VOLTAGE REGULATOR WITH RESET OUTPUT

FEATURES

- Very Low Dropout Voltage
- Reset Output for Microprocessor
- Very Low Quiescent Current (No Load)
- Internal Thermal / Overload Shutdown
- Low Noise Voltage
- Input and Output Voltage Sense
- ± 2.5 % Output Voltage Accuracy
- CMOS or TTL ON/OFF Control
- High Speed ON/OFF Transient (Typ. 50 µs)

APPLICATIONS

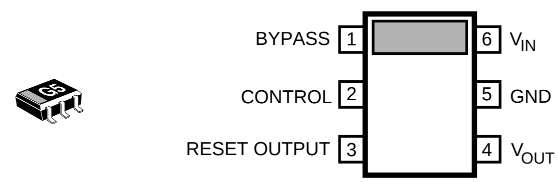
- Battery Powered Systems
- Cellular Telephones
- Pagers
- Personal Communications Equipment
- Portable Instrumentation
- Portable Consumer Equipment
- Radio Control Systems
- Toys
- Low Voltage Systems

DESCRIPTION

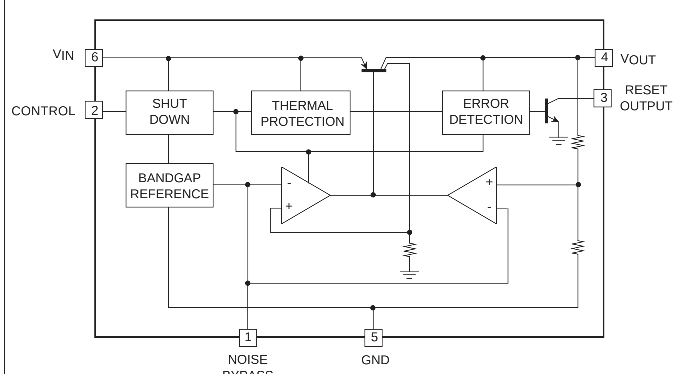
The TK119 series are low power, linear regulators with built-in electronic switches. Built-in voltage comparators provide a reset logic LOW level whenever the input or output voltage falls outside internally preset limits. The internal electronic switch can be controlled by CMOS or TLL levels. The device is in the OFF state when the control pin is biased HIGH.

An internal PNP pass-transistor is used in order to achieve low dropout voltage (typically 200 mV at 50 mA load current). The device has very low quiescent current (130 µA) in the ON mode with no load and 2 mA with 30 mA load. The quiescent current is typically 4 mA at 60 mA load. The current consumption in the OFF mode is 65 µA. An internal thermal shutdown circuit limits the junction temperature to below 150 °C. The load current is internally monitored and the device will shut down (no load current) in the presence of a short circuit at the output. The output noise is very low at 100 dB down from V_{OUT} when an external noise bypass capacitor is used. The TK119xx is available in a small SOT-23L surface mount package.

TK119XXM



BLOCK DIAGRAM



ORDERING INFORMATION

TK119 □□ M □□

Voltage Code — Tape/Reel Code

Voltage Code		Tape/Reel Code
22 = 2.25 V	35 = 3.5 V	BX : Bulk/Bag
27 = 2.75V	40 = 4.0 V	TL : Tape Left
30 = 3.0 V	48 = 4.8 V	
32 = 3.25V	50 = 5.0 V	

ABSOLUTE MAXIMUM RATINGS

Supply Voltage .... 17 V
Operating Voltage Range .... 1.8 to 16 V
Power Dissipation (Note1) .... 400 mW
Storage Temperature Range .... -55 to +150 °C
Operating Temperature Range .... -30 to +80 °C
Lead Soldering Temp. (10 sec.) .... 240 °C
Junction Temperature .... 150 °C

TK11922 ELECTRICAL CHARACTERISTICS

Test conditions: V_{IN} = (3.25 V, T_A = 25 °C, C_L = 10 µF, C_P = 0.01 µF), unless otherwise specified

SYMBOL	PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNITS
I_{IN}	Supply Current	I_O = 0 mA		140	300	µA
		V_{IN} = 1.25 V, I_O = 0 mA		380	900	µA
I_Q	Quiescent Current	I_O = 60 mA		2.5	10	mA
I_{STBY}	Standby Current	Output Off		95	160	µA
V_O	Regulated Output Voltage	I_O = 1 mA, T_A = 25 °C	2.17	2.25	2.33	V
		I_O = 1 mA, $-30 \le T_A \le 80$ ºC	2.13	2.25	2.37	V
V_{DROP}	Dropout Voltage	I_O = 30 mA		160	350	mV
I_O	Output Current				100	mA
Line Reg	Line Regulation	V_{IN} = 3.25 V → 12.25 V		±5	±50	mV
Load Reg	Load Regulation	I_O = 1 → 80 mA		20	100	mV
RR	Ripple Rejection	f = 400 Hz		68		dB
V_{NO}	Output Noise	10 Hz < f < 100 kHz		50		µV(rms)
$\Delta V_O/\Delta T_A$	Output Voltage Temperature Coefficient			±0.2		mV/°C
V_{DET}	Low Voltage Detector	(Note 2)	1.91	2.05	2.19	V
V_{Reset}	Saturation Voltage	I_{FLAG} = 100 µA		0.2	0.4	V
Control						
I_{CONT}	Control Pin Current	V_{CONT} = 5 V		25	100	µA
		V_{CONT} = 16 V		45	150	µA
V_{CONT}	Control Voltage	Output On			0.6	V
		Output Off	2.2			V
t_r	Output Rise Time	I_O = 30 mA, C_L = 0.1 µF, C_P = 0.1 µF		50		µs

Note 1: Power dissipation is 400 mW when mounted as recommended. Derate at 3.2 mW/°C for operation above T_A = 25 °C.
Note 2: $V_{DET} = V_{OUT}$ x 0.91. Values in the table are for reference only.

TK11927 ELECTRICAL CHARACTERISTICS

Test conditions: V_{IN} = (3.75V, T_A = 25 °C, C_L = 10 µF, C_P = 0.01 µF), unless otherwise specified

SYMBOL	PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNITS
I_{IN}	Supply Current	I_O = 0 mA		140	300	µA
		V_{IN} = 1.75 V, I_O = 0 mA		380	900	µA
I_Q	Quiescent Current	I_O = 60 mA		2.5	10	mA
I_{STBY}	Standby Current	Output Off		95	160	µA
V_O	Regulated Output Voltage	I_O = 1 mA, T_A = 25 °C	2.67	2.75	2.83	V
		I_O = 1 mA, -30 ≤ T_A ≤ 80 ºC	2.63	2.75	2.87	V
V_{DROP}	Dropout Voltage	I_O = 30 mA		160	350	mV
I_O	Output Current				100	mA
Line Reg	Line Regulation	V_{IN} = 3.75 V → 12.75 V		±5	±50	mV
Load Reg	Load Regulation	I_O = 1 → 80 mA		20	100	mV
RR	Ripple Rejection	f = 400 Hz		68		dB
V_{NO}	Output Noise	10 Hz < f < 100 kHz		50		µV(rms)
$\Delta V_O/\Delta T_A$	Output Voltage Temperature Coefficient			±0.2		mV/°C
V_{DET}	Low Voltage Detector	(Note 1)	2.47	2.61	2.75	V
V_{Reset}	Saturation Voltage	I_{FLAG} = 100 µA		0.2	0.4	V
Control						
I_{CONT}	Control Pin Current	V_{CONT} = 5 V		25	100	µA
		V_{CONT} = 16 V		45	150	µA
V_{CONT}	Control Voltage	Output On			0.6	V
		Output Off	2.2			V
t_r	Output Rise Time	I_O = 30 mA, C_L = 0.1 µF, C_P = 0.1 µF		50		µs

Note 1: V_{DET} = V_{OUT} x 0.95. Values in the table are for reference only.

TK11930 ELECTRICAL CHARACTERISTICS

Test conditions: V_{IN} = (4.0 V, T_A = 25 °C, C_L = 10 µF, C_P = 0.01 µF), unless otherwise specified

SYMBOL	PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNITS
I_{IN}	Supply Current	I_O = 0 mA		140	300	µA
		V_{IN} = 2.0 V, I_O = 0 mA		380	900	µA
I_Q	Quiescent Current	I_O = 60 mA		2.5	10	mA
I_{STBY}	Standby Current	Output Off		95	160	µA
V_O	Regulated Output Voltage	I_O = 1 mA, T_A = 25 °C	2.92	3.0	3.08	V
		I_O = 1 mA, -30 ≤ T_A ≤ 80 ºC	2.88	3.0	3.12	V
V_{DROP}	Dropout Voltage	I_O = 30 mA		160	350	mV
I_O	Output Current				100	mA
Line Reg	Line Regulation	V_{IN} = 4.0 V → 13.0 V		±5	±50	mV
Load Reg	Load Regulation	I_O = 1 → 80 mA		20	100	mV
RR	Ripple Rejection	f = 400 Hz		68		dB
V_{NO}	Output Noise	10 Hz < f < 100 kHz		50		µV(rms)
$\Delta V_O/\Delta T_A$	Output Voltage Temperature Coefficient			±0.2		mV/°C
V_{DET}	Low Voltage Detector	(Note 1)	2.71	2.85	2.99	V
V_{Reset}	Saturation Voltage	I_{FLAG} = 100 µA		0.2	0.4	V
Control						
I_{CONT}	Control Pin Current	V_{CONT} = 5 V		25	100	µA
		V_{CONT} = 16 V		45	150	µA
V_{CONT}	Control Voltage	Output On			0.6	V
		Output Off	2.2			V
t_r	Output Rise Time	I_O = 30 mA, C_L = 0.1 µF, C_P = 0.1 µF		50		µs

Note 1: V_{DET} = V_{OUT} x 0.95. Values in the table are for reference only.

TK11932 ELECTRICAL CHARACTERISTICS

Test conditions: V_{IN} = (4.25 V, T_A = 25 °C, C_L = 10 µF, C_P = 0.01 µF), unless otherwise specified

SYMBOL	PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNITS
I_{IN}	Supply Current	I_O = 0 mA		140	300	µA
		V_{IN} = 2.25V, I_O = 0 mA		380	900	µA
I_Q	Quiescent Current	I_O = 60 mA		2.5	10	mA
I_{STBY}	Standby Current	Output Off		95	160	µA
V_O	Regulated Output Voltage	I_O = 1 mA, T_A = 25 °C	3.17	3.25	3.33	V
		I_O = 1 mA, $-30 \leq T_A \leq 80$ ºC	3.13	3.25	3.37	V
V_{DROP}	Dropout Voltage	I_O = 30 mA		160	350	mV
I_O	Output Current				100	mA
Line Reg	Line Regulation	V_{IN} = 4.25 V → 13.25 V		±5	±50	mV
Load Reg	Load Regulation	I_O = 1 → 80 mA		20	100	mV
RR	Ripple Rejection	f = 400 Hz		68		dB
V_{NO}	Output Noise	10 Hz < f < 100 kHz		50		µV(rms)
$\Delta V_O/\Delta T_A$	Output Voltage Temperature Coefficient			±0.2		mV/°C
V_{DET}	Low Voltage Detector	(Note 1)	2.95	3.09	3.22	V
V_{Reset}	Saturation Voltage	I_{FLAG} = 100 µA		0.2	0.4	V
Control						
I_{CONT}	Control Pin Current	V_{CONT} = 5 V		25	100	µA
		V_{CONT} = 16 V		45	150	µA
V_{CONT}	Control Voltage	Output On			0.6	V
		Output Off	2.2			V
t_r	Output Rise Time	I_O = 30 mA, C_L = 0.1 µF, C_P = 0.1 µF		50		µs

Note 1: $V_{DET} = V_{OUT}$ x 0.95. Values in the table are for reference only.

TK11935 ELECTRICAL CHARACTERISTICS

Test conditions: V_{IN} = (4.5 V, T_A = 25 °C, C_L = 10 µF, C_P = 0.01 µF), unless otherwise specified

SYMBOL	PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNITS
I_{IN}	Supply Current	I_O = 0 mA		140	300	µA
		V_{IN} = 2.5 V, I_O = 0 mA		380	900	µA
I_Q	Quiescent Current	I_O = 60 mA		2.5	10	mA
I_{STBY}	Standby Current	Output Off		95	160	µA
V_O	Regulated Output Voltage	I_O = 1 mA, T_A = 25 °C	3.41	3.50	3.59	V
		I_O = 1 mA, -30 ≤ T_A ≤ 80 ºC	3.37	3.50	3.63	V
V_{DROP}	Dropout Voltage	I_O = 30 mA		160	350	mV
I_O	Output Current				100	mA
Line Reg	Line Regulation	V_{IN} = 4.5V → 13.5 V		±5	±50	mV
Load Reg	Load Regulation	I_O = 1 → 80 mA		20	100	mV
RR	Ripple Rejection	f = 400 Hz		68		dB
V_{NO}	Output Noise	10 Hz < f < 100 kHz		50		µV(rms)
$\Delta V_O/\Delta T_A$	Output Voltage Temperature Coefficient			±0.2		mV/°C
V_{DET}	Low Voltage Detector	(Note 1)	3.19	3.33	3.46	V
V_{Reset}	Saturation Voltage	I_{FLAG} = 100 µA		0.2	0.4	V
Control						
I_{CONT}	Control Pin Current	V_{CONT} = 5 V		25	100	µA
		V_{CONT} = 16 V		45	150	µA
V_{CONT}	Control Voltage	Output On			0.6	V
		Output Off	2.2			V
t_r	Output Rise Time	I_O = 30 mA, C_L = 0.1 µF, C_P = 0.1 µF		50		µs

Note 1: V_{DET} = V_{OUT} x 0.95. Values in the table are for reference only.

TK11940 ELECTRICAL CHARACTERISTICS

Test conditions: V_{IN} = (5.0 V, T_A = 25 °C, C_L = 10 µF, C_P = 0.01 µF), unless otherwise specified

SYMBOL	PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNITS
I_{IN}	Supply Current	I_O = 0 mA		140	300	µA
		V_{IN} = 3.0 V, I_O = 0 mA		380	900	µA
I_Q	Quiescent Current	I_O = 60 mA		2.5	10	mA
I_{STBY}	Standby Current	Output Off		95	160	µA
V_O	Regulated Output Voltage	I_O = 1 mA, T_A = 25 °C	3.90	4.0	4.10	V
		I_O = 1 mA, $-30 \leq T_A \leq 80$ ºC	3.86	4.0	4.14	V
V_{DROP}	Dropout Voltage	I_O = 30 mA		160	350	mV
I_O	Output Current				100	mA
Line Reg	Line Regulation	V_{IN} = 5.0 V → 14.0 V		±5	±50	mV
Load Reg	Load Regulation	I_O = 1 → 80 mA		20	100	mV
RR	Ripple Rejection	f = 400 Hz		68		dB
V_{NO}	Output Noise	10 Hz < f < 100 kHz		50		µV(rms)
$\Delta V_O/\Delta T_A$	Output Voltage Temperature Coefficient			±0.2		mV/°C
V_{DET}	Low Voltage Detector	(Note 1)	3.64	3.80	3.96	V
V_{Reset}	Saturation Voltage	I_{FLAG} = 100 µA		0.2	0.4	V
Control						
I_{CONT}	Control Pin Current	V_{CONT} = 5 V		25	100	µA
		V_{CONT} = 16 V		45	150	µA
V_{CONT}	Control Voltage	Output On			0.6	V
		Output Off	2.2			V
t_r	Output Rise Time	I_O = 30 mA, C_L = 0.1 µF, C_P = 0.1 µF		50		µs

Note 1: $V_{DET} = V_{OUT}$ x 0.95. Values in the table are for reference only.

TK11948 ELECTRICAL CHARACTERISTICS

Test conditions: V_{IN} = (5.8 V, T_A = 25 °C, C_L = 10 µF, C_P = 0.01 µF), unless otherwise specified

SYMBOL	PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNITS
I_{IN}	Supply Current	I_O = 0 mA		140	300	µA
		V_{IN} = 3.8 V, I_O = 0 mA		380	900	µA
I_Q	Quiescent Current	I_O = 60 mA		2.5	10	mA
I_{STBY}	Standby Current	Output Off		95	160	µA
V_O	Regulated Output Voltage	I_O = 1 mA, T_A = 25 °C	4.68	4.8	4.92	V
		I_O = 1 mA, $-30 \leq T_A \leq 80$ ºC	4.63	4.8	4.97	V
V_{DROP}	Dropout Voltage	I_O = 30 mA		160	350	mV
I_O	Output Current				100	mA
Line Reg	Line Regulation	V_{IN} = 5.8 V → 14.8 V		±5	±50	mV
Load Reg	Load Regulation	I_O = 1 → 80 mA		20	100	mV
RR	Ripple Rejection	f = 400 Hz		68		dB
V_{NO}	Output Noise	10 Hz < f < 100 kHz		50		µV(rms)
$\Delta V_O/\Delta T_A$	Output Voltage Temperature Coefficient			±0.2		mV/°C
V_{DET}	Low Voltage Detector	(Note 1)	4.38	4.56	4.74	V
V_{Reset}	Saturation Voltage	I_{FLAG} = 100 µA		0.2	0.4	V
Control						
I_{CONT}	Control Pin Current	V_{CONT} = 5 V		25	100	µA
		V_{CONT} = 16 V		45	150	µA
V_{CONT}	Control Voltage	Output On			0.6	V
		Output Off	2.2			V
t_r	Output Rise Time	I_O = 30 mA, C_L = 0.1 µF, C_P = 0.1 µF		50		µs

Note 1: $V_{DET} = V_{OUT} \times 0.95$. Values in the table are for reference only.

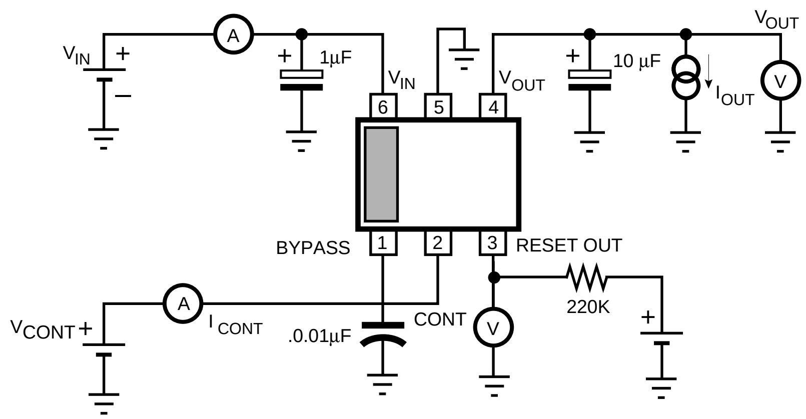
TK11950 ELECTRICAL CHARACTERISTICS

Test conditions: V_{IN} = (6.0 V, T_A = 25 °C, C_L = 10 µF, C_P = 0.01 µF), unless otherwise specified

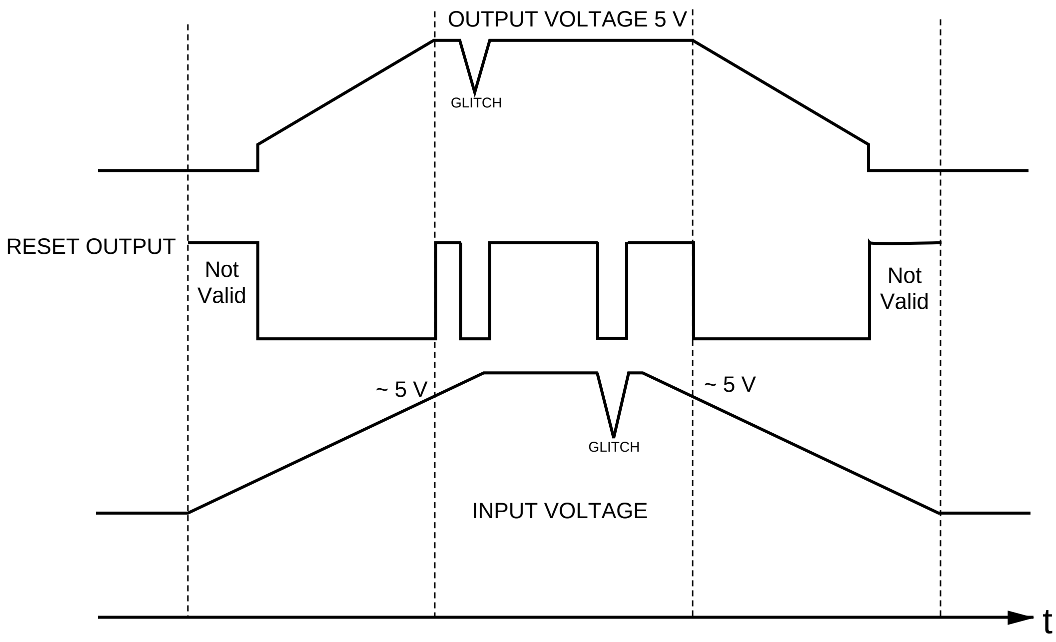
SYMBOL	PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNITS
I_{IN}	Supply Current	I_O = 0 mA		140	300	µA
		V_{IN} = 4.0 V, I_O = 0 mA		380	900	µA
I_Q	Quiescent Current	I_O = 60 mA		2.5	10	mA
I_{STBY}	Standby Current	Output Off		95	160	µA
V_O	Regulated Output Voltage	I_O = 1 mA, T_A = 25 °C	4.875	5.0	5.125	V
		I_O = 1 mA, -30 ≤ T_A ≤ 80 ºC	4.825	5.0	5.175	V
V_{DROP}	Dropout Voltage	I_O = 30 mA		160	350	mV
I_O	Output Current				100	mA
Line Reg	Line Regulation	V_{IN} = 6.0 V → 15.0 V		±5	±50	mV
Load Reg	Load Regulation	I_O = 1 → 80 mA		20	100	mV
RR	Ripple Rejection	f = 400 Hz		68		dB
V_{NO}	Output Noise	10 Hz < f < 100 kHz		50		µV(rms)
$\Delta V_O/\Delta T_A$	Output Voltage Temperature Coefficient			±0.2		mV/°C
V_{DET}	Low Voltage Detector	(Note 1)	4.56	4.75	4.94	V
V_{Reset}	Saturation Voltage	I_{FLAG} = 100 µA		0.2	0.4	V
Control						
I_{CONT}	Control Pin Current	V_{CONT} = 5 V		25	100	µA
		V_{CONT} = 16 V		45	150	µA
V_{CONT}	Control Voltage	Output On			0.6	V
		Output Off	2.2			V
t_r	Output Rise Time	I_O = 30 mA, C_L = 0.1 µF, C_P = 0.1 µF		50		µs

Note 1: $V_{DET} = V_{OUT}$ x 0.95. Values in the table are for reference only.

TEST CIRCUIT



TIMING DIAGRAM
PRINCIPLE OF OPERATION

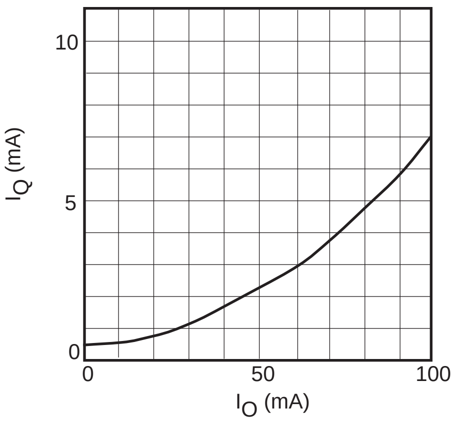


TYPICAL PERFORMANCE CHARACTERISTICS

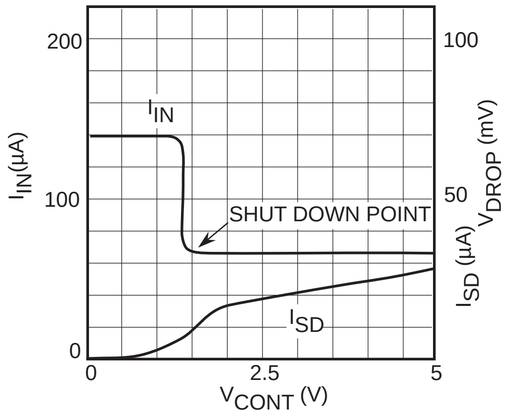
T_A = 25 °C, unless otherwise specified

TK119xx

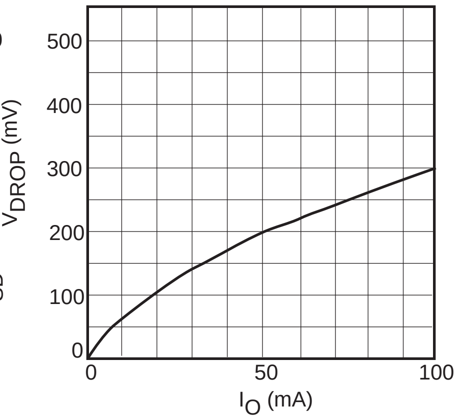
QUIESCENT CURRENT vs. LOAD CURRENT



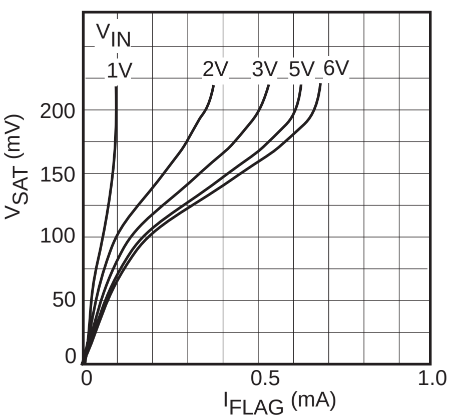
INPUT CURRENT vs. CONTROL VOLTAGE



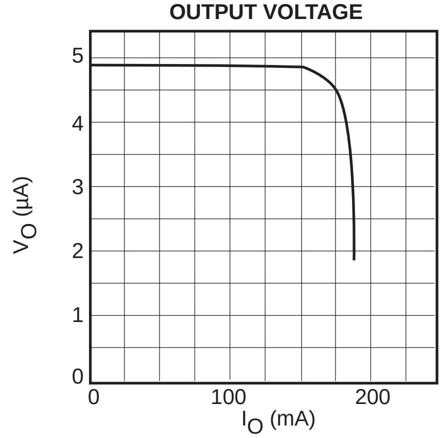
DROPOUT VOLTAGE vs. LOAD CURRENT



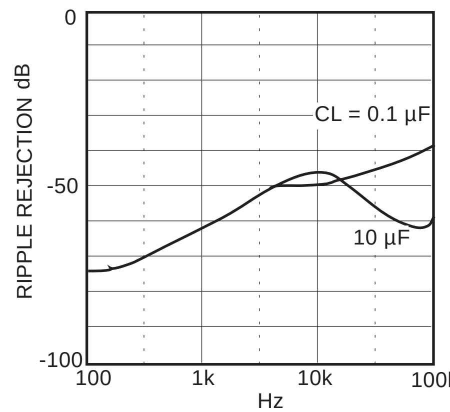
SATURATION VOLTAGE vs. ERROR OUTPUT CURRENT



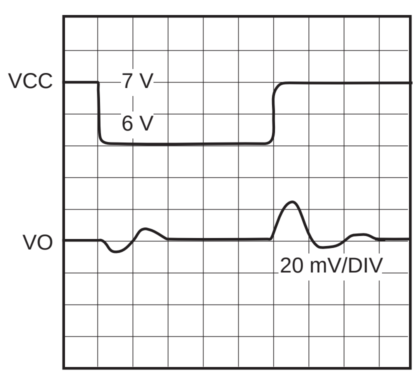
SHORT CIRCUIT VOLTAGE VS. OUTPUT VOLTAGE



RIPPLE REJECTION vs. FREQUENCY

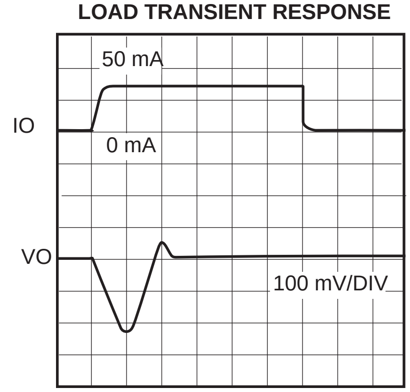


LINE TRANSIENT RESPONSE



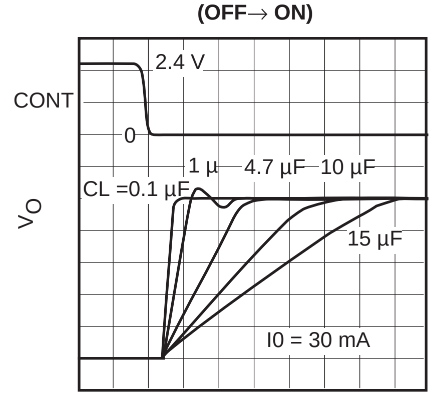
58 µS/div

LOAD TRANSIENT RESPONSE



50 µS/DIV

CONTROL RESPONSE (OFF→ ON)

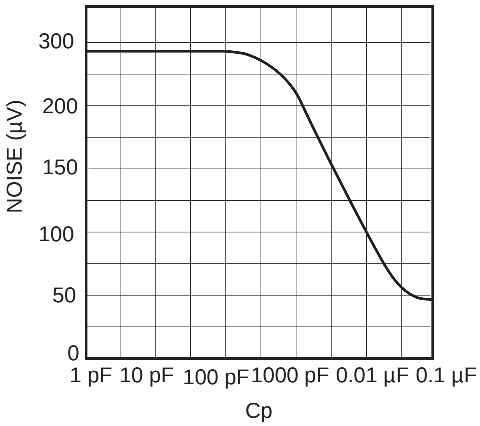


50 µS/DIV

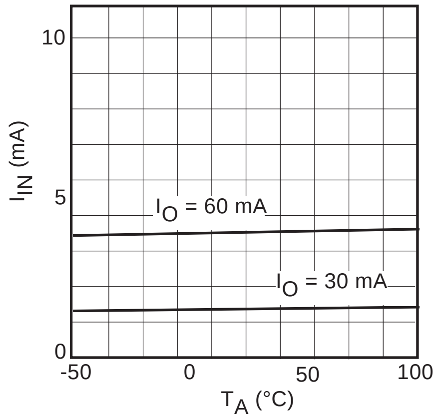
TYPICAL PERFORMANCE CHARACTERISTICS

T_A = 25 °C, unless otherwise specified

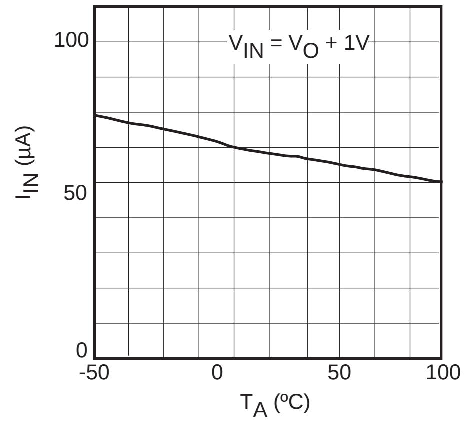
NOISE vs. BYPASS CAPACITOR



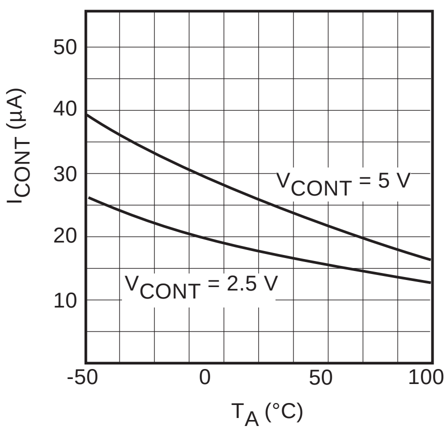
INPUT CURRENT vs. TEMPERATURE



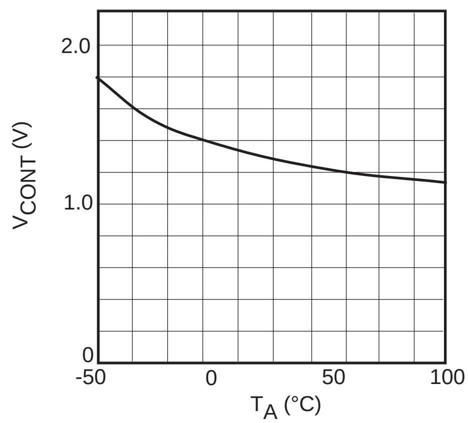
INPUT CURRENT (OUTPUT OFF) vs. TEMPERATURE



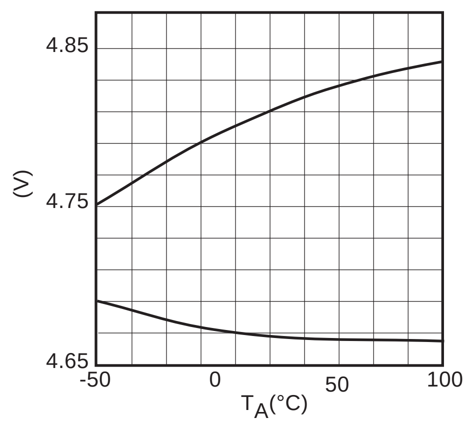
CONTROL PIN INPUT CURRENT vs. TEMPERATURE



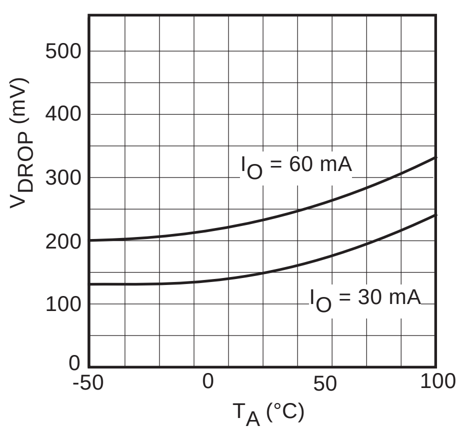
CONTROL PIN VOLTAGE vs. TEMPERATURE



VOLTAGE DETECTOR (HYSTERESIS) vs. TEMPERATURE



DROPOUT VOLTAGE vs. TEMPERATURE

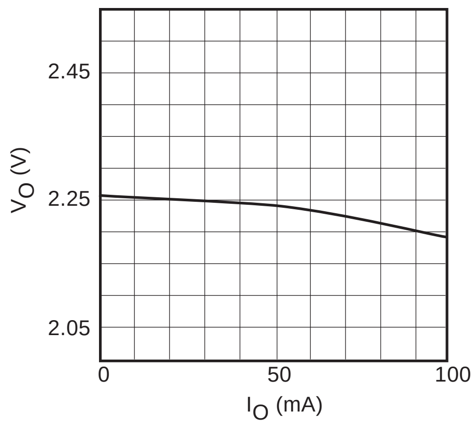


TYPICAL PERFORMANCE CHARACTERISTICS

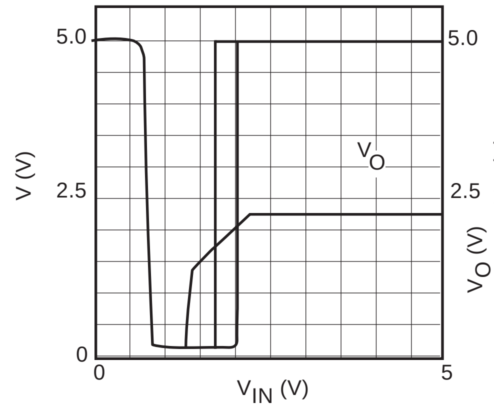
T_A = 25 °C, unless otherwise specified

TK11922

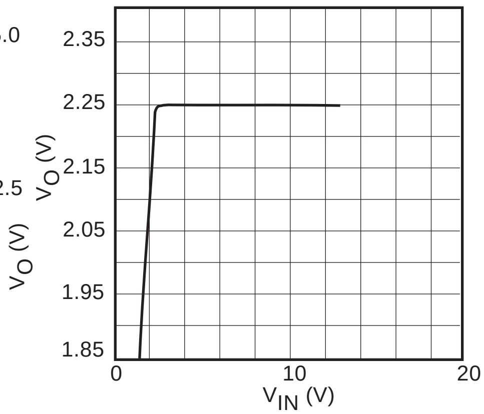
OUTPUT VOLTAGE vs. OUTPUT CURRENT



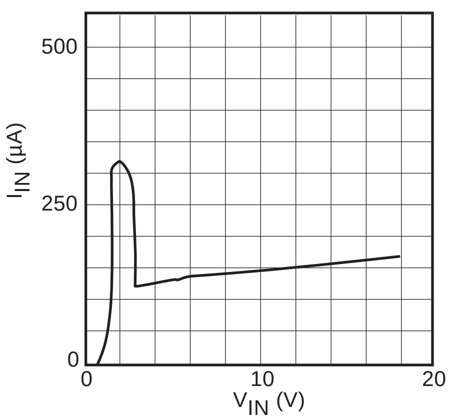
LOW VOLTAGE DETECTOR vs. INPUT VOLTAGE



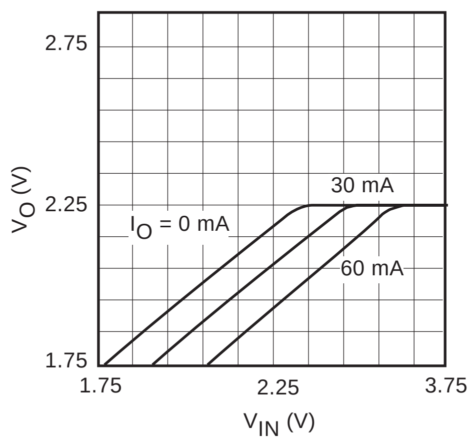
OUTPUT VOLTAGE vs. INPUT VOLTAGE



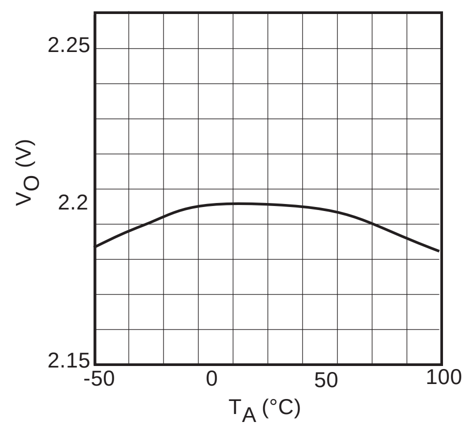
INPUT CURRENT (NO LOAD) vs. INPUT VOLTAGE



OUTPUT VOLTAGE vs. INPUT VOLTAGE

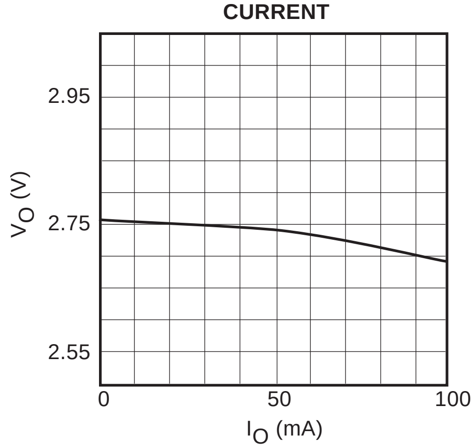


OUTPUT VOLTAGE vs. TEMPERATURE

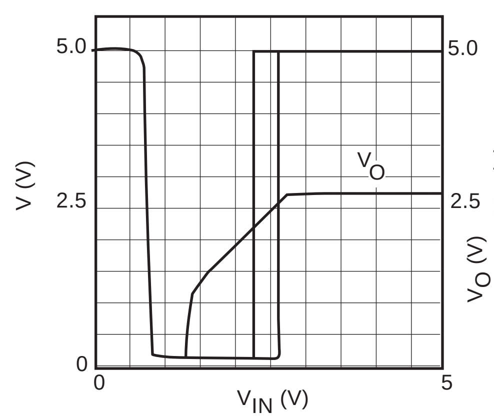


TK11927

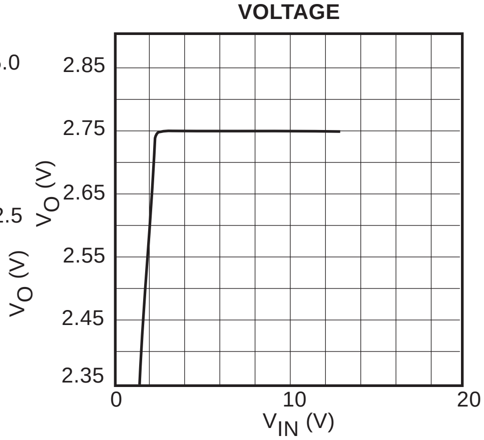
OUTPUT VOLTAGE vs. OUTPUT CURRENT



LOW VOLTAGE DETECTOR vs. INPUT VOLTAGE



OUTPUT VOLTAGE vs. INPUT VOLTAGE

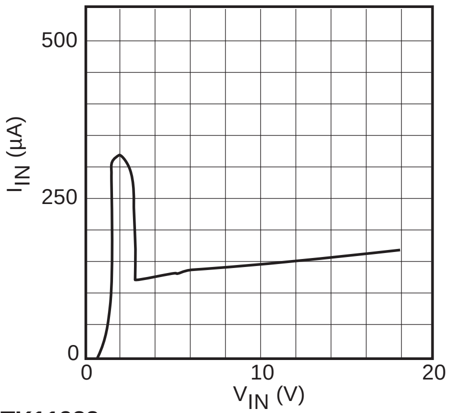


TYPICAL PERFORMANCE CHARACTERISTICS

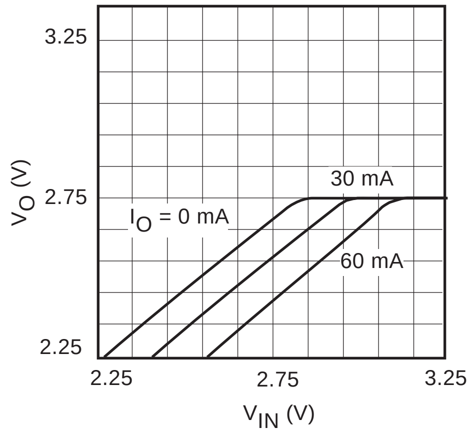
T_A = 25 °C, unless otherwise specified

TK11927 (CONT.)

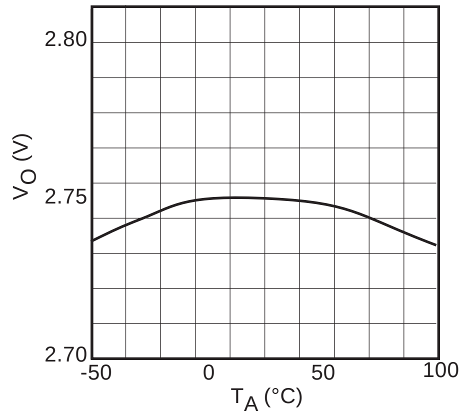
INPUT CURRENT (NO LOAD) vs. INPUT VOLTAGE



OUTPUT VOLTAGE vs. INPUT VOLTAGE

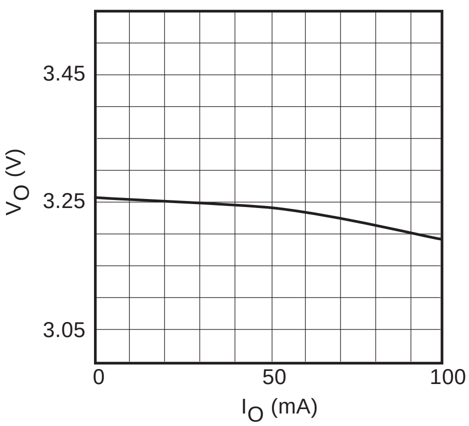


OUTPUT VOLTAGE vs. TEMPERATURE

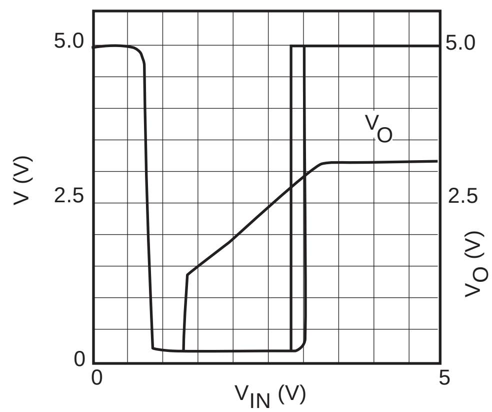


TK11932

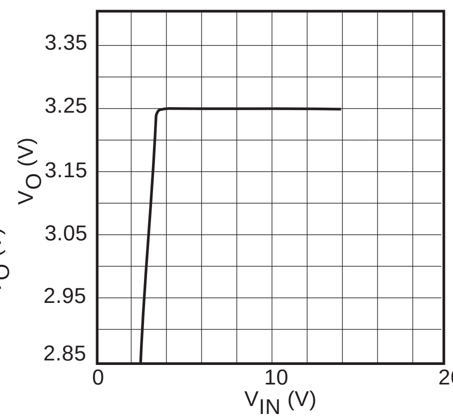
OUTPUT VOLTAGE vs. OUTPUT CURRENT



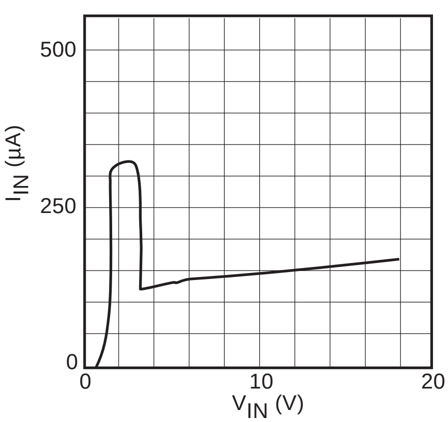
LOW VOLTAGE DETECTOR vs. INPUT VOLTAGE



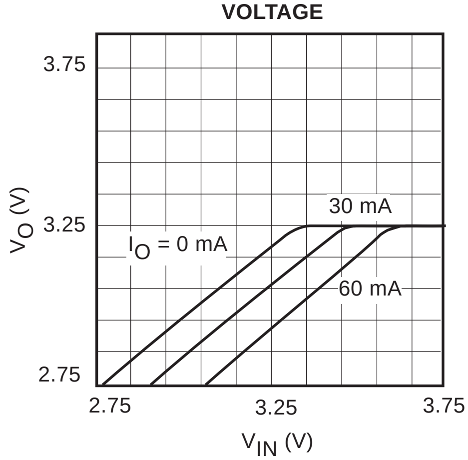
OUTPUT VOLTAGE vs. INPUT VOLTAGE



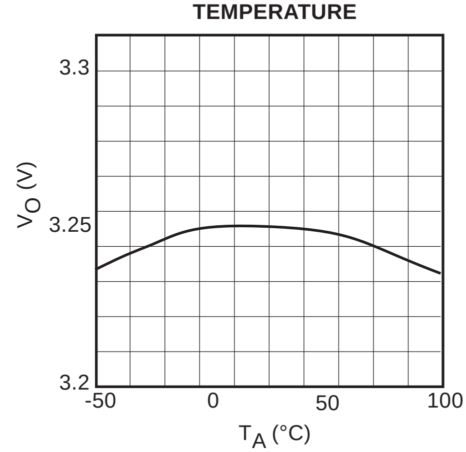
INPUT CURRENT (NO LOAD) vs. INPUT VOLTAGE



OUTPUT VOLTAGE vs. INPUT VOLTAGE



OUTPUT VOLTAGE vs. TEMPERATURE

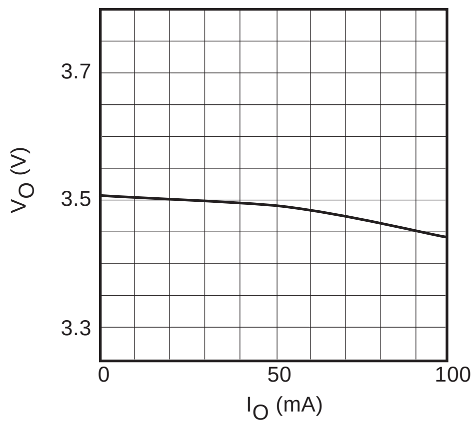


TYPICAL PERFORMANCE CHARACTERISTICS

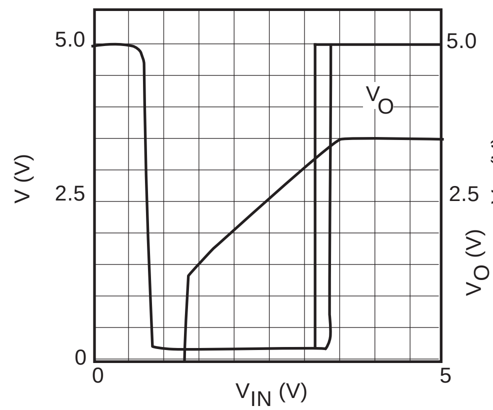
T_A = 25 °C, unless otherwise specified

TK11935

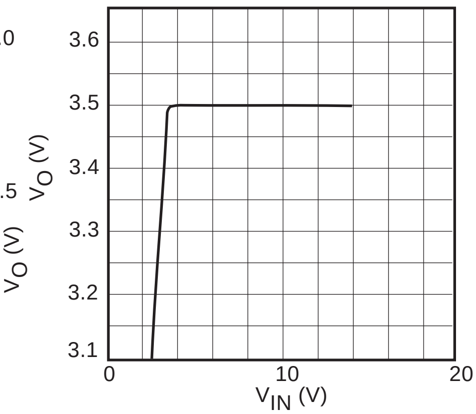
OUTPUT VOLTAGE vs. OUTPUT CURRENT



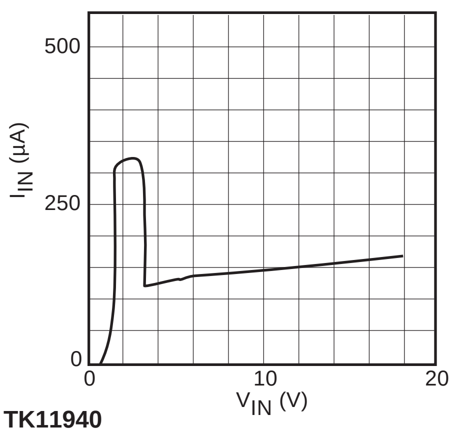
LOW VOLTAGE DETECTOR vs. INPUT VOLTAGE



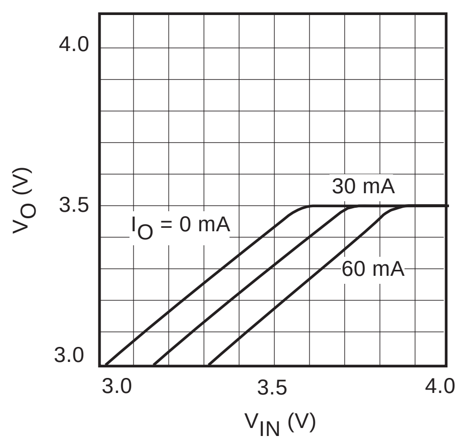
OUTPUT VOLTAGE vs. INPUT VOLTAGE



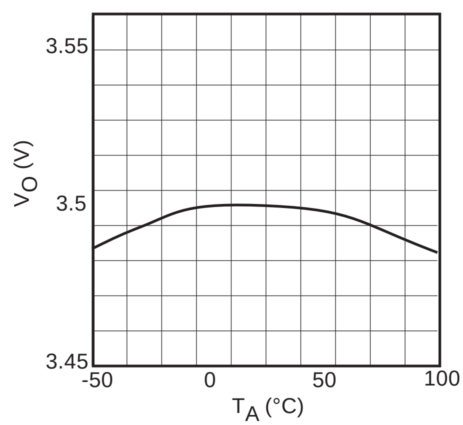
INPUT CURRENT (NO LOAD) vs. INPUT VOLTAGE



OUTPUT VOLTAGE vs. INPUT VOLTAGE

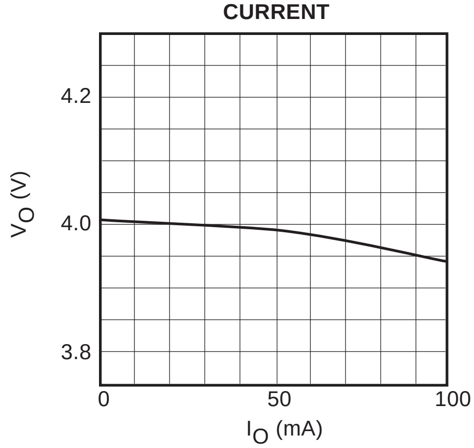


OUTPUT VOLTAGE vs. TEMPERATURE

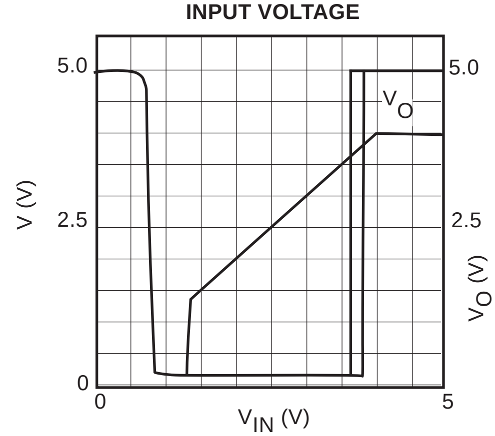


TK11940

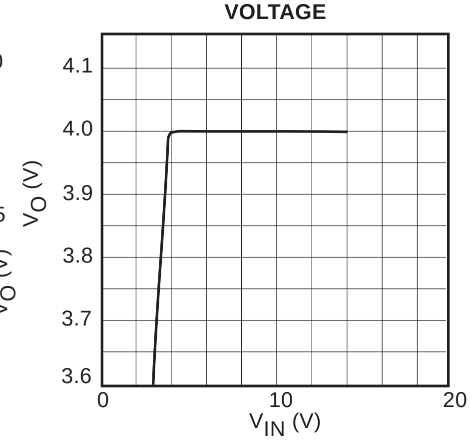
OUTPUT VOLTAGE vs. OUTPUT CURRENT



LOW VOLTAGE DETECTOR vs. INPUT VOLTAGE



OUTPUT VOLTAGE vs. INPUT VOLTAGE

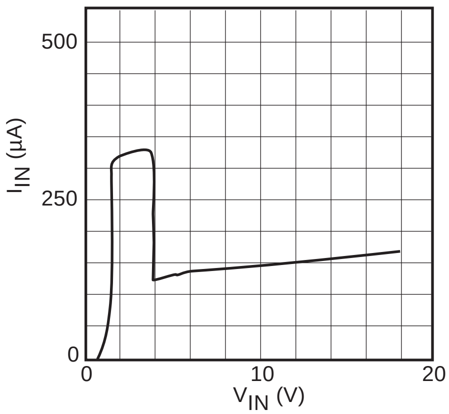


TYPICAL PERFORMANCE CHARACTERISTICS

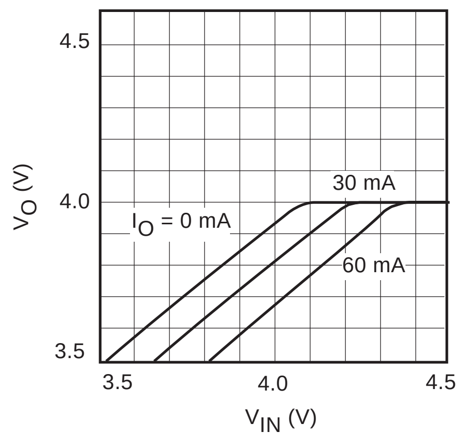
T_A = 25 °C, unless otherwise specified

TK11940 (CONT.)

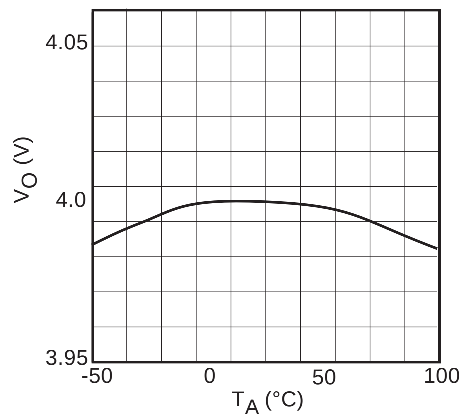
INPUT CURRENT (NO LOAD) vs. INPUT VOLTAGE



OUTPUT VOLTAGE vs. INPUT VOLTAGE

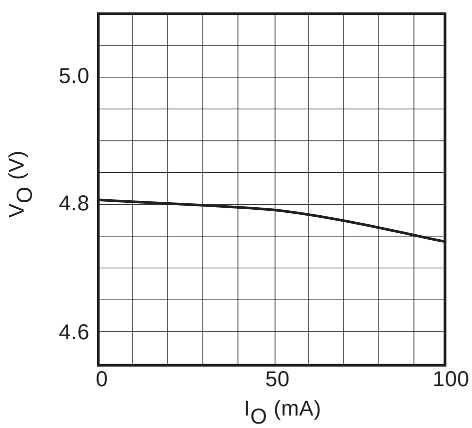


OUTPUT VOLTAGE vs. TEMPERATURE

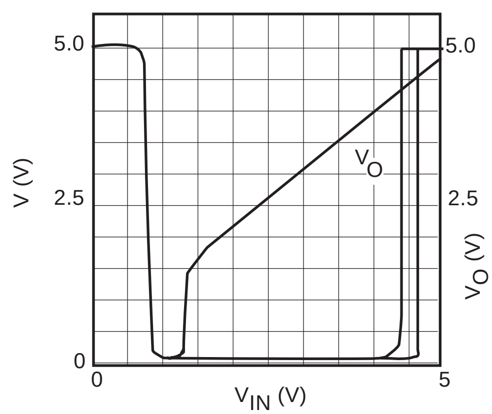


TK11948

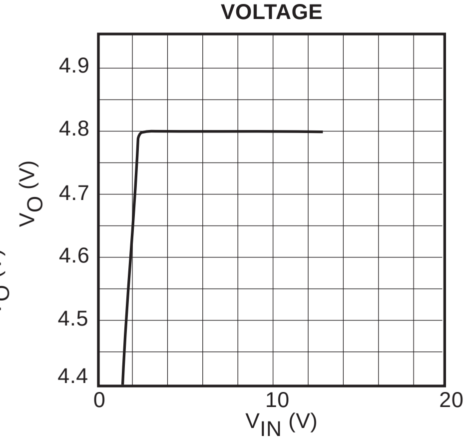
OUTPUT VOLTAGE vs. OUTPUT CURRENT



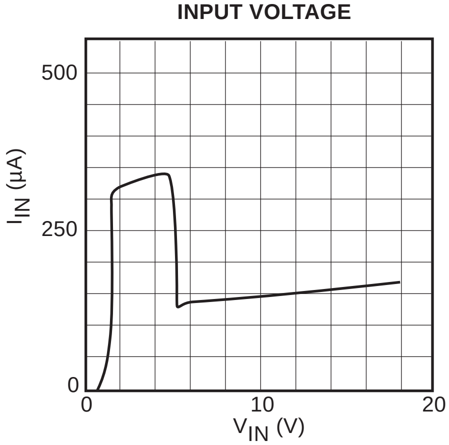
LOW VOLTAGE DETECTOR vs. INPUT VOLTAGE



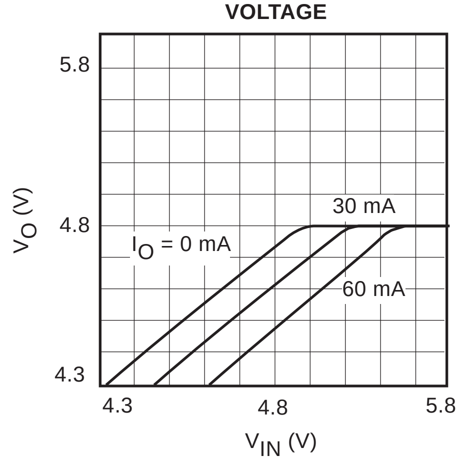
OUTPUT VOLTAGE vs. INPUT VOLTAGE



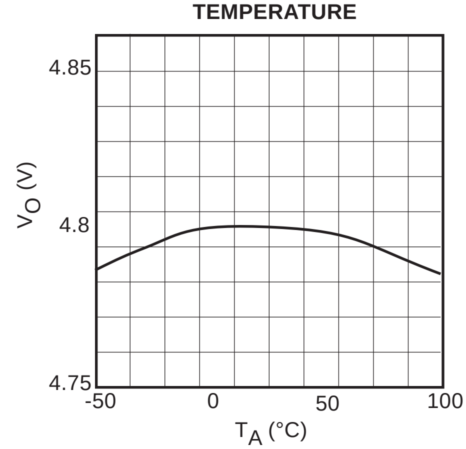
INPUT CURRENT (NO LOAD) vs. INPUT VOLTAGE



OUTPUT VOLTAGE vs. INPUT VOLTAGE



OUTPUT VOLTAGE vs. TEMPERATURE

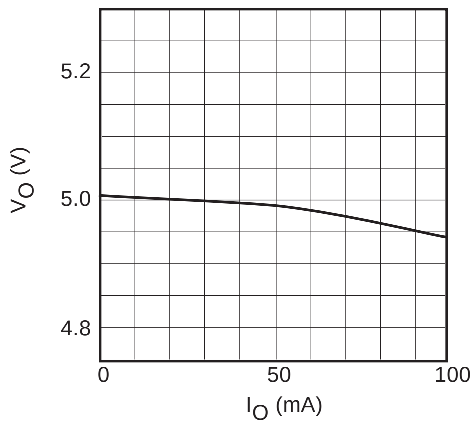


TYPICAL PERFORMANCE CHARACTERISTICS

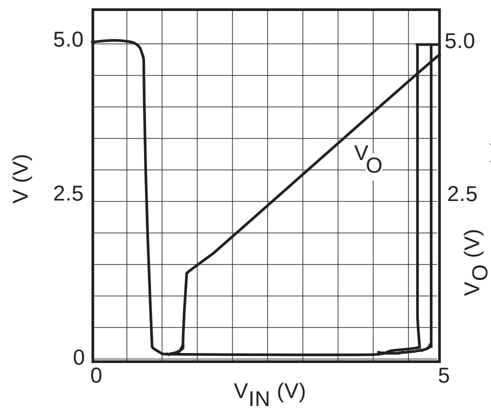
T_A = 25 °C, unless otherwise specified

TK11950

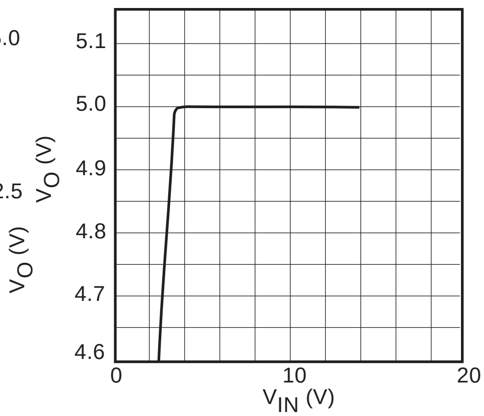
OUTPUT VOLTAGE vs. OUTPUT CURRENT



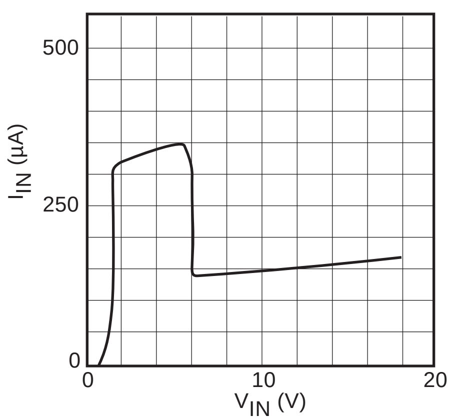
LOW VOLTAGE DETECTOR vs. INPUT VOLTAGE



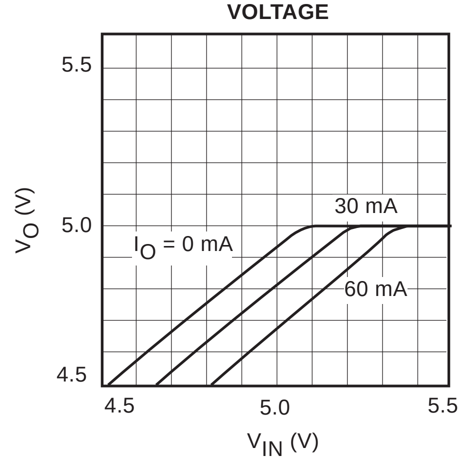
OUTPUT VOLTAGE vs. INPUT VOLTAGE



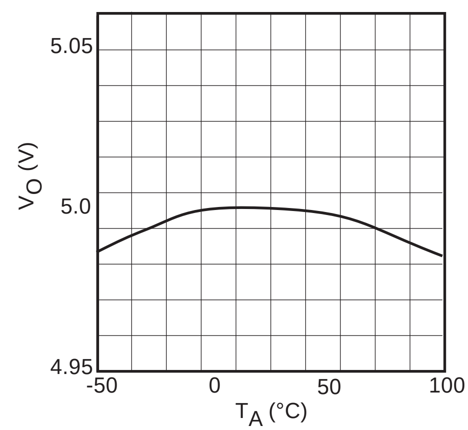
INPUT CURRENT (NO LOAD) vs. INPUT VOLTAGE



OUTPUT VOLTAGE vs. INPUT VOLTAGE



OUTPUT VOLTAGE vs. TEMPERATURE



DEFINITION AND EXPLANATION OF TECHNICAL TERMS

LINE REGULATION (LINE REG)

Line regulation is the relationship between change in output voltage due to a change in input voltage.

LOAD REGULATION (LOAD REG)

Load regulation is the relationship between change in output voltage due to a change in load current.

DROP OUT VOLTAGE (V_{DROP})

This is a measure of how well the regulator performs as the input voltage decreases. The smaller the number, the further the input voltage can decrease before regulation problems occur. Nominal output voltage is first measured when $V_{IN} = V_O + 1$ at a chosen load current. When the output voltage has dropped 100 mV from the nominal, $V_{IN} - V_O$ is the dropout voltage. This voltage is affected by load current and junction temperature.

OUTPUT NOISE VOLTAGE

This is the effective AC voltage that occurs on the output voltage under the condition where the input noise is low and with a given load, filter capacitor, and frequency range.

THERMAL PROTECTION

This is an internal feature which turns the regulator off when the junction temperature rises above 150 °C. After the regulator turns off, the temperature drops and the regulator output turns back on. Under certain conditions, the output waveform may appear to be an oscillation as the output turns off and on and back again in succession.

PACKAGE POWER DISSIPATION (P_D)

This is the power dissipation level at which the thermal sensor is activated. The IC contains an internal thermal sensor which monitors the junction temperature. When the junction temperature exceeds the monitor threshold of 150 °C, the IC is shutdown. The junction temperature rises as the difference between the input power (V_{IN} X I_{IN}) and the output power (V_O X I_O) increases. The rate of temperature rise is greatly affected by the mounting pad configuration on the PCB, the board material, and the ambient temperature. When the IC mounting has good thermal conductivity, the junction temperature will be low even if the power dissipation is great. When the radiation of heat is good, the device temperature will be low, even if the power loss is great. When mounted on the recommended mounting pad, the power dissipation of the SOT-23L is increased to 400mW. For operation at ambient temperatures over 25 °C, the power dissipation of the SOT23-L device should be derated at 3.2 mW/°C. To determine the power dissipation for shutdown when mounted, attach the device on the actual PCB and deliberately increase the output current (or raise the input voltage) until the thermal protection circuit is activated. Calculate the power dissipation of the device by subtracting the output power from the input power. The measurements should allow for the ambient temperature of the PCB. The value obtained from PD/(150 °C - T_A) is the derating factor. The PCB mounting pad should provide maximum thermal conductivity in order to maintain low device temperatures. As a general rule, the lower the temperature, the better the reliability of the device. The thermal resistance when mounted is expressed as follows:

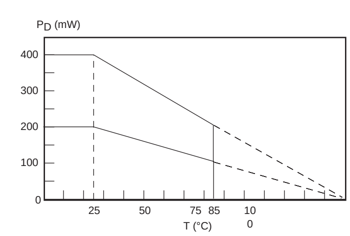
$$T_J = \Theta_{JA} \text{ X } P_D + T_A$$

For Toko IC's, the internal limit for junction temperature is 150 mounted is 150 °C. If the ambient temperature, T_A is 25 °C, then:

$$150\ °C = \Theta_{JA} \times P_D + 25\ °C$$
$$\Theta_{JA} \text{ X } P_D = 125\ °C$$
$$\Theta_{JA} = 125\ °C/P_D$$

P_D is the value when the thermal sensor is activated. A simple way to determine P_D is to calculate V_{IN} X I_{IN} when the output side is shorted. Input current gradually falls as temperature rises. You should use the value when the thermal equilibrium is reached.

The range of currents usable can also be found from the graph below:



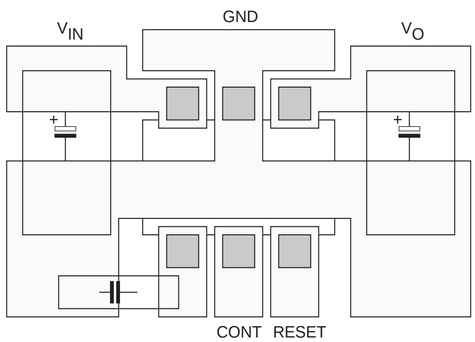
Procedure:
1) Find P_D
2) P_{D1} is taken to be PD X (0.8-0.9)
3) Plot P_{D1} against 25 °C
4) Connect P_{D1} to the point corresponding to 150 °C with a straight line.

DEFINITION AND EXPLANATION OF TECHNICAL TERMS (CONT.)

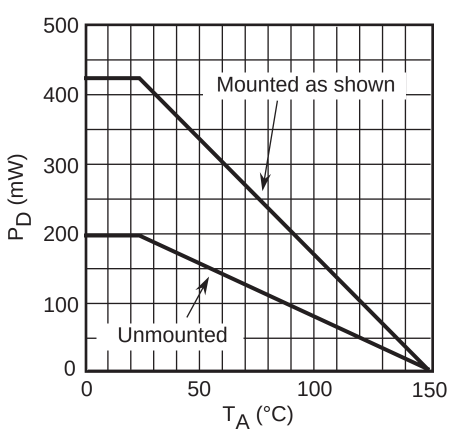
5) In design, take a vertical line from the maximum operat ing temperature (e.g. 75 °C.) to the derating curve.
6) Read off the value of P_D against the point at which the vertical line intersects the derating curve. This is taken as the maximum power dissipation, D_{PD}.

The maximum operating current is:

$$I_{OUT} = (D_{PD}/(V_{IN(MAX)} - V_{OUT})$$



SOT-23L Board Layout



SOT-23L Power Dissipation Curve

Copper pattern should be as large as possible. Power dissipation is 400 mW for the SOT-23L package. A low ESR capacitor is recommended. For low temperature operation, select a capacitor with a low ESR at the lowest operating temperature to prevent oscillation, degradation of ripple rejection and increase in noise. The minimum recommended capacitance is 2.2 µF.

INPUT/OUTPUT DECOUPLING CAPACITOR CONSIDERATIONS

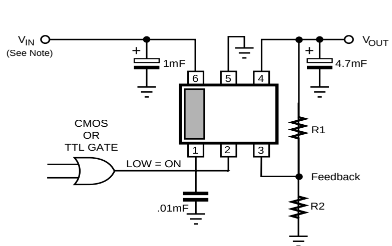
Voltage regulators require input and output decoupling capacitors. The required values of these capacitors vary with application. Capacitors made by different manufacturers can have different characteristics, particularly with regard to high frequencies and equivalent series resistance (ESR) over temperature. The type of capacitor is also important. For example, a 4.7 µF aluminum electrolytic may be required for a certain application. If a tantalum capacitor is used, a lower value of 2.2 µF would be adequate. It is important to consider the temperature characteristics of the decoupling capacitors. While Toko regulators are designed to operate as low as -40 °C, many capacitors will not operate properly at this temperature. The capacitance of aluminum electrolytic capacitors may decrease to 0 at low temperatures. This may cause oscillation on the output of the regulator since some capacitance is required to guarantee stability. Thus, it is important to consider the characteristics of the capacitor over temperature when selecting decoupling capacitors. The ESR is another important parameter. The ESR will increase with temperature, but low ESR capacitors are often larger and more costly. In general, Tantalum capacitors offer lower ESR than aluminum electrolytic, but new, low ESR aluminum electrolytic capacitors are now available from several manufacturers. Usually a bench test is sufficient to determine the minimum capacitance required for a particular application. After taking thermal characteristics and tolerance into account, the minimum capacitance value should be approximately two times the value. The recommended minimum capacitance for the TK119xx is 2.2 µF. Please note that linear regulators with a low dropout voltage have high internal loop gains which require care in guarding against oscillation caused by insufficient decoupling capacitance. The use of high quality decoupling capacitors suited for your application will guarantee proper operation of the circuit.

NOISE BYPASS CAPACITANCE SECTION

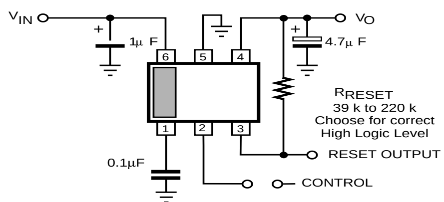
The noise bypass capacitance (C_P) should be connected as close as possible to pin 1 and ground. The recommended value for CP is 0.01 µF. The noise bypass terminal has a high impedance and care should be taken if the noise bypass capacitor is not used. This terminal is susceptible to external noise, and oscillation can occur when C_P is not used and the solder pad for this pin is made too large.

TYPICAL APPLICATIONS

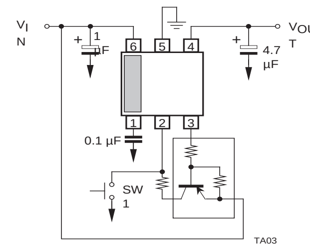
CONTROL FUNCTION UTILIZED



CONTROL FUNCTION NOT UTILIZED



LOW VOLTAGE SHUTDOWN



Note: Parallel connection of control pins is allowed if all devices use identical input voltage.

APPLICATION HINTS

The power dissipation of the TK119xx can be increased to 400 mW when mounted to the PC board as shown at left. Maximize copper foil area connecting to all IC pins for optimum performance. Place input and output bypass capacitors close to the GND pin. For best transient behavior and lowest output impedance, use as large a capacitor value as possible. The temperature coefficient of the capacitance and Equivalent Series Resistance (ESR) should be taken into account. These parameters can influence power supply noise and ripple rejection. In extreme cases, oscillation may occur. In order to maintain stability, the output bypass capacitor value should be minimum 0.1 µF for Tantalum electrolytic or 0.22 µF for Aluminum electrolytic.

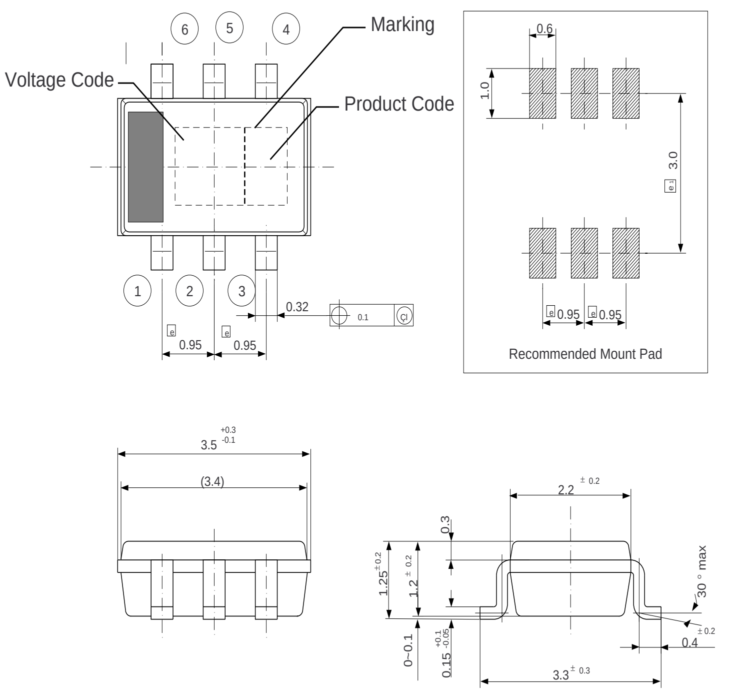
HANDLING MOLDED RESIN PACKAGES

All plastic molded packages absorb some moisture from the air. If moisture absorption occurs prior to soldering the device into the printed circuit board, increased separation of the lead from the plastic molding may occur, degrading the moisture barrier characteristics of the device. This property of plastic molding compounds should not be overlooked, particularly in the case of very small packages, where the plastic is very thin.

In order to preserve the original moisture barrier properties of the package, devices are stored and shipped in moisture proof bags filled with dry air. The bags should not be opened or damaged prior to the actual use of the devices. If this is unavoidable, the devices should be stored in a low relative humidity environment (40 to 65%) or in an enclosed environment with desiccant.

PACKAGE OUTLINE

SOT-23L



Marking Information

	Voltage Code
TK11922	G$\underline{2}$
TK11927	G$\overline{2}$
TK11930	G3
TK11932	G$\underline{3}$
TK11935	G$\overline{3}$
TK11940	G4
TK11948	G$\overline{4}$
TK11950	G5

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