Ordering number: EN4186B

Monolithic Linear IC

L88MS00T Series

4 to 12 V, 0.5 A Low Dropout Voltage Regulator with On/Off Function

Overview

The L88MS00T Series has an on-chip on/off function to maximize equipment power saving effectiveness. Because it can operate with a low input-output voltage difference, it contributes to smaller and more efficient set power supplies, optimum for audio-visual and office automation equipment.

Functions

- Output voltage L88MS04T: 4 V L88MS05T: 5 V
  L88MS06T: 6 V L88MS08T: 8 V
  L88MS09T: 9 V L88MS12T: 12 V
- On/off control of output voltage by strobe pin (active low)
- 500 mA output current

Features

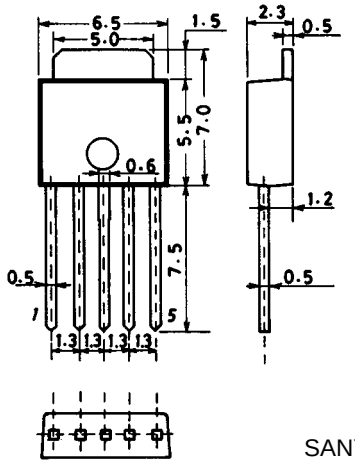
- Low minimum input-output voltage differential (0.4 V typ) enables to save energy and miniaturize transformer size.
- Quiescent current is low with output off (L88MS05T/I_Q OFF = 40 µA typ, except I_{STB}).
- Set size can be miniaturized with compact TP-5H power package.
- Surface mounting on board permits allowable power dissipation to be raised.
- Enhanced mount flexibility with range of formed products.
- On-chip protective circuitry (fold back short circuit, thermal over load).
- External noise suppression pin provided.

Package Dimensions

unit : mm

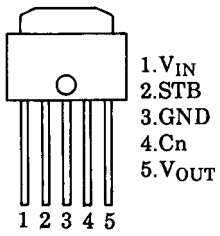
3103-TP-5H

[L88MS00T Series]



SANYO : TP-5H

Pin Assignment



Top view

Specifications

Maximum Ratings at Ta = 25°C (common to L88MS00T series)

Parameter	Symbol	Conditions	Ratings	Unit
Input voltage	V_{IN} max		18	V
Strobe pin input voltage	V_{ST} max		V_{IN} max	V
Allowable power dissipation	Pd max	Ta ≦ 25°C, no heat sink	1	W
		Tc = 25°C, with infinite heat sink	6.25	W
Thermal resistance (junction-atmosphere)	θj-a		125	°C/W
Thermal resistance (junction-to-case)	θj-c		20	°C/W
Operating temperature	Topr		–20 to +85	°C
Storage temperature	Tstg		–55 to +150	°C

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[L88MS04T]
Operating Conditions at Ta = 25 °C

Parameter	Symbol	Conditions	Ratings	Unit
Input voltage	V_{IN}		4.7 to 17	V
Output current	I_{OUT}		0 to 500	mA
Output on control voltage	V_{STL}		–0.3 to +0.8	V
Output off control voltage	V_{STH}		2.0 to V_{IN}	V

Operating Characteristics at Tj = 25 °C, V_{IN} = 7 V, I_O = 500 mA, C_{OUT} = 100 µF, C_{IN}, Cn = 1 µF, see specified Test Circuit.

Parameter	Symbol	Conditions	min	typ	max	Unit
[Output on, V_{ST} = "L"]						
Output voltage	V_{OUT}		3.88	4.0	4.12	V
Dropout voltage	V_{DROP1}			0.4	0.6	V
	V_{DROP2}	I_O = 150 mA		0.2	0.3	V
Line regulation	ΔV_{OLN}	4.7 V ≦ V_{IN} ≦ 17 V		10	50	mV
Load regulation	ΔV_{OLD}	5 mA ≦ I_{OUT} ≦ 500 mA		24	80	mV
Peak output current	I_{OP}		600	900		mA
Output short-circuit current	I_{OSC}			100	300	mA
Quiescent current	I_{Q1}	I_{OUT} = 0		1.9	5.0	mA
	I_{Q2}			24	50	mA
Output noise voltage	V_{NO}	10 Hz ≦ f ≦ 100 kHz		30		µVrms
Temperature coefficient of output voltage	$\Delta V_{OUT}/\Delta Tj$	Tj = 25 to 125 °C		±0.4		mV/°C
Ripple rejection	Rrej	f = 120 Hz, 5 V ≦ V_{IN} ≦ 17 V		72		dB
Output on control voltage	V_{STL}				0.8	V
[Output off, V_{ST} = "H"]						
Low output voltage	V_O OFF	V_{ST} = 5 V		20	200	mV
Static current	I_Q OFF	V_{ST} = 5 V, Except I_{STB}		35	70	µA
Output off control voltage	V_{STH}		2.0		V_{IN}	V

[L88MS05T]
Operating Conditions at Ta = 25 °C

Parameter	Symbol	Conditions	Ratings	Unit
Input voltage	V_{IN}		5.8 to 17	V
Output current	I_{OUT}		0 to 500	mA
Output on control voltage	V_{STL}		–0.3 to +0.8	V
Output off control voltage	V_{STH}		2.0 to V_{IN}	V

Operating Characteristics at Tj = 25 °C, V_{IN} = 8 V, I_O = 500 mA, C_{OUT} = 100 µF, C_{IN}, Cn = 1 µF, see specified Test Circuit.

Parameter	Symbol	Conditions	min	typ	max	Unit
[Output on, V_{ST} = "L"]						
Output voltage	V_{OUT}		4.85	5.0	5.15	V
Dropout voltage	V_{DROP1}			0.4	0.6	V
	V_{DROP2}	I_O = 150 mA		0.2	0.3	V
Line regulation	ΔV_{OLN}	5.8 V ≦ V_{IN} ≦ 17 V		10	50	mV
Load regulation	ΔV_{OLD}	5 mA ≦ I_{OUT} ≦ 500 mA		30	100	mV
Peak output current	I_{OP}		600	900		mA
Output short-circuit current	I_{OSC}			100	300	mA
Quiescent current	I_{Q1}	I_{OUT} = 0		2.0	5.0	mA
	I_{Q2}			24	50	mA
Output noise voltage	V_{NO}	10 Hz ≦ f ≦ 100 kHz		40		µVrms
Temperature coefficient of output voltage	$\Delta V_{OUT}/\Delta Tj$	Tj = 25 to 125 °C		±0.5		mV/°C
Ripple rejection	Rrej	f = 120 Hz, 6 V ≦ V_{IN} ≦ 17 V		74		dB
Output on control voltage	V_{STL}				0.8	V
[Output off, V_{ST} = "H"]						
Low output voltage	V_O OFF	V_{ST} = 5 V		20	200	mV
Static current	I_Q OFF	V_{ST} = 5 V, Except I_{STB}		40	80	µA
Output off control voltage	V_{STH}		2.0		V_{IN}	V

[L88MS06T]

Operating Conditions at Ta = 25 °C

Parameter	Symbol	Conditions	Ratings	Unit
Input voltage	V_{IN}		6.8 to 17	V
Output current	I_{OUT}		0 to 500	mA
Output on control voltage	V_{STL}		–0.3 to +0.8	V
Output off control voltage	V_{STH}		2.0 to V_{IN}	V

Operating Characteristics at Tj = 25 °C, V_{IN} = 9 V, I_O = 500 mA, C_{OUT} = 100 µF, C_{IN}, Cn = 1 µF, see specified Test Circuit.

Parameter	Symbol	Conditions	min	typ	max	Unit
[Output on, V_{ST} = "L"]						
Output voltage	V_{OUT}		5.82	6.0	6.18	V
Dropout voltage	V_{DROP1}			0.4	0.6	V
	V_{DROP2}	I_O = 150 mA		0.2	0.3	V
Line regulation	ΔV_{OLN}	6.8 V ≦ V_{IN} ≦ 17 V		10	50	mV
Load regulation	ΔV_{OLD}	5 mA ≦ I_{OUT} ≦ 500 mA		36	120	mV
Peak output current	I_{OP}		600	900		mA
Output short-circuit current	I_{OSC}			100	300	mA
Quiescent current	I_{Q1}	I_{OUT} = 0		2.1	5.0	mA
	I_{Q2}			24	50	mA
Output noise voltage	V_{NO}	10 Hz ≦ f ≦ 100 kHz		40		µVrms
Temperature coefficient of output voltage	$\Delta V_{OUT}/\Delta Tj$	Tj = 25 to 125 °C		±0.6		mV/°C
Ripple rejection	Rrej	f = 120 Hz, 7 V ≦ V_{IN} ≦ 17 V		76		dB
Output on control voltage	V_{STL}				0.8	V
[Output off, V_{ST} = "H"]						
Low output voltage	V_O OFF	V_{ST} = 5 V		20	200	mV
Static current	I_Q OFF	V_{ST} = 5 V, Except I_{STB}		60	120	µA
Output off control voltage	V_{STH}		2.0		V_{IN}	V

[L88MS08T]
Operating Conditions at Ta = 25 °C

Parameter	Symbol	Conditions	Ratings	Unit
Input voltage	V_{IN}		8.8 to 17	V
Output current	I_{OUT}		0 to 500	mA
Output on control voltage	V_{STL}		–0.3 to +0.8	V
Output off control voltage	V_{STH}		2.0 to V_{IN}	V

Operating Characteristics at Tj = 25 °C, V_{IN} = 11 V, I_O = 500 mA, C_{OUT} = 100 µF, C_{IN}, Cn = 1 µF, see specified Test Circuit.

Parameter	Symbol	Conditions	min	typ	max	Unit
[Output on, V_{ST} = "L"]						
Output voltage	V_{OUT}		7.76	8.0	8.24	V
Dropout voltage	V_{DROP1}			0.4	0.6	V
	V_{DROP2}	I_O = 150 mA		0.2	0.3	V
Line regulation	ΔV_{OLN}	8.8 V ≦ V_{IN} ≦ 17 V		10	50	mV
Load regulation	ΔV_{OLD}	5 mA ≦ I_{OUT} ≦ 500 mA		48	160	mV
Peak output current	I_{OP}		600	900		mA
Output short-circuit current	I_{OSC}			100	300	mA
Quiescent current	I_{Q1}	I_{OUT} = 0		2.2	5.0	mA
	I_{Q2}			24	50	mA
Output noise voltage	V_{NO}	10 Hz ≦ f ≦ 100 kHz		40		µVrms
Temperature coefficient of output voltage	$\Delta V_{OUT}/\Delta Tj$	Tj = 25 to 125 °C		±0.8		mV/°C
Ripple rejection	Rrej	f = 120 Hz, 9 V ≦ V_{IN} ≦ 17 V		76		dB
Output on control voltage	V_{STL}				0.8	V
[Output off, V_{ST} = "H"]						
Low output voltage	V_O OFF	V_{ST} = 5 V		20	200	mV
Static current	I_Q OFF	V_{ST} = 5 V, Except I_{STB}		150	300	µA
Output off control voltage	V_{STH}		2.0		V_{IN}	V

[L88MS09T]
Operating Conditions at Ta = 25 °C

Parameter	Symbol	Conditions	Ratings	Unit
Input voltage	V_{IN}		9.9 to 17	V
Output current	I_{OUT}		0 to 500	mA
Output on control voltage	V_{STL}		–0.3 to +0.8	V
Output off control voltage	V_{STH}		2.0 to V_{IN}	V

Operating Characteristics at Tj = 25 °C, V_{IN} = 12 V, I_O = 500 mA, C_{OUT} = 100 µF, C_{IN}, Cn = 1 µF, see specified Test Circuit.

Parameter	Symbol	Conditions	min	typ	max	Unit
[Output on, V_{ST} = "L"]						
Output voltage	V_{OUT}		8.73	9.0	9.27	V
Dropout voltage	V_{DROP1}			0.4	0.6	V
	V_{DROP2}	I_O = 150 mA		0.2	0.3	V
Line regulation	ΔV_{OLN}	9.9 V ≦ V_{IN} ≦ 17 V		10	50	mV
Load regulation	ΔV_{OLD}	5 mA ≦ I_{OUT} ≦ 500 mA		54	180	mV
Peak output current	I_{OP}		600	900		mA
Output short-circuit current	I_{OSC}			100	300	mA
Quiescent current	I_{Q1}	I_{OUT} = 0		2.3	5.0	mA
	I_{Q2}			24	50	mA
Output noise voltage	V_{NO}	10 Hz ≦ f ≦ 100 kHz		40		µVrms
Temperature coefficient of output voltage	$\Delta V_{OUT}/\Delta Tj$	Tj =25 to 125 °C		±0.9		mV/°C
Ripple rejection	Rrej	f = 120 Hz, 10 V ≦ V_{IN} ≦ 17 V		76		dB
Output on control voltage	V_{STL}				0.8	V
[Output off, V_{ST} = "H"]						
Low output voltage	V_O OFF	V_{ST} = 5 V		20	200	mV
Static current	I_Q OFF	V_{ST} = 5 V, Except I_{STB}		200	400	µA
Output off control voltage	V_{STH}		2.0		V_{IN}	V

[L88MS12T]

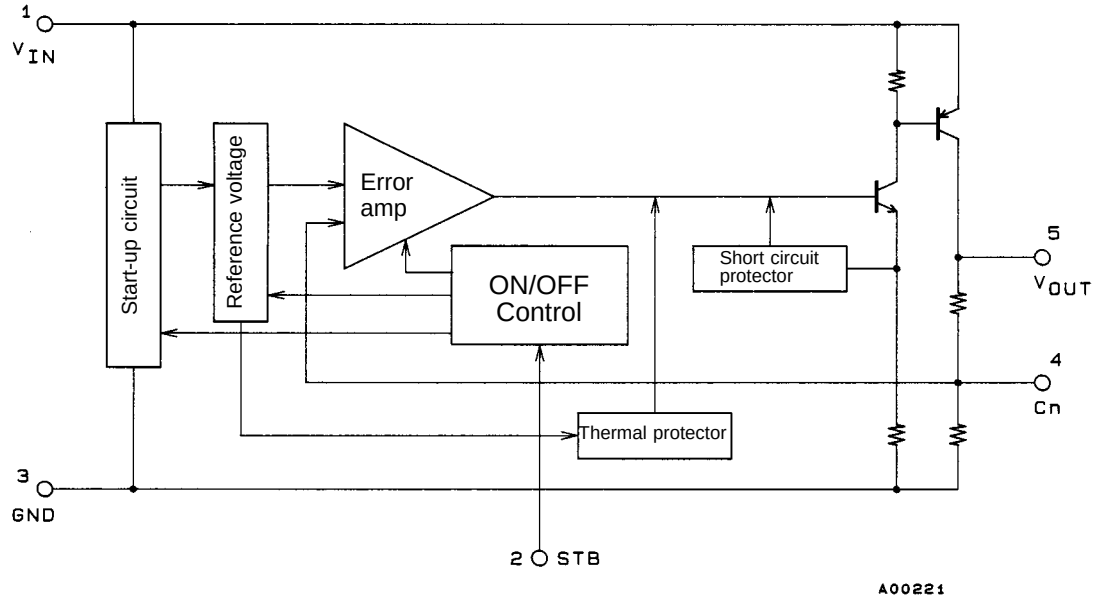
Operating Conditions at Ta = 25 °C

Parameter	Symbol	Conditions	Ratings	Unit
Input voltage	V_{IN}		13 to 17	V
Output current	I_{OUT}		0 to 500	mA
Output on control voltage	V_{STL}		–0.3 to +0.8	V
Output off control voltage	V_{STH}		2.0 to V_{IN}	V

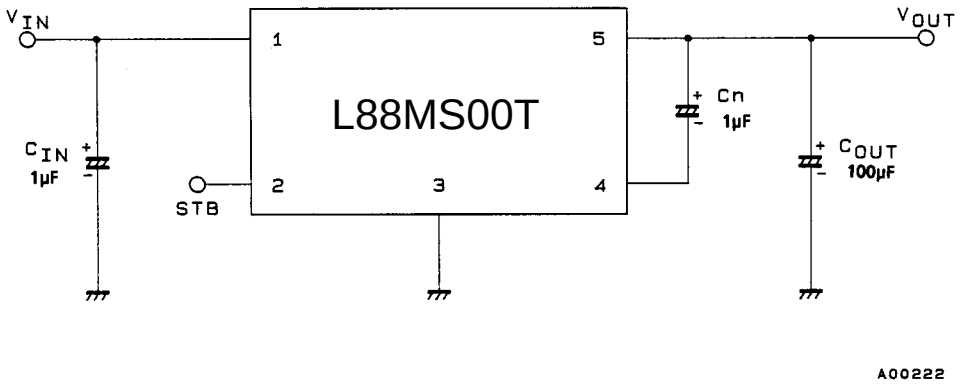
Operating Characteristics at Tj = 25 °C, V_{IN} = 15 V, I_O = 500 mA, C_{OUT} = 100 µF, C_{IN}, Cn = 1 µF, see specified Test Circuit.

Parameter	Symbol	Conditions	min	typ	max	Unit
[Output on, V_{ST} = "L"]						
Output voltage	V_{OUT}		11.64	12.0	12.36	V
Dropout voltage	V_{DROP1}			0.4	0.6	V
	V_{DROP2}	I_O = 150 mA		0.2	0.3	V
Line regulation	ΔV_{OLN}	13 V ≦ V_{IN} ≦ 17 V		10	50	mV
Load regulation	ΔV_{OLD}	5 mA ≦ I_{OUT} ≦ 500 mA		70	240	mV
Peak output current	I_{OP}		600	900		mA
Output short-circuit current	I_{OSC}			100	300	mA
Quiescent current	I_{Q1}	I_{OUT} = 0		2.6	5.0	mA
	I_{Q2}			24	50	mA
Output noise voltage	V_{NO}	10 Hz ≦ f ≦ 100 kHz		40		µVrms
Temperature coefficient of output voltage	$\Delta V_{OUT}/\Delta Tj$	Tj = 25 to 125 °C		±1.2		mV/°C
Ripple rejection	Rrej	f = 120 Hz, 13 V ≦ V_{IN} ≦ 17 V		76		dB
Output on control voltage	V_{STL}				0.8	V
[Output off, V_{ST} = "H"]						
Low output voltage	V_O OFF	V_{ST} = 5 V		20	200	mV
Static current	V_Q OFF	V_{ST} = 5 V, Except I_{STB}		500	1000	µA
Output off control voltage	V_{STH}		2.0		V_{IN}	V

Equivalent Circuit Block Diagram



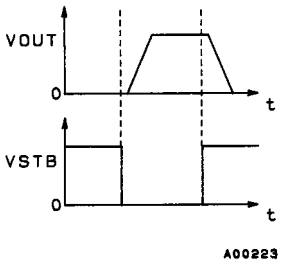
Test Circuit (Common to L88MS00T Series)



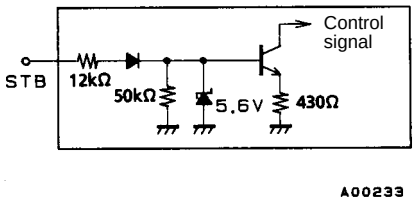
Notes: 1. Because the output capacitor C_{OUT} is set at over 100 µF to prevent oscillation at low temperatures, a capacitor that exhibits little change in capacity with temperature variations should be used (such as a tantalum capacitor).
2. Adding capacitor Cn enables external noise suppression and ripple rejection to be improved. However, attention should be given to system stability (phase margin).
3. To ensure operational stability, C_{IN}, C_{OUT}, and Cn should be placed as close to the IC as possible.
4. When the strobe (STB) pin is open, output is turned on by internal bias. When the strobe function is not used, the STB pin should be connected to GND to complete strobe operation.
5. When V_{IN} is minus (–) and GND is plus (+) (reversed connection), excessive current flow will occur.

Function Table

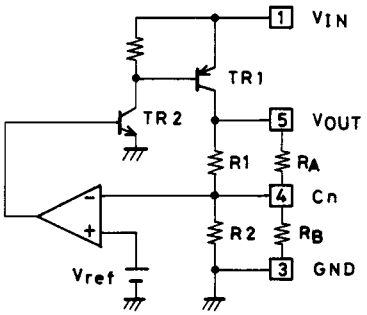
V_{STB}	V_{OUT}
L	H
H	L



On/off Control Input Equivalent Circuit



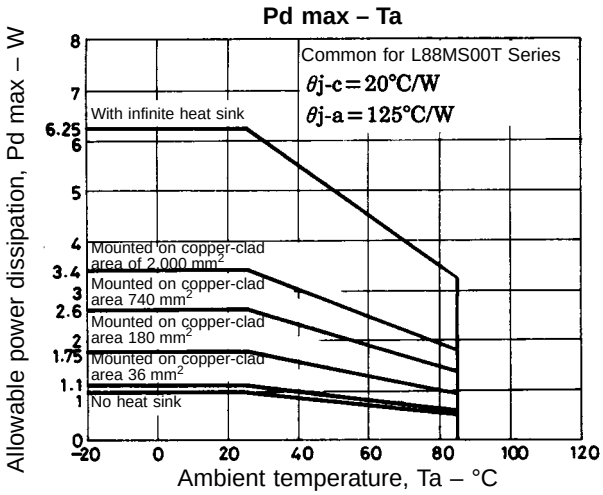
Sample Application Circuit



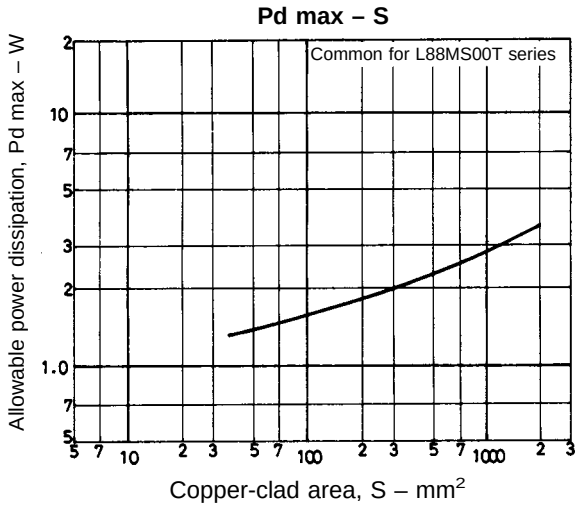
Adjustment of output voltage V_{OUT}

(1) Reducing V_{OUT}
V_{OUT} can be lowered by externally connecting a resistor R_A between the Cn and V_{OUT} pins.

(2) Increasing V_{OUT}
V_{OUT} can be raised by externally connecting a resistor R_B between the Cn and GND pins.

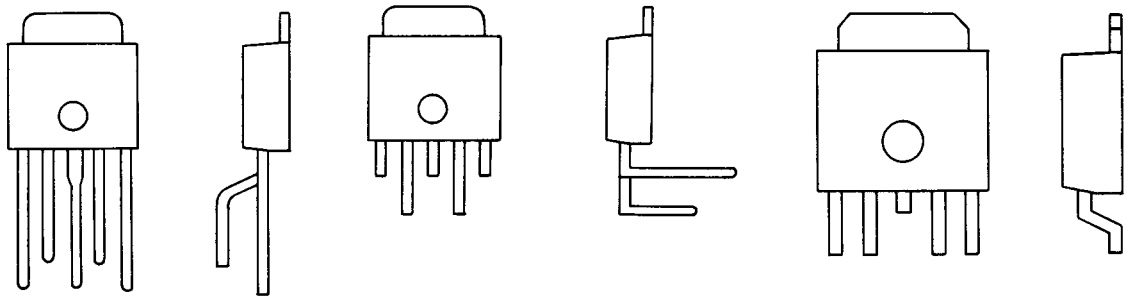


The allowable power dissipation is 1.0 W (Ta = 25°C) with no fin attached, but when mounted on a hybrid IC board or printed circuit board, high allowable power dissipation is achieved, despite the compact package. The graph below depicts the relationship between the copper-clad area and allowable power dissipation when mounted on a glass epoxy board ($50 \times 5\,0 \times 0.8$ tmm^3) with a copper thickness of 18 μm.

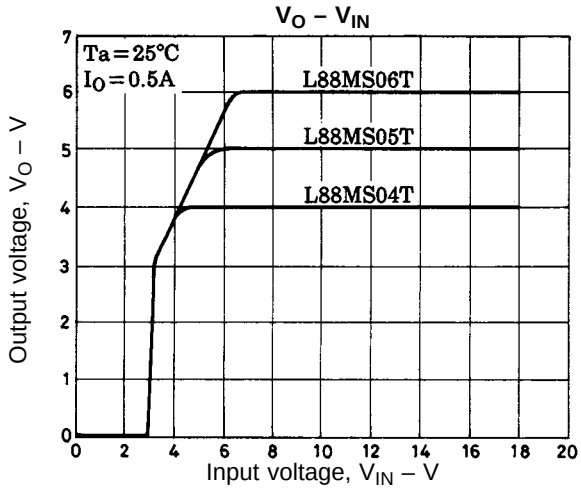


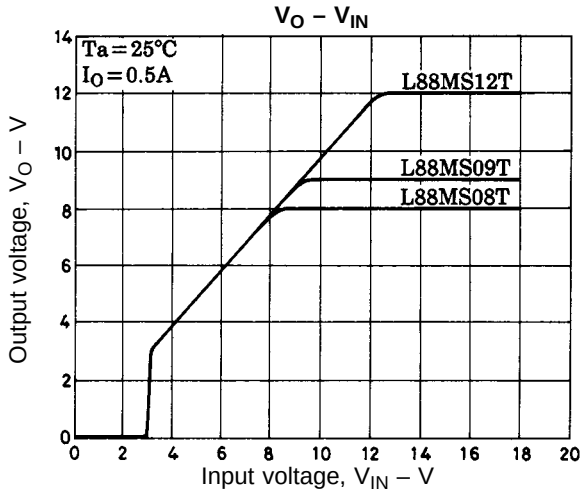
* Pd is the value for when the solder on the surface of the IC heat sink has melted completely and the surface mount is horizontal.
* Please be advised that the flow solder application system (full-heat method) cannot be recommended.

Lead Formings

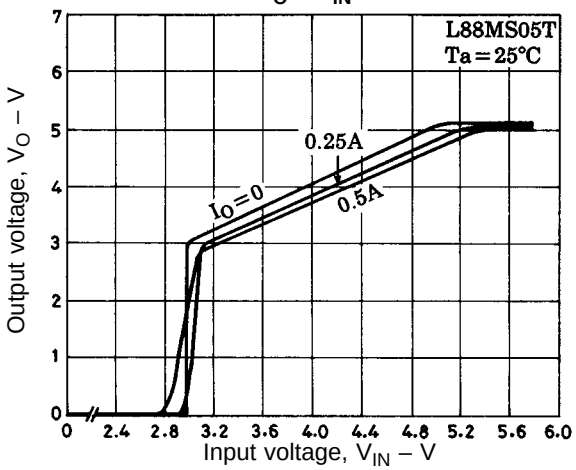


MA forming LR forming FA forming

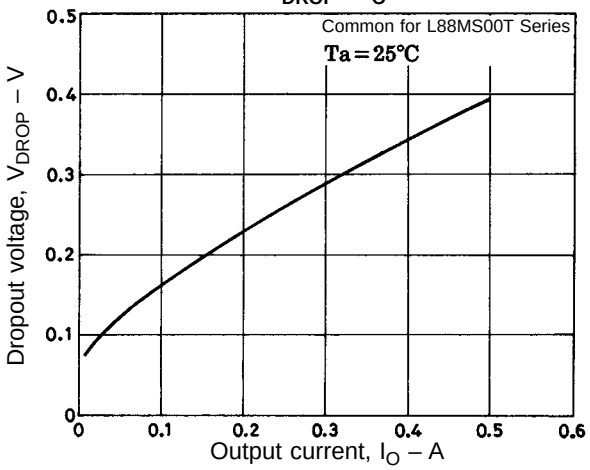




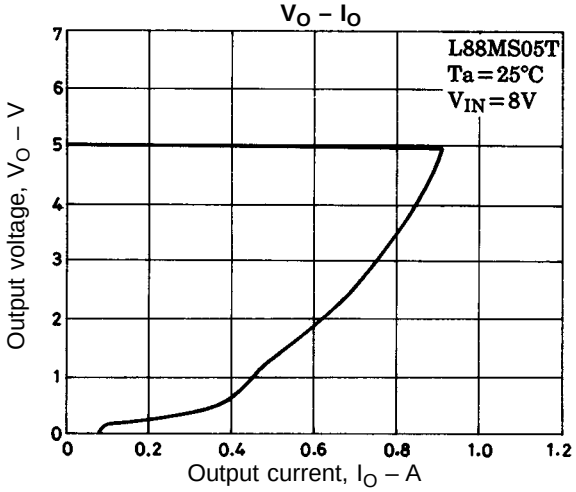
$V_O - V_{IN}$



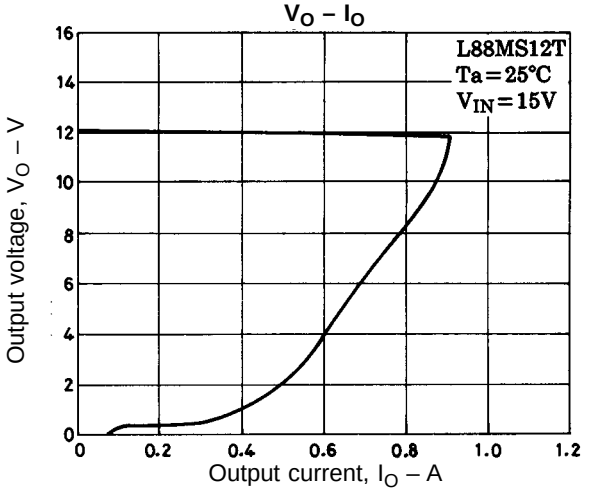
$V_{DROP} - I_O$



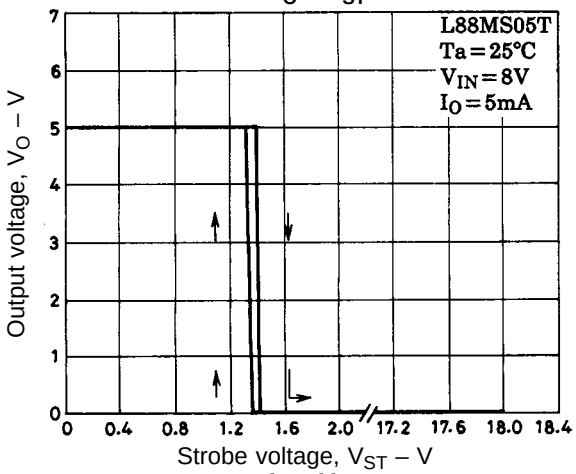
$V_O - I_O$



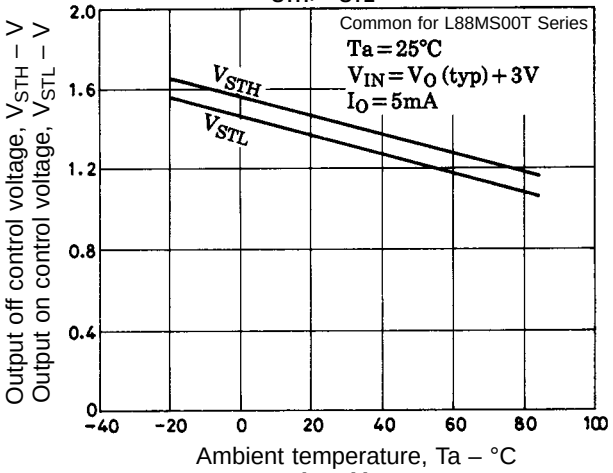
$V_O - I_O$



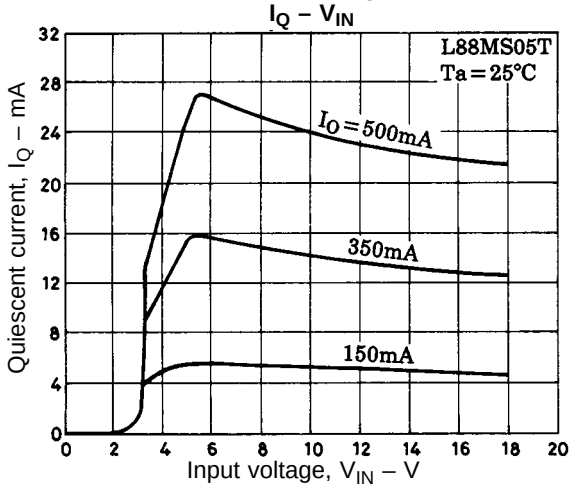
$V_O - V_{ST}$



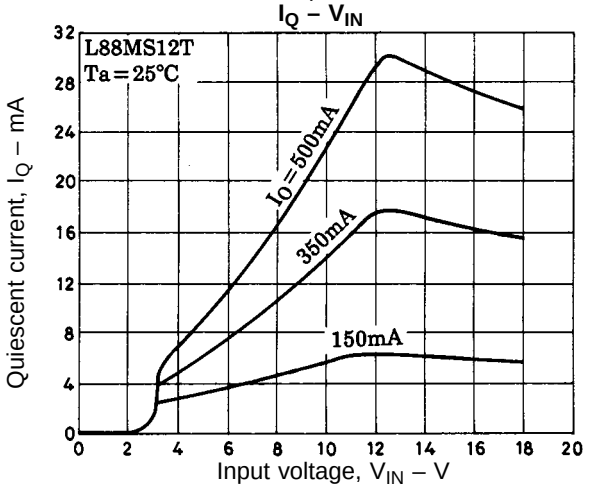
$V_{STH}, V_{STL} - Ta$



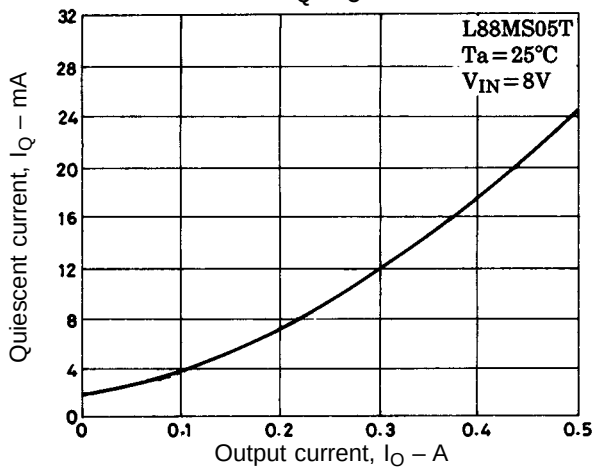
$I_Q - V_{IN}$



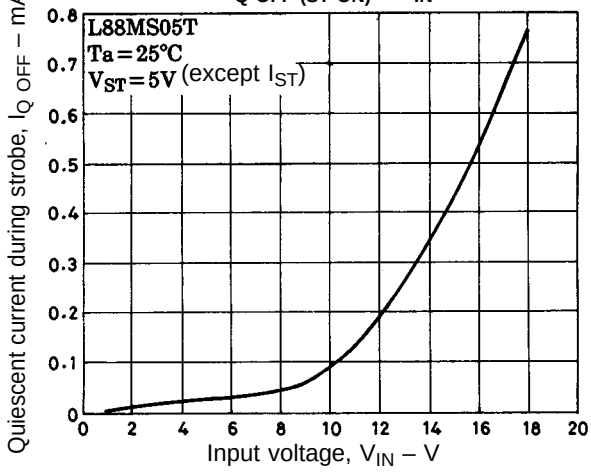
$I_Q - V_{IN}$



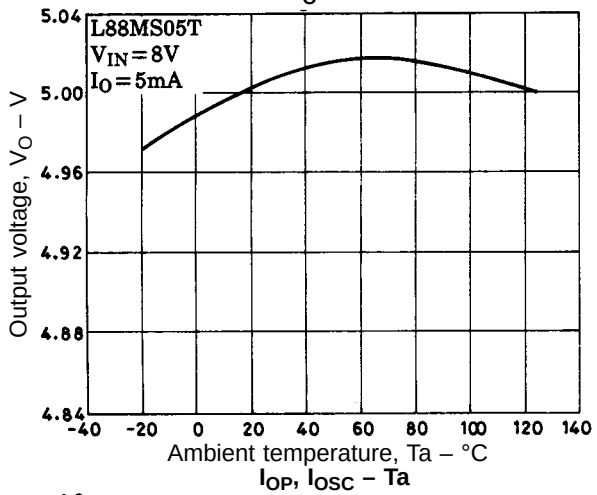
$I_Q - I_O$



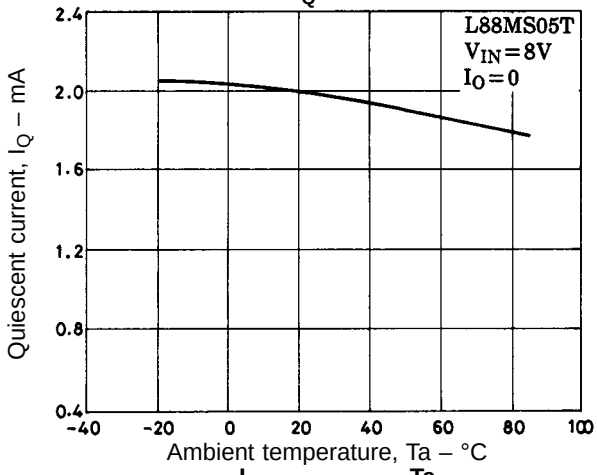
$I_{Q\ OFF\ (ST\ ON)} - V_{IN}$



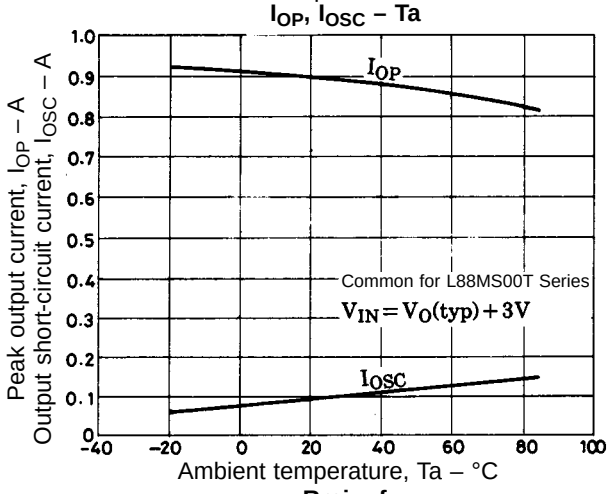
$V_O - Ta$



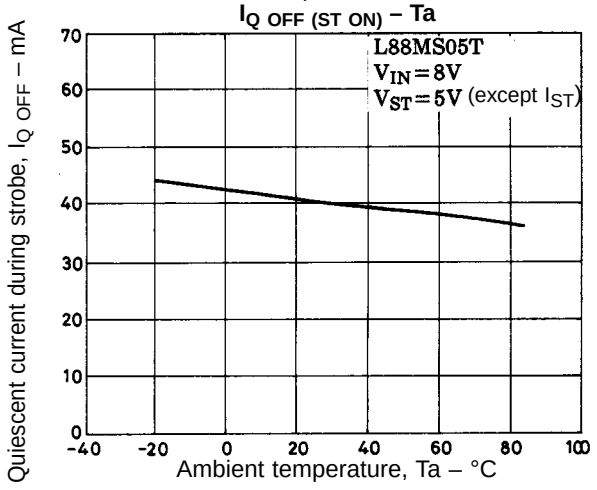
$I_Q - Ta$



$I_{OP}, I_{OSC} - Ta$



$I_{Q\ OFF\ (ST\ ON)} - Ta$



Rrej – f