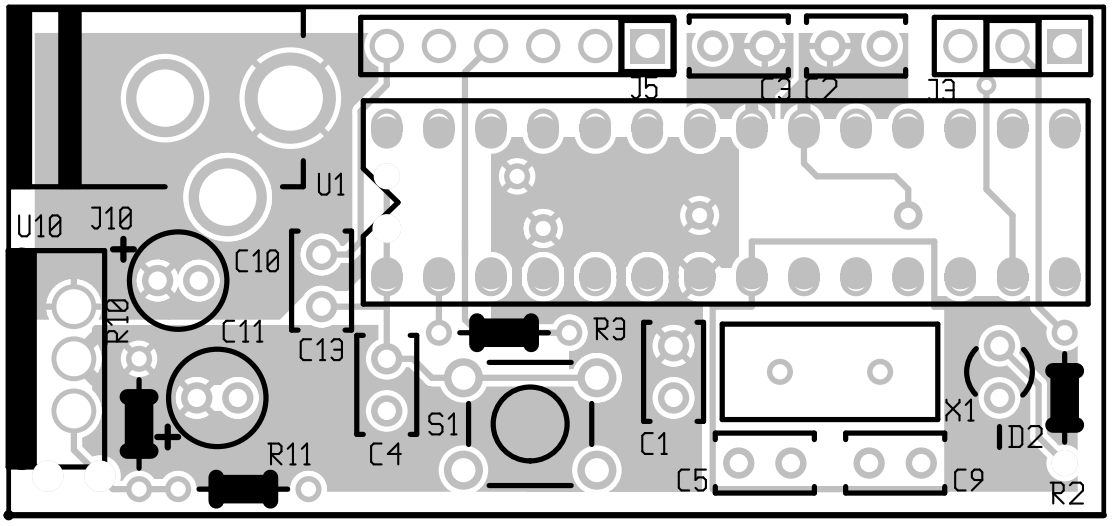


PICO1TR Description

The PICO1TR is a low-cost microcontroller development board that is compatible with the Arduino development tools. The board is 2.1" x 1" and all the I/O pins from the ATmega168/328 are brought out on 2 rows of 14 pins (300mil spacing).

Features

- **2.1" x 1"**
- Replaceable and upgradeable CPU
- Compatible with the Arduino development tools.
- ATmega328P running at 12MHz
- Adjustable Linear Regulator (V_{cc} = 3.3V to 5V) Output voltage is set by changing one resistor. Resistors for 3.3V and 5V operation are included.
- Two rows of 14 pins (300mil spacing) with all ATmega168/328 I/O functions.
- Six pin header for FTDI TTL-232R-3V3 cable.
- Debug LED that can be jumpered to Pin 7 or disconnected.
- A/D reference supply filtered per Atmel specification.
- Reset circuit per Atmel specification.

1 Assembling the PICO1TR

Semiconductors are electrostatic-sensitive devices. Proper ESD handling precautions need to be taken to avoid damage.

Do not cut any of the U1 socket pins until you have determined which pins are needed in your application. All of the PICO1TR I/O pins are the U1 socket pins. See subsection 1.6 for pin removal information.

The Bill of Materials (BOM) and Component List are in section 5. For full page assembly drawings see Figure 1 (top) and Figure 2 (bottom).

The kit includes resistors to trim the output regulator to 3.3V or 5V. When you are done assembling the kit you will have one extra resistor. If you have build a 3.3V board you will have a 1KΩ resistor left. If you have built a 5V board you will have either a 205 or 210Ω resistor left.

1.1 Bottom Side Components

- D1

  Line the cathode marking on D1 with the cathode marking on the silkscreen

- L1

  *The value of inductor L1 is not critical. Kits will contain an inductor with a value between 10*µH *and 20*µH

- R1

  10KΩ *(brown, black, black, red, brown)*

- C12 (optional, not included)

  *C12 is a noise reduction capacitor for the LDO regulator (U4). It is not required for most applications and is not included in the kit. The suggested value in the manufacturer's datasheet is 0.1*µF*.*

1.2 Power Supply Circuit Assembly

Solder the top side components:

- C10, C11

  C10 and C11 are polarized parts. The long lead is the positive. The short lead is the negative. Make sure that the **positive** *lead is inserted into positive hole in the PCB*

- R10

  124Ω *(brown, red, yellow, black, brown)*

- R11

  *For 3.3V operation this value will be either 205*Ω *(red, black, green, black, brown) or 210*Ω *(red, brown, black, black, brown) For 5V operation this value will be 374*Ω *(orange, violet, yellow, black, brown)*

- U10

  Make sure that the tab is aligned to the tab marking on the PCB.

- J10

1.3 Microcontroller Circuit Assembly

Solder the top side components:

- C1, C2, C3, C13, C4 (optional).

  C4 is optional and is not included in the kit. It is meant for applications that require additional filtering of the reset line. The reset function that uses the /RTS line from the USB interface will not function with C4 installed.

- D2

  The negative lead of the LED is the short lead. Align the short lead with the negative marking on the PCB.

- R2

  *For 3.3V operation use the 374*Ω *(orange, violet, yellow, black, brown). For 5V operation use the 1*KΩ *(brown, black, black brown, brown)*

- R3

  *10*KΩ *(brown, black, black, red, brown)*

- J3

- J5

- X1, C5, C9

- U1 (socket)

1.4 Electro-mechanical Components

Since the reset switch is sensitive to washing it should be placed on last. Lightly clean the board after the swicth is installed. If water does get into the switch let it dry out before applying power.
Solder the top side components:

- S1

1.5 IC Installation and Test

Remove the ATmega328P from the antistatic foam and insert it into the socket aligning the notch in the IC package with the notch mark indicated on the PCB silkscreen. Be careful to align pins on both sides of the socket prior to pressing the IC into the socket.

After inserting the ATmega328P into the `U1` socket the microcontroller section of the PICO1TR should be fully functional. If possibly apply power through `J10` with a current limited +5V supply. The current drawn should not exceed 10mA.

The PICO1TR should now be fully functional and is ready to program (see section 4). Depending on the application some of the pins on the U1 socket should be removed (see subsection 1.6).

1.6 Pin Removal

After operation of the PICO1TR is verified it is recommended that some of the U1 pins be cut flush to the PCB level. Each application is different and needs to reviewed. Pins like XTAL1 and XTAL2 can be affected by stray capacitance and noise. For most applications cutting the XTAL1, XTAL2, AREF and AVCC is recommended.

If your application may change over time then leave all pins intact and use care in your layout.

1.6.1 XTAL Pins

The XTAL circuit is susceptible to stray capacitance and noise so pins 9 and 10 should be cut flush to the PCB.

1.6.2 AREF

If you are not using an external analog reference then cut pin 21 flush to the board.

1.6.3 AVCC

If you are not powering the ADC from a different source then pin 20 should be cut flush to the board.

2 IO Connectors

J5 USB header for an FTDI TTL-232R-3V3 cable.

J10 Input power jack. See subsection 3.1

3 Electrical Hints

3.1 Power Supply

The PICO1TR is powered by a DC output wall adapter with an output voltage from 5.3V to 18V. The input voltage is limited by the amount of power dissipated in the linear regulator (U4). This varies by application.

It is critcal to keep the power dissipation in the LDO regulator (U4), to less than one watt. The voltage drop across U4 is

$$V_{drop} = V_{in} - V_{out}$$

Where V_{in} is the input voltage connected to J10 and V_{out} is the output voltage (see subsection 3.2). The power dissipated in U4 is given by

$$P_{diss} = V_{drop} \cdot I_{system}$$

where I_{system} is the load of the PICO1TR plus its peripheral circuitry.

3.2 Changing V_{cc}

V_{cc}, which is the output of the MC33269T regulator, is adjusted by changing the value of R11. The equation for V_{cc} is –

$$V_{cc} = 1.24 \cdot \frac{124 + R_{11}}{124}$$

R_{11} values for common output voltages are listed in Table 1. The PICO1TR kits come with both values listed in the table.

R_2 adjusts the current through the debug LED. At a forward current (I_f) of 2mA the LED has a typical forward voltage (V_f) of 2V. An I_f between 2mA and 5mA provides a reasonable brightness. The equation for R_2 is

$$\frac{V_{CC} - 2\text{V}}{5\text{mA}} < R_2 < \frac{V_{CC} - 2\text{V}}{2\text{mA}}$$

Recommended R_2 values are shown in Table 1.

V_{cc} (volts)	R_{11} (ohms)	R_2 (ohms)
3.3	205	374
5.0	374	1000

Table 1: R_{11} and R_2 values for 3.3V and 5V Operation

3.3 Pinout

The input and output pins for the PICO1TR are the socket pins of the microcontroller (U1). The pinout is listed in Table 2.

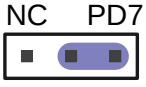
Pin Number	Pin Name	Arduino Number	Notes
2	RXD	0	
3	TXD	1	
4	PD2	2	
5	PD3	3	
6	PD4	4	
11	PD5	5	
12	PD6	6	
13	PD7	7	Debug LED
14	PB0	8	
15	PB1	9	
16	PB2	10	
17	PB3	11	MOSI
18	PB4	12	MISO
19	PB5	13	SCK
23	PC0	A0	
24	PC1	A1	
25	PC2	A2	
26	PC3	A3	
27	PC4	A4	SDA
28	PC5	A5	SCL
1	Reset		
9	XTAL1		PB6
10	XTAL2		PB7
7	VCC		
20	AVCC		
21	AREF		
8	GND		
22	GND		

Table 2: U1 Pinout

3.4 Debug LED

The debug LED, D2, can be connected to U1 pin 13 (PD7) of the ATmega328P or left disconnected. U1 pin 13 corresponds to Arduino pin 7

LED jumper in the disconnected position



LED jumper in the PD7 position

4 Programming the PICO1TR

The PICO1TR can be programmed using the Arduino tools (version 0011 or later).

4.1 Selecting the proper board

In order for the Arduino tools to recognize the wiblocks boards additional lines need to be added to the boards.txt file. The additional lines are shown in Listing 1 (with annotations). A file containing these adddions can be downloaded from wiblocks. Once boards.txt is modified select either wiblocks 168 at 12MHz or wiblocks 328 at 12MHz from the Tools->Board menu.

4.2 Downloading a program to the PICO1TR

The PICO1TR must be rebooted to start the program download. This can be done by pressing the reset button S1 immediately before starting the download. If your USB port is configured to set RTS on close then the reset will occur automatically.

Listing 1: boards.txt Modifications for the PICO1TR

```
1  wiblocks_168.name=wiblocks 168 at 12MHz
2  wiblocks_168.upload.protocol=stk500
3  wiblocks_168.upload.maximum_size=14336
4  wiblocks_168.upload.speed=19200
5  wiblocks_168.bootloader.low_fuses=0xff
6  wiblocks_168.bootloader.high_fuses=0xdd
7  wiblocks_168.bootloader.extended_fuses=0x00
8  wiblocks_168.bootloader.path=atmega168
9  wiblocks_168.bootloader.file=wiblocks_168.hex
10 wiblocks_168.bootloader.unlock_bits=0x3F
11 wiblocks_168.bootloader.lock_bits=0x0F
12 wiblocks_168.build.mcu=atmega168
13 wiblocks_168.build.f_cpu=12000000L
14 wiblocks_168.build.core=arduino
15
16 wiblocks_328.name=wiblocks 328 at 12MHz
17 wiblocks_328.upload.protocol=stk500
18 wiblocks_328.upload.maximum_size=30720
19 wiblocks_328.upload.speed=19200
20 wiblocks_328.bootloader.low_fuses=0xff
21 wiblocks_328.bootloader.high_fuses=0xdd
22 wiblocks_328.bootloader.extended_fuses=0x00
23 wiblocks_328.bootloader.path=atmega328
24 wiblocks_328.bootloader.file=wiblocks_328.hex
25 wiblocks_328.bootloader.unlock_bits=0x3F
26 wiblocks_328.bootloader.lock_bits=0x0F
27 wiblocks_328.build.mcu=atmega328p
28 wiblocks_328.build.f_cpu=12000000L
29 wiblocks_328.build.core=arduino
```

References

Atmel. (2009). 8-bit AVR Microcontroller with 4/8/16/32K Bytes In-System Programmable Flash. (Retrieved March 14, 2009, from http://www.atmel.com/dyn/resources/prod_documents/doc8025.pdf)

5 Assembly Documentation and Schematics

Table 3: Bill of Materials

Kit: PICO1TR-KIT

Qty	Reference	Part Number	Description
4	C1, C2, C3, C13	CAPR-0U10-50V-X7R-100M	capacitor, ceramic, 0.1uF, 10%, 50V, X7R
2	C5, C9	CAPR-20P0-100V-NPO-5T00	capacitor, ceramic, 20pF
2	C10, C11	CAPPR__Nichicon_UPW1E100MDD	capacitor, Nichicon UPW1E100MDD
1	D1	DIOA-1N4148	diode, 1N4148
1	D2	LEDR-1T-GRN-2M00	LED, T1, Green
1	J3	HDR_BR-3X1-100M	header, 3x1, 100mils
1	J5	HDR_BR-6X1-100M	header, 6x1, 100mils
1	J10	CON__CUI-PJ-202AH	power jack, 2.1mm
1	L1	INDA-10UH-130M-10T0	inductor, 10uH, 10%
2	R1, R3	RES-10K0-0W125-1T00	resistor, 10K, 1/8W, 1%
1	R2	RES-374R-0W125-1T00	resistor, 374 Ohm, 1/8W, 1%
1	R10	RES-124R-0W125-1T00	resistor, 124 Ohm, 1/8W, 1%
1	R11	RES-205R-0W125-1T00	resistor, 205 Ohm, 1/8W, 1%
1	S1	SW__Panasonic_EVQ-PAE04M	pushbutton
1	U1	IC__ATMEL_ATmega168-20PU	ATmega168-20PU
1	U10	VREG__On-Semi_MC33269TG	voltage regulator, adj, 800mA, TO-220
1	X1	XTAL-12M-20P-HC49US	crystal, 12MHz, 20pF, HC49US
1		JMP__Adamtech_MSBHG	Shunt with handle
1		DIP_WW-28P-300M	DIP Socket, 28 Pin, 300mil centers, Wire Wrap
1		wiblock_PICO1TR-PCB	
1		RES-1K00-0W125-1T00	resistor, 1K, 1/8W, 1%

Table 4: Component List

Kit: PICO1TR-KIT

Reference	Part Number	Description
C1	CAPR-0U10-50V-X7R-100M	capacitor, ceramic, 0.1uF, 10%, 50V, X7R
C2	CAPR-0U10-50V-X7R-100M	capacitor, ceramic, 0.1uF, 10%, 50V, X7R
C3	CAPR-0U10-50V-X7R-100M	capacitor, ceramic, 0.1uF, 10%, 50V, X7R
C13	CAPR-0U10-50V-X7R-100M	capacitor, ceramic, 0.1uF, 10%, 50V, X7R
C5	CAPR-20P0-100V-NPO-5T00	capacitor, ceramic, 20pF
C9	CAPR-20P0-100V-NPO-5T00	capacitor, ceramic, 20pF
C10	CAPPR__Nichicon_UPW1E100MDD	capacitor, Nichicon UPW1E100MDD
C11	CAPPR__Nichicon_UPW1E100MDD	capacitor, Nichicon UPW1E100MDD
D1	DIOA-1N4148	diode, 1N4148
D2	LEDR-1T-GRN-2M00	LED, T1, Green
J3	HDR_BR-3X1-100M	header, 3x1, 100mils
J5	HDR_BR-6X1-100M	header, 6x1, 100mils
J10	CON__CUI-PJ-202AH	power jack, 2.1mm
L1	INDA-10UH-130M-10T0	inductor, 10uH, 10%
R1	RES-10K0-0W125-1T00	resistor, 10K, 1/8W, 1%
R3	RES-10K0-0W125-1T00	resistor, 10K, 1/8W, 1%
R2	RES-374R-0W125-1T00	resistor, 374 Ohm, 1/8W, 1%
R10	RES-124R-0W125-1T00	resistor, 124 Ohm, 1/8W, 1%
R11	RES-205R-0W125-1T00	resistor, 205 Ohm, 1/8W, 1%
S1	SW__Panasonic_EVQ-PAE04M	pushbutton
U1	IC__ATMEL_ATmega168-20PU	ATmega168-20PU
U10	VREG__On-Semi_MC33269TG	voltage regulator, adj, 800mA, TO-220
X1	XTAL-12M-20P-HC49US	crystal, 12MHz, 20pF, HC49US
	JMP__Adamtech_MSBHG	Shunt with handle
	DIP_WW-28P-300M	DIP Socket, 28 Pin, 300mil centers, Wire Wrap
	wiblock_PICO1TR-PCB	
	RES-1K00-0W125-1T00	resistor, 1K, 1/8W, 1%

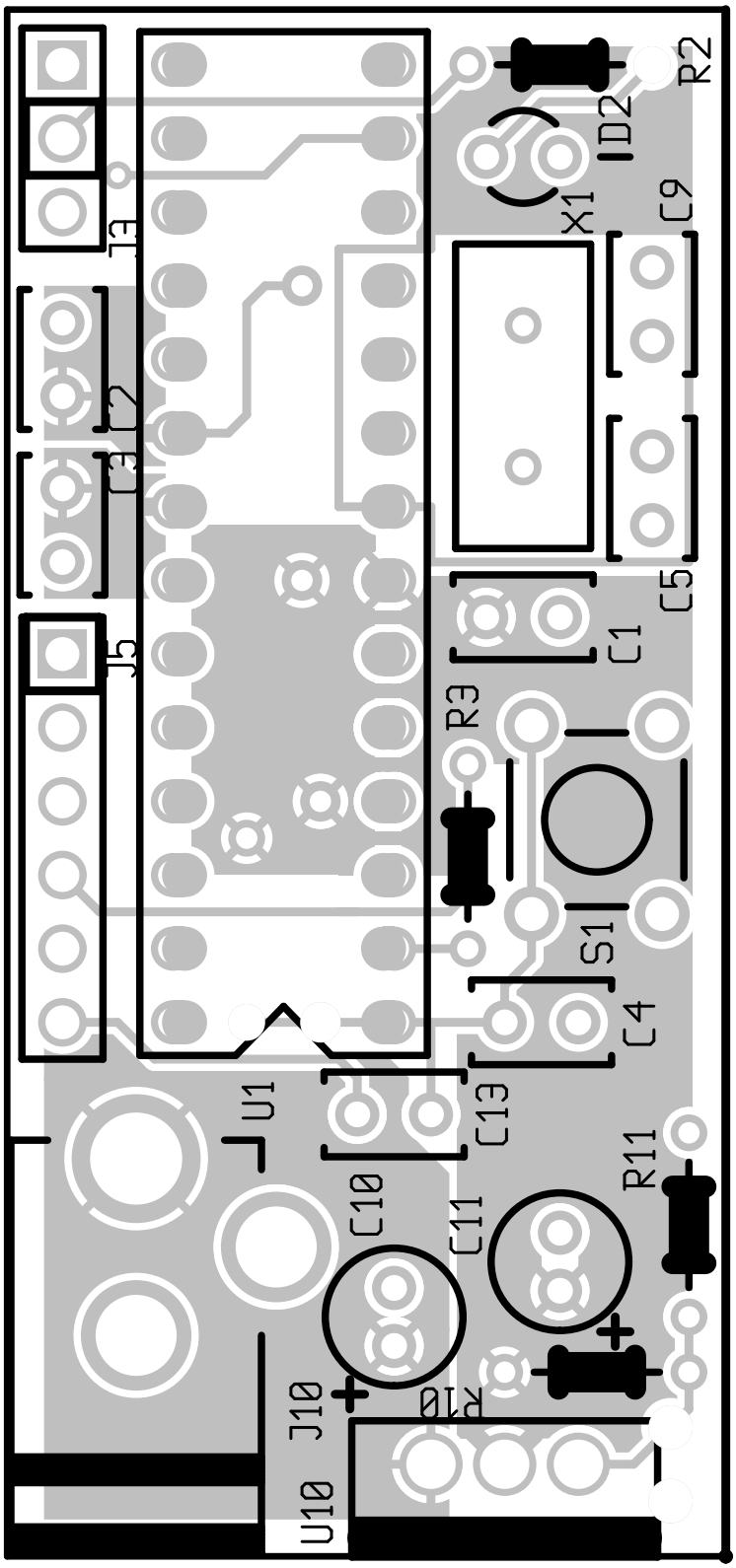


Figure 1: PICO1TR Top Side Assembly Drawing (Rev 1)

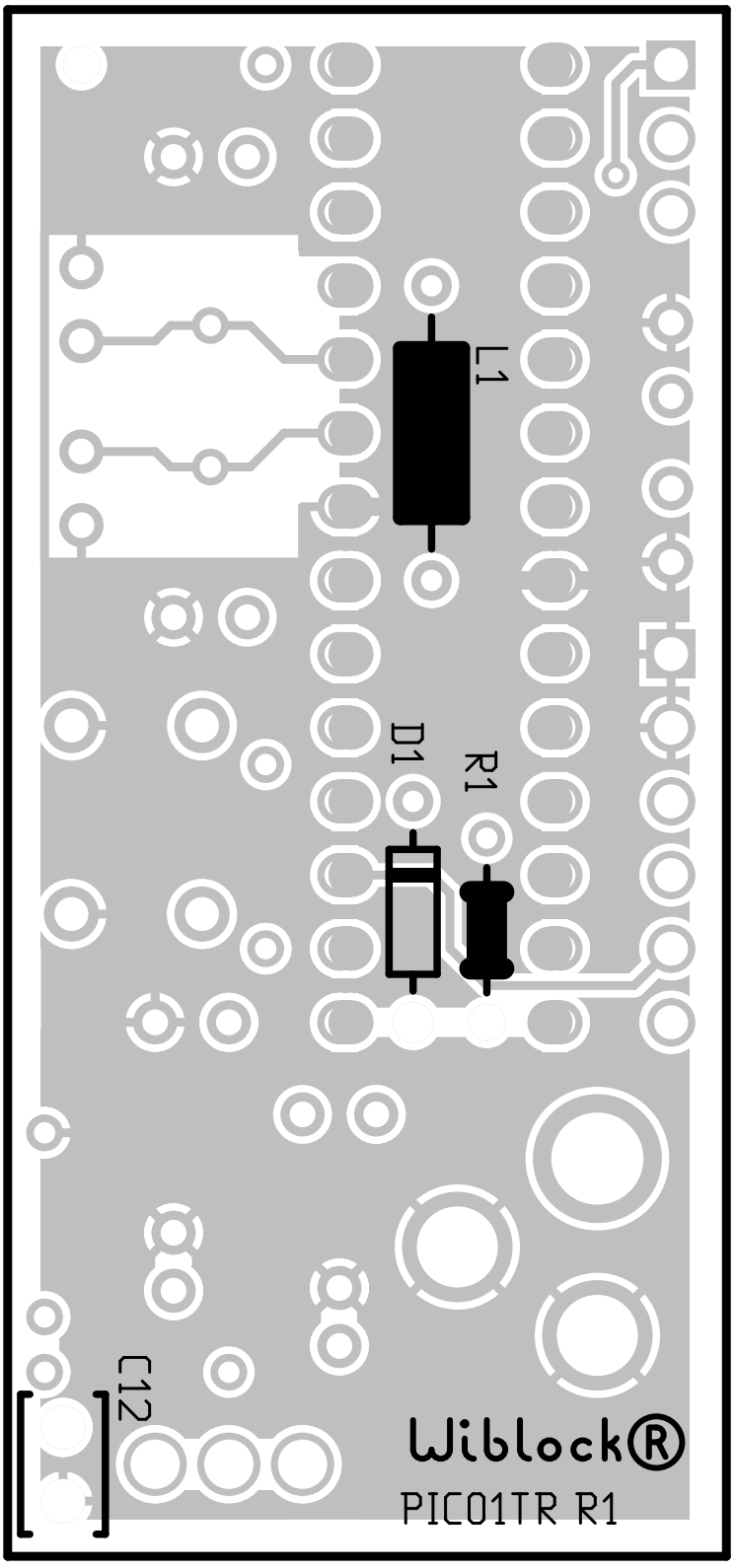


Figure 2: PICO1TR Bottom Side Assembly Drawing (Rev 1)

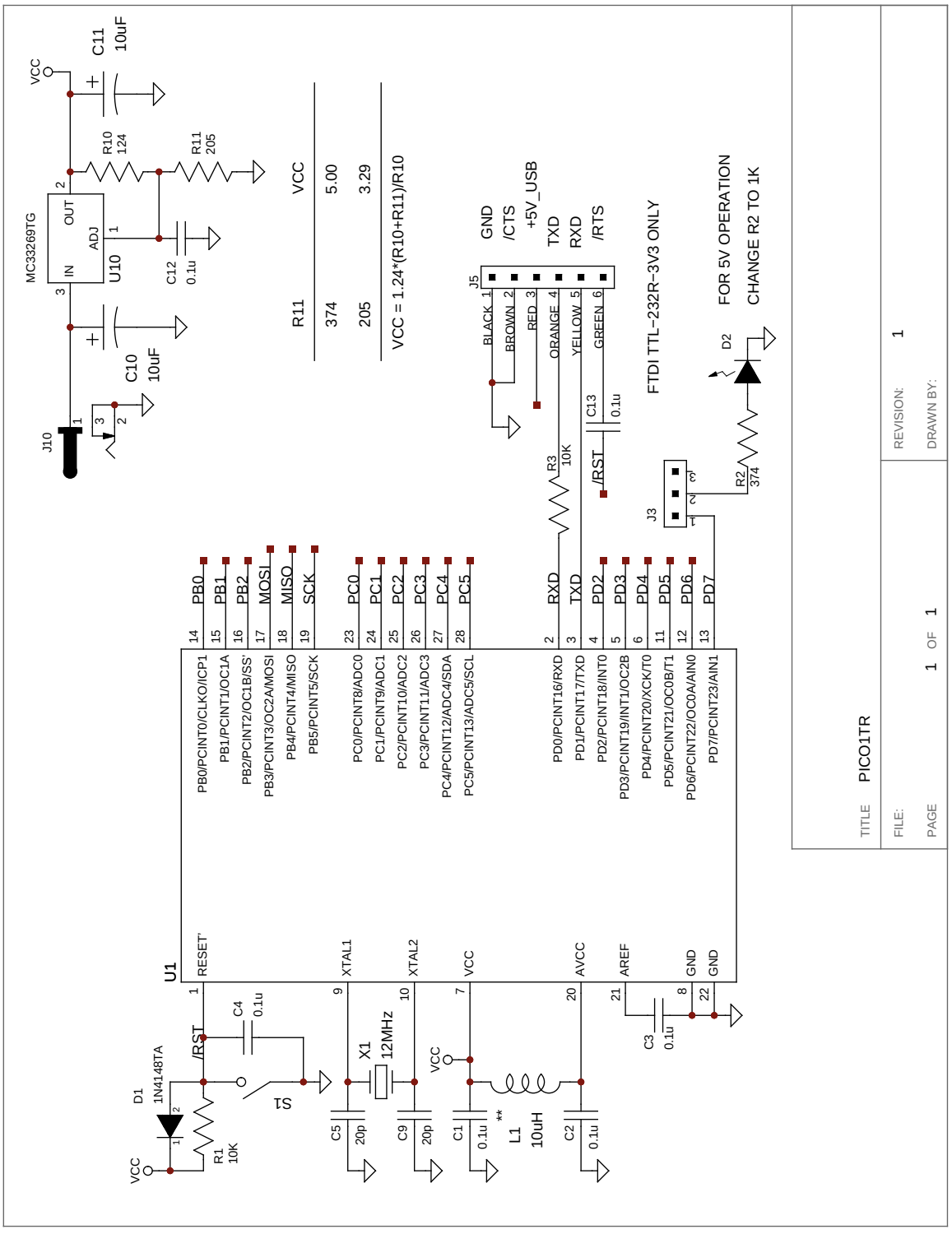


Figure 3: PICO1TR (Rev 1)

MC33269, NCV33269

800 mA, Adjustable Output, Low Dropout Voltage Regulator

The MC33269/NCV33269 series are low dropout, medium current, fixed and adjustable, positive voltage regulators specifically designed for use in low input voltage applications. These devices offer the circuit designer an economical solution for precision voltage regulation, while keeping power losses to a minimum.

The regulator consists of a 1.0 V dropout composite PNP−NPN pass transistor, current limiting, and thermal shutdown.

Features

- 3.3 V, 5.0 V, 12 V and Adjustable Versions
  2.85 V version available as MC34268
- Space Saving DPAK, SO−8 and SOT−223 Power Packages
- 1.0 V Dropout
- Output Current in Excess of 800 mA
- Thermal Protection
- Short Circuit Protection
- Output Trimmed to 1.0% Tolerance
- Pb−Free Packages are Available
- NCV Prefix for Automotive and Other Applications Requiring Site and Control Changes

DEVICE TYPE/NOMINAL OUTPUT VOLTAGE

MC33269D	Adj	MC33269D−5.0	5.0 V
MC33269DT	Adj	MC33269DT−5.0	5.0 V
NCV33269DTRK*	Adj	MC33269T−5.0	5.0 V
MC33269T	Adj		
MC33269D−3.3	3.3 V	MC33269D−012	12 V
MC33269DT−3.3	3.3 V	MC33269DT−012	12 V
NCV33269DTRK−3.3*	3.3 V	NCV33269DTRK−012*	12 V
MC33269T−3.3	3.3 V	MC33269T−012	12 V
MC33269ST−3.3	3.3 V		

*NCV prefix is for automotive and other applications requiring site and change control.

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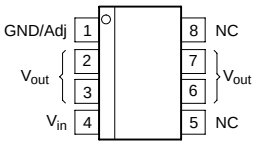
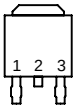
SO−8
D SUFFIX
CASE 751



(Top View)

DPAK
DT SUFFIX
CASE 369C



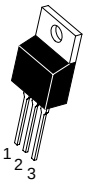
(Top View)

1. GND/Adj
2. V_{out}
3. V_{in}

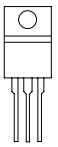
SOT−223
ST SUFFIX
CASE 318E

(Top View)

Heatsink surface (shown as terminal 4 in case outline drawing) is connected to Pin 2.



TO−220AB
T SUFFIX
CASE 221AB



(Top View)

1. GND/Adj
2. V_{out}
3. V_{in}

Heatsink surface (shown as terminal 4 in case outline drawing) is connected to Pin 2.

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 7 of this data sheet.

DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 9 of this data sheet.

MAXIMUM RATINGS

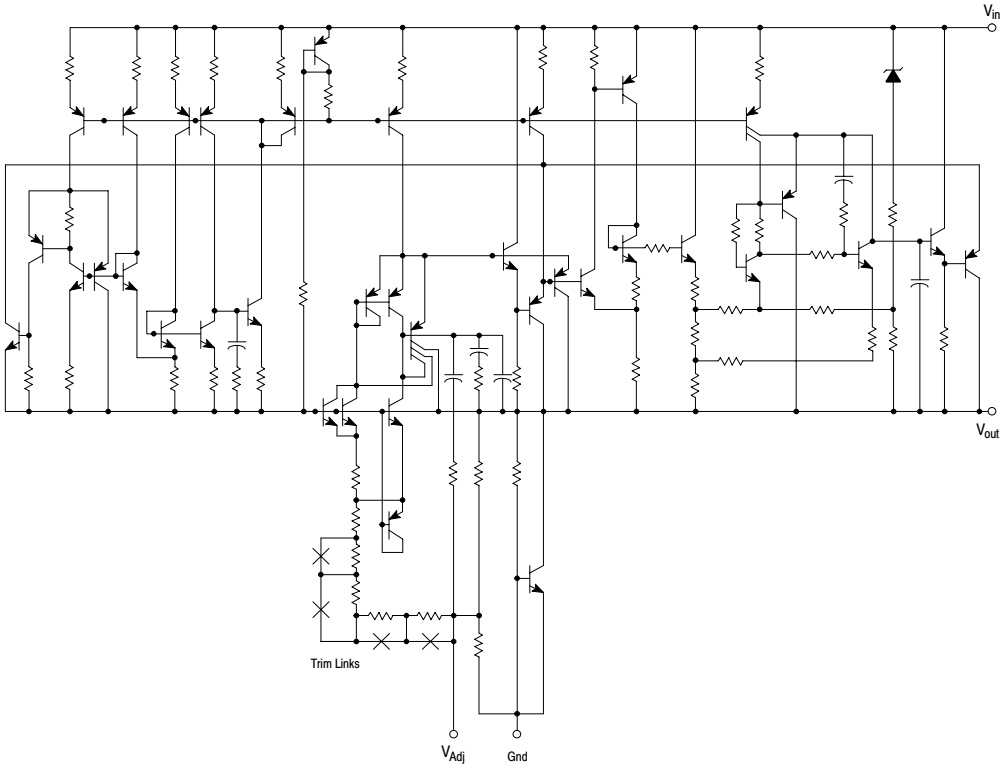
Rating		Symbol	Value	Unit
Power Supply Input Voltage		V_{in}	20	V
Power Dissipation				
Case 369C (DPAK)	T_A = 25°C	P_D	Internally Limited	W
	Thermal Resistance, Junction−to−Ambient	θ_{JA}	92	°C/W
	Thermal Resistance, Junction−to−Case	θ_{JC}	6.0	°C/W
Case 751 (SO−8)	T_A = 25°C	P_D	Internally Limited	W
	Thermal Resistance, Junction−to−Ambient	θ_{JA}	160	°C/W
	Thermal Resistance, Junction−to−Case	θ_{JC}	25	°C/W
Case 221A (TO−220)	T_A = 25°C	P_D	Internally Limited	W
	Thermal Resistance, Junction−to−Ambient	θ_{JA}	65	°C/W
	Thermal Resistance, Junction−to−Case	θ_{JC}	5.0	°C/W
Case 318E (SOT−223)	T_A = 25°C	P_D	Internally Limited	W
	Thermal Resistance, Junction−to−Ambient	θ_{JA}	156	°C/W
	Thermal Resistance, Junction−to−Case	θ_{JC}	15	°C/W
Operating Die Junction Temperature Range		T_J	−40 to +150	°C
Operating Ambient Temperature Range	MC33269	T_A	−40 to +125	°C
	NCV33269		−40 to +125	
Storage Temperature		T_{stg}	−55 to +150	°C
Electrostatic Discharge Sensitivity (ESD)	Human Body Model (HBM)	ESD	4000	V
	Machine Model (MM)		400	

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

ELECTRICAL CHARACTERISTICS (C_O = 10 μF, T_A = 25°C, for min/max values T_A = −40°C to +125°C, unless otherwise noted.)

Characteristic		Symbol	Min	Typ	Max	Unit
Output Voltage (I_{out} = 10 mA, T_A = 25°C)		V_O				V
	3.3 Suffix (V_{CC} = 5.3 V)		3.27	3.3	3.33	
	5.0 Suffix (V_{CC} = 7.0 V)		4.95	5.0	5.05	
	12 Suffix (V_{CC} = 14 V)		11.88	12	12.12	
Output Voltage (Line, Load and Temperature) (Note 1) (1.25 V ≤ V_{in} − V_{out} ≤ 15 V, I_{out} = 500 mA) (1.35 V ≤ V_{in} − V_{out} ≤ 10 V, I_{out} = 800 mA)		V_O				V
	3.3 Suffix		3.23	3.3	3.37	
	5.0 Suffix		4.9	5.0	5.1	
	12 Suffix		11.76	12	12.24	
Reference Voltage for Adjustable Voltage (I_{out} = 10 mA, V_{in} − V_{out} = 2.0 V, T_A = 25°C)		V_{ref}	1.235	1.25	1.265	V
Reference Voltage (Line, Load and Temperature) (Note 1) for Adjustable Voltage (1.25 V ≤ V_{in} − V_{out} ≤ 15 V, I_{out} = 500 mA) (1.35 V ≤ V_{in} − V_{out} ≤ 10 V, I_{out} = 800 mA)		V_{ref}	1.225	1.25	1.275	V
Line Regulation	(I_{out} = 10 mA, V_{in} = [V_{out} + 1.5 V] to V_{in} = 20 V, T_A = 25°C)	Reg_{line}	−	−	0.3	%
Load Regulation	(V_{in} = V_{out} + 3.0 V, I_{out} = 10 mA to 800 mA, T_A = 25°C)	Reg_{load}	−	−	0.5	%
Dropout Voltage	(I_{out} = 500 mA)	V_{in} − V_{out}	−	1.0	1.25	V
	(I_{out} = 800 mA)		−	1.1	1.35	
Ripple Rejection	(10 V_{pp}, 120 Hz Sinewave; I_{out} = 500 mA)	RR	55	−	−	dB
Current Limit	(V_{in} − V_{out} = 10 V)	I_{Limit}	800	−	−	mA
Quiescent Current (Fixed Output)	(1.5 V ≤ V_{out} ≤ 3.3 V)	I_Q	−	5.5	8.0	mA
	(5 V ≤ V_{out} ≤ 12 V)		−	−	20	
Minimum Required Load Current	Fixed Output Voltage	I_{Load}	−	−	0	mA
	Adjustable Voltage		8.0	−	−	
Adjustment Pin Current		I_{Adj}	−	−	120	μA

1. The MC33269−12, V_{in} − V_{out} is limited to 8.0 V maximum, because of the 20 V maximum rating applied to V_{in}.



This device contains 38 active transistors.

Figure 1. Internal Schematic

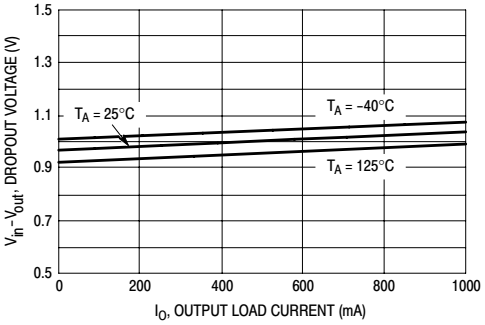


Figure 2. Dropout Voltage versus Output Load Current

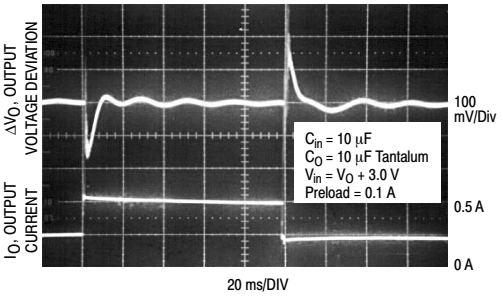


Figure 3. Transient Load Regulation

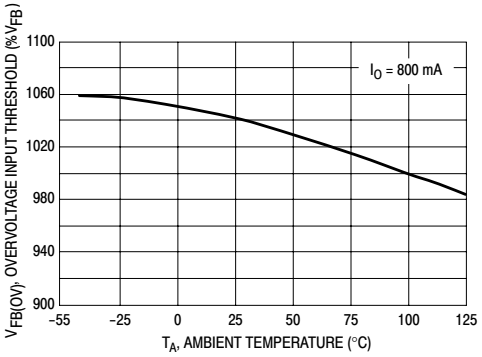


Figure 4. Dropout Voltage versus Temperature

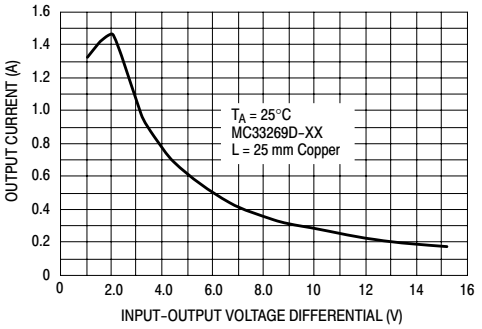


Figure 5. MC33269−XX Output DC Current versus Input−Output Differential Voltage

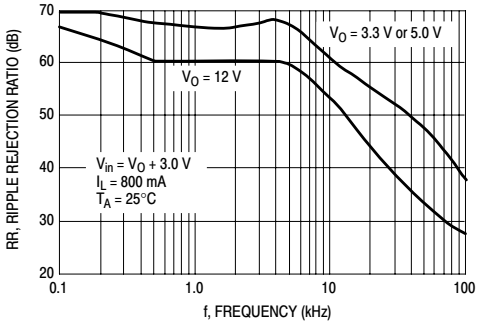


Figure 6. MC33269 Ripple Rejection versus Frequency

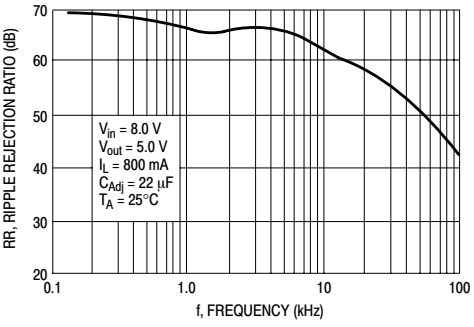


Figure 7. MC33269−ADJ Ripple Rejection versus Frequency

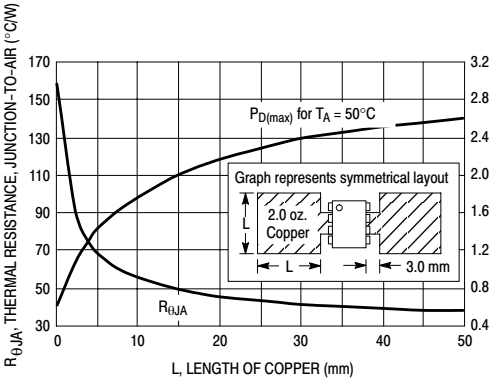


Figure 8. SOP−8 Thermal Resistance and Maximum Power Dissipation versus P.C.B. Copper Length

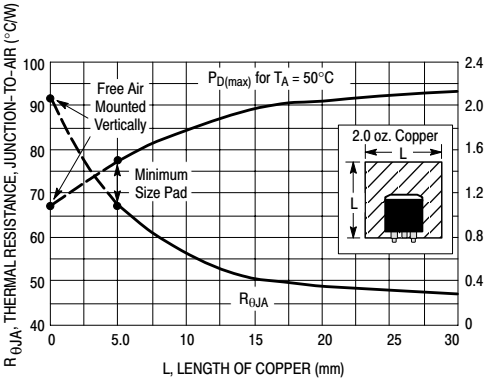


Figure 9. DPAK Thermal Resistance and Maximum Power Dissipation versus P.C.B. Copper Length

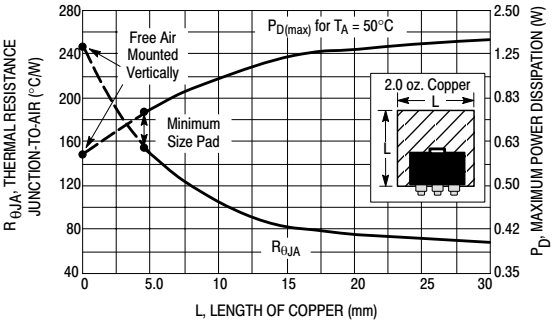


Figure 10. SOT−223 Thermal Resistance and Maximum Power Dissipation versus P.C.B. Copper Length

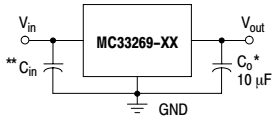
APPLICATIONS INFORMATION

Figures 11 through 15 are typical application circuits. The output current capability of the regulator is in excess of 800 mA, with a typical dropout voltage of less than 1.0 V. Internal protective features include current and thermal limiting.

* The MC33269 requires an external output capacitor for stability. The capacitor should be at least 10 μF with an equivalent series resistance (ESR) of less than 10 Ω but greater than 0.2 Ω over the anticipated operating temperature range. With economical electrolytic capacitors, cold temperature operation can pose a problem. As temperature decreases, the capacitance also decreases and the ESR increases, which could cause the circuit to oscillate. Also capacitance and ESR of a solid tantalum capacitor is more stable over temperature. The use of a low ESR ceramic capacitor placed within close proximity to the output of the device could cause instability.

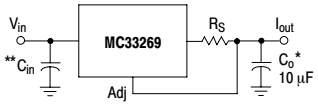
** An input bypass capacitor is recommended to improve transient response or if the regulator is connected to the supply input filter with long wire lengths. This will reduce the circuit's sensitivity to the input line impedance at high frequencies. A 0.33 μF or larger tantalum, mylar, ceramic, or other capacitor having low internal impedance at high frequencies should be chosen. The bypass capacitor should be mounted with shortest possible lead or track length directly across the regulator's input terminals. **Applications should be tested over all operating conditions to insure stability.**

Internal thermal limiting circuitry is provided to protect the integrated circuit in the event that the maximum junction temperature is exceeded. When activated, typically at 170°C, the output is disabled. There is no hysteresis built into the thermal limiting circuit. As a result, if the device is overheating, the output will appear to be oscillating. This feature is provided to prevent catastrophic failures from accidental device overheating. **It is not intended to be used as a substitute for proper heat−sinking.**



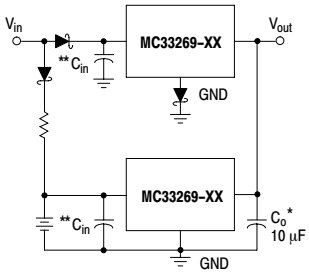
An input capacitor is not necessary for stability, however it will improve the overall performance.

Figure 11. Typical Fixed Output Application



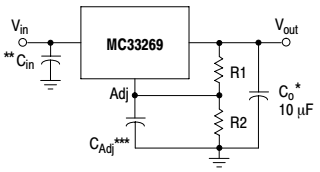
$$I_{out} = \frac{1.25}{R_S}$$

Figure 13. Current Regulator



The Schottky diode in series with the ground leg of the upper regulator shifts its output voltage higher by the forward voltage drop of the diode. This will cause the lower device to remain off until the input voltage is removed.

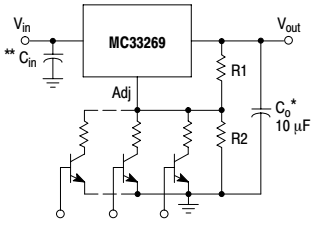
Figure 14. Battery Backed−Up Power Supply



$$V_{out} = 1.25 \left(1 + \frac{R2}{R1}\right) + I_{Adj} R2$$

***C_{Adj} is optional, however it will improve the ripple rejection. The MC34269 develops a 1.25 V reference voltage between the output and the adjust terminal. Resistor R1, operates with constant current to flow through it and resistor R2. This current should be set such that the Adjust Pin current causes negligible drop across resistor R2. The total current with minimum load should be greater than 8.0 mA.

Figure 12. Typical Adjustable Output Application



R_2 sets the maximum output voltage. Each transistor reduces the output voltage when turned on.

Figure 15. Digitally Controlled Voltage Regulator

ORDERING INFORMATION

Device	Package	Shipping Information†
MC33269D	SO−8	98 Units / Rail
MC33269DG	SO−8 (Pb−Free)	
MC33269DR2	SO−8	2500 Units / Tape & Reel
MC33269DR2G	SO−8 (Pb−Free)	
MC33269DT	DPAK	75 Units / Rail
MC33269DTG	DPAK (Pb−Free)	
MC33269DTRK	DPAK	2500 Units / Tape & Reel
MC33269DTRKG	DPAK (Pb−Free)	
MC33269T	TO−220	50 Units / Rail
MC33269TG	TO−220 (Pb−Free)	
MC33269D−3.3	SO−8	98 Units / Rail
MC33269D−3.3G	SO−8 (Pb−Free)	
MC33269DR2−3.3	SO−8	2500 Units / Tape & Reel
MC33269DR2−3.3G	SO−8 (Pb−Free)	
MC33269DT−3.3	DPAK	75 Units / Rail
MC33269DT−3.3G	DPAK (Pb−Free)	
MC33269DTRK−3.3	DPAK	2500 Units / Tape & Reel
MC33269DTRK−3.3G	DPAK (Pb−Free)	
MC33269ST−3.3T3	SOT−223	4000 Units / Tape & Reel
MC33269ST−3.3T3G	SOT−223 (Pb−Free)	
MC33269T−3.3	TO−220	50 Units / Rail
MC33269T−3.3G	TO−220 (Pb−Free)	
MC33269D−5.0	SO−8	98 Units / Rail
MC33269D−5.0G	SO−8 (Pb−Free)	
MC33269DR2−5.0	SO−8	2500 Units / Tape & Reel
MC33269DR2−5.0G	SO−8 (Pb−Free)	
MC33269DT−5.0	DPAK	75 Units / Rail
MC33269DT−5.0G	DPAK (Pb−Free)	
MC33269DTRK−5.0	DPAK	2500 Units / Tape & Reel
MC33269DTRK−5.0G	DPAK (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.
*NCV prefix is for automotive and other applications requiring site and control changes.

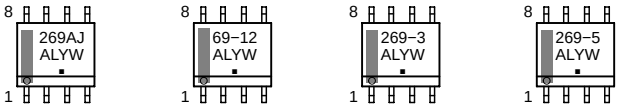
ORDERING INFORMATION (continued)

Device	Package	Shipping Information†
MC33269T−5.0	TO−220	50 Units / Rail
MC33269T−5.0G	TO−220 (Pb−Free)	
MC33269D−012	SO−8	98 Units / Rail
MC33269D−012G	SO−8 (Pb−Free)	
MC33269DR2−012	SO−8	2500 Units / Tape & Reel
MC33269DR2−012G	SO−8 (Pb−Free)	
MC33269DT−012	DPAK	75 Units / Rail
MC33269DT−012G	DPAK (Pb−Free)	
MC33269DTRK−012	DPAK	2500 Units / Tape & Reel
MC33269DTRK−012G	DPAK (Pb−Free)	
MC33269T−012	TO−220	50 Units / Rail
MC33269T−012G	TO−220 (Pb−Free)	
NCV33269DTRK*	DPAK	2500 Units / Tape & Reel
NCV33269DTRKG*	DPAK (Pb−Free)	
NCV33269DTRK−3.3*	DPAK	
NCV33269DTRK−3.3G*	DPAK (Pb−Free)	
NCV33269DTRK−012*	DPAK	
NCV33269DTRK−012G*	DPAK (Pb−Free)	

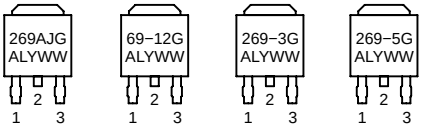
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.
*NCV prefix is for automotive and other applications requiring site and control changes.

MARKING DIAGRAMS

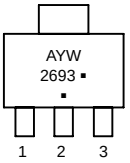
SO−8
D SUFFIX
CASE 751



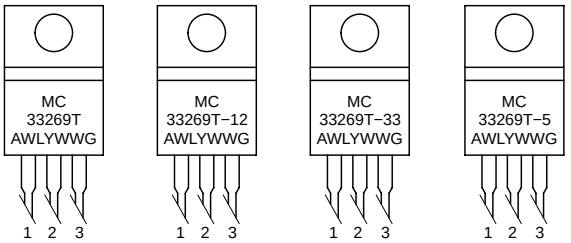
DPAK
DT SUFFIX
CASE 369C



SOT−223
ST SUFFIX
CASE 318E



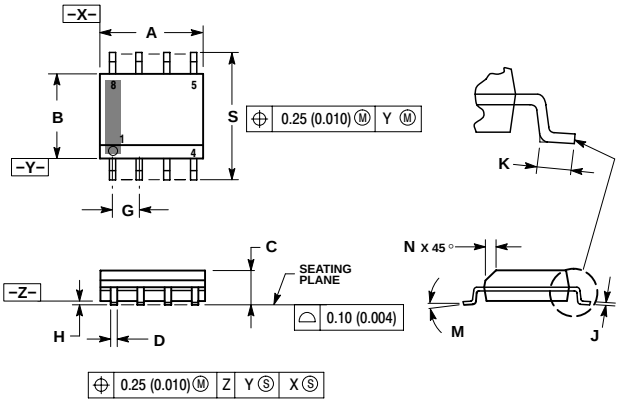
TO−220AB
T SUFFIX
CASE 221A



A = Assembly Location
L, WL = Wafer Lot
Y = Year
W, WW = Work Week
G = Pb−Free Package
▪ = Pb−Free Package
(Note: Microdot may be in either location)

PACKAGE DIMENSIONS

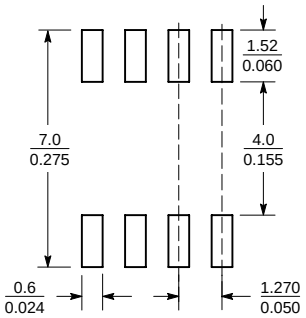
SO−8
D SUFFIX
CASE 751−07
ISSUE AH



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751−01 THRU 751−06 ARE OBSOLETE. NEW STANDARD IS 751−07.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.197
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.020
G	1.27 BSC		0.050 BSC	
H	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
K	0.40	1.27	0.016	0.050
M	0 °	8 °	0 °	8 °
N	0.25	0.50	0.010	0.020
S	5.80	6.20	0.228	0.244

SOLDERING FOOTPRINT*

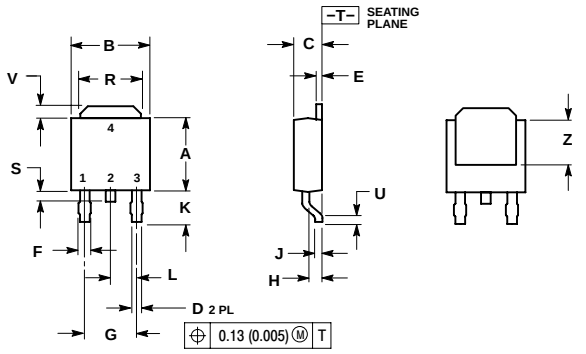


SCALE 6:1 (mm / inches)

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

PACKAGE DIMENSIONS

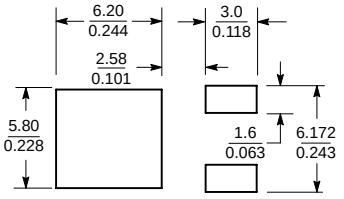
DPAK
DT SUFFIX
CASE 369C−01
ISSUE O



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.235	0.245	5.97	6.22
B	0.250	0.265	6.35	6.73
C	0.086	0.094	2.19	2.38
D	0.027	0.035	0.69	0.88
E	0.018	0.023	0.46	0.58
F	0.037	0.045	0.94	1.14
G	0.180 BSC		4.58 BSC	
H	0.034	0.040	0.87	1.01
J	0.018	0.023	0.46	0.58
K	0.102	0.114	2.60	2.89
L	0.090 BSC		2.29 BSC	
R	0.180	0.215	4.57	5.45
S	0.025	0.040	0.63	1.01
U	0.020	−−−	0.51	−−−
V	0.035	0.050	0.89	1.27
Z	0.155	−−−	3.93	−−−

SOLDERING FOOTPRINT*

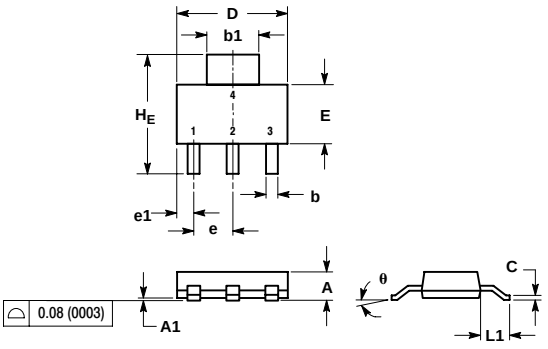


SCALE 3:1 (mm / inches)

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

PACKAGE DIMENSIONS

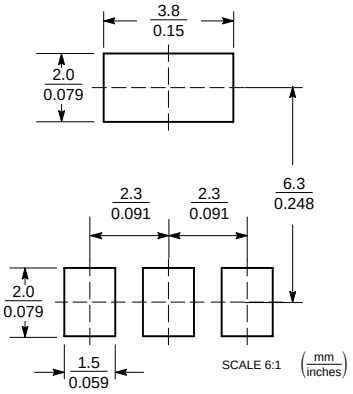
SOT−223
ST SUFFIX
CASE 318E−04
ISSUE L



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	MILLIMETERS			INCHES		
DIM	MIN	NOM	MAX	MIN	NOM	MAX
A	1.50	1.63	1.75	0.060	0.064	0.068
A1	0.02	0.06	0.10	0.001	0.002	0.004
b	0.60	0.75	0.89	0.024	0.030	0.035
b1	2.90	3.06	3.20	0.115	0.121	0.126
c	0.24	0.29	0.35	0.009	0.012	0.014
D	6.30	6.50	6.70	0.249	0.256	0.263
E	3.30	3.50	3.70	0.130	0.138	0.145
e	2.20	2.30	2.40	0.087	0.091	0.094
e1	0.85	0.94	1.05	0.033	0.037	0.041
L1	1.50	1.75	2.00	0.060	0.069	0.078
H_E	6.70	7.00	7.30	0.264	0.276	0.287
θ	0°	–	10°	0°	–	10°

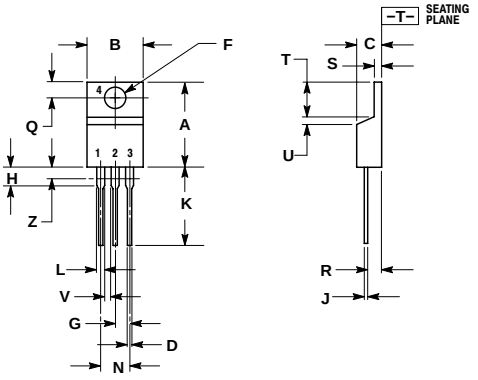
SOLDERING FOOTPRINT*



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

PACKAGE DIMENSIONS

TO−220AB, SINGLE GAUGE
T SUFFIX
CASE 221AB−01
ISSUE O



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.570	0.620	14.48	15.75
B	0.380	0.405	9.66	10.28
C	0.160	0.190	4.07	4.82
D	0.025	0.035	0.64	0.88
F	0.142	0.147	3.61	3.73
G	0.095	0.105	2.42	2.66
H	0.110	0.155	2.80	3.93
J	0.018	0.025	0.46	0.64
K	0.500	0.562	12.70	14.27
L	0.045	0.060	1.15	1.52
N	0.190	0.210	4.83	5.33
Q	0.100	0.120	2.54	3.04
R	0.080	0.110	2.04	2.79
S	0.020	0.055	0.508	1.39
T	0.235	0.255	5.97	6.47
U	0.000	0.050	0.00	1.27
V	0.045	---	1.15	---
Z	---	0.080	---	2.04

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
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ON Semiconductor Website: **www.onsemi.com**

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MC33269/D