MC78PC00 Series

Low Noise 150 mA Low Drop Out (LDO) Linear Voltage Regulator

The MC78PC00 are a series of CMOS linear voltage regulators with high output voltage accuracy, low supply current, low dropout voltage, and high Ripple Rejection. Each of these voltage regulators consists of an internal voltage reference, an error amplifier, resistors, a current limiting circuit and a chip enable circuit.

The dynamic Response to line and load is fast, which makes these products ideally suited for use in hand−held communication equipment. The MC78PC00 series are housed in the SOT−23 5 lead package, for maximum board space saving.

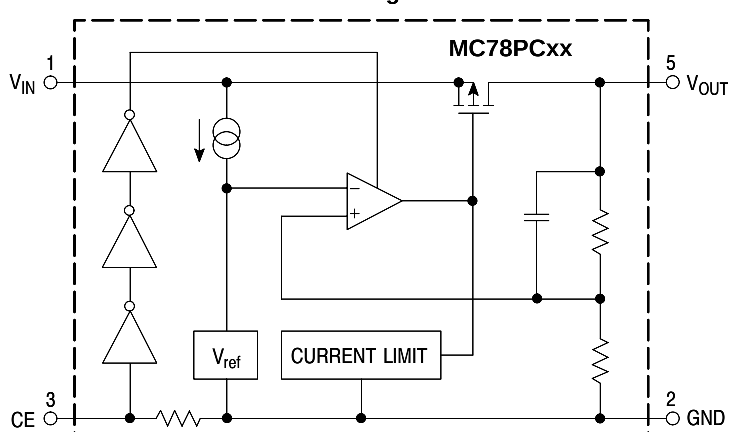
MC78PC00 Features:

- Ultra−Low Supply Current: typical 35 μA in ON mode with no load.
- Standby Mode: typical 0.1 μA.
- Low Dropout Voltage: typical 0.2 V @ I_{OUT} = 100 mA.
- High Ripple Rejection: typical 70 dB @ f = 1 kHz.
- Low Temperature−Drift Coefficient of Output Voltage: typical ±100 ppm/°C.
- Excellent Line Regulation: typical 0.05%/V.
- High Accuracy Output Voltage: ±2.0%.
- Fast Dynamic Response to Line and Load.
- Small Package: SOT−23 5 leads.
- Built−in Chip Enable circuit (CE input pin).
- Identical Pinout to the LP2980/1/2.
- Pb−Free Packages are Available

MC78PC00 Applications:

- Power source for cellular phones (GSM, CDMA, TDMA), Cordless Phones (PHS, DECT) and 2−way radios.
- Power source for domestic appliances such as cameras, VCRs and camcorders.
- Power source for battery−powered equipment.

Block Diagram



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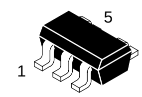
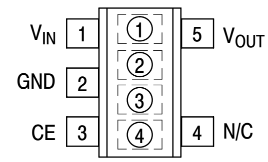


SOT−23−5
N SUFFIX
CASE 1212

PIN CONNECTIONS



(Top View)

DEVICE MARKING
(4 digits are available for device marking)

	Marking	Voltage Version
① ②	K8	1.8 V
	F5	2.5 V
	F8	2.8 V
	G0	3.0 V
	G3	3.3 V
	J0	5.0 V
③ ④		Lot Number

PIN DESCRIPTION

Pin #	Symbol	Description
1	V_{IN}	Input Pin
2	GND	Ground Pin
3	CE	Chip Enable Pin
4	N/C	No Connection
5	V_{OUT}	Output Pin

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 14 of this data sheet.

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Input Voltage	V_{IN}	9.0	V
Input Voltage	V_{CE}	−0.3 ~V_{IN} +0.3	V
Output Voltage	V_{OUT}	−0.3 ~V_{IN} +0.3	V
Power Dissipation	P_D	250	mW
Operating Temperature Range	T_A	−40 to +85	°C
Operating Junction Temperature	T_J	+125	°C
Maximum Junction Temperature	T_{Jmax}	+150	°C
Storage Temperature Range	T_{stg}	−55 to +125	°C

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

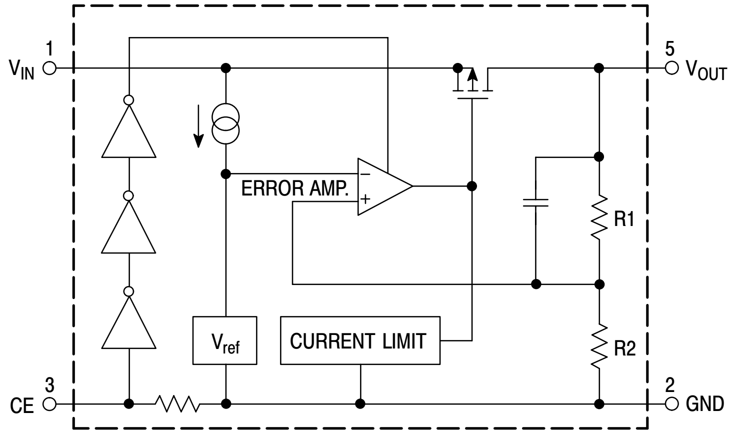
Characteristic	Symbol	Min	Typ	Max	Unit
Output Voltage (V_{IN} = V_{OUT} + 1.0 V, I_{OUT} = 30 mA) MC78PC18 MC78PC25 MC78PC28 MC78PC30 MC78PC33 MC78PC50	V_{OUT}	 1.764 2.450 2.744 2.94 3.234 4.9	 1.80 2.50 2.80 3.00 3.3 5.0	 1.836 2.550 2.856 3.06 3.366 5.1	V
Nominal Output Current (V_{IN} = V_{OUT} + 1.0 V, V_{OUT} = $V_{OUT(nom)}$ − 0.1 V)	I_{OUT}	150	−	−	mA
Load Regulation (V_{IN} = V_{OUT} + 1.0 V, 1.0 mA ≤ I_{OUT} ≤ 80 mA)	$\Delta V_{OUT}/\Delta I_{OUT}$	−	12	40	mV
Supply Current in ON mode (V_{IN} = V_{OUT} + 1.0 V, I_{OUT} = 0 mA)	I_{SS}	−	35	70	μA
Supply Current in OFF mode, i.e. V_{CE} = GND (V_{IN} = V_{OUT} + 1.0 V, I_{OUT} = 0 mA)	$I_{standby}$	−	0.1	1.0	μA
Ripple Rejection (f = 1.0 kHz, Ripple 0.5 V_{p-p}, V_{IN} = V_{OUT} + 1.0 V)	RR	−	70	−	dB
Input Voltage	V_{IN}	−	−	8.0	V
Output Voltage Temperature Coefficient (I_{OUT} = 30 mA, −40°C ≤ T_A ≤ +85°C)	$\Delta V_{OUT}/\Delta T$	−	±100	−	ppm/°C
Short Circuit Current Limit (V_{OUT} = 0 V)	I_{lim}	−	50	−	mA
CE Pull−down Resistance	R_{PD}	2.5	5.0	10	MΩ
CE Input Voltage “H” (ON Mode)	V_{IH}	1.5	−	V_{IN}	V
CE Input Voltage “L” (OFF Mode)	V_{IL}	0	−	0.25	V
Output Noise Voltage (f = 10 Hz to 100 kHz)	e_n	−	30	−	μV_{rms}

ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE V_{OUT} (T_A = 25°C)

Characteristic	Symbol	Min	Typ	Max	Unit
Dropout Voltage (I_{OUT} = 100 mA) 1.8 ≤ V_{OUT} ≤ 1.9 2.0 ≤ V_{OUT} ≤ 2.4 2.5 ≤ V_{OUT} ≤ 2.7 2.8 ≤ V_{OUT} ≤ 3.3 3.4 ≤ V_{OUT} ≤ 6.0	V_{DIF}	 − − − − −	 0.60 0.35 0.24 0.20 0.17	 1.40 0.70 0.35 0.30 0.26	V
Line Regulation (V_{OUT} + 0.5 V ≤ V_{IN} ≤ 8.0 V, I_{OUT} = 30 mA)	$\Delta V_{OUT}/\Delta V_{IN}$	 −	 0.05	 0.20	%/V

OPERATION

MC78PC00



In the MC78PC00, the output voltage V_{OUT} is detected by R1, R2. The detected output voltage is then compared to the internal voltage reference by the error amplifier. Both a current limiting circuit for short circuit protection, and a chip enable circuit are included.

TEST CIRCUITS

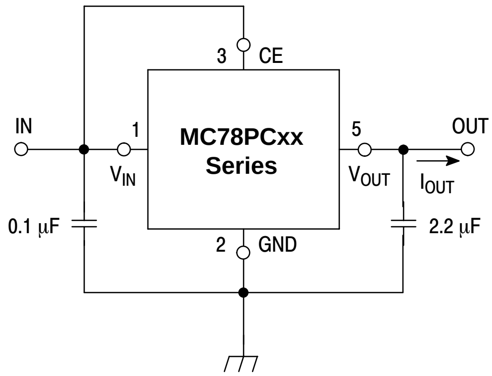


Figure 1. Standard Test Circuits

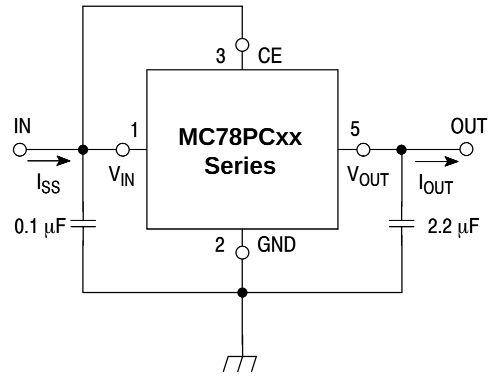


Figure 2. Supply Current Test Circuit

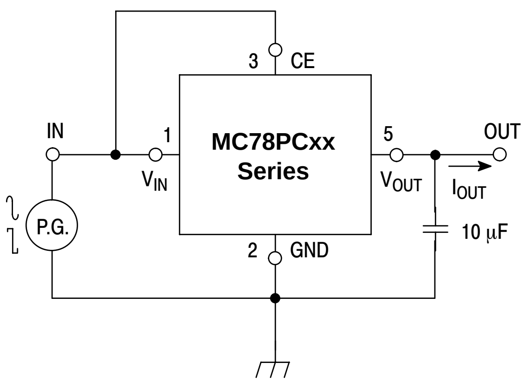


Figure 3. Ripple Rejection, Line Transient Response Test Circuit

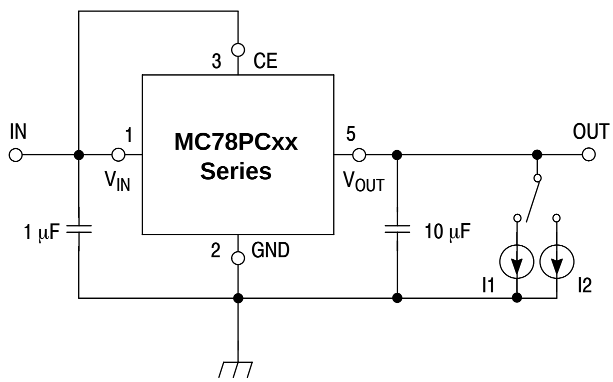


Figure 4. Load Transient Response Test Circuit

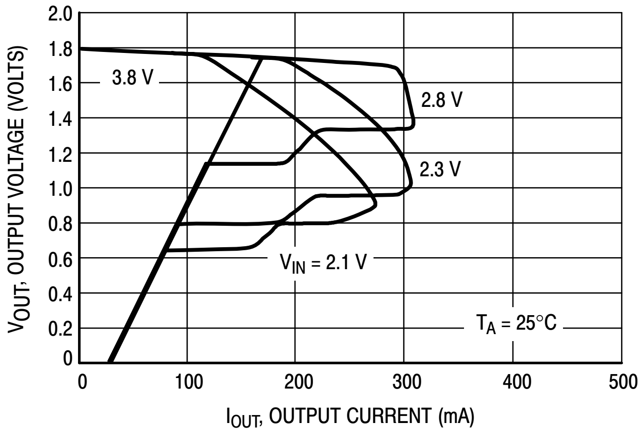


Figure 5. MC78PC18 Output Voltage versus Output Current

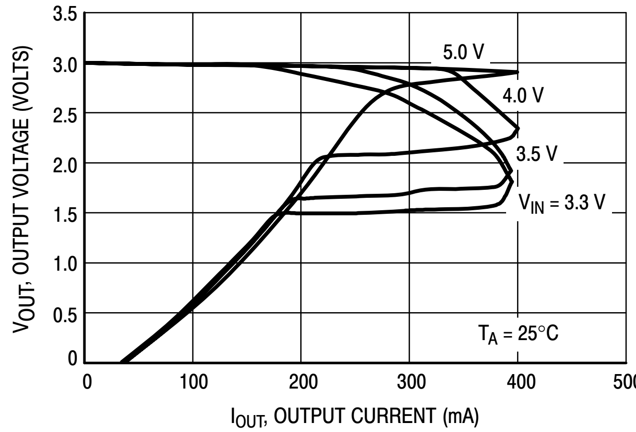


Figure 6. MC78PC30 Output Voltage versus Output Current

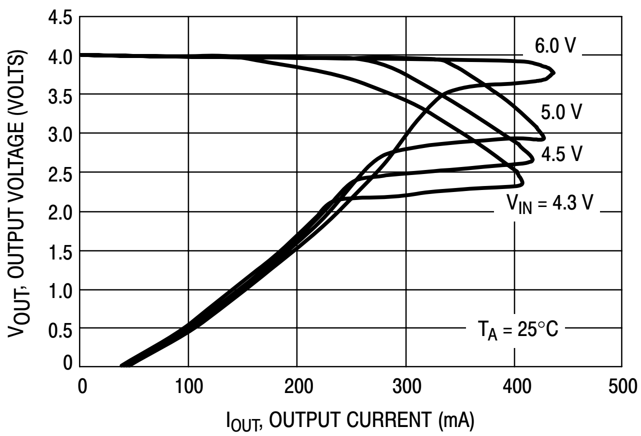


Figure 7. MC78PC40 (4.0 V) Output Voltage versus Output Current

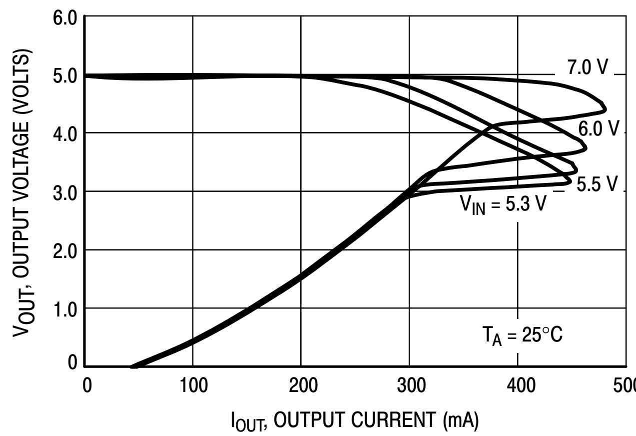


Figure 8. MC78PC50 Output Voltage versus Output Current

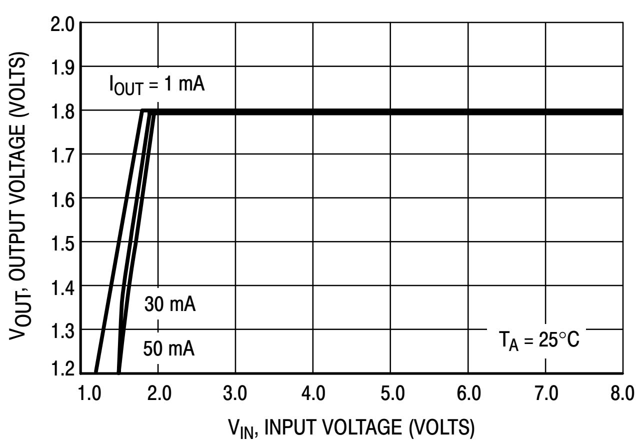


Figure 9. MC78PC18 Output Voltage versus Input Voltage

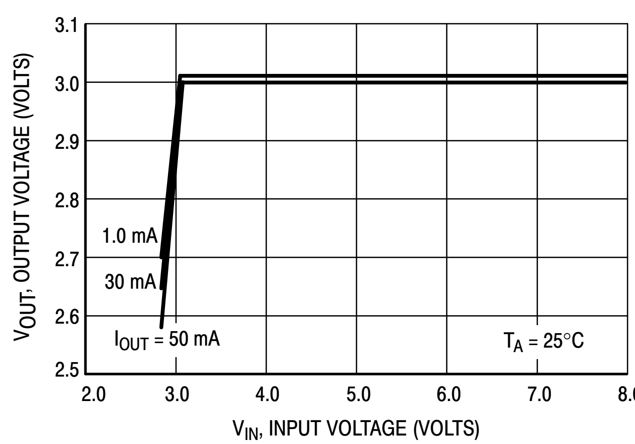


Figure 10. MC78PC30 Output Voltage versus Input Voltage

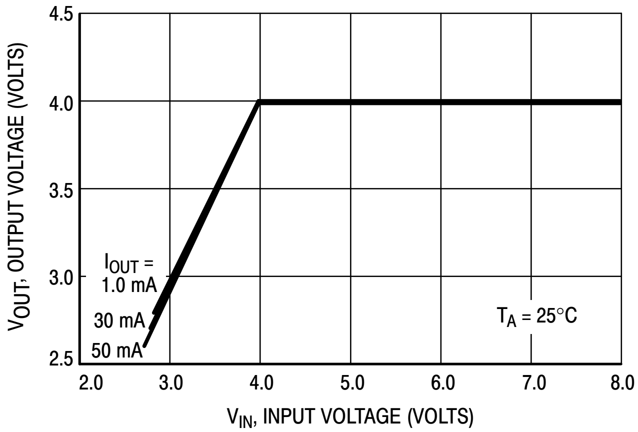


Figure 11. MC78PC40 (4.0 V) Output Voltage versus Input Voltage

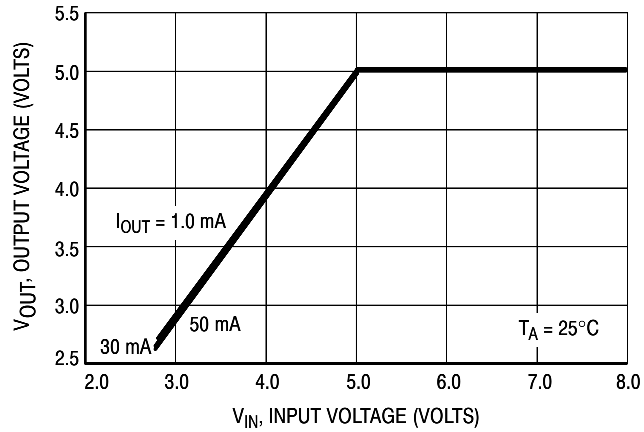


Figure 12. MC78PC50 Output Voltage versus Input Voltage

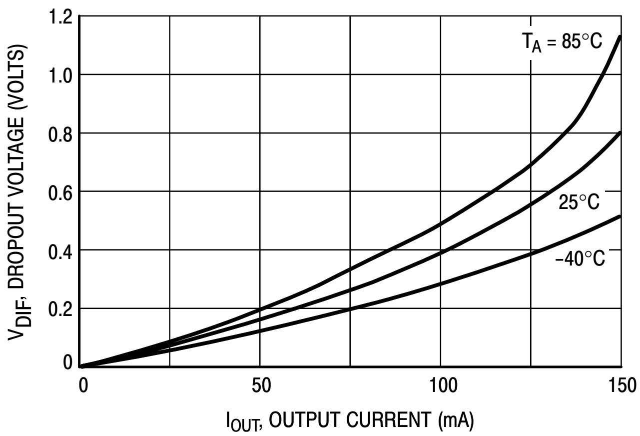


Figure 13. MC78PC18 Dropout Voltage versus Output Current

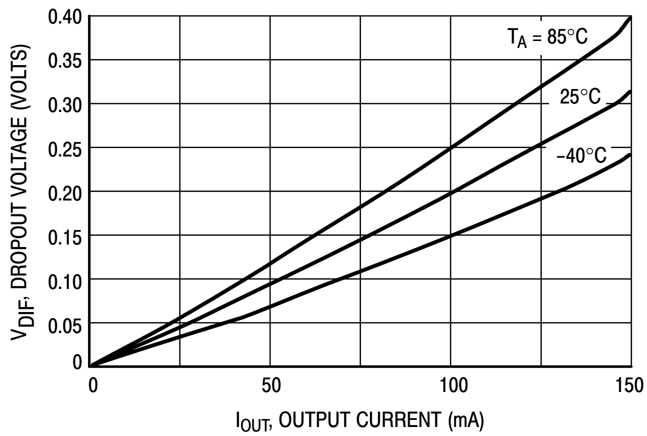


Figure 14. MC78PC30 Dropout Voltage versus Output Current

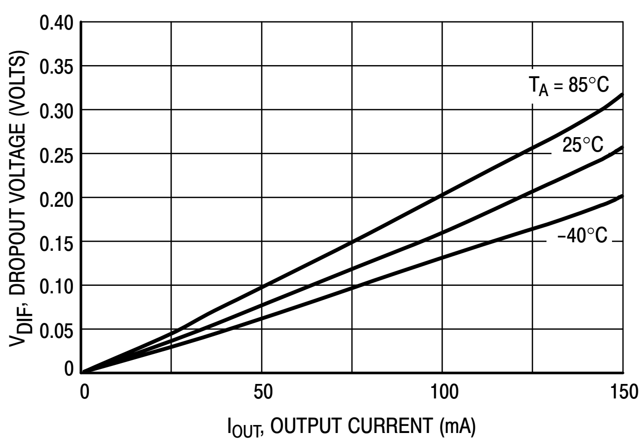


Figure 15. MC78PC40 (4.0 V) Dropout Voltage versus Output Current

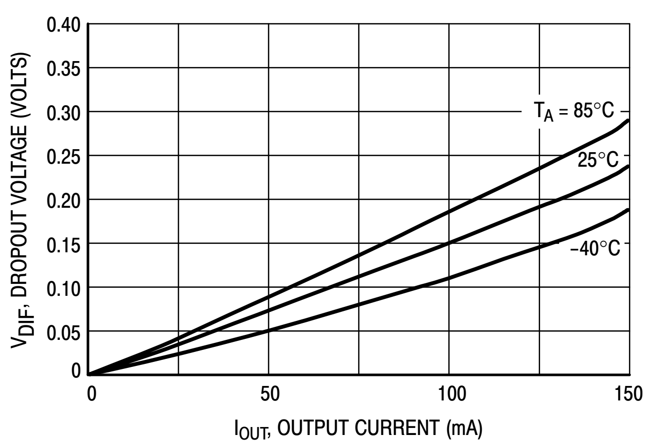


Figure 16. MC78PC50 Dropout Voltage versus Output Current

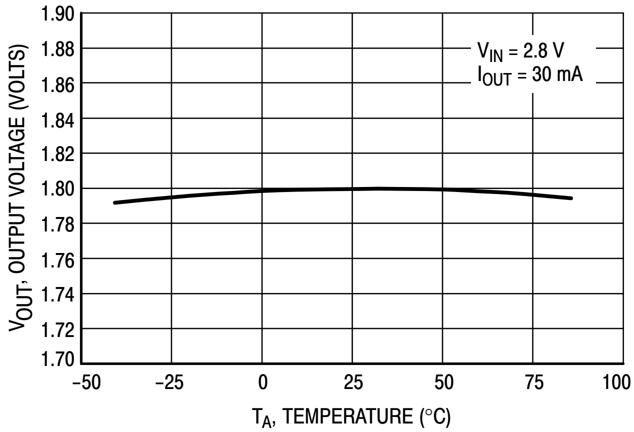


Figure 17. MPC78PC18 Output Voltage versus Temperature

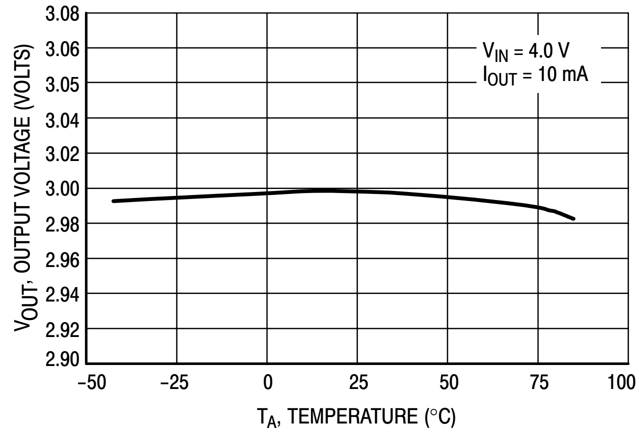


Figure 18. MC78PC30 Output Voltage versus Temperature

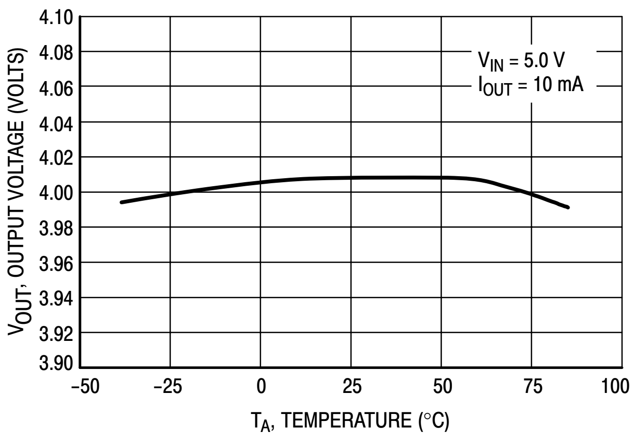


Figure 19. MC78PC40 (4.0 V) Output Voltage versus Temperature

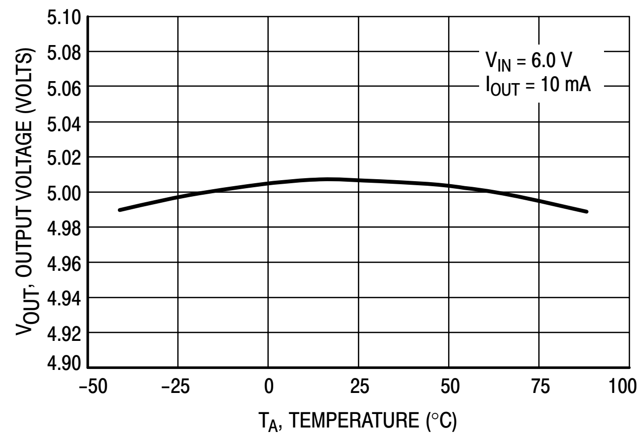


Figure 20. MC78PC50 Output Voltage versus Temperature

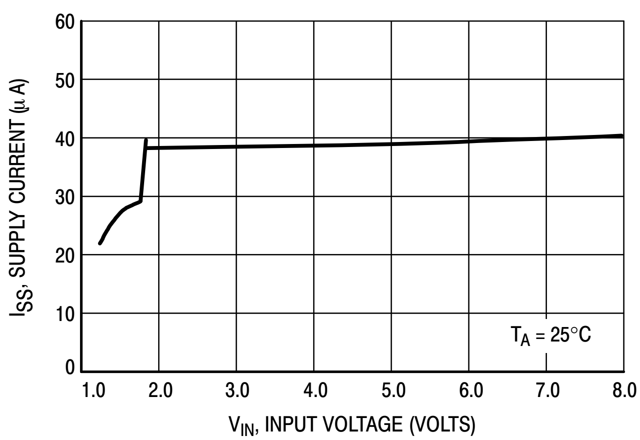


Figure 21. MC78PC18 Supply Current versus Input Voltage

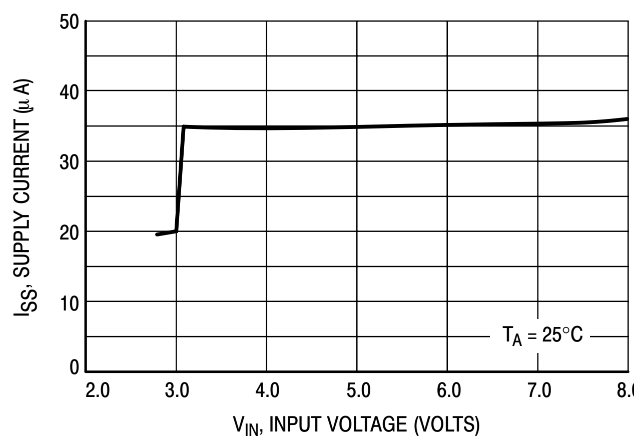


Figure 22. MC78PC30 Supply Current versus Input Voltage

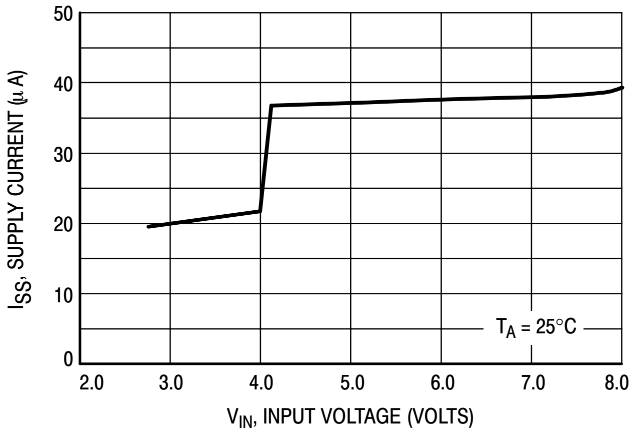


Figure 23. MC78PC40 (4.0 V) Supply Current versus Input Voltage

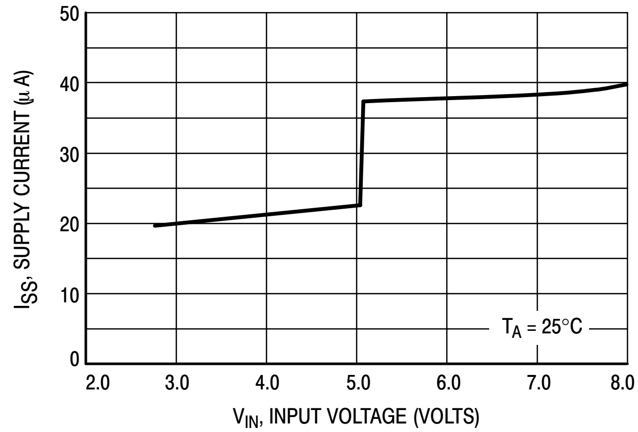


Figure 24. MC78PC50 Supply Current versus Input Voltage

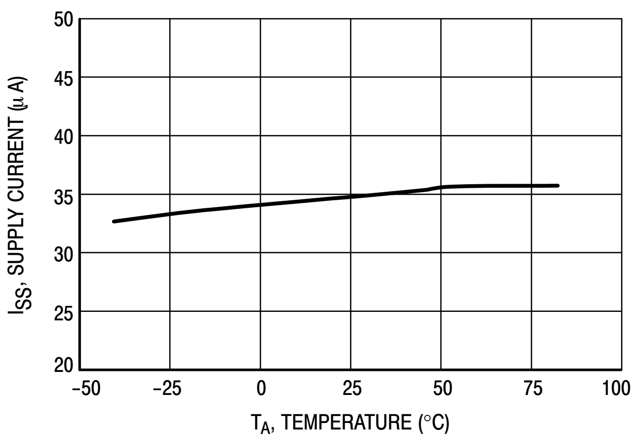


Figure 25. MC78PC30 Supply Current versus Temperature

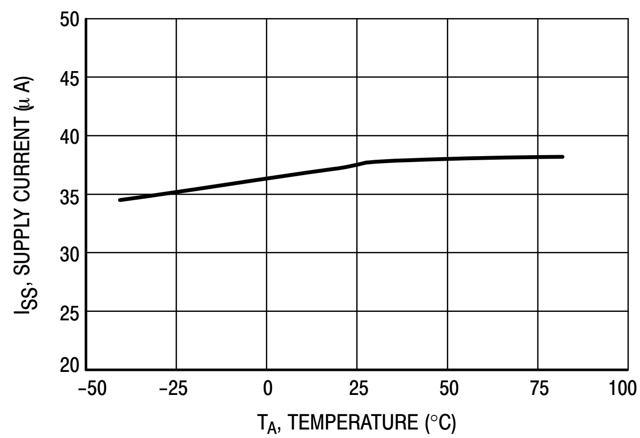


Figure 26. MC78PC40 (4.0 V) Supply Current versus Temperature

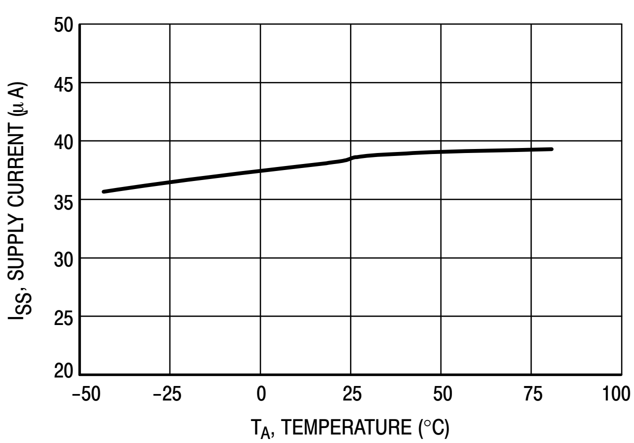


Figure 27. MC78PC50 Supply Current versus Temperature

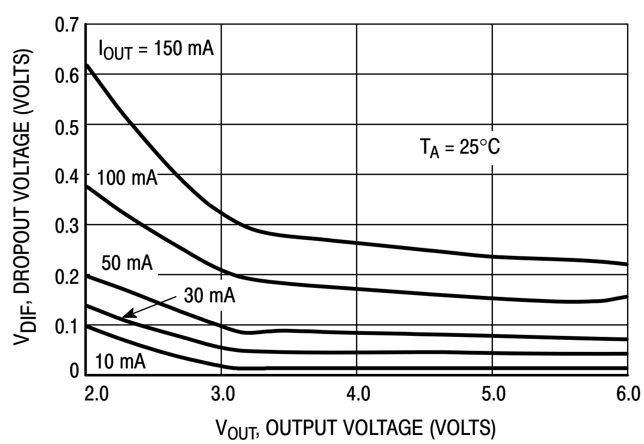


Figure 28. Dropout Voltage versus Output Voltage

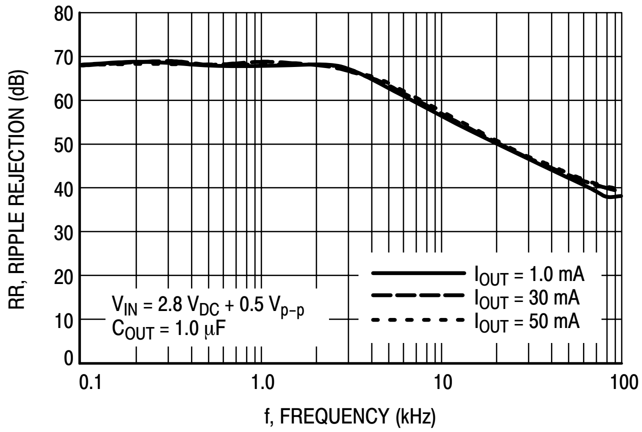


Figure 29. MC78PC18 Ripple Rejection versus Frequency

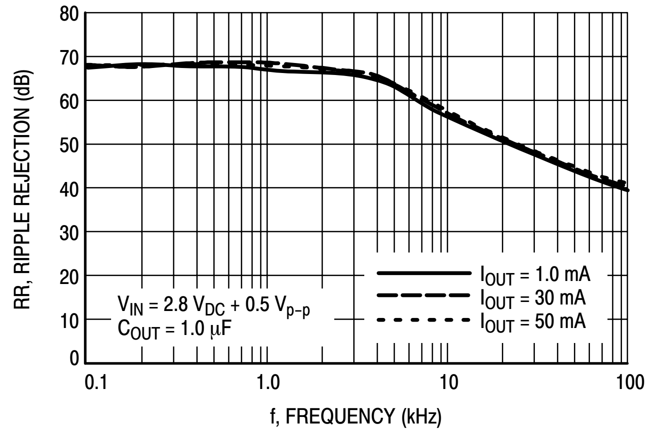


Figure 30. MC78PC18 Ripple Rejection versus Frequency

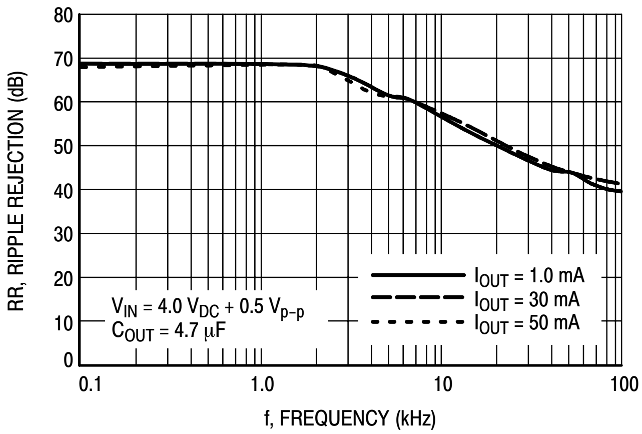


Figure 31. MC78PC30 Ripple Rejection versus Frequency

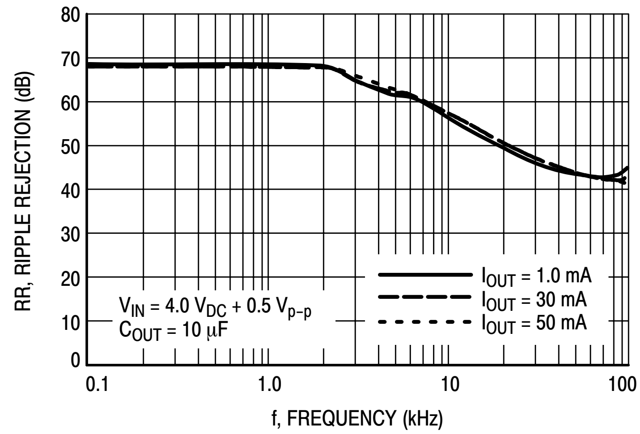


Figure 32. MC78PC30 Ripple Rejection versus Frequency

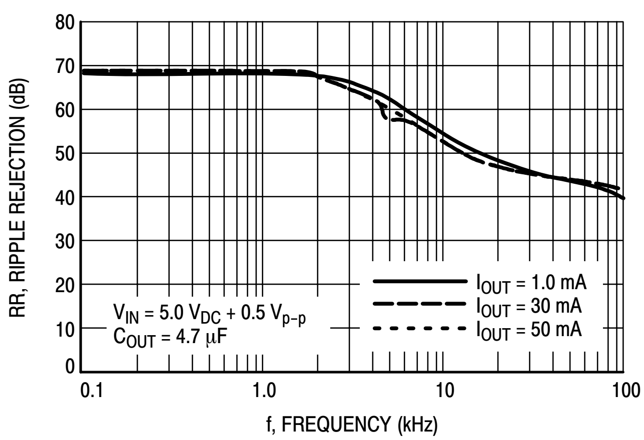


Figure 33. MC78PC40 (4.0 V) Ripple Rejection versus Frequency

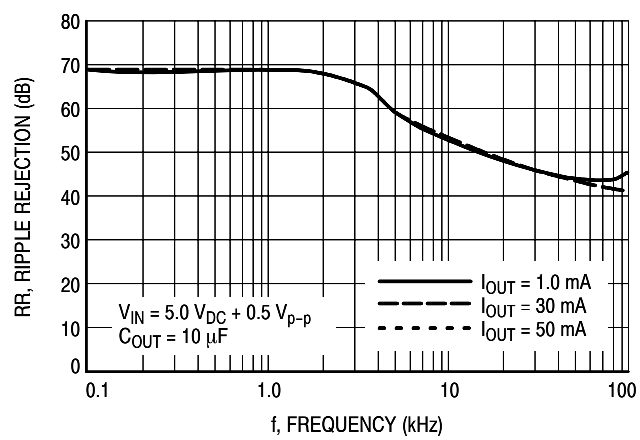


Figure 34. MC78PC40 (4.0 V) Ripple Rejection versus Frequency

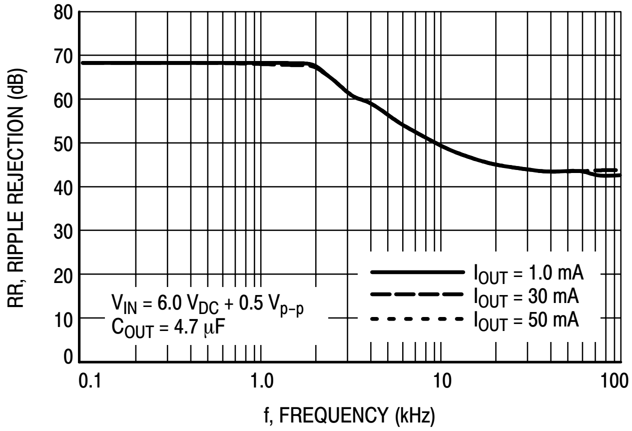


Figure 35. MC78PC50 Ripple Rejection versus Frequency

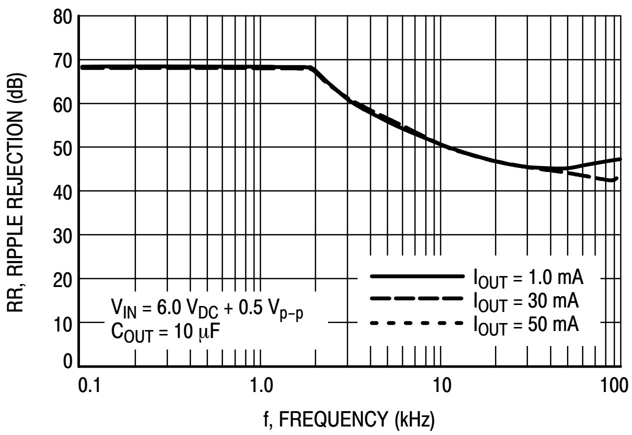


Figure 36. MC78PC50 Ripple Rejection versus Frequency

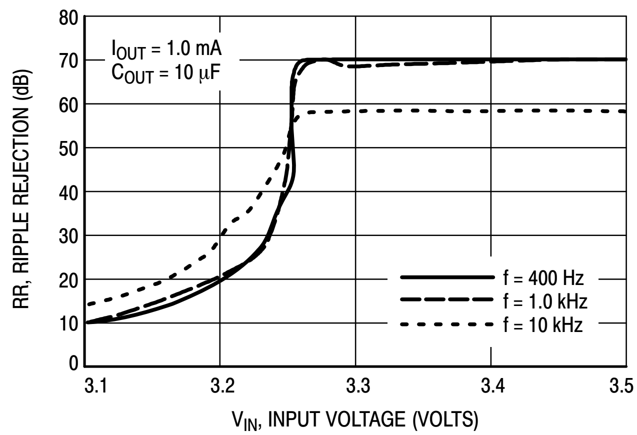


Figure 37. MC78PC30 Ripple Rejection versus Input Voltage (DC Bias)

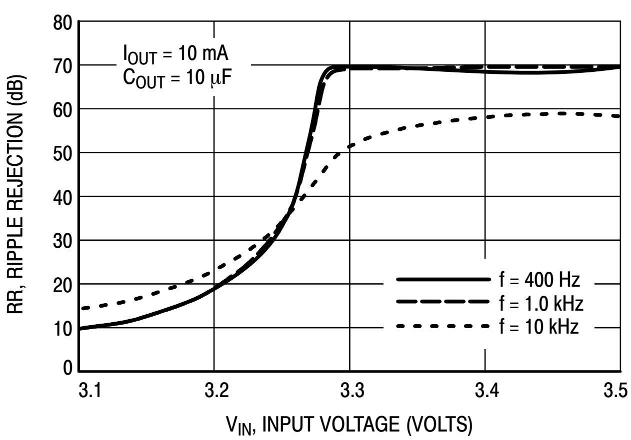


Figure 38. MC78PC30 Ripple Rejection versus Input Voltage (DC Bias)

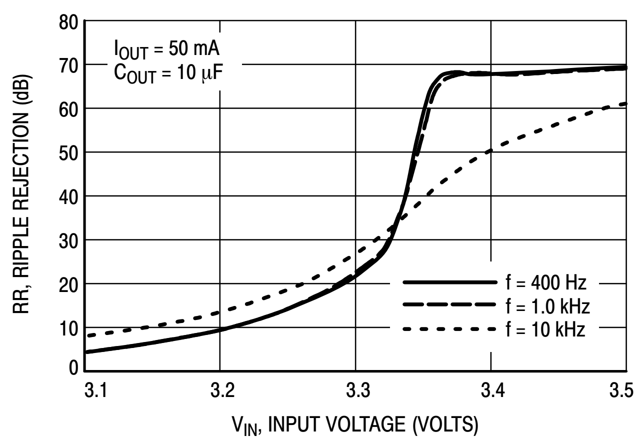


Figure 39. MC78PC30 Ripple Rejection versus Input Voltage (DC Bias)

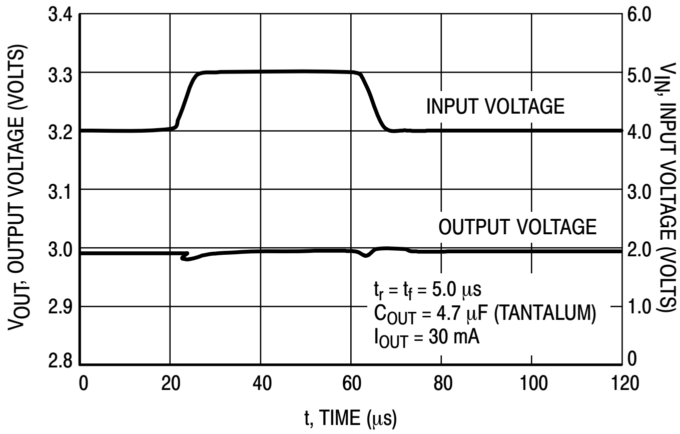


Figure 40. MC78PC30 Line Transient Response

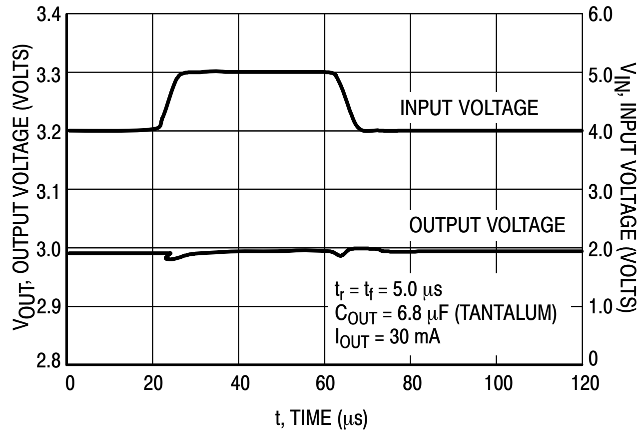


Figure 41. MC78PC30 Line Transient Response

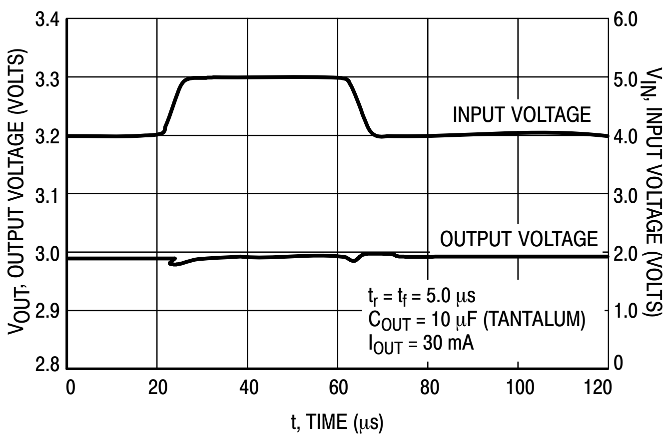


Figure 42. MC78PC30 Line Transient Response

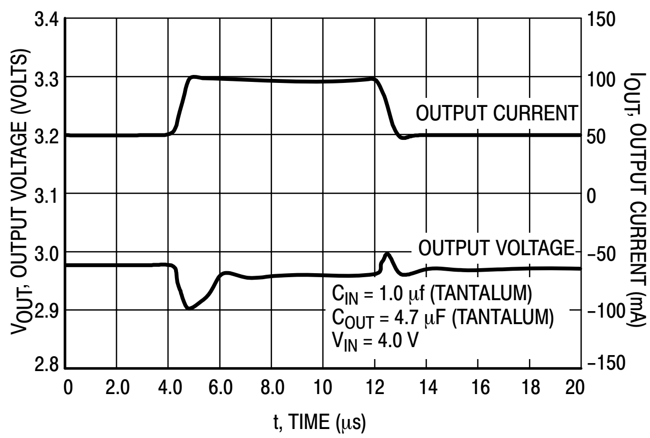


Figure 43. MC78PC30 Load Transient Response

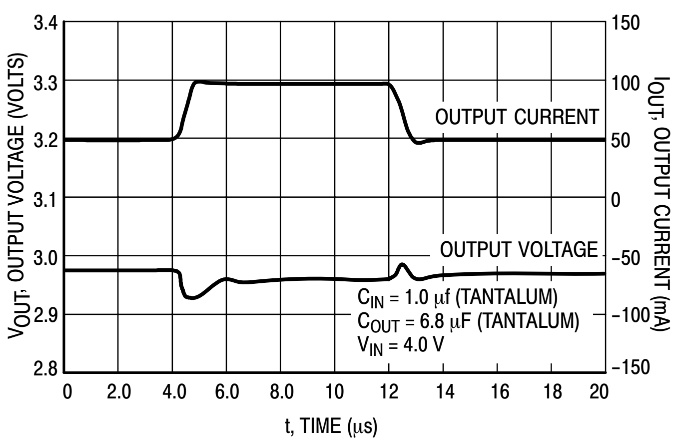


Figure 44. MC78PC30 Load Transient Response

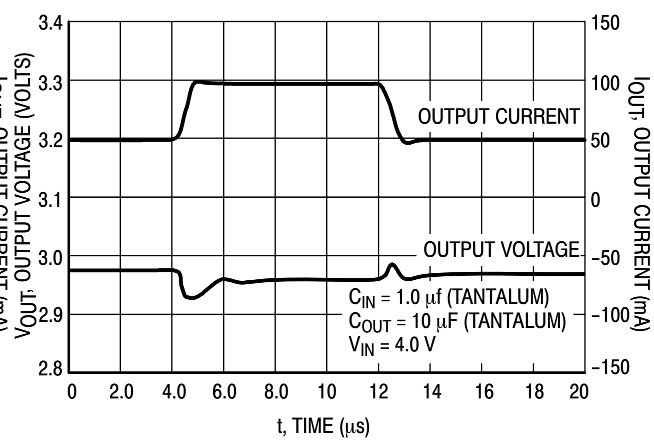


Figure 45. MC78PC30 Load Transient Response

APPLICATION HINTS

When using these circuits, please be sure to observe the following points:

- Phase compensation is made for securing stable operation even if the load current varies. For this reason, be sure to use a capacitor C_{OUT} with good frequency characteristics and ESR (Equivalent Series Resistance) as described in the graphs on page 11.
  On page 11, the relations between I_{OUT} (Output Current) and ESR of Output Capacitor are shown. The conditions where the white noise level is under 40 μV (Avg.) are marked by the shaded area in the graph. (note: When additional ceramic capacitors are connected to the Output Pin with Output capacitor for phase compensation, there is a possibility that the operation will be unstable. Because of this, test these circuits with as same external components as ones to be used on the PCB).

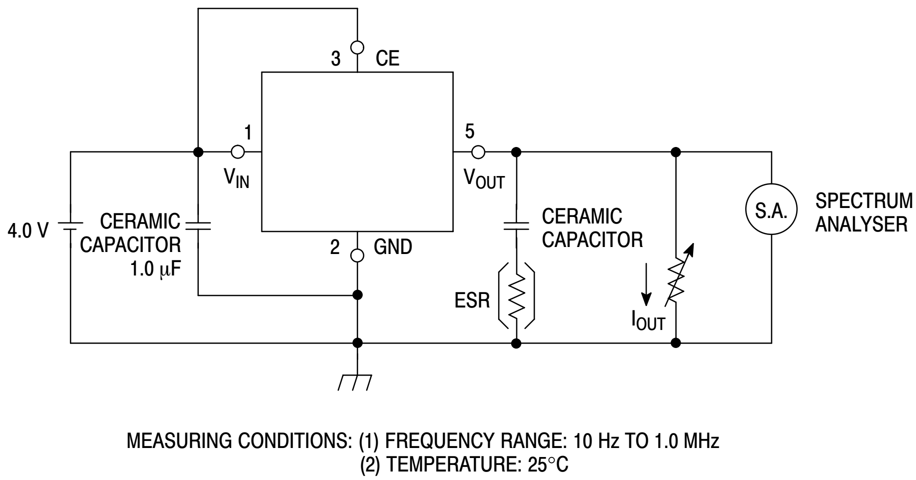


Figure 46. Measuring Circuit for White Noise: MC78PC30

- Please be sure the V_{in} and GND lines are sufficiently wide. When the impedance of these lines is high, there is a chance to pick up noise or to malfunction.
- Connect the capacitor with a capacitance of 1.0 μF or more between V_{in} and GND as close as possible to V_{in} or GND.
- Set external components, especially the Output Capacitor, as close as possible to the circuit, and make the wiring as short as possible.

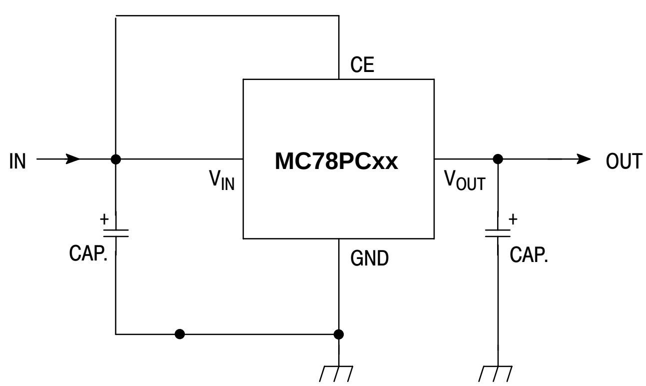


Figure 47. Typical Application

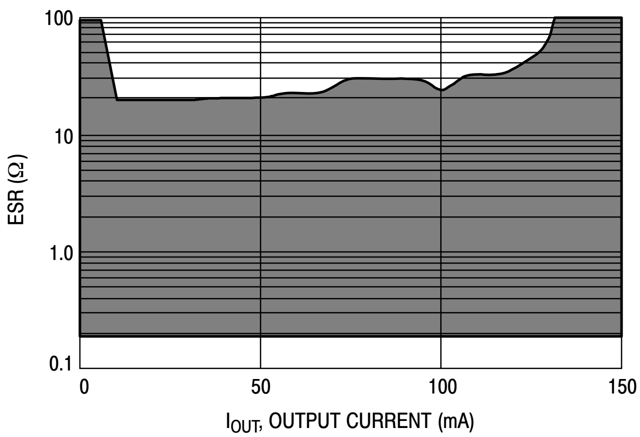


Figure 48. Ceramic Capacitor 4.7 μF

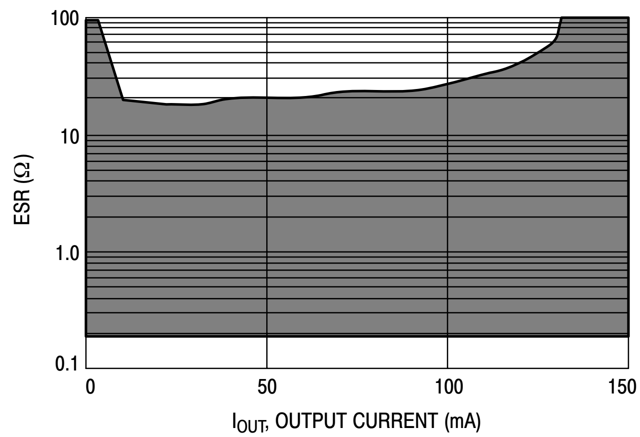


Figure 49. Ceramic Capacitor 6.8 μF

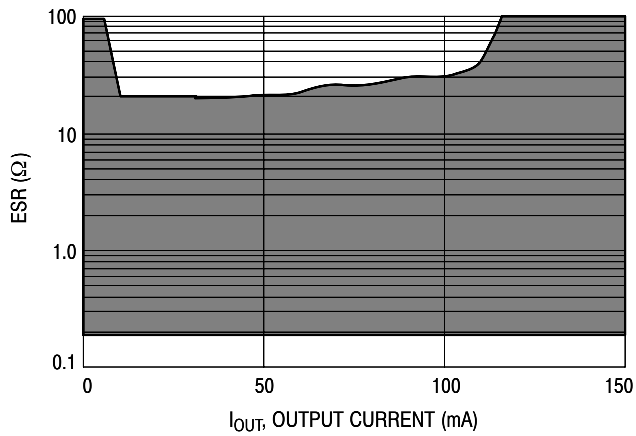
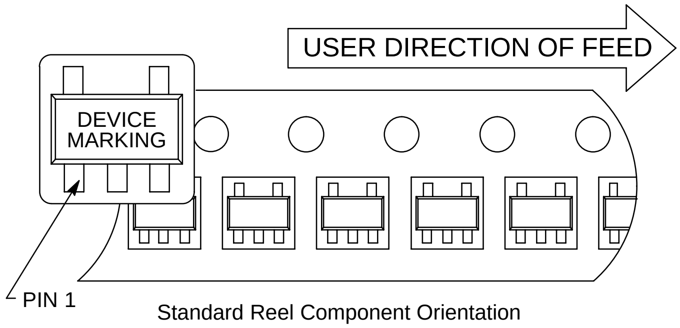


Figure 50. Ceramic Capacitor 10 μF

TAPE AND REEL INFORMATION

Component Taping Orientation for 5L SOT−23 Devices



Tape & Reel Specifications Table

Package	Tape Width (W)	Pitch (P)	Part Per Full Reel	Reel Diameter
5L SOT−23	8 mm	4 mm	3000	7 inches

ORDERING INFORMATION

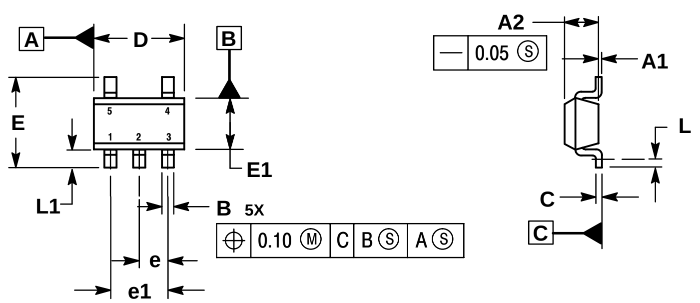
Device	Package	Shipping†
MC78PC18NTR	SOT−23 5 Leads	3000 Units/Tape & Reel
MC78PC18NTRG	SOT−23 5 Leads (Pb−Free)	
MC78PC25NTR	SOT−23 5 Leads	
MC78PC25NTRG	SOT−23 5 Leads (Pb−Free)	
MC78PC28NTR	SOT−23 5 Leads	
MC78PC28NTRG	SOT−23 5 Leads (Pb−Free)	
MC78PC30NTR	SOT−23 5 Leads	
MC78PC30NTRG	SOT−23 5 Leads (Pb−Free)	
MC78PC33NTR	SOT−23 5 Leads	
MC78PC33NTRG	SOT−23 5 Leads (Pb−Free)	
MC78PC50NTR	SOT−23 5 Leads	
MC78PC50NTRG	SOT−23 5 Leads (Pb−Free)	

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

Other voltages are available. Consult your ON Semiconductor representative.

PACKAGE DIMENSIONS

SOT−23−5
N SUFFIX
PLASTIC PACKAGE
CASE 1212−01
ISSUE O



NOTES:
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DATUM C IS A SEATING PLANE.

	MILLIMETERS	
DIM	MIN	MAX
A1	0.00	0.10
A2	1.00	1.30
B	0.30	0.50
C	0.10	0.25
D	2.80	3.00
E	2.50	3.10
E1	1.50	1.80
e	0.95 BSC	
e1	1.90 BSC	
L	0.20	---
L1	0.45	0.75

SOLDERING FOOTPRINT*

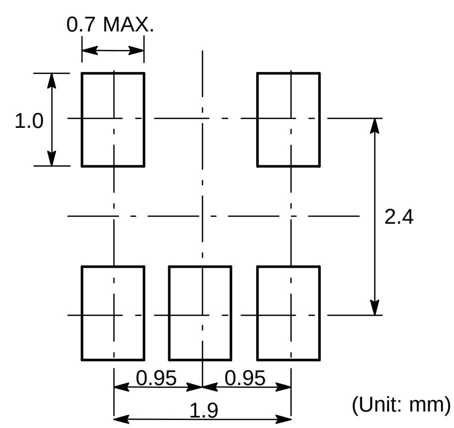


Figure 51. SOT−23−5

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
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