Code No.: IC3F4738	Total Pages	Page
	17	1

Product Standards

Part No.	AN8015SH
Package Code No.	SSOP010-P-0225A

Analogue LSI Business Unit
Semiconductor Company
Matsushita Electric Industrial Co., Ltd.

Established by	Applied by	Checked by	Prepared by
K.Komichi	M.Hiramatsu	J.Hara	J.Morita
K.Komichi	M.Hiramatsu	J.Hara	J.Morita

2006-08-24	
Established	Revised

Contents

AN8015SH

Single-channel step-down, step-up, or inverting use DC-DC converter control IC

■ Overview

AN8015SH is a single-channel DC-DC converter control IC using the PWM method.

This IC can provide any one output type from among step-down, step-up and inverting output.

Its operating supply voltage range is wide and its consumption current is small. In addition, since it uses the 10-pin surface mounting type package with 0.5 mm pitch, it is suitable for highly efficient miniature potable power supply, especially for a negative output power supply.

■ Features

- Wide operating supply voltage range (3.6 V to 34 V)
- Small consumption current (1.8 mA typical)
- Converter control in a wide output frequency range is possible (2 kHz to 500 kHz).
- Built-in timer latch short-circuit protection circuit (charge current : 1.1 μA typical)
- Incorporating the under-voltage lock-out (U.V.L.O) circuit
- Incorporating a high precision reference voltage circuit (2.46 V (allowance: ±3%))
- Output block is open-collector (darlington) type.
- High absolute maximum rating of output current (100 mA)
- Maximum duty ratio is fixed and has small sample-to-sample variations (90% ±5%)

■ Applications

- LCD displays, digital still cameras, and PDAs

■ Package

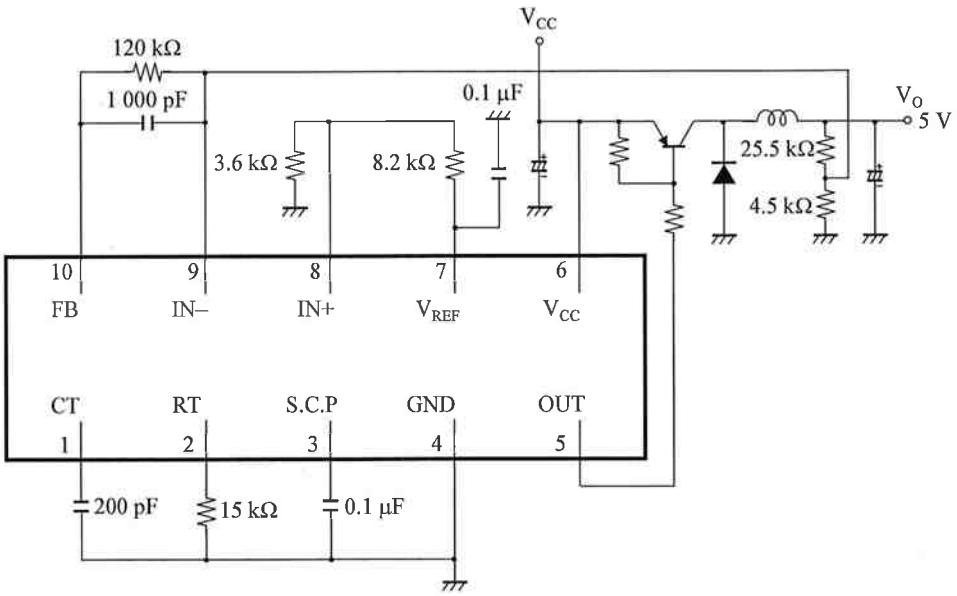
- 10 pin Plastic Shrink Small Outline Package (SSOP Type)

■ Type

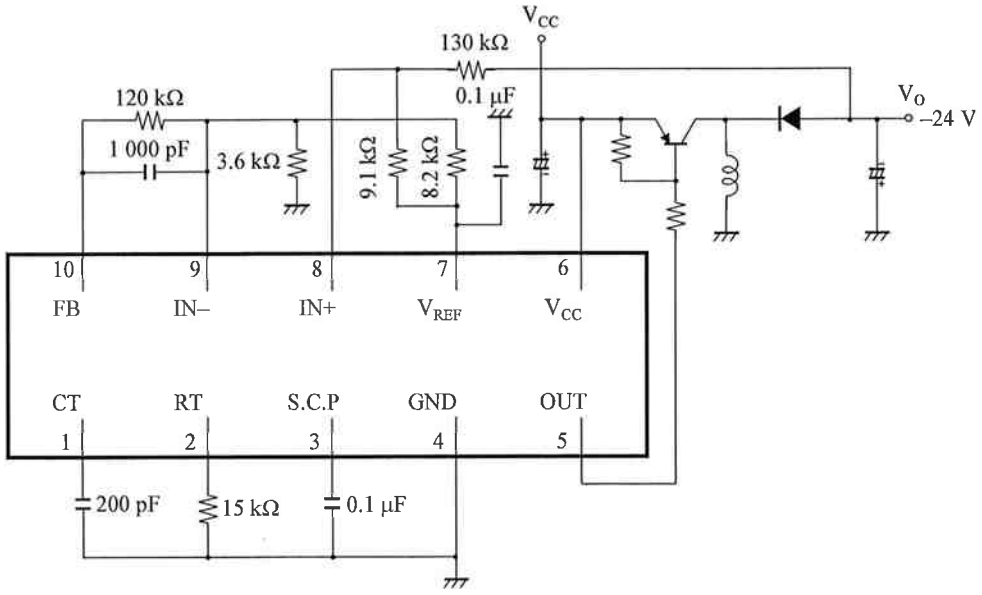
- Silicon Monolithic Bipolar IC

■ Application Circuit Example

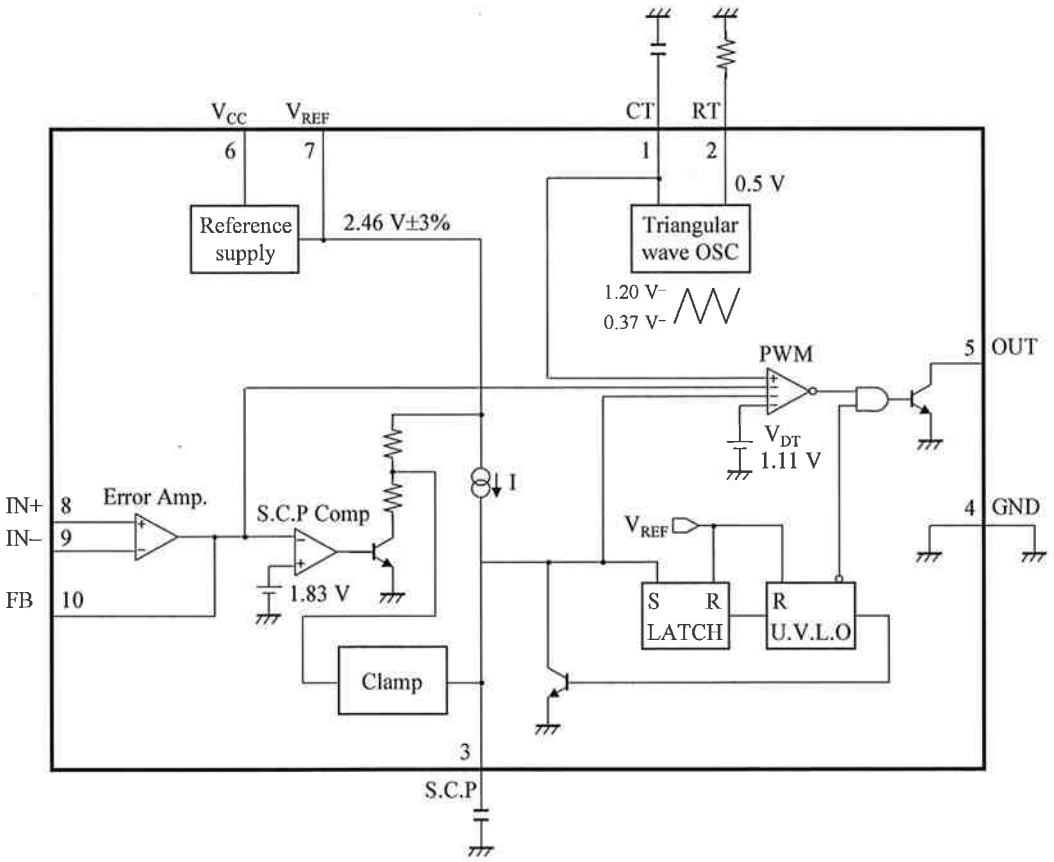
1. Chopper method step-down type



2. Chopper method inverting type



■ Block Diagram



■ Pin Descriptions

Pin No.	Pin name	Type	Description
1	CT	—	Pin for connecting oscillator timing capacitor
2	RT	—	Pin for connecting oscillator timing resistor
3	S.C.P	—	Pin for connection the time constant setting capacitor for short-circuit protection
4	GND	Ground	Grounding pin
5	OUT	Output	Open collector type output pin
6	V_{CC}	Power supply	Power supply voltage application pin
7	V_{REF}	Output	Reference voltage output pin
8	IN+	Input	Error amplifier non-inverted input pin
9	IN–	Input	Error amplifier inverted input pin
10	FB	Output	Output pin of error amplifier

■ Absolute Maximum Ratings

A No.	Parameter	Symbol	Rating	Unit	Notes
1	Supply voltage	V_{CC}	35	V	*1
2	Supply current	I_{CC}	—	mA	—
3	Power dissipation	P_D	115	mW	*2
4	Operating ambient temperature	T_{opr}	−30 to +85	°C	*3
5	Storage temperature	T_{stg}	−55 to +150	°C	*3
6	IN− pin allowable application voltage	V_{IN-}	− 0.3 to V_{REF}	V	—
7	IN+ pin allowable application voltage	V_{IN+}	− 0.3 to V_{REF}	V	—
8	Output pin allowable application voltage	V_{OUT}	35	V	—
9	Collector output current	I_{OUT}	100	mA	—

Notes) *1 : The values under the condition not exceeding the above absolute maximum ratings and the power dissipation.

*2 : The power dissipation shown is the value at T_a = 85°C for the independent (unmounted) IC package.
When using this IC, refer to the P_D-T_a diagram of the package standard page 4 and use under the condition not exceeding the allowable value.

*3 : Except for the power dissipation, operating ambient temperature, and storage temperature, all ratings are for T_a = 25°C.

■ Operating supply voltage range

Parameter	Symbol	Range	Unit	Notes
Supply voltage range	V_{CC}	3.6 to 34	V	*

Note) *: The values under the condition not exceeding the above absolute maximum ratings and the power dissipation.

■ Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit	Notes
Error amplifier input voltage	V_{IN}	− 0.1	0.8	V	*
Collector output voltage	V_{OUT}	—	34	V	*
Collector output current	I_{OUT}	—	50	mA	*
Timing capacitance	C_T	100	27 000	pF	*
Timing resistance	R_T	5.6	15	kΩ	*
Oscillation frequency	f_{OUT}	2	500	kHz	*
Reference voltage output current	I_{REF}	−3	0	mA	*
Time constant setting capacitance for soft start short-circuit protection	C_{SCP}	1 000	—	pF	*

Note) *: Do not apply current or voltage from external source to any pin not listed above.
In the circuit current, (+) means the current flowing into IC and (−) means the current flowing out of IC.

■ Electrical Characteristics at V_{CC} = 12 V, R_T = 15 kΩ, C_T = 200 pF

Note) T_a = 25°C±2°C unless otherwise specified.

B No.	Parameter	Symbol	Test circuits	Conditions	Limits			Unit	Notes
					Min	Typ	Max		
Reference Voltage Block									
1	Reference voltage	V_{REF}	1	I_{REF} = –1 mA	2.386	2.46	2.534	V	
2	Input regulation with input fluctuation	Line	1	V_{CC} = 3.6 to 34 V I_{REF} = –1 mA	—	5	20	mV	
3	Load regulation	Load	1	I_{REF} = – 0.1 to –1 mA	—	2	10	mV	
U.V.L.O. Block									
4	Circuit operation start voltage	V_{UON}	2	—	2.8	3.1	3.4	V	
5	Hysteresis width	V_{HYS}	2	—	100	200	300	mV	
Error Amplifier Block									
6	Input offset voltage	V_{IO}	3	—	–6	—	6	mV	
7	Input bias current	I_B	3	—	–500	–25	—	nA	
8	Common-mode input voltage range	V_{ICR}	3	—	– 0.1	—	0.8	V	
9	High-level output voltage	V_{EH}	4	—	V_{REF} – 0.3	V_{REF} – 0.1	—	V	
10	Low-level output voltage	V_{EL}	4	—	—	0.1	0.3	V	
Output Block									
11	Oscillation frequency	f_{OUT}	5	R_T = 15 kΩ, C_T = 200 pF	175	195	215	kHz	
12	Maximum duty ratio	D_{MAX}	5	R_T = 15 kΩ, C_T = 200 pF	85	90	95	%	
13	Output saturation voltage	V_{OL}	5	I_O = 50 mA, R_T = 15 kΩ	—	0.9	1.2	V	
14	Output leak current	I_{LEAK}	5	V_{CC} = 34 V, when output transistor is off	—	—	10	μA	
Short-circuit Protection Circuit Block									
15	Input threshold voltage	V_{THPC}	6	—	1.73	1.83	1.93	V	
16	Input standby voltage	V_{STBY}	6	—	1.15	1.25	1.35	V	
17	Input latch voltage	V_{IN}	6	—	—	30	120	mV	
18	Charge current	I_{CHG}	6	V_{SCP} = 0 V	–1.32	–1.1	– 0.88	μA	
Whole Device									
19	Total consumption current	I_{CC}	1	R_T = 15 kΩ	—	1.8	2.8	mA	

■ Electrical Characteristics (Reference values for design) at V_{CC} = 12 V, R_T = 15 kΩ, C_T = 200 pF

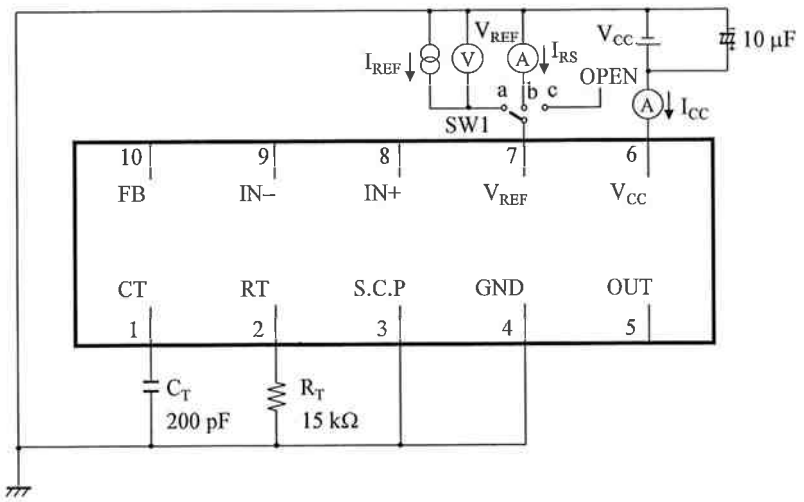
Note) T_a = 25°C±2°C unless otherwise specified.

B No.	Parameter	Symbol	Test circuits	Conditions	Reference values			Unit	Notes
					Min	Typ	Max		
Reference Voltage Block									
20	Input regulation with input fluctuation 2	L_{INE2}	1	V_{CC} = 3.6 V to 20 V	—	10 (max)	—	mV	*1
21	Output voltage temperature characteristics 1	V_{TC1}	1	Ta = –30 to 25°C	—	±0.5	—	%	*1
22	Output voltage temperature characteristics 2	V_{TC2}	1	Ta = 25 to 85°C	—	±0.5	—	%	*1
23	Reference short-circuit current	I_{RS}	1	—	—	–20	—	mA	*1
Error Amplifier Block									
24	Output sink current	I_{SINK}	4	V_{FB} = 0.8 V	—	8	—	mA	*1
25	Output source current	I_{SOURCE}	4	V_{FB} = 0.8 V	—	–120	—	μA	*1
26	Open-loop gain	A_V	4	—	—	70	—	dB	*1
27	Common-mode ripple rejection ratio	CMRR	3	—	—	50	—	dB	*1
Output Block									
28	RT pin voltage	V_{RT}	5	—	—	0.5	—	V	*1
29	Maximum oscillation frequency	$f_{OUT(MAX)}$	5	R_T = 5.6 kΩ, C_T = 150 pF	—	500	—	kHz	*1
30	Frequency supply voltage characteristics	f_{dV}	5	f_{OUT} = 200 kHz, V_{CC} = 3.6 V to 34 V	—	±2	—	%	*1
31	Frequency temperature characteristics 1	$f_{dT}1$	5	f_{OUT} = 200 kHz , Ta = –30 to 25°C	—	±3	—	%	*1
32	Frequency temperature characteristics 2	$f_{dT}2$	5	f_{OUT} = 200 kHz , Ta = 25 to 85°C	—	±3	—	%	*1
Short-circuit Protection Circuit Block									
33	Comparator threshold voltage	V_{THL}	6	—	—	1.83	—	V	*1
Whole Device									
34	Total consumption current 2	$I_{CC}2$	1	R_T = 5.6 kΩ, C_T = 150 pF	—	2.5	—	mA	*1

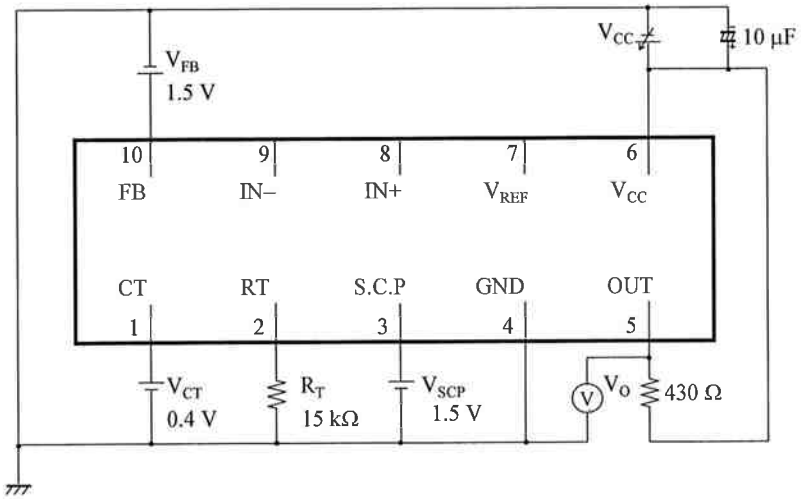
Note) *1: The above characteristics are reference values for design of the IC and are not guaranteed by inspection.
If a problem does occur related to these characteristics, Matsushita will respond in good faith to user concerns.

■ Test Circuit Diagram

1. Test Circuit 1

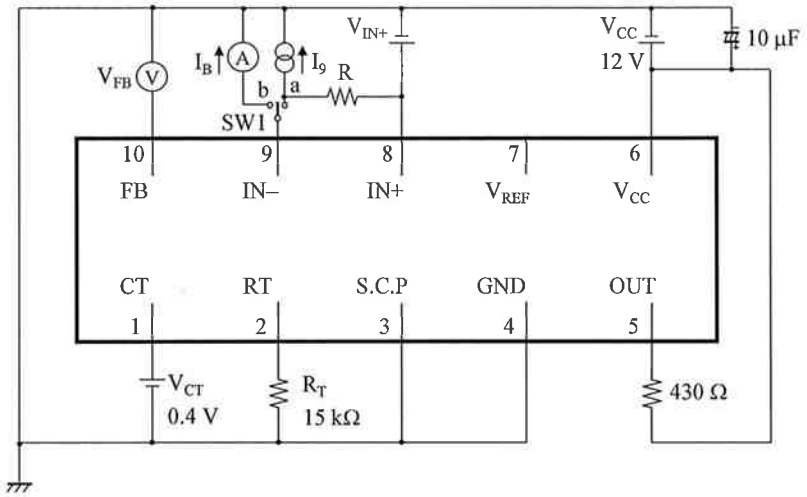


2. Test Circuit 2

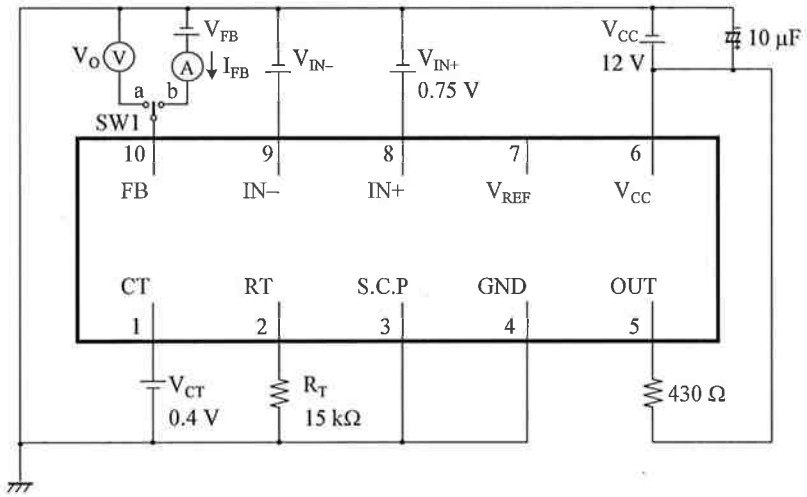


■ Test Circuit Diagram (continued)

3. Test Circuit 3

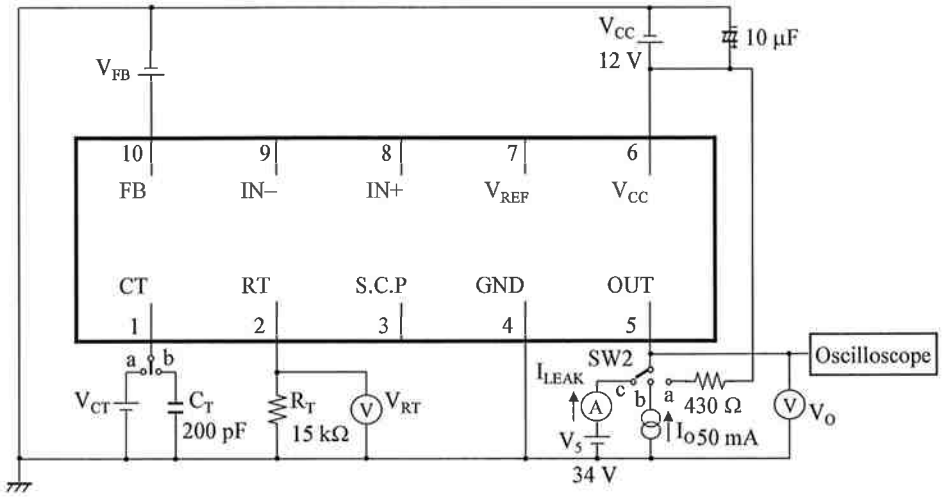


4. Test Circuit 4

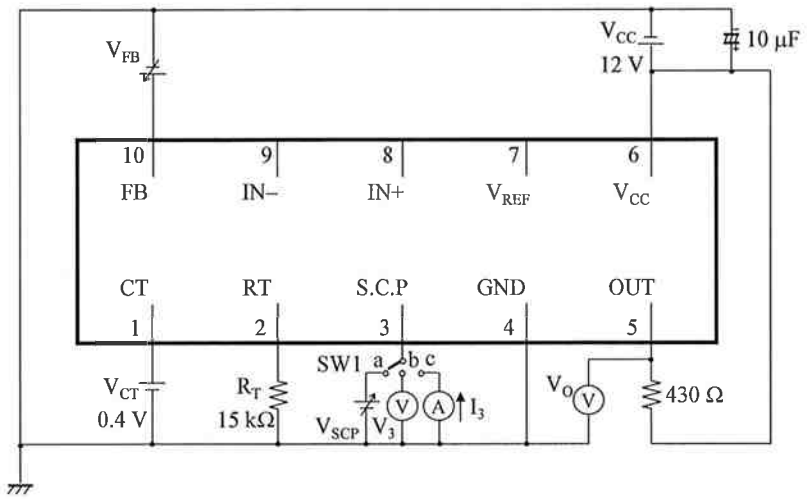


■ Test Circuit Diagram (continued)

5. Test Circuit 5



6. Test Circuit 6

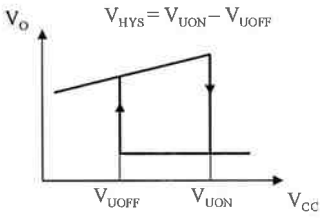


■ Electrical Characteristics Test Procedures

1. Test Circuit1

C No.	Parameter	Conditions	Measuring Method
1	Reference voltage	SW1 = a, V_{CC} = 12 V, I_{REF} = –1 mA	Measure the voltage of V_{REF}.
2	Input regulation with input fluctuation	SW1 = a, V_{CC} = 3.6 V → 34 V, I_{REF} = 0 A	Check the regulation of V_{REF}.
3	Load regulation	SW1 = a, V_{CC} = 12 V, I_{REF} = – 0.1 mA → –1 mA	Check the regulation of V_{REF}.
19	Total consumption current	SW1 = c, V_{CC} = 12 V, RT = 15 kΩ	Measure the current of I_{CC}.
23	Reference short-circuit current	SW1 = b, V_{CC} = 12 V	Measure the current of I_{RS}.

2. Test Circuit2

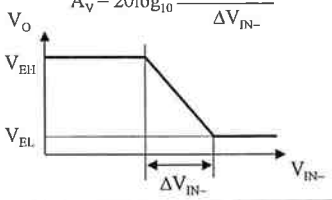
C No.	Parameter	Conditions	Measuring Method
4	Circuit operation start voltage	V_{CT} = 0.4 V, V_{SCP} = 1.5 V, V_{FB} = 1.5 V	Measure the V_{CC} voltage when the V_O changes from High to Low level while increasing the V_{CC} voltage gradually.
5	Hysteresis width	V_{CT} = 0.4 V, V_{SCP} = 1.5 V, V_{FB} = 1.5 V	

3. Test Circuit3

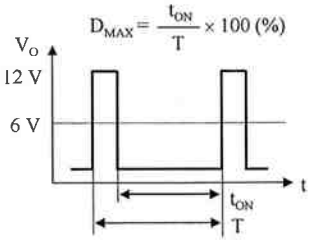
C No.	Parameter	Conditions	Measuring Method
6	Input offset voltage	SW1 = a, V_{CC} = 12 V, V_{IN+} = 0.75 V, V_{CT} = 0.4 V	Measure the I_9 current when the V_{FB} changes while increasing the I_9 current gradually, calculate $V_{IO} = R \times I_9$.
8	Common-mode input voltage range	SW1 = a, V_{CC} = 12 V, V_{CT} = 0.4 V	Check the V_{FB} voltage when V_{IN+} = – 0.1 V or 0.8 V, while changes the I_9 current gradually.
27	Common-mode ripple rejection ratio	SW1 = a, V_{CC} = 12 V, V_{CT} = 0.4 V	Measure the difference of ΔV_{IO} when V_{IN+} = – 0.1 V or 0.8 V, and calculate from the following formula. $CMRR = 20\log_{10}\frac{0.9}{\Delta V_{IO}}$
7	Input bias current	SW1 = b, V_{CC} = 12 V, V_{IN+} = 0.75 V, V_{CT} = 0.4 V	Measure the current of I_B.

■ Electrical Characteristics Test Procedures (continued)

4. Test Circuit4

C No.	Parameter	Conditions	Measuring Method
9	High-level output voltage	SW1 = a, V_{CC} = 12 V, V_{CT} = 0.4 V, V_{IN+} = 0.75 V, V_{IN-} = 0.7 V	Measure the voltage of V_O.
10	Low-level output voltage	SW1 = a, V_{CC} = 12 V, V_{CT} = 0.4 V, V_{IN+} = 0.75 V, V_{IN-} = 0.8 V	Measure the voltage of V_O.
24	Output sink current	SW1 = b, V_{CC} = 12 V, V_{CT} = 0.4 V, V_{IN+} = 0.75 V, V_{IN-} = 0.8 V, V_{FB} = 0.8 V	Measure the current of I_{FB}.
25	Output source current	SW1 = b, V_{CC} = 12 V, V_{CT} = 0.4 V, V_{IN+} = 0.75 V, V_{IN-} = 0.7 V, V_{FB} = 0.8 V	Measure the current of I_{FB}.
26	Open-loop gain	SW1 = a, V_{CC} = 12 V, V_{CT} = 0.4 V	$A_V = 20\log_{10}\frac{V_{EH} - V_{EL}}{\Delta V_{IN-}}$ 

5. Test Circuit5

C No.	Parameter	Conditions	Measuring Method
11	Oscillation frequency	SW1 = b, SW2 = a, V_{CC} = 12 V, V_{FB} = 1.5 V	Oscilloscope waveform $f_{OUT} = \frac{1}{T}$ Hz
12	Maximum duty ratio	SW1 = b, SW2 = a, V_{CC} = 12 V, V_{FB} = 1.5 V	$D_{MAX} = \frac{t_{ON}}{T} \times 100\ (\%)$ 
13	Output saturation voltage	SW1 = a, SW2 = b, V_{CC} = 12 V, V_{FB} = 0.5 V, V_{CT} = 0.4 V, I_O = 50 mA	Measure the voltage of V_O.
14	Output leak current	SW1 = a, SW2 = c, V_{CC} = 12 V, V_{FB} = 0.3 V, V_{CT} = 0.4 V, V_5 = 34 V	Measure the current of I_{LEAK}.
28	RT pin voltage	SW1 = b, SW2 = a, V_{CC} = 12 V, V_{FB} = 1.5 V	Measure the voltage of V_{RT}.