LOW DROPOUT REGULATOR

FEATURES

- **Low Dropout Voltage**
- **Low Quiescent Current**
- **Very Stable Output**
- **Extremely Small Package (SOT-25)**
- **On/Off Control Function**

APPLICATIONS

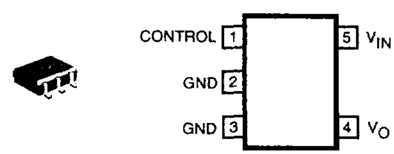
- **Battery Powered Systems**
- **Portable Consumer Equipment**
- **Cordless Telephones**
- **Personal Communications Equipment**
- **Radio Control Systems**
- **Toys**
- **Low Voltage Systems**

DESCRIPTION

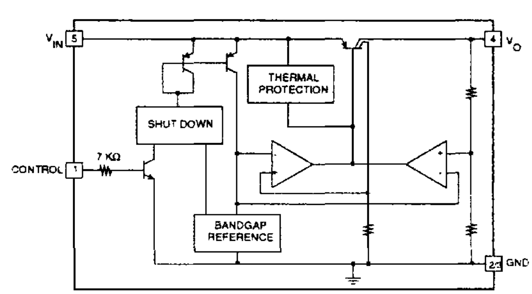
The TK713xx is a low dropout, linear regulator with a built-in electronic switch. Since a PNP power transistor is used, dropout voltage is very low, making it possible to maintain a stable output voltage even as the battery voltage decreases. This allows longer battery life. The TK713xx has a control pin to turn the output on or off. The input current is 10 µA when the output is off.

The TK713xx is available in a very small SOT-25 surface mount package.

TK713xx



BLOCK DIAGRAM



ORDERING INFORMATION

TK713 □□ M □□

Voltage Code — Tape/Reel Code

VOLTAGE CODE
15 = 1.5 V
20 = 2.0 V
25 = 2.5 V
28 = 2.8 V
30 = 3.0 V
33 = 3.3 V
40 = 4.0 V
45 = 4.5 V
50 = 5.0 V

TAPE/REEL CODE
BX : Bulk/Bag
TL : Tape Left

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ABSOLUTE MAXIMUM RATINGS

Input Voltage .... 15 V
Power Dissipation (Note1) .... 350 mW
Operating Voltage Range .... 1.4 to 14.0 V
Junction Temperature .... 150 °C
Storage Temperature Range .... -55 to +150 °C
Operating Temperature Range .... -30 to +80 °C
Lead Soldering Temp. (10 sec.) .... 240 °C

TK71315 ELECTRICAL CHARACTERISTICS

Test Conditions: T_A = 25 °C, V_{IN} = 1.8 V, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
$I_{IN}1$	Supply Current 1	V_{IN} = 1.8 V, I_O = 0 mA		150	300	µA
$I_{IN}2$	Supply Current 2	V_{IN} = 1.3 V, I_O = 0 mA		2.0	5.0	mA
$I_{IN}3$	Supply Current 3	V_{IN} = 3.0 V, Output Off		12	40	µA
V_O	Regulated Output Voltage	V_{IN} =1.8 V, I_O = 10 mA	1.42	1.5	1.58	V
V_{DROP}	Dropout Voltage	I_O = 30 mA		100	250	mV
I_O	Output Current		40	60		mA
I_Q	Quiescent Current	V_{IN} = 1.8 V, I_O = 30 mA		1.5	3.5	mA
Line Reg	Line Regulation	V_{IN} = 1.8 V → 6.0 V		0.9	15	mV
Load Reg	Load Regulation	I_O = 1 mA → 30 mA		15	40	mV
RR	Ripple Rejection	C_L = 3.3 µF, f = 400 Hz, I_O =10 mA		66		dB
$\Delta V_O/\Delta T_A$	Output Voltage Temperature Dependency			0.1		mV/°C
Control Terminal Specification						
$I_{CONT}1$	Control Current 1	V_{CONT} = 1.0 V, R_C = 0 Ω, Output Off		43	60	µA
$I_{CONT}2$	Control Current 2	V_{CONT} = 1.2 V, R_C = 100 KΩ Output Off		4.5		µA
$V_{CONT}1$	Control Voltage 1	R_C = 100 kΩ, Output On			0.4	V
$V_{CONT}2$	Control Voltage 2	R_C = 100 kΩ, Output Off	1.2			V

Note 1: Power dissipation is 350 mW when mounted as recommended. Power dissipation must be derated at 2.8 mW/ °C for operation above 25 °C.

TK71320 ELECTRICAL CHARACTERISTICS

Test Conditions: T_A = 25 °C, V_{IN} = 3.0 V, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
$I_{IN}1$	Supply Current 1	V_{IN} = 3.0 V, I_O = 0 mA		130	300	µA
$I_{IN}2$	Supply Current 2	V_{IN} = 1.9 V, I_O = 0 mA		1.4	3.0	mA
$I_{IN}3$	Supply Current 3	V_{IN} = 8.0 V, Output Off		12	40	µA
V_O	Regulated Output Voltage	V_{IN} = 3.0 V, I_O = 10 mA	1.9	2.0	2.1	V
V_{DROP}	Dropout Voltage	I_O = 30 mA		100	200	mV
I_O	Output Current		100	160		mA
I_Q	Quiescent Current	V_{IN} = 3.0 V, I_O = 30 mA		1.5	3.5	mA
Line Reg	Line Regulation	V_{IN} = 3.0 V → 13.5 V		10	30	mV
Load Reg	Load Regulation	I_O = 1 mA → 60 mA		20	40	mV
RR	Ripple Rejection	C_L = 3.3 µF, f = 400 Hz, I_O = 10 mA		63		dB
$\Delta V_O/\Delta T_A$	Output Voltage Temperature Dependency			0.15		mV/°C
Control Terminal Specification						
$I_{CONT}1$	Control Current 1	V_{CONT} = 1.0 V, R_C = 0 Ω, Output Off		43	60	µA
$I_{CONT}2$	Control Current 2	V_{CONT} = 1.2 V, R_C = 100 KΩ Output Off		4.5		µA
$V_{CONT}1$	Control Voltage 1	R_C = 100 kΩ, Output On			0.4	V
$V_{CONT}2$	Control Voltage 2	R_C = 100 kΩ, Output Off	1.2			V

TK71325 ELECTRICAL CHARACTERISTICS

Test Conditions: T_A = 25 °C, V_{IN} = 3.5 V, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
$I_{IN}1$	Supply Current 1	V_{IN} = 3.5 V, I_O = 0 mA		130	300	µA
$I_{IN}2$	Supply Current 2	V_{IN} = 2.0 V, I_O = 0 mA		1.4	3.0	mA
$I_{IN}3$	Supply Current 3	V_{IN} = 8.0 V, Output Off		12	40	µA
V_O	Regulated Output Voltage	V_{IN} = 3.5 V, I_O = 10 mA	2.4	2.5	2.6	V
V_{DROP}	Dropout Voltage	I_O = 30 mA		100	200	mV
I_O	Output Current		100	160		mA
I_Q	Quiescent Current	V_{IN} = 3.5 V, I_O = 30 mA		1.5	3.5	mA
Line Reg	Line Regulation	V_{IN} = 3.5 V → 13.5 V		10	30	mV
Load Reg	Load Regulation	I_O = 1 mA → 60 mA		20	40	mV
RR	Ripple Rejection	C_L = 3.3 µF, f = 400 Hz, I_O =10 mA		63		dB
$\Delta V_O/\Delta T_A$	Output Voltage Temperature Dependency			0.15		mV/°C
Control Terminal Specification						
$I_{CONT}1$	Control Current 1	V_{CONT} = 1.0 V, R_C = 0 Ω, Output Off		43	60	µA
$I_{CONT}2$	Control Current 2	V_{CONT} = 1.2 V, R_C = 100 KΩ Output Off		4.5		µA
$V_{CONT}1$	Control Voltage 1	R_C = 100 kΩ, Output On			0.4	V
$V_{CONT}2$	Control Voltage 2	R_C = 100 kΩ, Output Off	1.2			V

TK71328 ELECTRICAL CHARACTERISTICS

Test Conditions: T_A = 25 °C, V_{IN} = 3.8 V, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
$I_{IN}1$	Supply Current 1	V_{IN} = 3.8 V, I_O = 0 mA		130	300	µA
$I_{IN}2$	Supply Current 2	V_{IN} = 2.5 V, I_O = 0 mA		1.4	3.0	mA
$I_{IN}3$	Supply Current 3	V_{IN} = 8.0 V, Output Off		12	40	µA
V_O	Regulated Output Voltage	V_{IN} = 3.8 V, I_O = 10 mA	2.7	2.8	2.9	V
V_{DROP}	Dropout Voltage	I_O = 30 mA		100	200	mV
I_O	Output Current		100	160		mA
I_Q	Quiescent Current	V_{IN} = 3.8 V, I_O = 30 mA		1.5	3.5	mA
Line Reg	Line Regulation	V_{IN} = 3.8 V → 13.8 V		10	30	mV
Load Reg	Load Regulation	I_O = 1 mA → 60 mA		20	40	mV
RR	Ripple Rejection	C_L = 3.3 µF, f = 400 Hz, I_O = 10 mA		63		dB
$\Delta V_O/\Delta T_A$	Output Voltage Temperature Dependency			0.18		mV/°C
Control Terminal Specification						
$I_{CONT}1$	Control Current 1	V_{CONT} = 1.0 V, R_C = 0 Ω, Output Off		43	60	µA
$I_{CONT}2$	Control Current 2	V_{CONT} = 1.2 V, R_C = 100 KΩ Output Off		4.5		µA
$V_{CONT}1$	Control Voltage 1	R_C = 100 kΩ, Output On			0.4	V
$V_{CONT}2$	Control Voltage 2	R_C = 100 kΩ, Output Off	1.2			V

TK71330 ELECTRICAL CHARACTERISTICS

Test Conditions: T_A = 25 °C, V_{IN} = 4.0 V, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
$I_{IN}1$	Supply Current 1	V_{IN} = 4.0 V, I_O = 0 mA		130	300	µA
$I_{IN}2$	Supply Current 2	V_{IN} = 2.5 V, I_O = 0 mA		1.4	3.0	mA
$I_{IN}3$	Supply Current 3	V_{IN} = 8.0 V, Output Off		12	40	µA
V_O	Regulated Output Voltage	V_{IN} = 4.0 V, I_O = 10 mA	2.9	3.0	3.1	V
V_{DROP}	Dropout Voltage	I_O = 30 mA		100	200	mV
I_O	Output Current		100	160		mA
I_Q	Quiescent Current	V_{IN} = 4.0 V, I_O = 30 mA		1.5	3.5	mA
Line Reg	Line Regulation	V_{IN} = 4.0 V → 14.0 V		10	30	mV
Load Reg	Load Regulation	I_O = 1 mA → 60 mA		20	40	mV
RR	Ripple Rejection	C_L = 3.3 µF, f = 400 Hz, I_O = 10 mA		63		dB
$\Delta V_O/\Delta T_A$	Output Voltage Temperature Dependency			0.18		mV/°C
Control Terminal Specification						
$I_{CONT}1$	Control Current 1	V_{CONT} = 1.0 V, R_C = 0 Ω, Output Off		43	60	µA
$I_{CONT}2$	Control Current 2	V_{CONT} = 1.2 V, R_C = 100 KΩ Output Off		4.5		µA
$V_{CONT}1$	Control Voltage 1	R_C = 100 kΩ, Output On			0.4	V
$V_{CONT}2$	Control Voltage 2	R_C = 100 kΩ, Output Off	1.2			V

TK71333 ELECTRICAL CHARACTERISTICS

Test Conditions: T_A = 25 °C, V_{IN} = 3.9 V, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
$I_{IN}1$	Supply Current 1	V_{IN} = 3.9 V, I_O = 0 mA		130	300	µA
$I_{IN}2$	Supply Current 2	V_{IN} = 2.8 V, I_O = 0 mA		1.4	3.0	mA
$I_{IN}3$	Supply Current 3	V_{IN} = 8.0 V, Output Off		12	40	µA
V_O	Regulated Output Voltage	V_{IN} = 3.9 V, I_O = 10 mA	3.2	3.3	3.4	V
V_{DROP}	Dropout Voltage	I_O = 30 mA		100	200	mV
I_O	Output Current		100	160		mA
I_Q	Quiescent Current	V_{IN} = 3.9 V, I_O = 30 mA		1.5	3.5	mA
Line Reg	Line Regulation	V_{IN} = 3.9 V → 14.0 V		10	30	mV
Load Reg	Load Regulation	I_O = 1 mA → 60 mA		20	40	mV
RR	Ripple Rejection	C_L = 3.3 µF, f = 400 Hz, I_O =10 mA		63		dB
$\Delta V_O/\Delta T_A$	Output Voltage Temperature Dependency			0.18		mV/°C
Control Terminal Specification						
$I_{CONT}1$	Control Current 1	V_{CONT} = 1.0 V, R_C = 0 Ω, Output Off		43	60	µA
$I_{CONT}2$	Control Current 2	V_{CONT} = 1.2 V, R_C = 100 KΩ Output Off		4.5		µA
$V_{CONT}1$	Control Voltage 1	R_C = 100 kΩ, Output On			0.4	V
$V_{CONT}2$	Control Voltage 2	R_C = 100 kΩ, Output Off	1.2			V

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TK71340 ELECTRICAL CHARACTERISTICS

Test Conditions: T_A = 25 °C, V_{IN} = 4.6 V, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
$I_{IN}1$	Supply Current 1	V_{IN} = 4.6 V, I_O = 0 mA		130	300	µA
$I_{IN}2$	Supply Current 2	V_{IN} = 3.5 V, I_O = 0 mA		1.4	3.0	mA
$I_{IN}3$	Supply Current 3	V_{IN} = 8.0 V, Output Off		12	40	µA
V_O	Regulated Output Voltage	V_{IN} = 4.6 V, I_O = 10 mA	3.88	4.0	4.12	V
V_{DROP}	Dropout Voltage	I_O = 30 mA		100	200	mV
I_O	Output Current		100	160		mA
I_Q	Quiescent Current	V_{IN} = 4.6 V, I_O = 30 mA		1.5	3.5	mA
Line Reg	Line Regulation	V_{IN} = 4.6 V → 14.0 V		10	30	mV
Load Reg	Load Regulation	I_O = 1 mA → 60 mA		20	40	mV
RR	Ripple Rejection	C_L = 3.3 µF, f = 400 Hz, I_O = 10 mA		63		dB
$\Delta V_O/\Delta T_A$	Output Voltage Temperature Dependency			0.20		mV/°C
Control Terminal Specification						
$I_{CONT}1$	Control Current 1	V_{CONT} = 1.0 V, R_C = 0 Ω, Output Off		43	60	µA
$I_{CONT}2$	Control Current 2	V_{CONT} = 1.2 V, R_C = 100 KΩ Output Off		4.5		µA
$V_{CONT}1$	Control Voltage 1	R_C = 100 kΩ, Output On			0.4	V
$V_{CONT}2$	Control Voltage 2	R_C = 100 kΩ, Output Off	1.2			V

TK71345 ELECTRICAL CHARACTERISTICS

Test Conditions: T_A = 25 °C, V_{IN} = 5.1 V, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
$I_{IN}1$	Supply Current 1	V_{IN} = 5.1 V, I_O = 0 mA		130	300	µA
$I_{IN}2$	Supply Current 2	V_{IN} = 4.0 V, I_O = 0 mA		1.4	3.0	mA
$I_{IN}3$	Supply Current 3	V_{IN} = 8.0 V, Output Off		12	40	µA
V_O	Regulated Output Voltage	V_{IN} = 5.1 V, I_O = 10 mA	4.36	4.5	4.64	V
V_{DROP}	Dropout Voltage	I_O = 30 mA		100	200	mV
I_O	Output Current		100	160		mA
I_Q	Quiescent Current	V_{IN} = 5.1 V, I_O = 30 mA		1.5	3.5	mA
Line Reg	Line Regulation	V_{IN} = 5.1 V → 14.0 V		10	30	mV
Load Reg	Load Regulation	I_O = 1 mA → 60 mA		20	40	mV
RR	Ripple Rejection	C_L = 3.3 µF, f = 400 Hz, I_O = 10 mA		63		dB
$\Delta V_O/\Delta T_A$	Output Voltage Temperature Dependency			0.25		mV/°C
Control Terminal Specification						
$I_{CONT}1$	Control Current 1	V_{CONT} = 1.0 V, R_C = 0 Ω, Output Off		43	60	µA
$I_{CONT}2$	Control Current 2	V_{CONT} = 1.2 V, R_C = 100 KΩ Output Off		4.5		µA
$V_{CONT}1$	Control Voltage 1	R_C = 100 kΩ, Output On			0.4	V
$V_{CONT}2$	Control Voltage 2	R_C = 100 kΩ, Output Off	1.2			V

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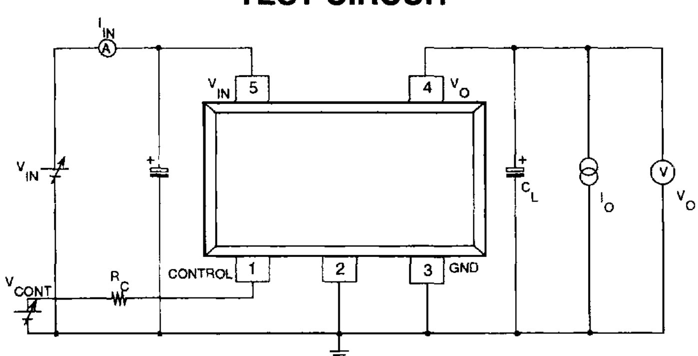
TK71350 ELECTRICAL CHARACTERISTICS

Test Conditions: T_A = 25 °C, V_{IN} = 5.6 V, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
$I_{IN}1$	Supply Current 1	V_{IN} = 5.6 V, I_O = 0 mA		130	300	µA
$I_{IN}2$	Supply Current 2	V_{IN} = 4.0V, I_O = 0 mA		1.4	3.0	mA
$I_{IN}3$	Supply Current 3	V_{IN} = 8.0 V, Output Off		12	40	µA
V_O	Regulated Output Voltage	V_{IN} = 5.6 V, I_O = 10 mA	4.85	5.0	5.15	V
V_{DROP}	Dropout Voltage	I_O = 30 mA		100	200	mV
I_O	Output Current		100	160		mA
I_Q	Quiescent Current	V_{IN} = 5.6 V, I_O = 30 mA		1.5	3.5	mA
Line Reg	Line Regulation	V_{IN} = 5.6 V → 14.0 V		10	30	mV
Load Reg	Load Regulation	I_O = 1 mA → 60 mA		20	40	mV
RR	Ripple Rejection	C_L = 3.3 µF, f = 400 Hz, I_O =10 mA		63		dB
$\Delta V_O/\Delta T_A$	Output Voltage Temperature Dependency			0.25		mV/°C
Control Terminal Specification						
$I_{CONT}1$	Control Current 1	V_{CONT} = 1.0 V, R_C = 0 Ω, Output Off		43	60	µA
$I_{CONT}2$	Control Current 2	V_{CONT} = 1.2 V, R_C = 100 KΩ Output Off		4.5		µA
$V_{CONT}1$	Control Voltage 1	R_C = 100 kΩ, Output On			0.4	V
$V_{CONT}2$	Control Voltage 2	R_C = 100 kΩ, Output Off	1.2			V

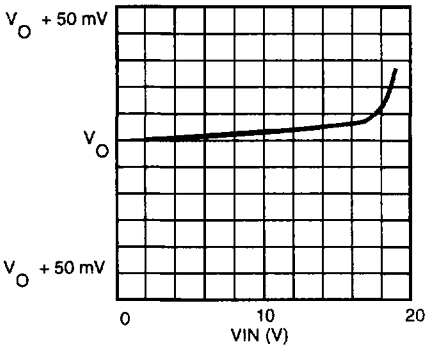
TEST CIRCUIT



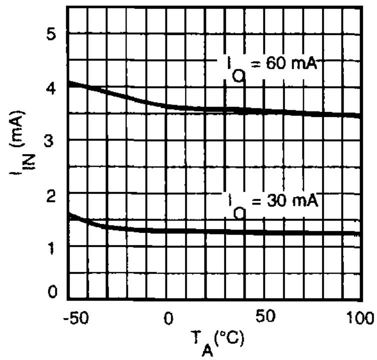
TYPICAL PERFORMANCE CHARACTERISTICS

T_A = 25 °C unless otherwise specified

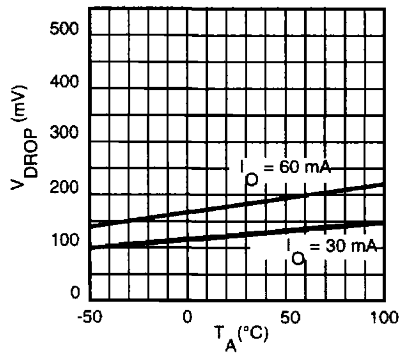
OUTPUT VOLTAGE vs. INPUT VOLTAGE



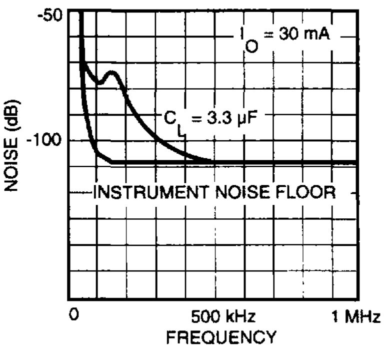
INPUT CURRENT vs. AMBIENT TEMPERATURE



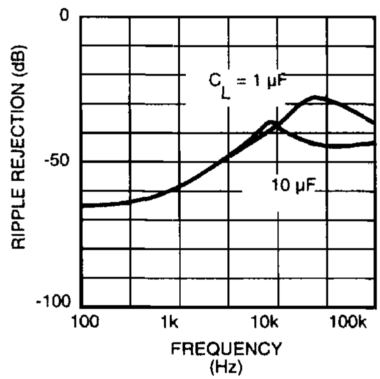
DROPOUT VOLTAGE vs. AMBIENT TEMPERATURE



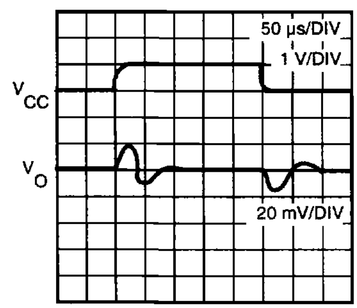
NOISE SPECTRUM



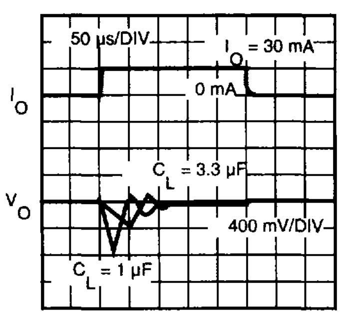
RIPPLE REJECTION vs FREQUENCY



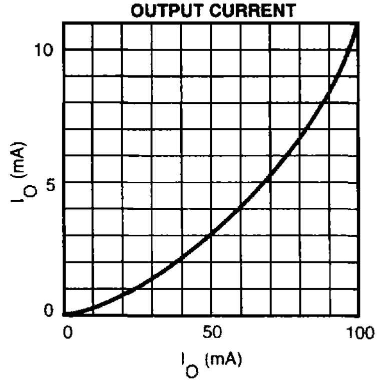
LINE TRANSIENT RESPONSE



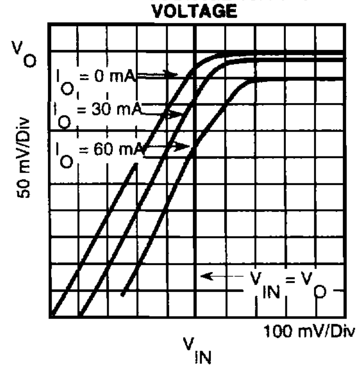
LOAD TRANSIENT RESPONSE



QUIESCENT CURRENT vs. OUTPUT CURRENT



OUTPUT VOLTAGE vs. INPUT VOLTAGE



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TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

T_A = 25 °C unless otherwise specified

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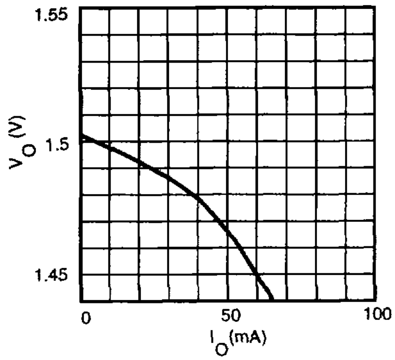
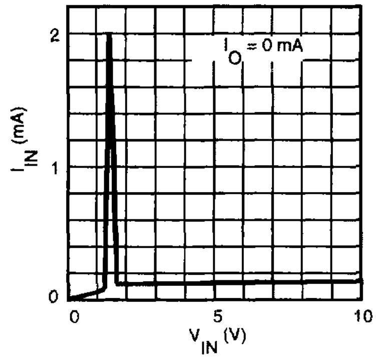
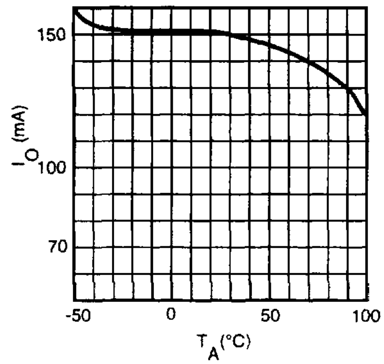
OUTPUT VOLTAGE vs. OUTPUT CURRENT



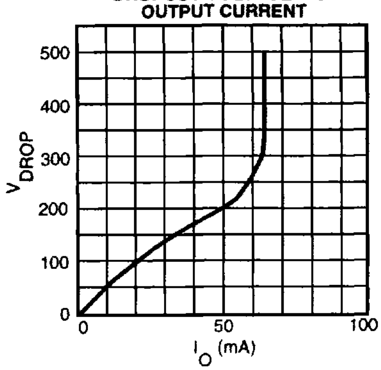
INPUT CURRENT vs. INPUT VOLTAGE



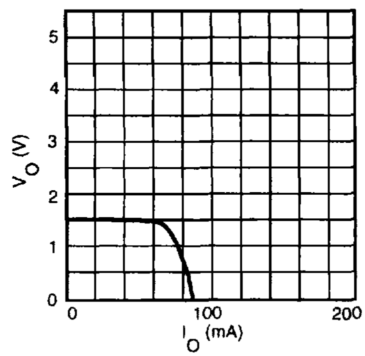
OUTPUT CURRENT vs. AMBIENT TEMPERATURE



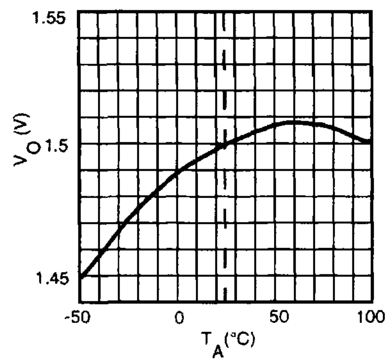
DROPOUT VOLTAGE VS. OUTPUT CURRENT



SHORT CIRCUIT PROTECTION



OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



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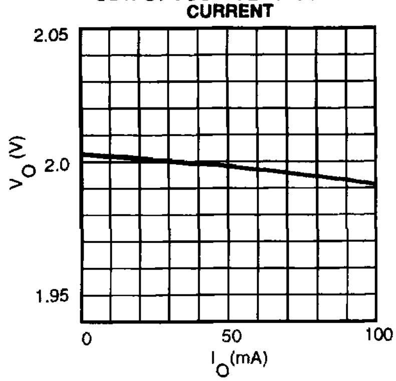
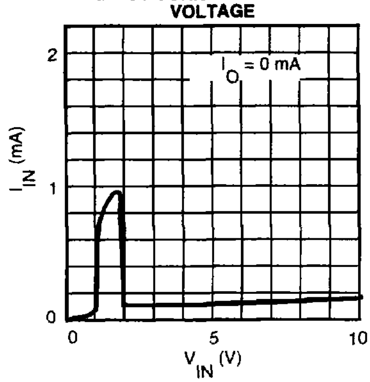
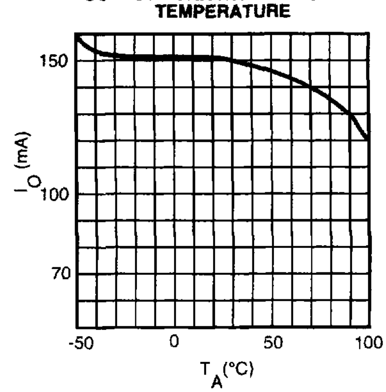
OUTPUT VOLTAGE vs. OUTPUT CURRENT



INPUT CURRENT vs. INPUT VOLTAGE



OUTPUT CURRENT vs. AMBIENT TEMPERATURE

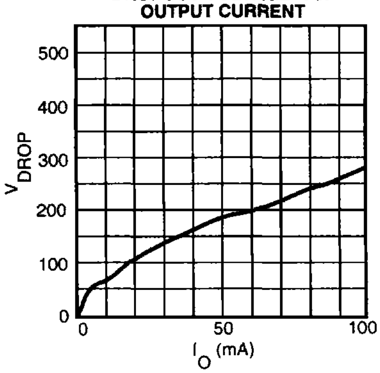


TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

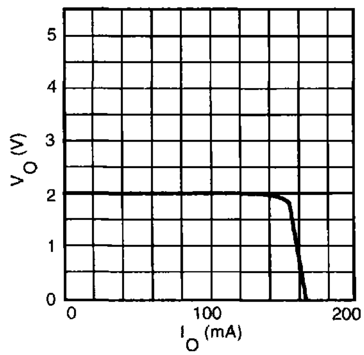
TK71320(CONT.)

T_A = 25 °C unless otherwise specified

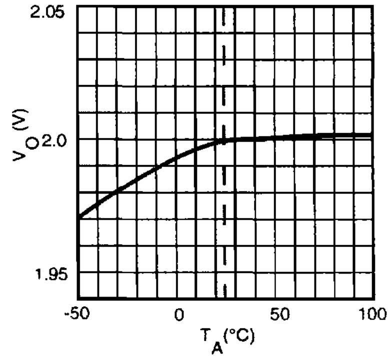
DROPOUT VOLTAGE VS. OUTPUT CURRENT



SHORT CIRCUIT PROTECTION

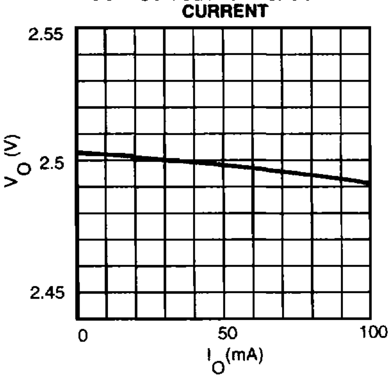


OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE

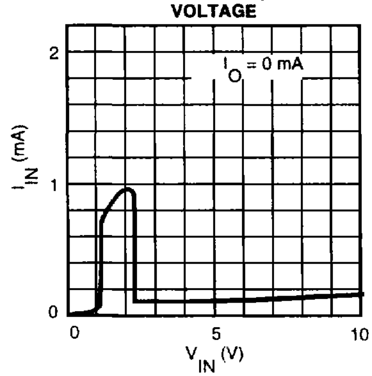


TK71325

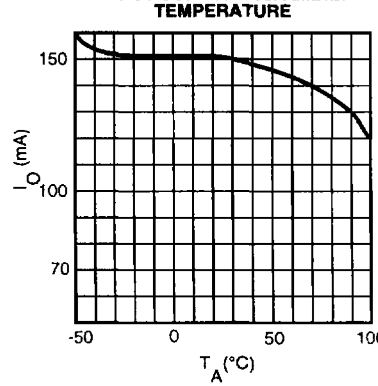
OUTPUT VOLTAGE vs. OUTPUT CURRENT



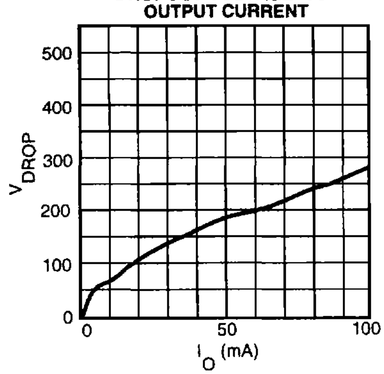
INPUT CURRENT vs. INPUT VOLTAGE



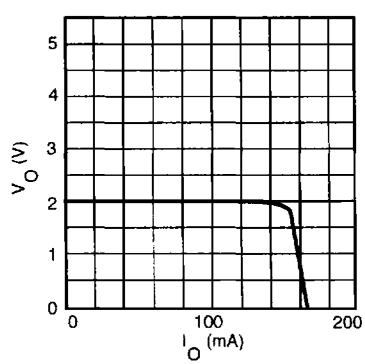
OUTPUT CURRENT vs. AMBIENT TEMPERATURE



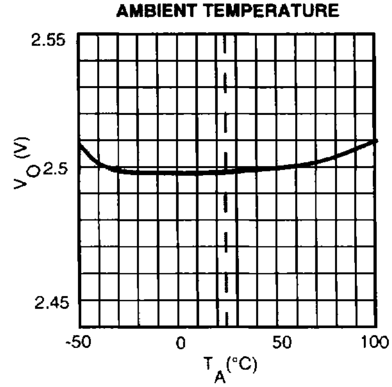
DROPOUT VOLTAGE VS. OUTPUT CURRENT



SHORT CIRCUIT PROTECTION



OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE

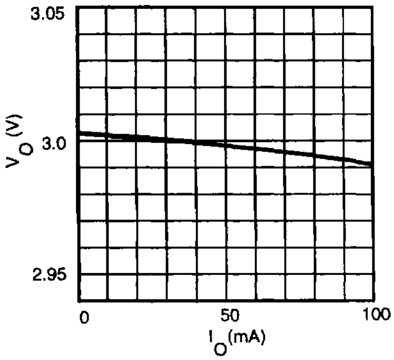


TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

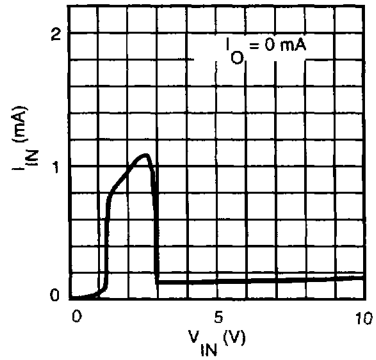
T_A = 25 °C unless otherwise specified

TK71330

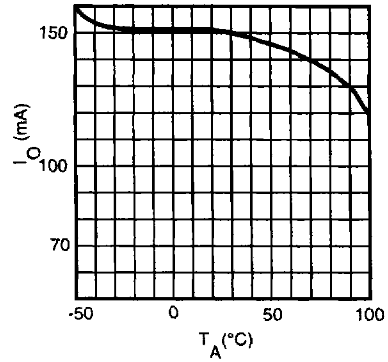
OUTPUT VOLTAGE vs. OUTPUT CURRENT



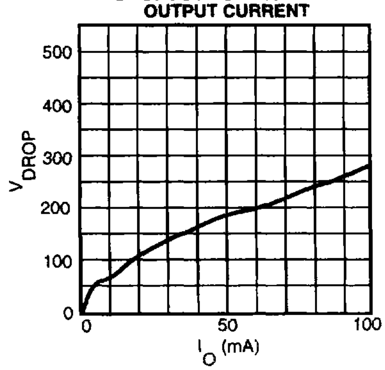
INPUT CURRENT vs. INPUT VOLTAGE



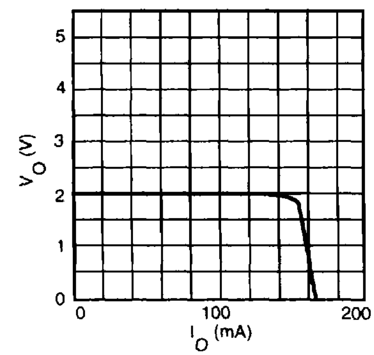
OUTPUT CURRENT vs. AMBIENT TEMPERATURE



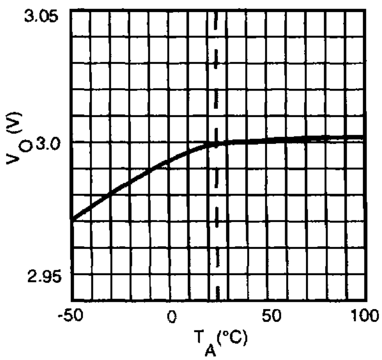
DROPOUT VOLTAGE VS. OUTPUT CURRENT



SHORT CIRCUIT PROTECTION

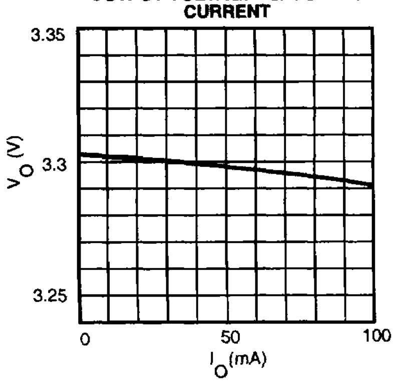


OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE

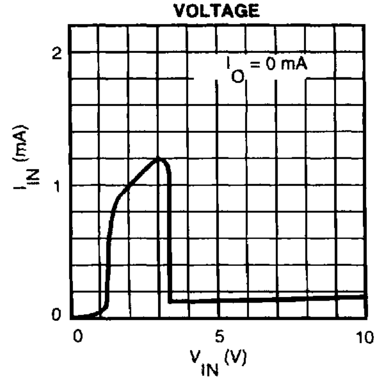


TK71333

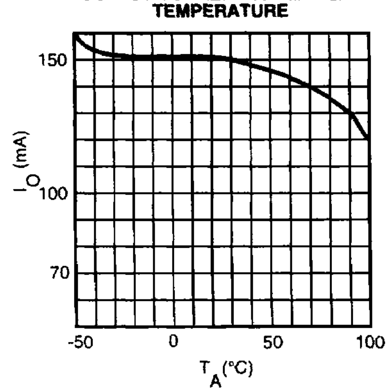
OUTPUT VOLTAGE vs. OUTPUT CURRENT



INPUT CURRENT vs. INPUT VOLTAGE



OUTPUT CURRENT vs. AMBIENT TEMPERATURE

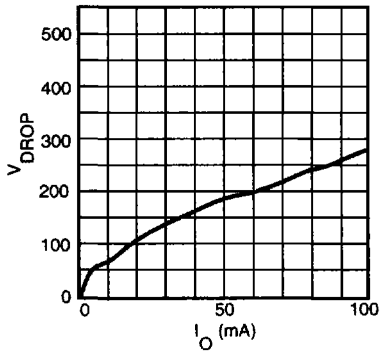


TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

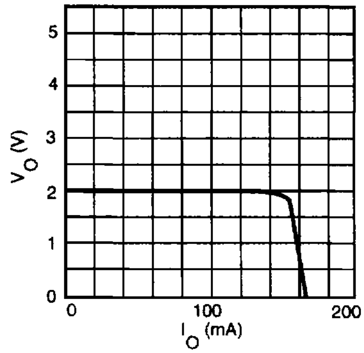
TK71333(CONT.)

T_A = 25 °C unless otherwise specified

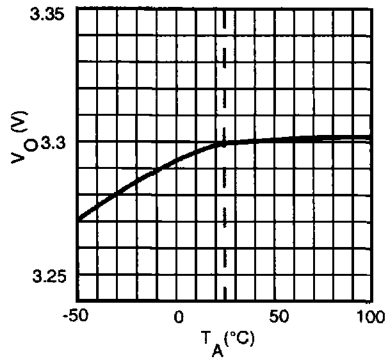
DROPOUT VOLTAGE VS. OUTPUT CURRENT



SHORT CIRCUIT PROTECTION

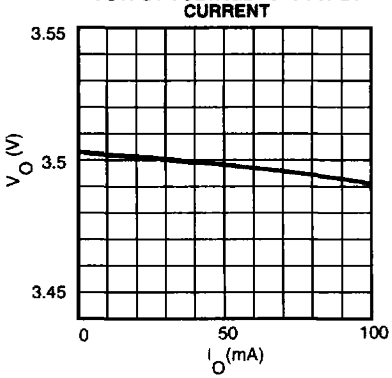


OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE

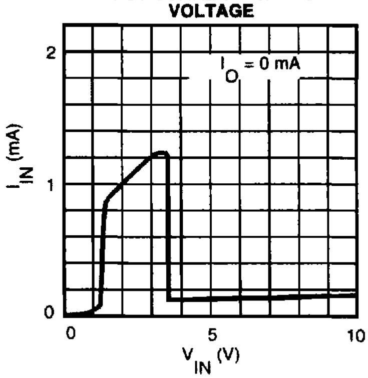


TK71335

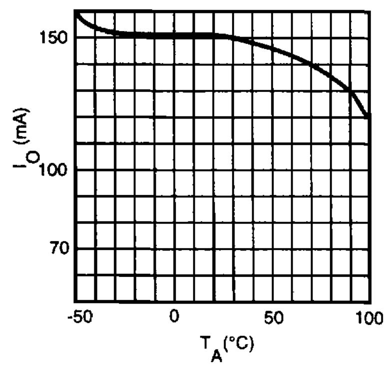
OUTPUT VOLTAGE vs. OUTPUT CURRENT



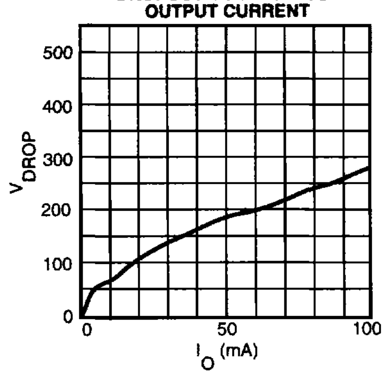
INPUT CURRENT vs. INPUT VOLTAGE



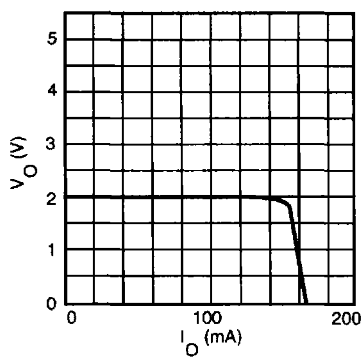
OUTPUT CURRENT vs. AMBIENT TEMPERATURE



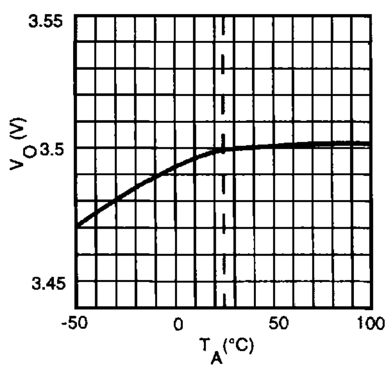
DROPOUT VOLTAGE VS. OUTPUT CURRENT



SHORT CIRCUIT PROTECTION



OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE

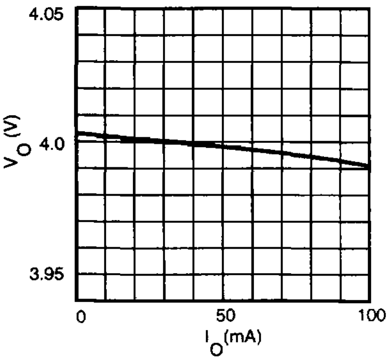


TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

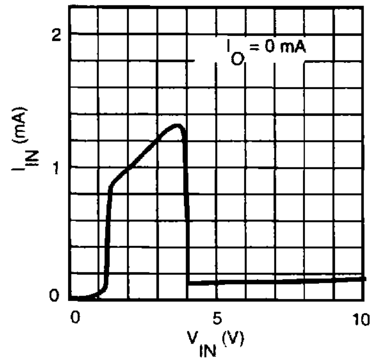
T_A = 25 °C unless otherwise specified

TK71340

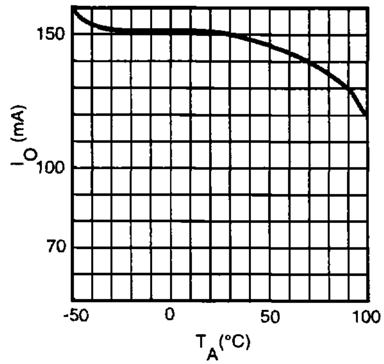
OUTPUT VOLTAGE vs. OUTPUT CURRENT



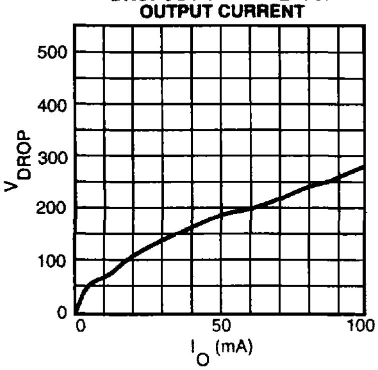
INPUT CURRENT vs. INPUT VOLTAGE



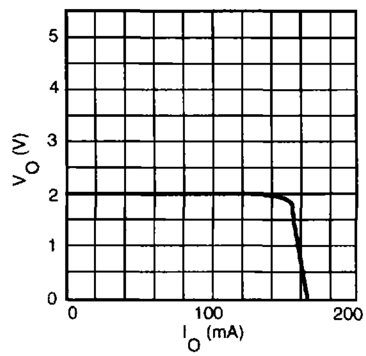
OUTPUT CURRENT vs. AMBIENT TEMPERATURE



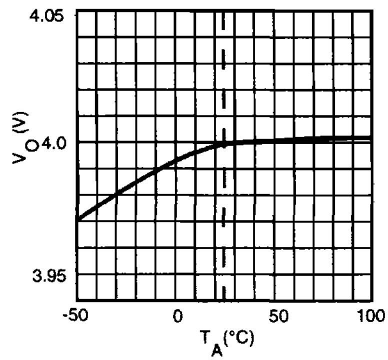
DROPOUT VOLTAGE VS. OUTPUT CURRENT



SHORT CIRCUIT PROTECTION

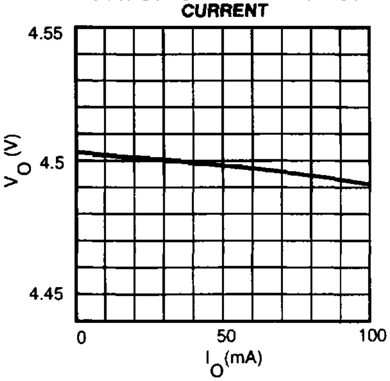


OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE

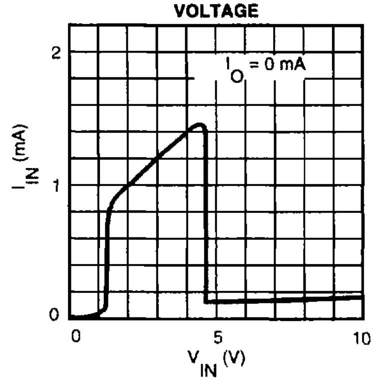


TK71345

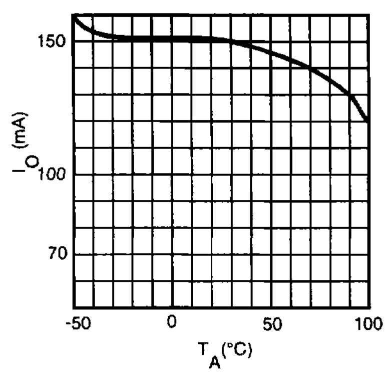
OUTPUT VOLTAGE vs. OUTPUT CURRENT



INPUT CURRENT vs. INPUT VOLTAGE



OUTPUT CURRENT vs. AMBIENT TEMPERATURE

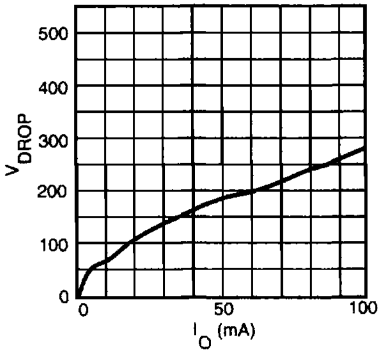


TYPICAL PERFORMANCE CHARACTERISTICS (CONT.)

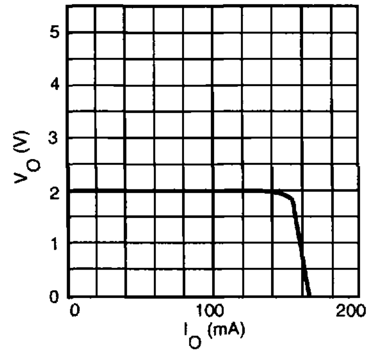
T_A = 25 °C unless otherwise specified

TK71345(CONT.)

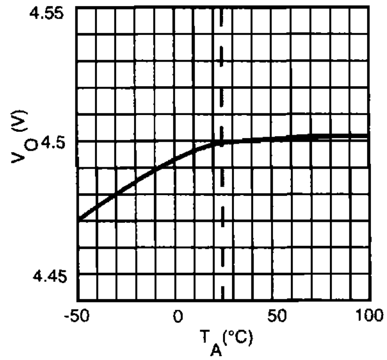
DROPOUT VOLTAGE VS. OUTPUT CURRENT



SHORT CIRCUIT PROTECTION

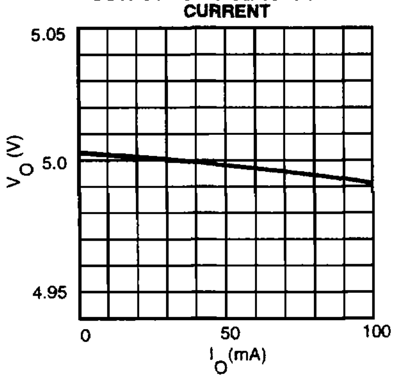


OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE

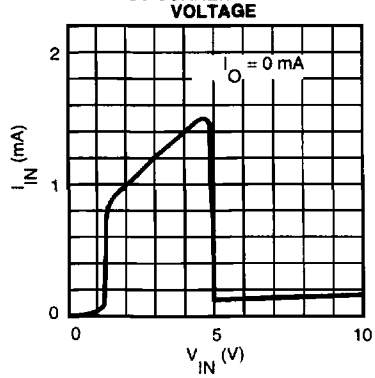


TK71350

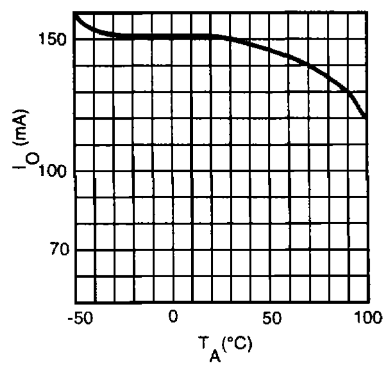
OUTPUT VOLTAGE vs. OUTPUT CURRENT



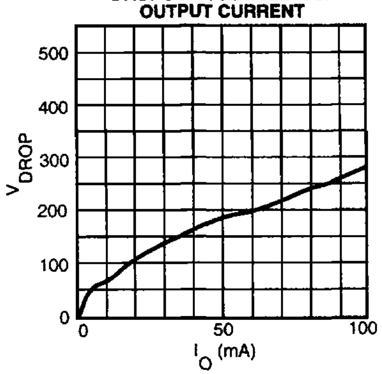
INPUT CURRENT vs. INPUT VOLTAGE



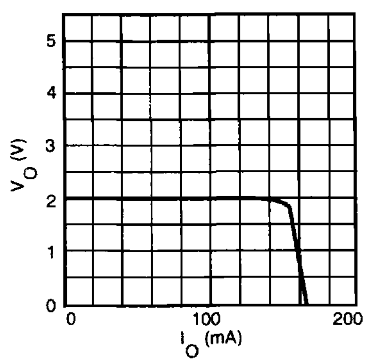
OUTPUT CURRENT vs. AMBIENT TEMPERATURE



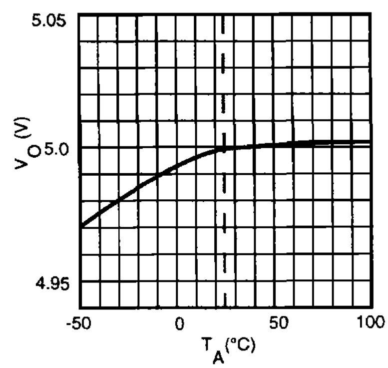
DROPOUT VOLTAGE VS. OUTPUT CURRENT



SHORT CIRCUIT PROTECTION



OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



I

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 value of the temperature rise depends on the circuit board, the PCB pattern, the materials of PCB and the ambient temperature. When the radiation of heat is good, the device temperature will be low, even if the power loss is great.

To find the power dissipation when mounted, mount the IC on the PCB, then deliberately increase the output current or raise the input voltage to activate the overheat sensor circuit and calculate the power dissipation (Input Power - Output Power) when the circuit is activated. When taking the required measurements, be sure to allow for the ambient temperature of the PCB. The value obtained by dividing the power dissipation by (150 - T_A) °C is the rate of derating per degree. Try to ensure good heat release to reduce temperature. Generally, the lower the temperature of element, the better the reliability of the device. Power dissipation is 350 mW for the SOT-25 package.

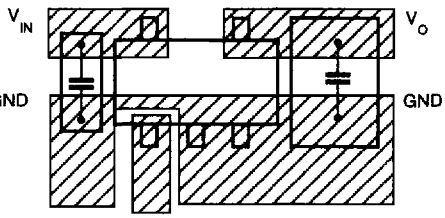
INPUT/OUTPUT DECOUPLING CAPACITOR CONSIDERATIONS

Voltage regulators require input and output decoupling capacitors. The required value 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 this value. The recommended minimum capacitance for the TK713xx is 2.2 µF for a tantalum capacitor or 3.3 µF for an aluminum electrolytic. 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.

APPLICATION NOTES

OPTIMUM PERFORMANCE

Optimum performance can only be achieved when the IC is mounted on a PC board according to the diagram below. This is because of the extremely small package and limited power dissipation. Shape the metal portion of the PCB as shown in the following drawing.



Use a large bypass capacitor and connect it in a place near GND of the IC. Pay attention to temperature characteristics of the capacitor, especially the increase of ESR and decrease of capacitance in low temperatures. Oscillation, reduction of ripple rejection and increased noise may occur in some cases if the proper capacitor is not used. The minimum recommend output capacitor is 1.0 µF to maintain stability. The standard test condition is 3.3 µF (T_A = 25 °C).