

PWM SWITCHING REGULATOR CONTROL IC FOR SLAVE TYPE

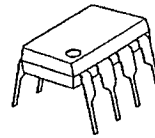
■ GENERAL DESCRIPTION

The NJM2378 is a high speed switching regulator control IC, and directly drive an external Bipolar Transistor to use internal totempole output circuit.

The NJM2378 operate slave mode which synchronous external oscillation frequency, and the slave mode reduce the total noise.

The NJM2378 is suitable for flyback type switching regulation up to 10W and several output power supply for LCD panel.

■ PACKAGE OUTLINE



NJM2378D



NJM2378M



NJM2378E

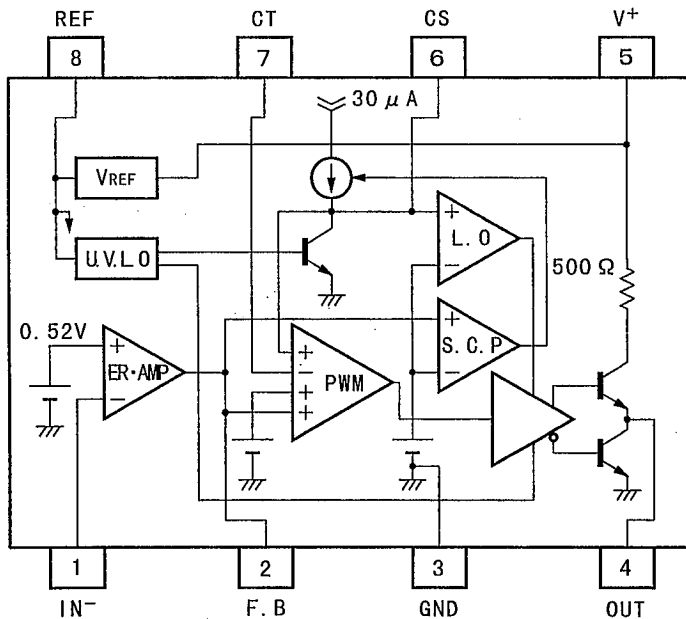


NJM2378V

■ FEATURES

- Operating Voltage (3.6~32V)
- Reference Voltage (2.5V±2%)
- Input Outside
  - Oscillator Frequency (5~350 kHz)
- Output Switch Current (±8mA min.)
- Under Voltage Lockouts Circuit
- Bipolar Technology
- Package Outline DIP8, DMP8, EMP8, SSOP8

■ BLOCK DIAGRAM



PIN FUNCTION

1. IN<sup>-</sup>
2. F. B
3. GND
4. OUT
5. V<sup>+</sup>
6. CS
7. CT
8. REF



# NJM2378

## ■ ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V <sup>+</sup>	36	V
Reference Output Current	I <sub>OR</sub>	10	mA
Output Current	I <sub>O</sub>	±50	mA
CT Pin Voltage	V <sub>CT</sub>	1.5	V
Power Dissipation	P <sub>D</sub>	(DIP8) 700 (DMP8) 300 (EMP8) 300 (SSOP8) 250	mW
Operating Temperature Range	T <sub>OPR</sub>	-40~+85	°C
Storage Temperature Range	T <sub>STG</sub>	-50~+125	°C

## ■ RECOMMENDED OPERATING CONDITIONS (V<sup>+</sup>=6V, Ta=25°C)

PARAMETER	SYMBOL	MIN.	MAX.	UNIT
Operating Voltage	V <sup>+</sup>	3.6	32	V
Feed Back Resistor	R <sub>NF</sub>	100	—	kΩ
Oscillate	f <sub>OSC</sub>	5	350	kHz

### INPUT WAVEFORME

PARAMETER	SYMBOL	RECOMMENDED	UNIT
Triangle Waveform	V <sub>P-P</sub>	0.5	V
Offset Voltage	V <sub>OFFSET</sub>	0.5	V

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■ ELECTRICAL CHARACTERISTICS

( $V^+=6V$ ,  $R_T=33k\Omega$ ,  $C_T=1000pF$ ,  $T_a=25^\circ C$  OSC: Triangle Waveform,  $V_{P-P}=0.5V$ , Offset=0.5V,  $f_{osc}=100kHz$ )  
 REFERENCE VOLTAGE BLOCK

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	$V_{REF}$	$I_{OR}=1mA$	2.45	2.50	2.55	V
Line Regulation	$L_{INE}$	$V^+=3.6\sim 32V$ , $I_{OR}=1mA$	—	6.8	20.7	mV
Load Regulation	$L_{OAD}$	$I_{OR}=0.1\sim 5.0mA$	—	5	30	mV

OSCILLATOR BLOCK

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reference Voltage	$V_B$		0.51	0.52	0.53	V
Input Bias Current	$I_B$		—	5	100	nA
Open Loop Gain	$A_V$		—	90	—	dB
Gain Band width Product	$G_B$		—	0.6	—	MHz
Maximum Output Voltage (F.B Pin)	$V_{OM+}$ $V_{OM-}$	$R_{NF}=100k\Omega$ $R_{NF}=100k\Omega$	$V_{REF}-0.2$ —	—	— 200	V mV
Output Source Current	$I_{OM+}$	$V_{OM}=1V$	40	85	200	$\mu A$

PWM COMPARATOR BLOCK

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Triangle Waveform Input Minimum Voltage (CT Pin)	$OSC_{LO}$	CT Pin Triangle Waveform Input	0	—	0.4	V
Triangle Waveform Input Maximum Voltage (CT Pin)	$OSC_{HI}$	CT Pin Triangle Waveform Input	0.7	—	1.3	V
Input Threshold Voltage (F.B Pin)	$V_{TH0}$	duty·cycle=0%	—	0.55	0.65	V
Input Threshold Voltage (F.B Pin)	$V_{TH50}$	duty·cycle=50%	—	0.87	—	V
Maximum Duty Cycle	$\alpha M$	F.B Pin=1.2V	55	64	85	%

SOFT START CIRCUIT BLOCK

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Bias Current (CS Pin)	$I_{BCS}$		—	250	650	nA
Input Threshold Voltage (CS Pin)	$V_{THCS0}$	duty·cycle=0%	—	0.25	0.35	V
Input Threshold Voltage (CS Pin)	$V_{THCS50}$	duty·cycle=50%	—	0.52	—	V

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## ■ ELECTRICAL CHARACTERISTICS

( $V^+=6V$ ,  $R_T=33k\Omega$ ,  $C_T=1000pF$ ,  $T_a=25^\circ C$  OSC: Triangle Waveform,  $V_{P-P}=0.5V$ , OFFSET=0.5V,  $f_{OSC}=100kHz$ )  
 SHORT CIRCUIT PROTECTION

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Threshold Voltage (F. B Pin)	$V_{THPC}$		1.20	1.50	1.80	V
Charge Current (CS Pin)	$I_{CHG}$	CS Pin=0V, F. B Pin=2V	10	30	50	$\mu A$
Latch mode Threshold Voltage (CS Pin)	$V_{THLA}$		1.20	1.50	1.80	V

### UNDER VOLTAGE LOCKOUT

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
ON Threshold Voltage	$V_{THON}$		—	2.70	—	V
OFF Threshold Voltage	$V_{THOFF}$		—	2.52	—	V
Hysteresis Voltage	$V_{HYS}$		60	180	—	mV

### OUTPUT

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
H-Output Voltage (OUT Pin)	$V_{OH}$	$R_L=10k\Omega$	3.50	4.00	—	V
L-Output Voltage (OUT Pin)	$V_{OL}$	Output Sink Current=20mA	—	0.25	0.65	V
Output Source Current (OUT Pin)	$I_{SOURCE}$	OUT Pin=0V	8	11	—	mA

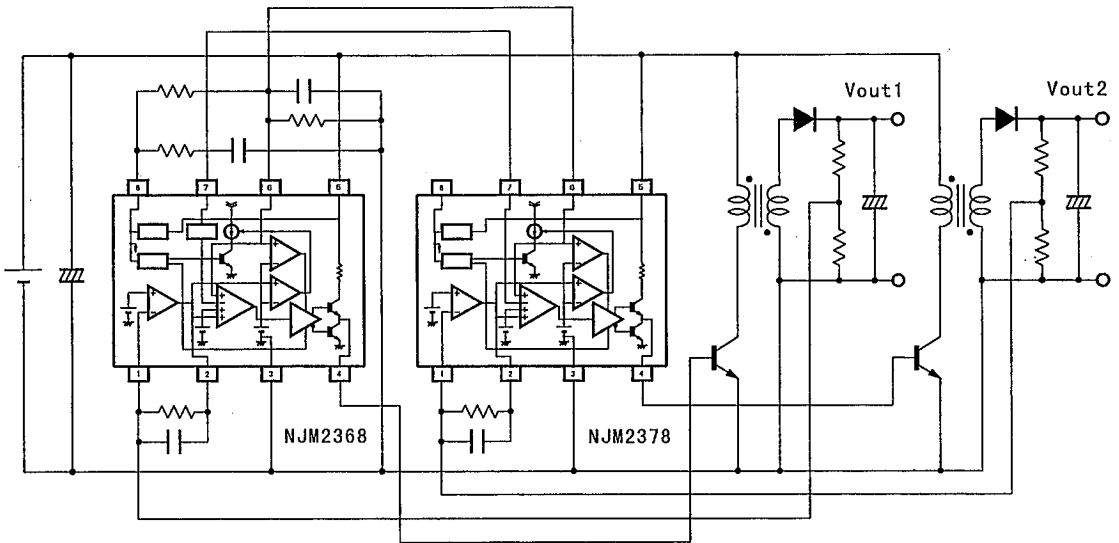
### GENERAL CHARACTERISTICS

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Quiescent Current	$I_{CCLA}$	Latch Mode	—	1.6	2.2	mA
Average Quiescent Current	$I_{CCAV}$	$R_L=\infty$ , duty cycle=50%	—	3.5	4.8	mA

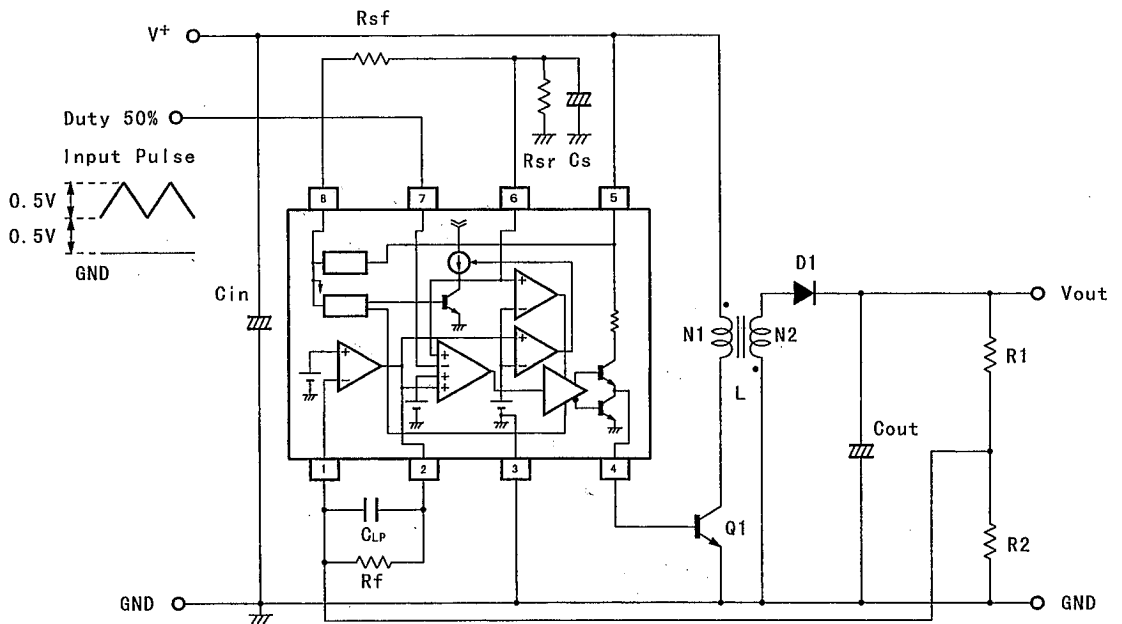
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## ■ TYPICAL APPLICATIONS

Synchronous mode with NJM2368



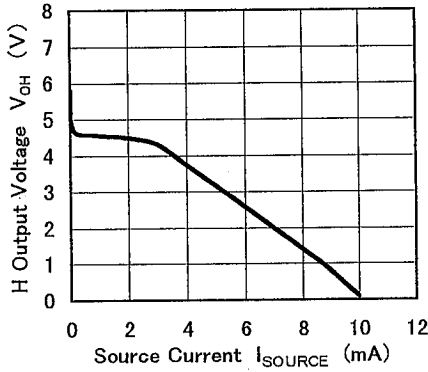
External pulse mode



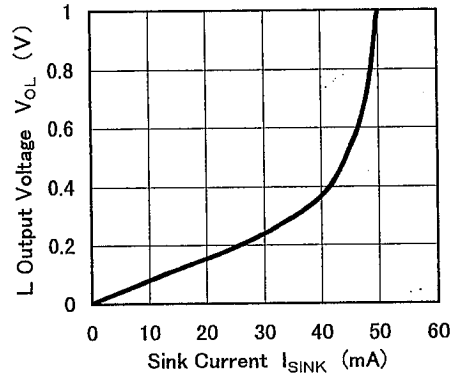
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## TYPICAL CHARACTERISTICS

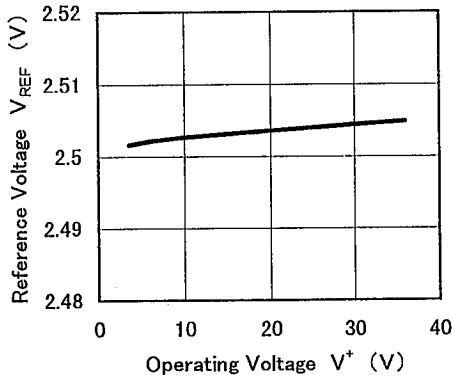
H Output Voltage(OUT Pin) vs. Source Current  
 ( $V^+=6V, OUT\ Pin=0V, OSC: Triangle\ Waveform$   
 $V_{P-P}=0.5V, Offset=0.5V, f_{osc}=100kHz, T_a=25^\circ C$ )



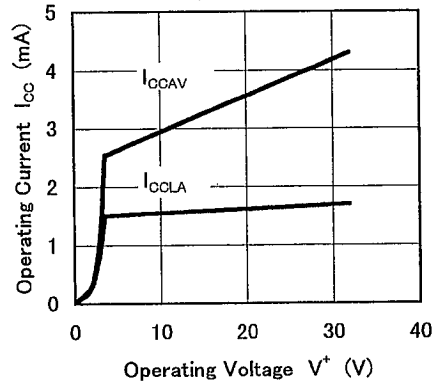
L Output Voltage(OUT Pin) vs. Sink Current  
 ( $V^+=6V, OSC: Triangle\ Waveform$   
 $V_{P-P}=0.5V, Offset=0.5V, f_{osc}=100kHz, T_a=25^\circ C$ )



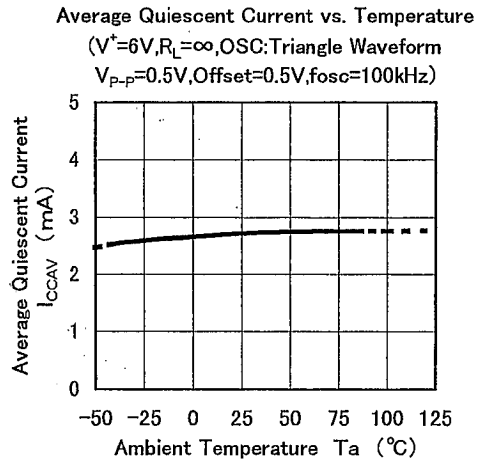
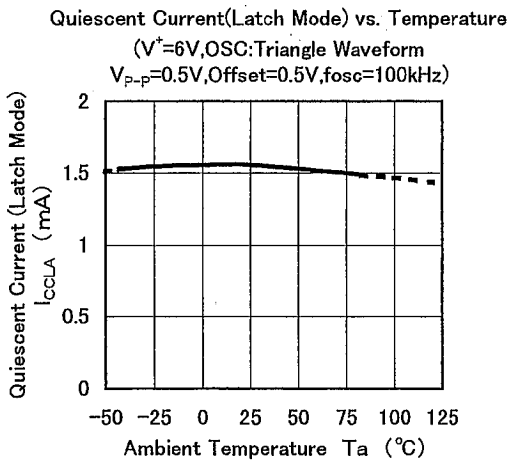
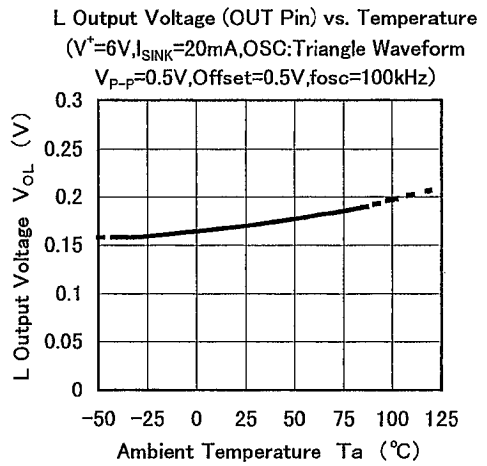
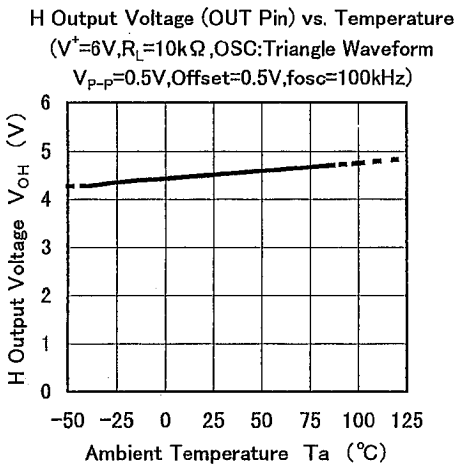
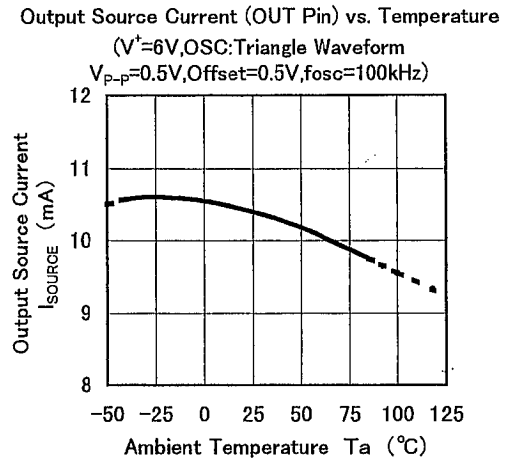
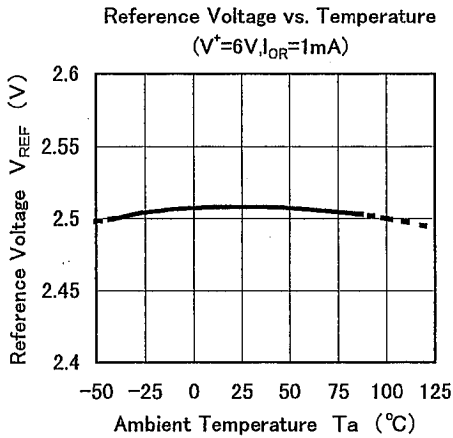
Reference Voltage vs. Operating Voltage  
 ( $T_a=25^\circ C$ )



Operating Current vs. Operating Voltage  
 ( $T_a=25^\circ C$ )



■ TYPICAL CHARACTERISTICS



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## MEMO

[CAUTION]

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