

POWER INTEGRATED CIRCUIT

Switching Regulator 5 Amp Positive and Negative Power Output Stages

PIC600
PIC601
PIC602
PIC610
PIC611
PIC612

FEATURES

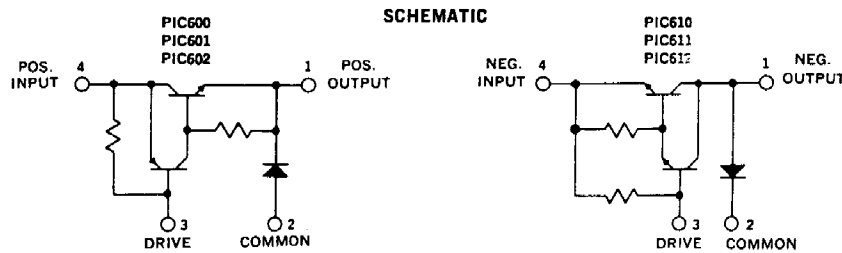
- Designed and characterized for switching regulator applications
- Cost saving design reduces size, improves efficiency, reduces noise and RFI
- High operating frequency (to > 100kHz) results in smaller inductor-capacitor filter and improved power supply response time
- High operating efficiency: Typical 2A circuit performance —
Rise and Fall time < 75ns
Efficiency > 85%
- No reverse recovery spike generated by commutating diode (See note)
- Electrically isolated, 4-Pin, TO-66 hermetic case

DESCRIPTION

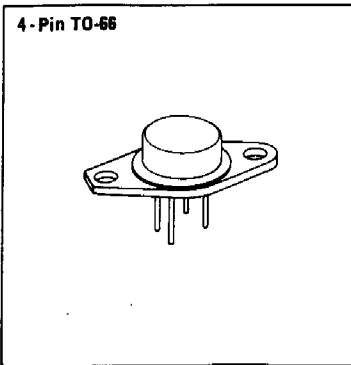
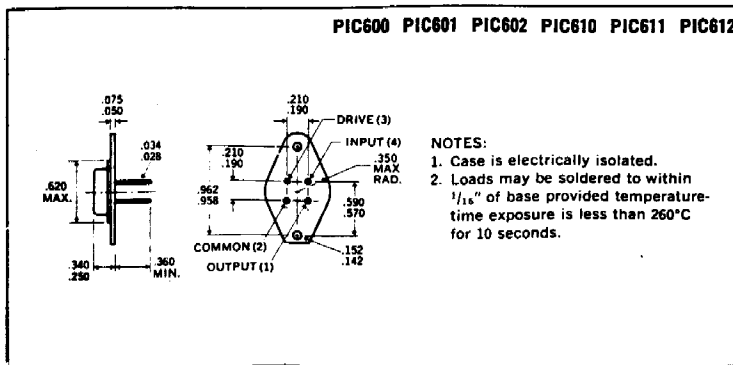
ESP Switching Regulator is a unique hybrid transistor circuit, specifically designed, constructed and specified for use in high current switching regulator applications. The designer is thus relieved of one of the most time consuming, tedious and critical aspects of switching regulator design: choosing the appropriate switching transistors and commutating diode, and empirically determining the optimum drive and bias conditions:

The PIC600 series switching regulators are designed and characterized to be driven with standard integrated circuit voltage regulators. They are completely characterized over their entire operating range of -55°C to $+125^{\circ}\text{C}$. The devices are enclosed in a special 4-pin TO-66 package, hermetically sealed for high reliability. The hybrid circuit construction utilizes thick film resistors on a beryllia substrate for maximum thermal conductivity and resultant low thermal impedance. All of the active elements in the hybrid are fully passivated.

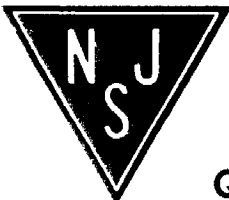
Application Notes U-68 and U-76 provide a detailed description of the hybrid circuit and design guidance for specific circuit applications.



MECHANICAL SPECIFICATIONS



NJ Semi-Conductors reserves the right to change test conditions, parameter limits and package dimensions without notice. Information furnished by NJ Semi-Conductors is believed to be both accurate and reliable at the time of going to press. However, NJ Semi-Conductors assumes no responsibility for any errors or omissions discovered in its use. NJ Semi-Conductors encourages customers to verify that datasheets are current before placing orders.



ABSOLUTE MAXIMUM RATINGS

	PIC600	PIC601	PIC602	PIC610	PIC611	PIC612
Input Voltage, $V_{4,2}$	60V	80V	100V	-60V	-80V	-100V
Output Voltage, $V_{1,2}$	60V	80V	100V	-60V	-80V	-100V
Drive-Input Reverse Voltage, $V_{3,4}$	5V	5V	5V	-5V	-5V	-5V
Output Current, I_1	15A	5A	5A	-5A	-5A	-5A
Drive Current, I_3	-0.2A	-0.2A	-0.2A	0.2A	0.2A	0.2A
Thermal Resistance						
Junction to Case, θ_{JC}				4.0°C/W		
Power Switch				4.0°C/W		
Commutating Diode				60.0°C/W		
Case to Ambient, θ_{CA}				-55°C to +125°C		
Operating Temperature Range, T_C				+150°C		
Maximum Junction Temperature, T_J				-65°C to +150°C		
Storage Temperature Range						

ELECTRICAL SPECIFICATIONS (at 25°C unless noted)

Test	Symbol	PIC600, 601, 602			PIC610, 611, 612			Units	Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.		
Current Delay Time	t_{di}	—	20	40	—	20	40	ns	$V_{in} = 25V(-25V)$
Current Rise Time	t_{ri}	—	50	75	—	50	75	ns	$V_{out} = 5V(-5V)$
Voltage Rise Time	t_{rv}	—	30	50	—	30	50	ns	$I_{out} = 2A(-2A)$
Voltage Storage Time	t_{sv}	—	700	—	—	700	—	ns	$I_3 = -20mA(20mA)$
Voltage Fall Time	t_{fv}	—	50	75	—	50	75	ns	See Figure 2.
Current Fall Time	t_{fi}	—	70	150	—	70	150	ns	See notes 1., 2., 4.
Efficiency (Notes 2. & 4.)	η	—	85	—	—	85	—	%	
On-State Voltage (Note 3.)	$V_{4-1(on)}$	—	1.0	1.5	—	-1.0	-1.5	V	$I_4 = 2A(-2A), I_3 = -0.2A(0.2A)$
On-State Voltage (Note 3.)	$V_{4-1(on)}$	—	2.5	3.5	—	-2.5	-3.5	V	$I_4 = 5A(-5A), I_3 = -0.2A(0.2A)$
Diode Forward Voltage (Note 3.)	$V_{2-1(on)}$	—	.8	1.0	—	-.8	-1.0	V	$I_2 = 2A(-2A)$
Diode Forward Voltage (Note 3.)	$V_{2-1(on)}$	—	1.0	1.5	—	-1.0	-1.5	V	$I_2 = 5A(-5A)$
Off-State Current	I_{4-1}	—	0.1	10	—	-0.1	-10	μA	$V_4 =$ Rated input voltage
Off-State Current	I_{4-1}	—	10	—	—	-10	—	μA	$V_4 =$ Rated input voltage, $T_A = 100^\circ C$
Diode Reverse Current	I_{1-2}	—	1.0	10	—	-1.0	-10	μA	$V_1 =$ Rated output voltage
Diode Reverse Current	I_{1-2}	—	500	—	—	500	—	μA	$V_1 =$ Rated output voltage, $T_A = 100^\circ C$

Notes:

1. In switching an inductive load, the current will lead the voltage on turn-on and lag the voltage on turn-off (see Figure 2). Therefore, Voltage Delay Time (t_{dv}) $\cong t_{di} + t_{ri}$ and Current Storage Time (t_{cs}) $\cong t_{fv} + t_{fi}$.
2. The efficiency is a measure of internal power losses and is equal to Output Power divided by Input Power. The switching speed circuit of Figure 1, in which the efficiency is measured, is representative of typical operating conditions for the PIC600 series switching regulators.
3. Pulse test: Duration = 300ms, Duty Cycle $\leq 2\%$.
4. As can be seen from the switching waveforms shown in Figure 2, no reverse or forward recovery spike is generated by the commutating diode during switching! This reduces self-generated noise, since no current spike is fed through the switching regulator. It also improves efficiency and reliability, since the power switch only carries current during turn-on.