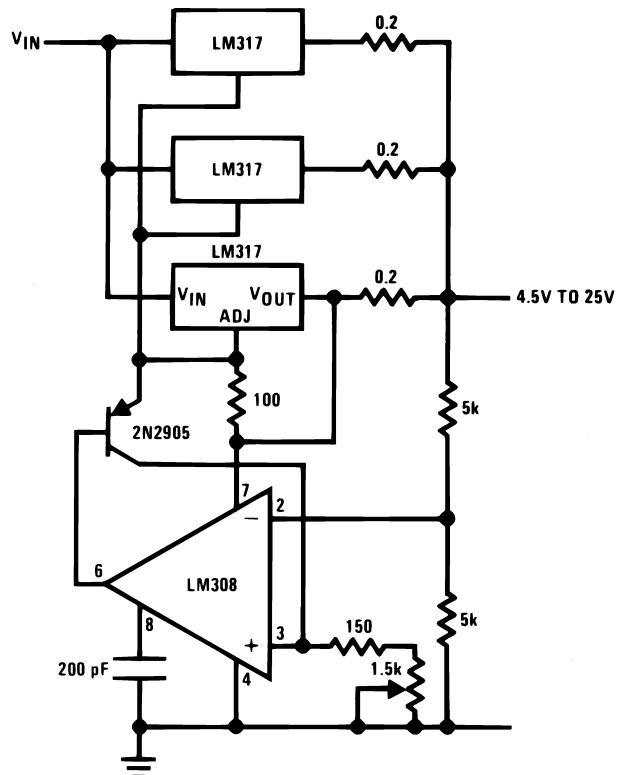
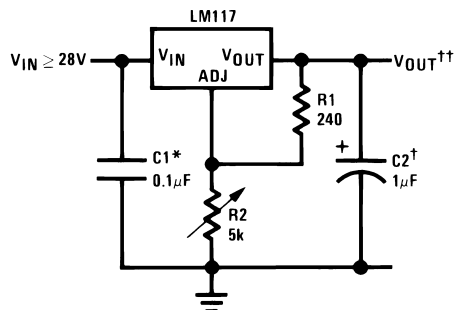


Figure 39. Adjustable 4A Regulator



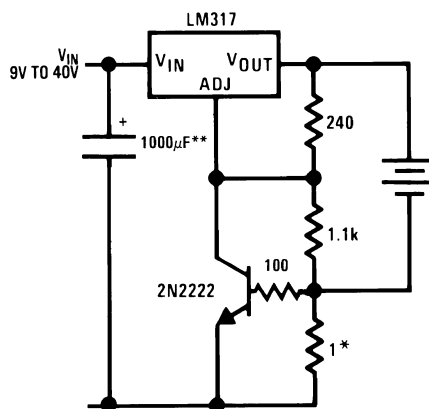
Full output current not available at high input-output voltages

*Needed if device is more than 6 inches from filter capacitors.

†Optional—improves transient response. Output capacitors in the range of 1μF to 1000μF of aluminum or tantalum electrolytic are commonly used to provide improved output impedance and rejection of transients.

$$\dagger\dagger V_{OUT} = 1.25V \left(1 + \frac{R2}{R1} \right) + I_{ADJ}(R2)$$

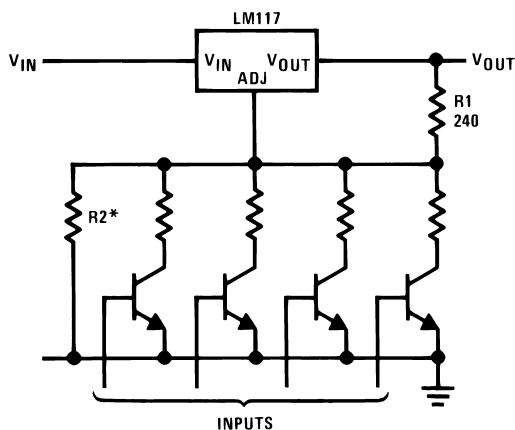
Figure 40. 1.2V–25V Adjustable Regulator



*Sets peak current (0.6A for 1Ω)

**The 1000μF is recommended to filter out input transients

Figure 41. Current Limited 6V Charger



*Sets maximum V_OUT

Figure 42. Digitally Selected Outputs

REVISION HISTORY

Date Released	Revision	Section	Changes
03/17/06	A	New Release to corporate format	5 MDS data sheets were consolidated into one corporate data sheet format. Clarified ΔI_{Adj} Line versus ΔI_{Adj} Load by separating the parameters in all of the tables. MNLM117–K Rev 1C1, MNLM117–X Rev 0A0, MNLM117–E Rev 0B1, MRLM117–X–RH Rev 2A0, MRLM117–K–RH Rev 3A0 will be archived.
06/29/06	B	Features, Ordering Information Table, Rad Hard Electrical Section for PFM and CFP packages and Notes	Deleted NSID LM117WGRQML, no longer available. Added Available with Radiation Ensured, Low Dose NSID's to table 5962R9951705VXA LM117HRLQMLV, 5962R9951705VZA LM117WGRLQMLV, and reference to Note 11 and 12. Note 12 to Rad Hard Electrical Heading for PFM and CFP packages. Note 12 to Notes. Archive Revision A.
11/30/2010	C	Features, Ordering Table, Absolute Ratings, LM117H, WG and K RH Drift Electrical Table	Added radiation info., Update with current device information and format, T0–39 Pkg weight, Vo (Recov). Revision B will be Archived.
09/06/2011	D	Ordering Information, Absolute Ratings	Order Info: Added 'GW' NSIDS and SMD numbers. Abs Max Ratings: Added 'GW' Theta JA and Theta JC along with 'GW' weight. Revision C will be Archived. Deleted Ordering Information table.
04/17/2013	D		Changed layout of National Data Sheet to TI format.

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
LM117E/883	Active	Production	LCCC (NAJ) 20	50 TUBE	Yes	Call TI	Level-1-NA-UNLIM	-55 to 125	LM117E /883 Q ACO /883 Q >T
LM117GW/883	Active	Production	CFP (NAC) 16	88 TUBE	No	SNPB	Level-1-NA-UNLIM	-	LM117GW /883 Q ACO /883 Q >T
LM117H MD8	Active	Production	DIESALE (Y) 0	196 JEDEC TRAY (5+1)	Yes	Call TI	Level-1-NA-UNLIM	-55 to 125	
LM117H/883	Active	Production	TO (NDT) 3	20 JEDEC TRAY (5+1)	No	Call TI	Level-1-NA-UNLIM	-55 to 125	LM117H/883 Q ACO LM117H/883 Q >T
LM117K/883	Active	Production	TO (K) 2	50 TRAY NON-STD	Yes	Call TI	Level-1-NA-UNLIM	-55 to 125	LM117K /883 Q ACO /883 Q >T
LM117KG MD8	Active	Production	DIESALE (Y) 0	196 JEDEC TRAY (5+1)	Yes	Call TI	Level-1-NA-UNLIM	-55 to 125	

⁽¹⁾ **Status:** For more details on status, see our [product life cycle](#).

⁽²⁾ **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

⁽⁴⁾ **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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OTHER QUALIFIED VERSIONS OF LM117QML :

- Space : [LM117QML-SP](#)

NOTE: Qualified Version Definitions:

- Space - Radiation tolerant, ceramic packaging and qualified for use in Space-based application

TUBE



*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
LM117E/883	NAJ	LCCC	20	50	470	11	3810	0

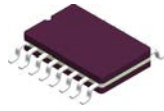
TRAY



Chamfer on Tray corner indicates Pin 1 orientation of packed units.

*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	Unit array matrix	Max temperature (°C)	L (mm)	W (mm)	K0 (μm)	P1 (mm)	CL (mm)	CW (mm)
LM117H/883	NDT	TO-CAN	3	20	2 X 10	150	126.49	61.98	8890	11.18	12.95	18.54
LM117K/883	K	TO-CAN	2	50	9 X 6	NA	292.1	215.9	25654	3.87	22.3	25.4

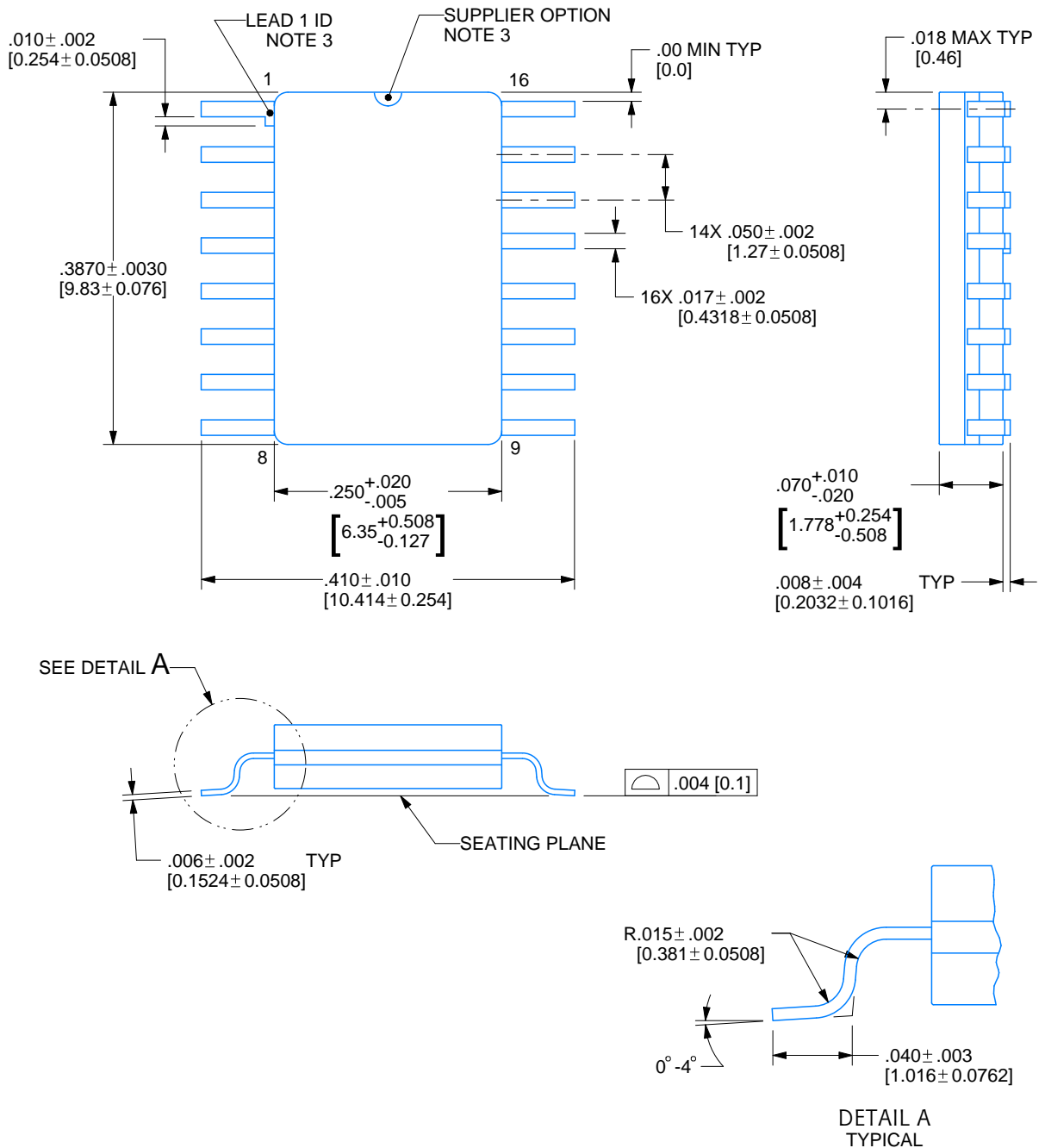


NAC0016A

PACKAGE OUTLINE

CFP - 2.33mm max height

CERAMIC FLATPACK



4215198/C 08/2022

NOTES:

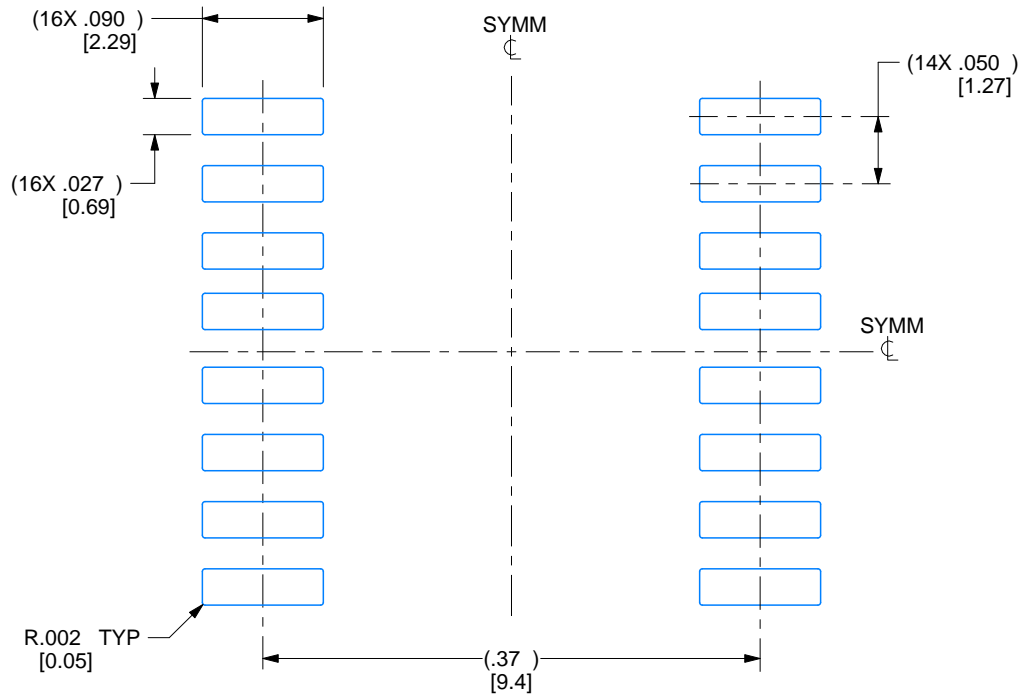
- Controlling dimension is Inch. Values in [] are millimeters. Dimensions in () for reference only.
- For solder thickness and composition, see the "Lead Finish Composition/Thickness" link in the packaging section of the Texas Instruments website
- Lead 1 identification shall be:
 - A notch or other mark within this area
 - A tab on lead 1, either side
- No JEDEC registration as of December 2021

EXAMPLE BOARD LAYOUT

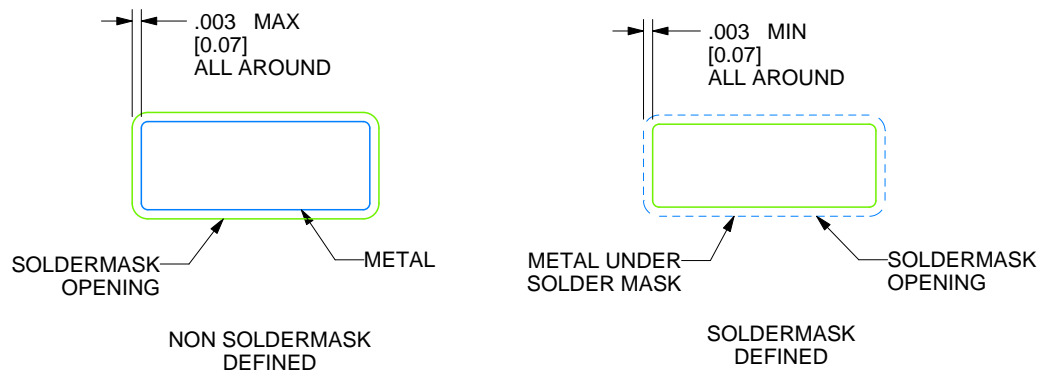
NAC0016A

CFP - 2.33mm max height

CERAMIC FLATPACK



RECOMMENDED LAND PATTERN



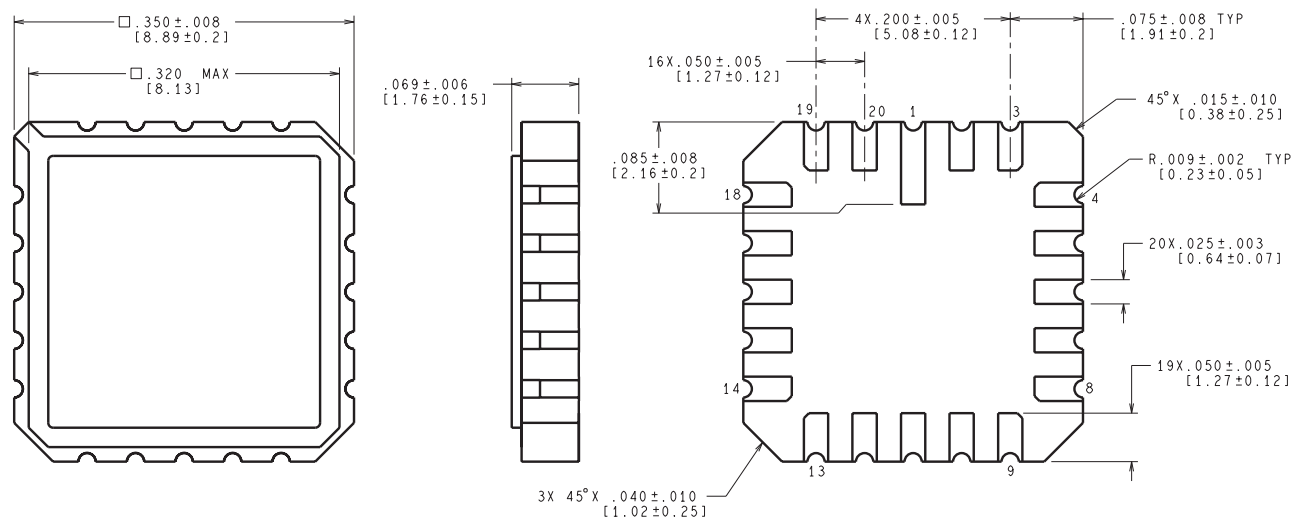
4215198/C 08/2022

REVISIONS

REV	DESCRIPTION	E.C.N.	DATE	BY/APP'D
A	RELEASE TO DOCUMENT CONTROL	2197879	12/30/2021	TINA TRAN / ANIS FAUZI
B	NO CHANGE TO DRAWING; REVISION FOR YODA RELEASE;	2198832	02/15/2022	K. SINCERBOX
C	.387± .003 WAS .39000± .00012;	2200917	08/08/2022	D. CHIN / K. SINCERBOX



NAJ0020A



CONTROLLING DIMENSION IS INCH
VALUES IN [] ARE MILLIMETERS

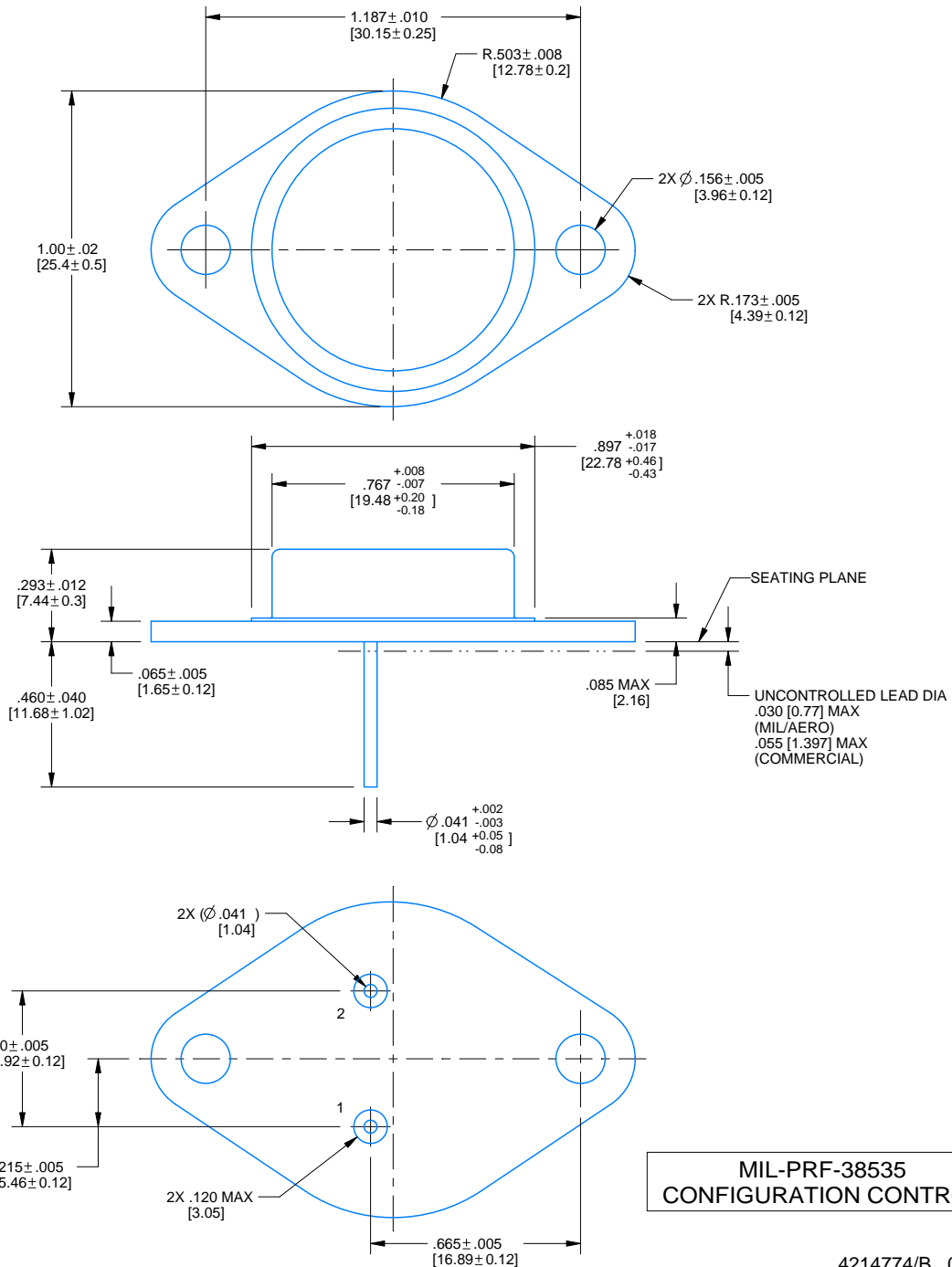
E20A (Rev F)

K0002A

PACKAGE OUTLINE

TO-CAN - 7.747 mm max height

TRANSISTOR OUTLINE



4214774/B 09/2024

NOTES:

1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Leads not to be bent greater than 15° .

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