- **Very Low Dropout Voltage, Less Than 0.6 V at 750 mA**
- **Low Quiescent Current**
- **TTL- and CMOS-Compatible Enable on TL751M Series**
- **60-V Load-Dump Protection**
- **Overvoltage Protection**
- **Internal Thermal Overload Protection**
- **Internal Overcurrent-Limiting Circuitry**

description

The TL750M and TL751M series are low-dropout positive voltage regulators specifically designed for battery-powered systems. The TL750M and TL751M series incorporate onboard overvoltage and current-limiting protection circuitry to protect the devices and the regulated system. Both series are fully protected against 60-V load-dump and reverse-battery conditions. Extremely low quiescent current, even during full-load conditions, makes the TL750M and TL751M series ideal for standby power systems.

The TL750M and TL751M series offers 5-V, 8-V, 10-V, and 12-V options. The TL751M series has the addition of an enable ($\overline{\text{ENABLE}}$) input. The $\overline{\text{ENABLE}}$ input gives the designer complete control over power up, allowing sequential power up or emergency shutdown. When $\overline{\text{ENABLE}}$ is high, the regulator output is placed in the high-impedance state. The $\overline{\text{ENABLE}}$ input is TTL- and CMOS-compatible.

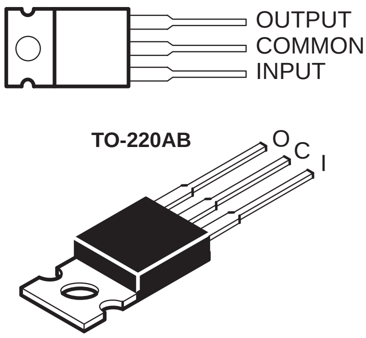
The TL750MxxC and TL751MxxC are characterized for operation over the virtual junction temperature range 0°C to 125°C.

AVAILABLE OPTIONS

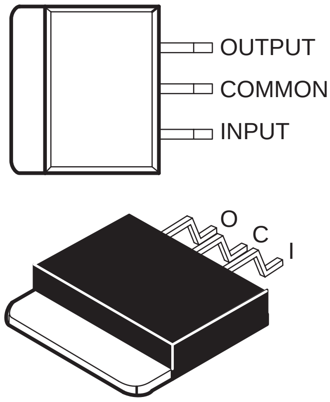
T_J	V_O TYP (V)	PACKAGED DEVICES				CHIP FORM (Y)
		HEAT-SINK MOUNTED (3-PIN) (KC)	PLASTIC FLANGE MOUNT (KTE)	PLASTIC FLANGE MOUNT (KTG)	PLASTIC FLANGE MOUNT (KTP)	
0°C to 125°C	5	TL750M05CKC	TL750M05CKTE	TL751M05CKTG	TL750M05CKTPR	TL750M05Y
	8	TL750M08CKC	TL750M08CKTE	TL751M08CKTG	TL750M08CKTPR	TL750M08Y
	10	TL750M10CKC	TL750M10CKTE	TL751M10CKTG	TL750M10CKTPR	TL750M10Y
	12	TL750M12CKC	TL750M12CKTE	TL751M12CKTG	TL750M12CKTPR	TL750M12Y

The KTE and KTG packages are available taped and reeled. The KTP is only available taped and reeled. Add the suffix R to device type (e.g., TL750M05CKTER). Chip forms are tested at 25°C.

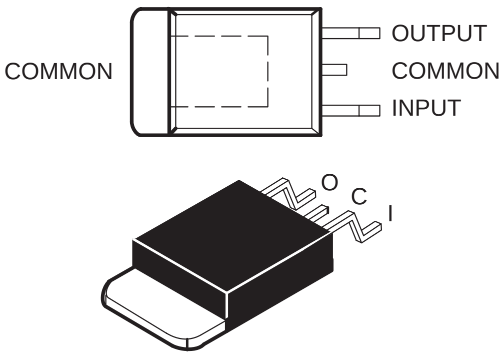
TL750M . . . KC PACKAGE†
(TOP VIEW)



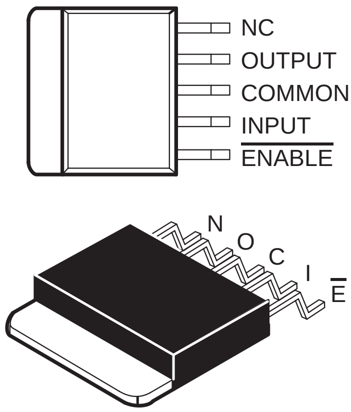
TL750M . . . KTE PACKAGE†
(TOP VIEW)



TL750M . . . KTP PACKAGE†
(TOP VIEW)

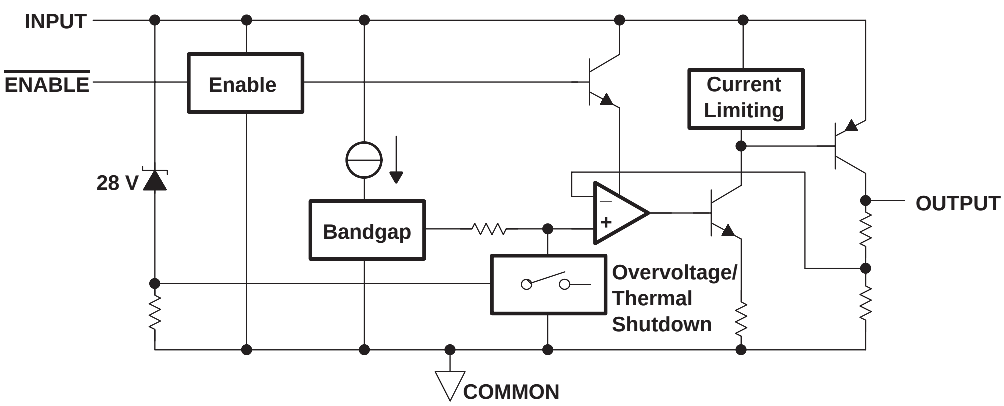


TL751M . . . KTG PACKAGE†
(TOP VIEW)



† The common terminal is in electrical contact with the mounting base.
NC – No internal connection

TL751Mxx functional block diagram



DEVICE COMPONENT COUNT	
Transistors	46
Diodes	14
Resistors	44
Capacitors	4
JFETs	1
Tunnels (emitter R)	2

absolute maximum ratings over virtual junction temperature range (unless otherwise noted)†

Continuous input voltage	26 V
Transient input voltage (see Figure 3)	60 V
Continuous reverse input voltage	–15 V
Transient reverse input voltage: t = 100 ms	–50 V
Package thermal impedance, θ_{JA} (see Notes 1 and 2): KC package	22°C/W
KTE package	23°C/W
KTG package	23°C/W
KTP package	28°C/W
Virtual junction temperature range, T_J	0°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C
Storage temperature range, T_{stg}	–65°C to 150°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. Maximum power dissipation is a function of T_J(max), θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) – T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can impact reliability. Due to variation in individual device electrical characteristics and thermal resistance, the built-in thermal overload protection may be activated at power levels slightly above or below the rated dissipation.

2. The package thermal impedance is calculated in accordance with JESD 51.

recommended operating conditions

		MIN	MAX	UNIT
Input voltage range, V_I	TL75xM05	6	26	V
	TL75xM08	9	26	
	TL75xM10	11	26	
	TL75xM12	13	26	
High-level $\overline{ENABLE}$ input voltage, V_{IH}	TL751Mxx	2	15	V
Low-level $\overline{ENABLE}$ input voltage, V_{IL}	TL751Mxx	0	0.8	V
Output current range, I_O	TL75xMxxC		750	mA
Operating virtual junction temperature range, T_J	TL75xMxxC	0	125	°C

electrical characteristics, V_I = 14 V, I_O = 300 mA, T_J = 25°C

PARAMETER	TL751MXXX			UNIT
	MIN	TYP	MAX	
Response time, $\overline{ENABLE}$ to output		50		µs

electrical characteristics, V_I = 14 V, I_O = 300 mA, $\overline{\text{ENABLE}}$ at 0 V for TL751M05, T_J = 25°C (unless otherwise noted) (see Note 3)

PARAMETER	TEST CONDITIONS		TL750M05C TL751M05C			UNIT
			MIN	TYP	MAX	
Output voltage			4.95	5	5.05	V
	T_J = 0°C to 125°C		4.9		5.1	
Input voltage regulation	V_I = 9 V to 16 V,	I_O = 250 mA		10	25	mV
	V_I = 6 V to 26 V,	I_O = 250 mA		12	50	
Ripple rejection	V_I = 8 V to 18 V,	f = 120 Hz	50	55		dB
Output voltage regulation	I_O = 5 mA to 750 mA			20	50	mV
Dropout voltage	I_O = 500 mA				0.5	V
	I_O = 750 mA				0.6	
Output noise voltage	f = 10 Hz to 100 kHz			500		μV
Bias current	I_O = 750 mA			60	75	mA
	I_O = 10 mA				5	
Bias current (TL751M05C and TL751M05Q only)	$\overline{\text{ENABLE}}$ $V_{IH} \geq 2$ V				200	μA

NOTE 3: Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.1-μF capacitor across the input and a 10-μF tantalum capacitor on the output, with equivalent series resistance within the guidelines shown in Figure 3.

electrical characteristics, V_I = 14 V, I_O = 300 mA, $\overline{\text{ENABLE}}$ at 0 V for TL751M08, T_J = 25°C (unless otherwise noted) (see Note 3)

PARAMETER	TEST CONDITIONS		TL750M08C TL751M08C			UNIT
			MIN	TYP	MAX	
Output voltage			7.92	8	8.08	V
	T_J = 0°C to 125°C		7.84		8.16	
Input voltage regulation	V_I = 10 V to 17 V,	I_O = 250 mA		12	40	mV
	V_I = 9 V to 26 V,	I_O = 250 mA		15	68	
Ripple rejection	V_I = 11 V to 21 V,	f = 120 Hz	50	55		dB
Output voltage regulation	I_O = 5 mA to 750 mA			24	80	mV
Dropout voltage	I_O = 500 mA				0.5	V
	I_O = 750 mA				0.6	
Output noise voltage	f = 10 Hz to 100 kHz			500		μV
Bias current	I_O = 750 mA			60	75	mA
	I_O = 10 mA				5	
Bias current (TL751Mxx only)	$\overline{\text{ENABLE}}$ $V_{IH} \geq 2$ V				200	μA

NOTE 3: Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.1-μF capacitor across the input and a 10-μF tantalum capacitor on the output, with equivalent series resistance within the guidelines shown in Figure 3.

electrical characteristics, V_I = 14 V, I_O = 300 mA, $\overline{ENABLE}$ at 0 V for TL751M10, T_J = 25°C (unless otherwise noted) (see Note 3)

PARAMETER	TEST CONDITIONS		TL750M10C TL751M10C MIN	TYP	MAX	UNIT
Output voltage			9.9	10	10.1	V
	T_J = 0°C to 125°C		9.8		10.2	
Input voltage regulation	V_I = 12 V to 18 V,	I_O = 250 mA		15	43	mV
	V_I = 11 V to 26 V,	I_O = 250 mA		20	75	
Ripple rejection	V_I = 13 V to 23 V,	f = 120 Hz	50	55		dB
Output voltage regulation	I_O = 5 mA to 750 mA			30	100	mV
Dropout voltage	I_O = 500 mA				0.5	V
	I_O = 750 mA				0.6	
Output noise voltage	f = 10 Hz to 100 kHz			1000		µV
Bias current	I_O = 750 mA			60	75	mA
	I_O = 10 mA				5	
Bias current (TL751Mxx only)	$\overline{ENABLE}$ $V_{IH} \geq 2$ V				200	µA

NOTE 3: Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.1-µF capacitor across the input and a 10-µF tantalum capacitor on the output, with equivalent series resistance within the guidelines shown in Figure 3.

electrical characteristics, V_I = 14 V, I_O = 300 mA, $\overline{ENABLE}$ at 0 V for TL751M12, T_J = 25°C (unless otherwise noted) (see Note 3)

PARAMETER	TEST CONDITIONS		TL750M12C TL751M12C MIN	TYP	MAX	UNIT
Output voltage			11.88	12	12.12	V
	T_J = 0°C to 125°C		11.76		12.24	
Input voltage regulation	V_I = 14 V to 19 V,	I_O = 250 mA		15	43	mV
	V_I = 13 V to 26 V,	I_O = 250 mA		20	78	
Ripple rejection	V_I = 13 V to 23 V,	f = 120 Hz	50	55		dB
Output voltage regulation	I_O = 5 mA to 750 mA			30	120	mV
Dropout voltage	I_O = 500 mA				0.5	V
	I_O = 750 mA				0.6	
Output noise voltage	f = 10 Hz to 100 kHz			1000		µV
Bias current	I_O = 750 mA			60	75	mA
	I_O = 10 mA				5	
Bias current (TL751Mxx only)	$\overline{ENABLE}$ $V_{IH} \geq 2$ V				200	µA

NOTE 3: Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.1-µF capacitor across the input and a 10-µF tantalum capacitor on the output, with equivalent series resistance within the guidelines shown in Figure 3.

electrical characteristics, V_I = 14 V, I_O = 300 mA, $\overline{\text{ENABLE}}$ at 0 V, T_J = 25°C (unless otherwise noted) (see Note 3)

PARAMETER	TEST CONDITIONS		TL750M05Y			UNIT
			MIN	TYP	MAX	
Output voltage				5		V
Input voltage regulation	V_I = 9 V to 16 V,	I_O = 250 mA		10		mV
	V_I = 6 V to 26 V,	I_O = 250 mA		12		
Ripple rejection	V_I = 8 V to 18 V,	f = 120 Hz		55		dB
Output voltage regulation	I_O = 5 mA to 750 mA			20		mV
Output noise voltage	f = 10 Hz to 100 kHz			500		µV
Bias current	I_O = 750 mA			60		mA

NOTE 3: Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.1-µF capacitor across the input and a 10-µF tantalum capacitor on the output, with equivalent series resistance within the guidelines shown in Figure 3.

electrical characteristics, V_I = 14 V, I_O = 300 mA, $\overline{\text{ENABLE}}$ at 0 V, T_J = 25°C (unless otherwise noted) (see Note 3)

PARAMETER	TEST CONDITIONS		TL750M08Y			UNIT
			MIN	TYP	MAX	
Output voltage				8		V
Input voltage regulation	V_I = 10 V to 17 V,	I_O = 250 mA		12		mV
	V_I = 9 V to 26 V,	I_O = 250 mA		15		
Ripple rejection	V_I = 11 V to 21 V,	f = 120 Hz		55		dB
Output voltage regulation	I_O = 5 mA to 750 mA			24		mV
Output noise voltage	f = 10 Hz to 100 kHz			500		µV
Bias current	I_O = 750 mA			60		mA

NOTE 3: Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.1-µF capacitor across the input and a 10-µF tantalum capacitor on the output, with equivalent series resistance within the guidelines shown in Figure 3.

electrical characteristics, V_I = 14 V, I_O = 300 mA, $\overline{\text{ENABLE}}$ at 0 V, T_J = 25°C (unless otherwise noted) (see Note 3)

PARAMETER	TEST CONDITIONS		TL750M10Y			UNIT
			MIN	TYP	MAX	
Output voltage				10		V
Input voltage regulation	V_I = 12 V to 18 V,	I_O = 250 mA		15		mV
	V_I = 11 V to 26 V,	I_O = 250 mA		20		
Ripple rejection	V_I = 13 V to 23 V,	f = 120 Hz		55		dB
Output voltage regulation	I_O = 5 mA to 750 mA			30		mV
Output noise voltage	f = 10 Hz to 100 kHz			1000		µV
Bias current	I_O = 750 mA			60		mA

NOTE 3: Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.1-µF capacitor across the input and a 10-µF tantalum capacitor on the output, with equivalent series resistance within the guidelines shown in Figure 3.

TL751M12Y electrical characteristics, V_I = 14 V, I_O = 300 mA, $\overline{\text{ENABLE}}$ at 0 V, T_J = 25°C (unless otherwise noted) (see Note 3)

PARAMETER	TEST CONDITIONS		TL750M12Y MIN	TL750M12Y TYP	TL750M12Y MAX	UNIT
Output voltage				12		V
Input voltage regulation	V_I = 14 V to 19 V,	I_O = 250 mA		15		mV
	V_I = 13 V to 26 V,	I_O = 250 mA		20		
Ripple rejection	V_I = 13 V to 23 V,	f = 120 Hz		55		dB
Output voltage regulation	I_O = 5 mA to 750 mA			30		mV
Output noise voltage	f = 10 Hz to 100 kHz			1000		µV
Bias current	I_O = 750 mA			60		mA

NOTE 3: Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.1-µF capacitor across the input and a 10-µF tantalum capacitor on the output, with equivalent series resistance within the guidelines shown in Figure 3.

PARAMETER MEASUREMENT INFORMATION

The TL751Mxx is a low-dropout regulator. This means that the capacitance loading is important to the performance of the regulator because it is a vital part of the control loop. The capacitor value and the equivalent series resistance (ESR) both affect the control loop and must be defined for the load range and the temperature range. Figures 1 and 2 can establish the capacitance value and ESR range for the best regulator performance.

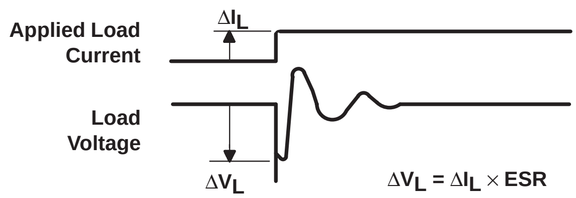
Figure 1 shows the recommended range of ESR for a given load with a 10-µF capacitor on the output. This figure also shows a maximum ESR limit of 2 Ω and a load-dependent minimum ESR limit.

For applications with varying loads, the lightest load condition should be chosen because it is the worst case. Figure 2 shows the relationship of the reciprocal of ESR to the square root of the capacitance with a minimum capacitance limit of 10 µF and a maximum ESR limit of 2 Ω. This figure establishes the amount that the minimum ESR limit shown in Figure 1 can be adjusted for different capacitor values. For example, where the minimum load needed is 200 mA, Figure 2 suggests an ESR range of 0.8 Ω to 2 Ω for 10 µF. Figure 2 shows that changing the capacitor from 10 µF to 400 µF can change the ESR minimum by greater than 3/0.5 (or 6). Therefore, the new minimum ESR value is 0.8/6 (or 0.13 Ω). This allows an ESR range of 0.13 Ω to 2 Ω , achieving an expanded ESR range by using a larger capacitor at the output. For better stability in low-current applications, a small resistance placed in series with the capacitor (see Table 1) is recommended, so that ESRs better approximate those shown in Figures 1 and 2.

PARAMETER MEASUREMENT INFORMATION

Table 1. Compensation for Increased Stability at Low Currents

MANUFACTURER	CAPACITANCE	ESR TYP	PART NUMBER	ADDITIONAL RESISTANCE
AVX	15 μF	0.9 Ω	TAJB156M010S	1 Ω
KEMET	33 μF	0.6 Ω	T491D336M010AS	0.5 Ω



OUTPUT CAPACITOR
EQUIVALENT SERIES RESISTANCE (ESR)
vs
LOAD CURRENT RANGE

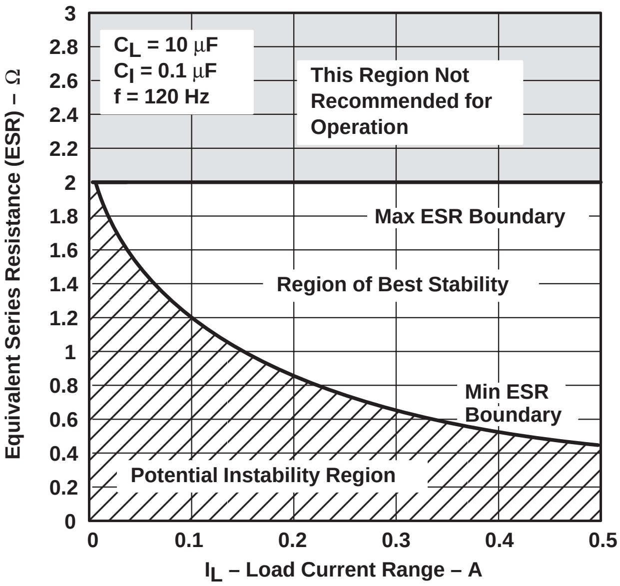


Figure 1

STABILITY
vs
EQUIVALENT SERIES RESISTANCE (ESR)

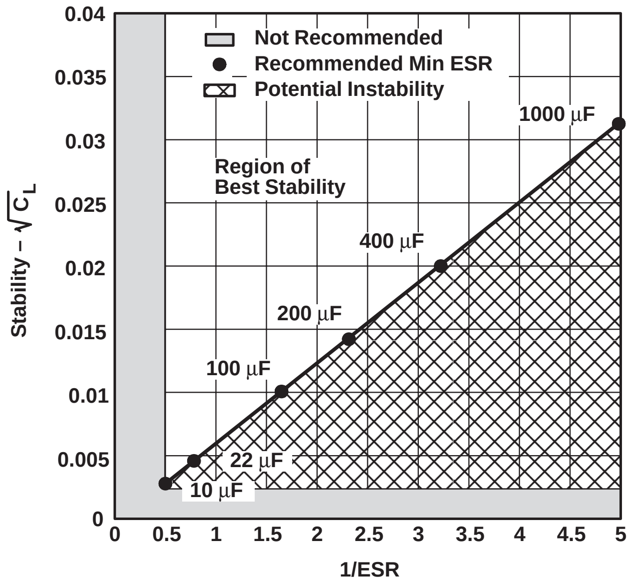


Figure 2

TYPICAL CHARACTERISTICS

Table of Graphs

		FIGURE
Transient input voltage vs Time		3
Output voltage vs Input voltage		4
Input current vs Input voltage	I_O = 10 mA	5
	I_O = 100 mA	6
Dropout voltage vs Output current		7
Quiescent current vs Output current		8
Load transient response		9
Line transient response		10

TRANSIENT INPUT VOLTAGE vs TIME

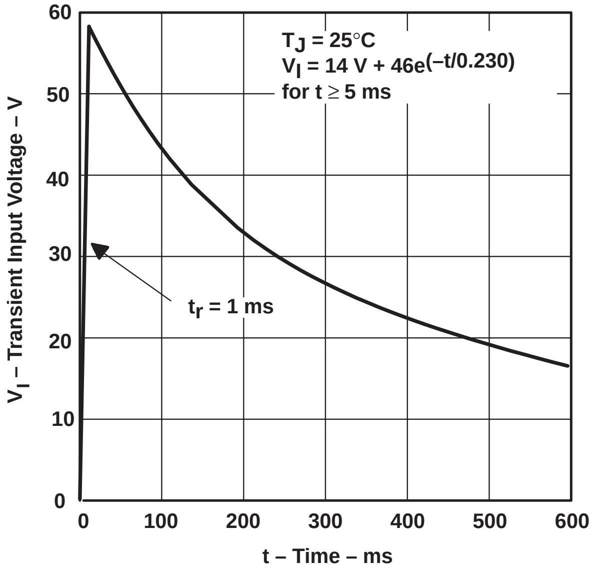


Figure 3

OUTPUT VOLTAGE vs INPUT VOLTAGE

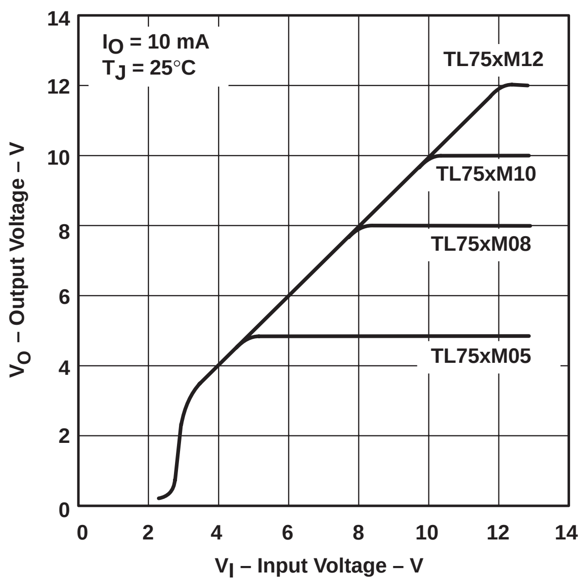


Figure 4

TYPICAL CHARACTERISTICS

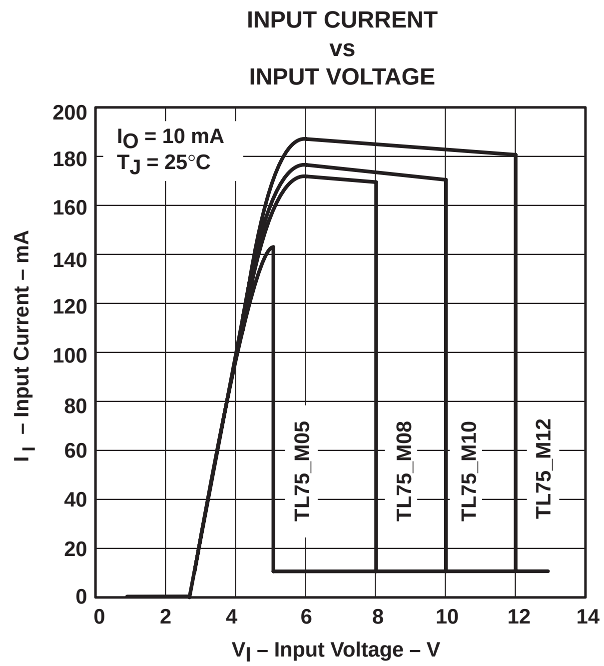


Figure 5

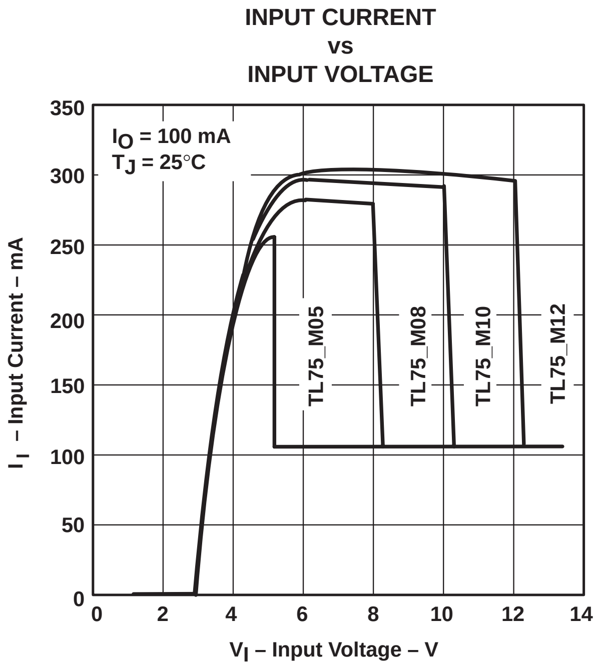


Figure 6

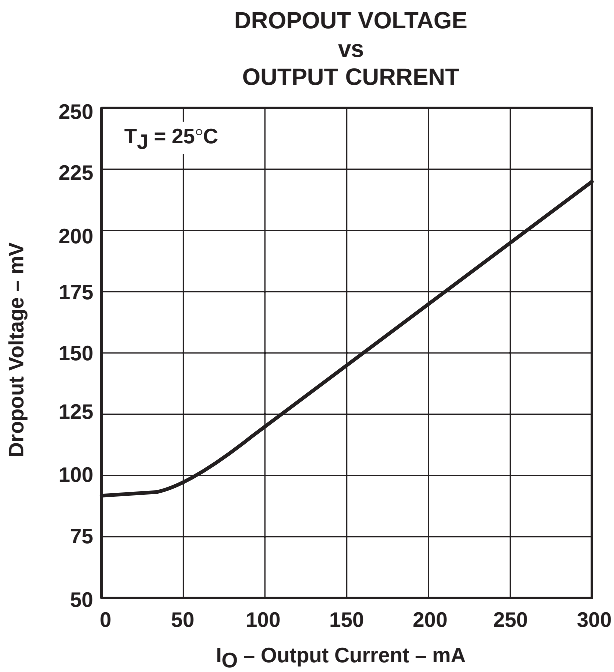


Figure 7

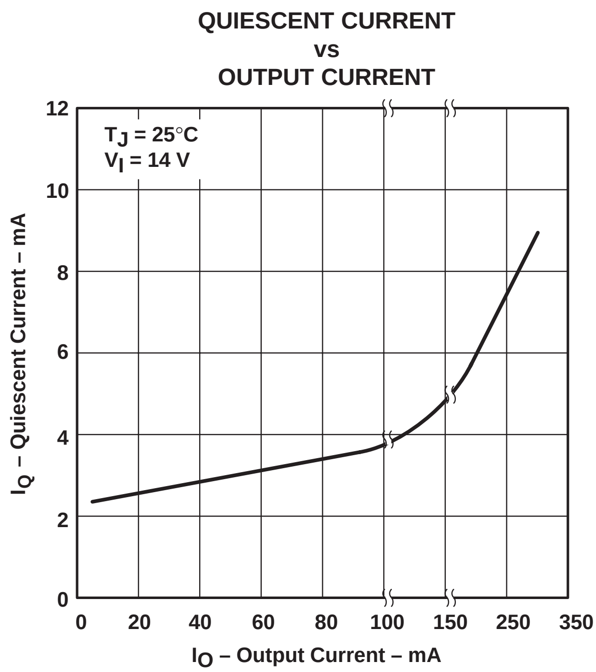


Figure 8

TYPICAL CHARACTERISTICS

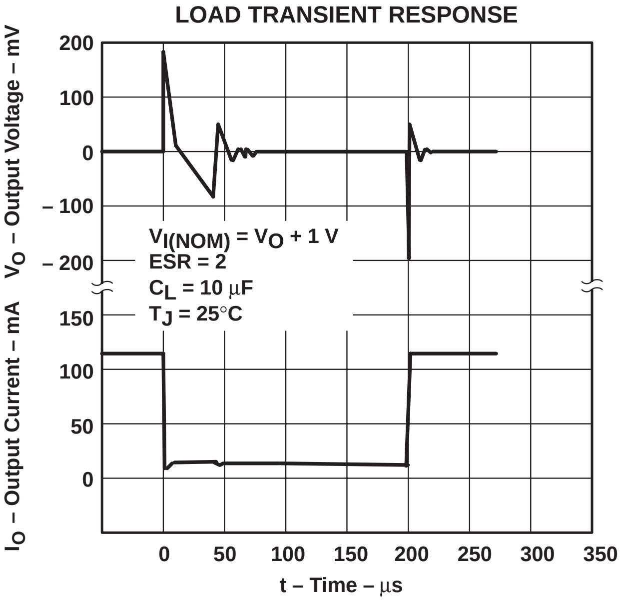


Figure 9

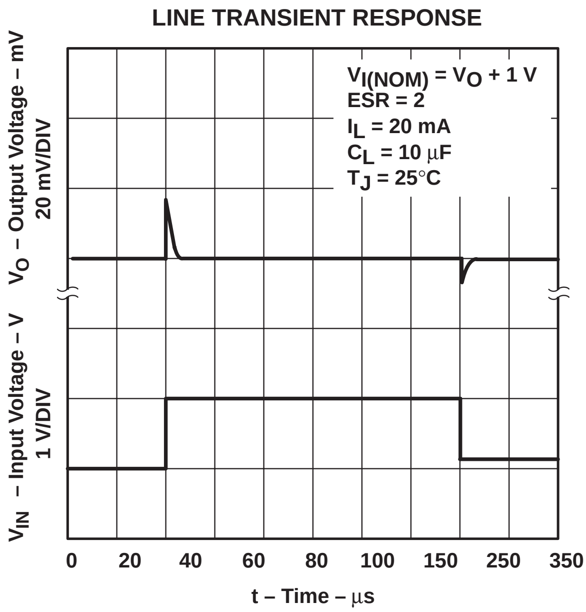


Figure 10

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