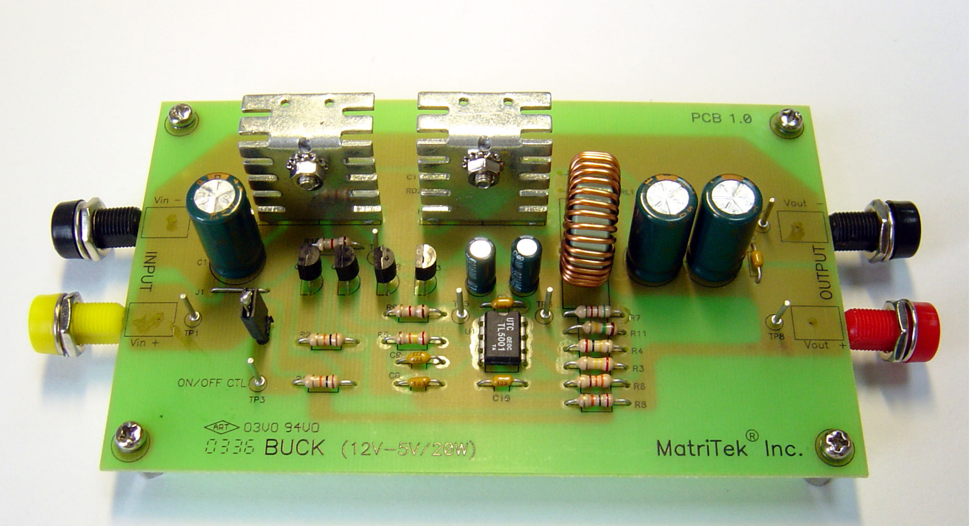
NTHU EE677000

科目：BUCK Switching Regulator 實作



BUCK CONVERTER

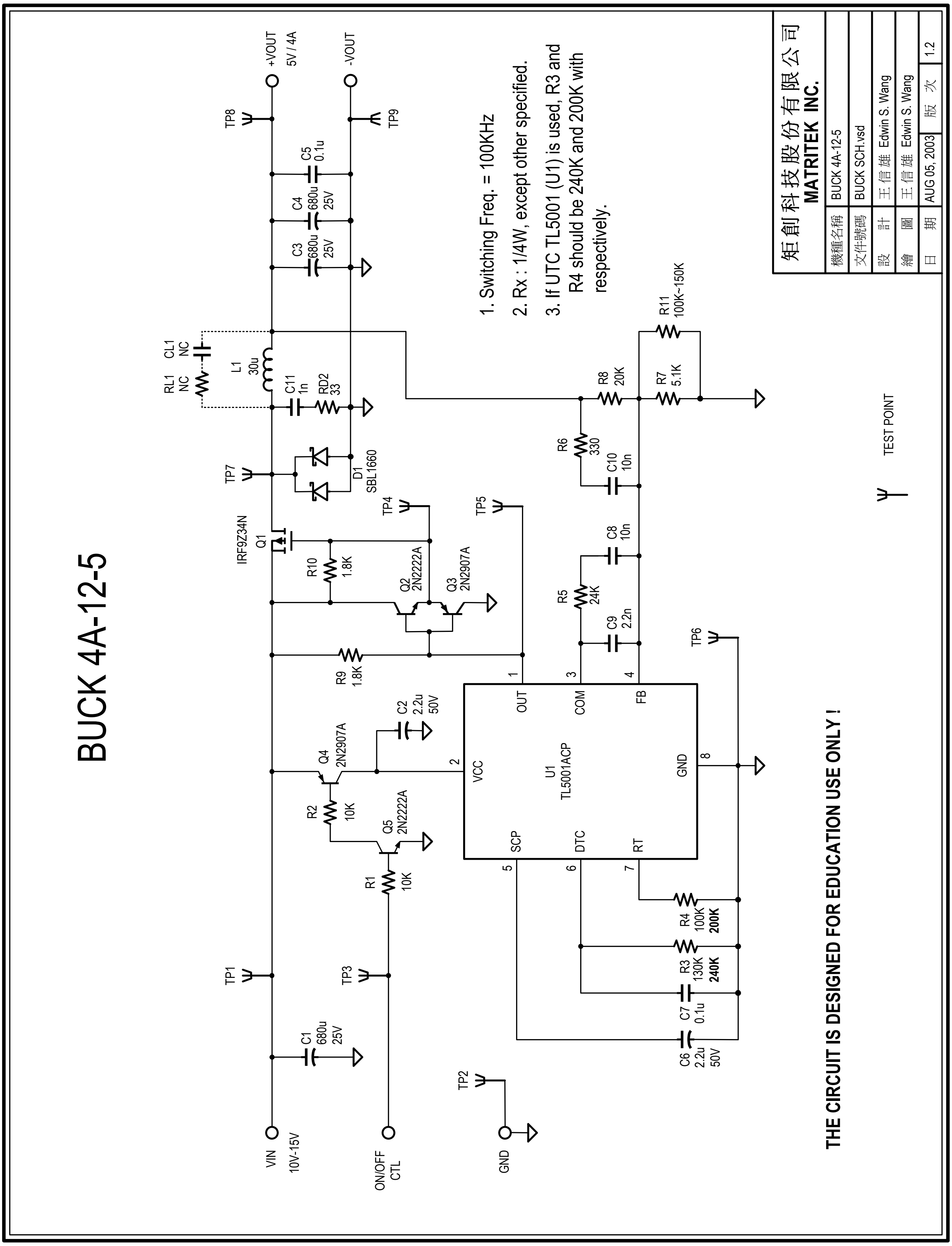
1. 材料元器件一套
2. 簡易規格
3. 電路圖 BUCK SCH
4. 磁性元件繞製圖
5. 印刷電路板圖面
6. 材料表
7. 組裝步驟與注意事項
8. 參考資料
9. 評估與量測

Model Name : BUCK 4A-12-5

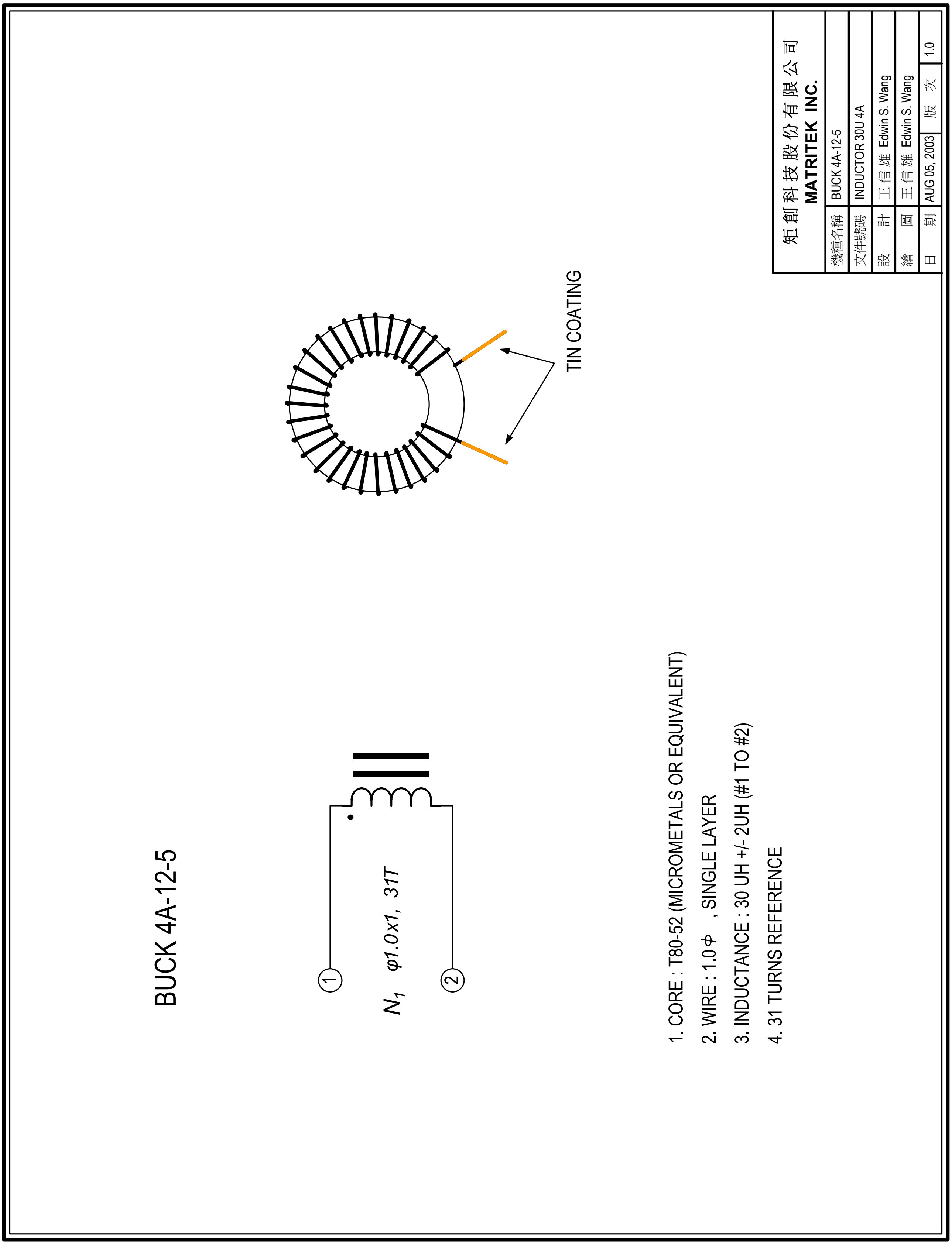
【GENERAL SPECIFICATION】

• INPUT VOLTAGE	8 VDC TO 12VDC
• OUTPUT VOLATGE	5VDC
• OUTPUT CURRENT	0.1 A TO 4A
• OUTPUT RIPPLE VOLTAGE	50mV
• LOAD REGULATION	+/- 1%
• LINE REGULATION	+/- 1%
• TRANSIENT RESPONSE @ 2A TO 4A, 0.1A/uS	
OVERSHOOT / UNDERSHOOT	200mV
SETTLING TIME	500Us
• START UP	
RISE TIME	100 mS
OVERSHORT	250 mV
DELAY TIME	0.5 mS
• SHORT-CIRCUIT PROTECTION	LATCHED
• EFFICIENCY	> 85% @ I/P : 10V , O/P : 4A
• REMOTE CONTROL	HIGH ACTIVE

【SCHEMATICS】

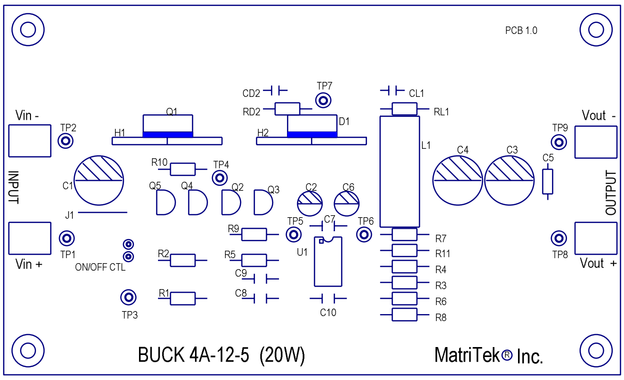

BUCK 4A-12-5
1. Switching Freq. = 100KHz
2. Rx : 1/4W, except other specified.
3. If UTC TL5001 (U1) is used, R3 and R4 should be 240K and 200K with respectively.
THE CIRCUIT IS DESIGNED FOR EDUCATION USE ONLY !
TEST POINT
+VOUT 5V / 4A
-VOUT
VIN 10V-15V
ON/OFF CTL
GND
TP1
TP2
TP3
TP4
TP5
TP6
TP7
TP8
TP9
C1 680u 25V
C2 2.2u 50V
C3 680u 25V
C4 680u 25V
C5 0.1u
C6 2.2u 50V
C7 0.1u
C8 10n
C9 2.2n
C10 10n
C11 1n
CL1 NC
RL1 NC
RD2 33
L1 30u
D1 SBL1660
Q1 IRF9Z34N
Q2 2N2222A
Q3 2N2907A
Q4 2N2907A
Q5 2N2222A
R1 10K
R2 10K
R3 130K 240K
R4 100K 200K
R5 24K
R6 330
R7 5.1K
R8 20K
R9 1.8K
R10 1.8K
R11 100K~150K
U1 TL5001ACP
OUT
COM
FB
VCC
GND
SCP
DTC
RT
矩創科技股份有限公司
MATRITEK INC.
機種名稱 BUCK 4A-12-5
文件號碼 BUCK SCH.vsd
設 計 王信雄 Edwin S. Wang
繪 圖 王信雄 Edwin S. Wang
日 期 AUG 05, 2003
版 次 1.2

【INDUCTOR】



矩創科技股份有限公司
MATRITEK INC.
機種名稱 BUCK 4A-12-5
文件號碼 INDUCTOR 30U 4A
設 計 王信雄 Edwin S. Wang
繪 圖 王信雄 Edwin S. Wang
日 期 AUG 05, 2003
版 次 1.0
TIN COATING
BUCK 4A-12-5
1
2
N1 φ1.0x1, 31T
1. CORE : T80-52 (MICROMETALS OR EQUIVALENT)
2. WIRE : 1.0Φ , SINGLE LAYER
3. INDUCTANCE : 30 UH +/- 2UH (#1 TO #2)
4. 31 TURNS REFERENCE

【PCB 文字面】


PCB 1.0
Vin -
INPUT
Vin +
TP2
TP1
TP3
TP4
TP5
TP6
TP7
TP8
TP9
ON/OFF CTL
Q1
H1
H2
D1
CD2
RD2
CL1
RL1
L1
R10
C1
J1
Q5
Q4
Q2
Q3
C2
C6
C7
U1
R9
R2
R5
R1
C9
C8
C10
C4
C3
C5
R7
R11
R4
R3
R6
R8
Vout -
OUTPUT
Vout +
BUCK 4A-12-5 (20W)
MatriTek® Inc.

【BUCK 4A-12-5 PART LIST】

項次	PCB 位置	規格說明	數 量
1	R1	RES 10K +/-1% 1/4W	1
2	R2	RES 10K +/-1% 1/4W	1
3	R3	RES 240K +/-1% 1/4W	1
4	R4	RES 200K +/-1% 1/4W	1
5	R5	RES 24K +/-1% 1/4W	1
6	R6	RES 330 +/-1% 1/4W	1
7	R7	RES 5K1 +/-1% 1/4W	1
8	R8	RES 20K +/-1% 1/4W	1
9	R9	RES 1K8 +/-1% 1/4W	1
10	R10	RES 1K8 +/-1% 1/4W	1
11	R11	RES 150K +/-1% 1/4W	1
12	RD2	RES 33 +/-1% 1/4W	1
13	RL1	RES NC +/-1% 1/4W	0
14	C1	EC 680U 25V 10X20	1
15	C2	EC 2U2 50V 6X11	1
16	C3	EC 680U 25V 10X20	1
17	C4	EC 680U 25V 10X20	1
18	C5	MLCC 104 50V	1
19	C6	EC 2U2 50V 6X11	1
20	C7	MLCC 104 50V	1
21	C8	MLCC 103 50V	1
22	C9	MLCC 222 50V	1
23	C10	MLCC 103 50V	1
24	C11	MLCC 102 50V	1
25	CL1	MLCC NC 50V	0
26	L1	CHOKE 30U 4A T80-52	1
27	Q1	PMOS IRF9Z34N 55V/19A	1
28	Q2	XTOR NPN 2N2222A	1
29	Q3	XTOR PNP 2N2907A	1
30	Q4	XTOR PNP 2N2907A	1
31	Q5	XTOR NPN 2N2222A	1
32	D1	SBD SBL1660 60V/16A TO220	1
33	U1	IC PWM CONTROLLER TL5001ACP	1
34	H1,H2	HEATSINK 20X30X1	2
35	SCREW	SCREW PAN HEAD M3X7	2
36	NUT	NUT M3	6
37		INSULATOR TO-220	2
38		INSULATOR SILICON TO-220	2
39	TP1~9	TEST PIN 0.8D 10mm	9
40	IN/OUT	POWER CONNECTOR	4
42		COPPER STAND	4
41	PCB	PCB 3X5 BUCK 4A-12-5	1

【BUCK 4A-12-5 組裝步驟與注意事項】

- 組裝工具
  (1) 溫控電烙鐵 30W，圓尖頭
  (2) 焊錫絲 0.6Φ ~ 1.0Φ
  (3) 梅花起子
  (4) 尖嘴鉗
  (6) 斜口鉗

- 量測設備
  (1) 直流電源 60V / 3A
  (2) 電子負載 60V / 60A / 300W (DYNAMIC FUNCTION)
  (3) 100MHZ 以上數位儲存式示波器 DSO (可 HARDCOPY 畫面)
  (4) 100KHZ 以上 LCR METER
  (5) DIGITAL MULTIMETER
  (6) 電流探棒 CURRENT PROBE (OPTIONAL)
  (7) GAIN-PHASE ANALYZER (OPTIONAL)

- 組裝一般注意事項
  (1) 對照料表，清點材料。必要時可用 RLC METER 確認電感、電容與電阻值。
  (2) 階層式組立步驟：先將獨立單元組立 (如功率半導體與散熱片組合)，再依零件高低由低而高依次焊錫固定。
  (3) 焊錫作業注意"三點同溫"原則，避免空焊、冷焊發生，也避免零件(特別是 IC)過熱損壞。

- 組裝步驟

  (1) 組立 MOSFET Q1 與 SBD D1 與散熱片。注意絕緣片與絕緣粒子。
  (2) 找一根零件腳當跳線 J1，並焊接於 PCB 上。
  (3) 將次高的零件，六顆積層陶瓷電容(MLCC)，焊於 PCB 上。
  (4) 其次是 1/4W 的電阻，共 12 顆。
  (5) 接著焊 IC (U1)，注意 IC 腳位標示。
  (6) 焊接九支 TEST PIN。
  (7) 接著是 Q2 ~ Q5。
  (8) 依序將所有電解電容、電感焊上。
  (9) 再來是帶散熱片的 Q1 與 D1 組合。
  (10) 檢查零件是否已完全裝在 PCB 上。
  (11) 接著焊輸入與輸出的 PIN (或 CONNECTOR)
  (12) 最後將銅柱鎖定，完成 PCB 作業。

【評估與量測】

注意： (1) 輸入電源供應器的最大輸出電流須設定在 3A。

(2) 仔細查看電路圖，明確瞭解 TEST PIN 是哪一點。

(3) 確定 ON/OFF REMOTE CONTROL 在 “ENABLE” (HIGH)

(4) 輸入端與輸出端要確認再開機。

1. CONVERSION EFFICIENCY
2. LOAD REGULATION
3. LINE REGULATION
4. OUTPUT RIPPLE & NOISE (PIN 8 TO PIN 9) (DSO)
5. DYNAMIC RESPONSE (PIN 8 TO PIN 9) (DSO)
6. DUTY CONTROL SIGNAL (PIN 4 TO PIN 6) AND DIODE VOLTAGE (PIN 7 TO PIN 9) (DSO)
7. REMOTE CONTROL (PIN 3 TO PIN 2) (DSO)
8. START-UP (PIN 8 TO PIN 9) (DSO)
9. INDUCTOR CURRENT (OPTIONAL) (DSO + CURRENT PROBE)
10. GAIN / PHASE MARGIN (OPTIONAL) (GAIN-PHASE ANALYZER)

靜態測試記錄

輸入電壓 = 8V

輸出電流	0.5A	1A	1.5A	2A	2.5A	3A	3.5A	4A
V_O								
I_{IN}								

輸入電壓 = 10V

輸出電流	0.5A	1A	1.5A	2A	2.5A	3A	3.5A	4A
V_O								
I_{IN}								

輸入電壓 = 12V

輸出電流	0.5A	1A	1.5A	2A	2.5A	3A	3.5A	4A
V_O								
I_{IN}								

注意：

(1) 輸入電壓讀值：用 DMM 量 PIN 1 TO PIN 2；輸入電流讀值：可直接於電源供應器表頭讀取；輸出電壓讀值：用 DMM 量 PIN 8 TO PIN 9；輸出電流讀值：可直接於電子負載表頭讀取。

1. CONVERSION EFFICIENCY

用量取的資料，計算出效率，並以 EXCEL 作圖。($\eta = \dfrac{V_O \cdot I_O}{V_{IN} \cdot I_{IN}}$)

2. LOAD REGULATION

定義：$Load\ Regulation = \left| \dfrac{V_{O,min\,load} - V_{O,full\,load}}{V_{O,min\,load}} \right| \times 100\%$ @ specified input voltage

用量取的資料，分別計算在三種輸入電壓下的負載穩壓率。

3. LINE REGULATION

定義：$$Line\ Regulation = \left| \frac{V_{O,min\ input} - V_{O,max\ input}}{V_{O,min\ input}} \right| \times 100\% \quad \text{@ specified load}$$

用量取的資料，分別計算在輸出電流爲 0.5A, 2A, 4A 條件下下的線電壓穩壓率。

4. OUTPUT RIPPLE AND NOISE

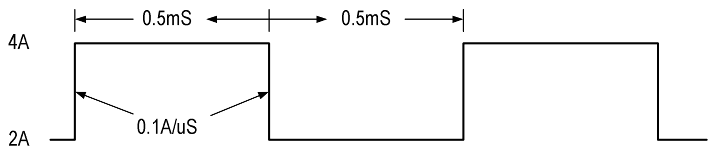
條件：輸出滿載 (4A)

輸入電壓 = 8V, 10V, 12V

觀察記錄：用數位示波器觀察輸出電壓(AC Coupling)，並將波形記錄存檔。注意量測技巧，以免探棒耦合雜訊。

5. DYNAMIC RESPONSE

條件：負載設定



輸入電壓 = 8V, 10V, 12V

觀察記錄：用數位示波器觀察輸出電壓動態響應(AC Coupling)，並將波形記錄存檔。注意量測技巧，以免探棒耦合雜訊。

6. DUTY CONTROL 信號與 DIODE VOLTAGE

條件：負載設定 = 0.1A, Boundary Current, 2A, 4A

輸入電壓 = 10V

觀察記錄：用數位示波器觀察 pin 4 與 pin 7 的電壓，並將波形記錄存檔。其中緩慢整

電子負載，使達到 CCM/DCM 界線。觀查重點：DUTY 與負載變化的關係。

7. REMOTE CONTROL

電路設計了一個 Remote Control 的功能，當 pin 3 (對 pin 6) 電壓爲"HIGH" (短路)時，控制 IC 才能動作，當 pin 3 (對 pin 6)爲"LOW" (或開路)時，控制 IC 無法動作，也就沒有輸出了。

可以接一個很小的單刀單擲開關，連接 ON/OFF CONTROL 與輸入電壓，觀察 ON/OFF CONTROL 對輸出的影響，包括延遲時間。

8. START-UP

觀察從輸入電壓灌入到輸出電壓穩定的現象。DUAL CHANNEL 量輸入與輸出電壓，以及 SOFT START 功能。

【參考資料】

(1) UTC TL5001 Data Sheet

(2) IRF9Z34N Data Sheet

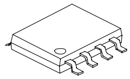
(3) SBL1660CT Data Sheet

(4) Aluminum Electrolytic Capacitor, SC-series Data Sheet

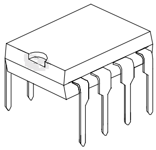
(5) Iron Powder Data Sheet

(6) Inductor Analysis T80-52 30U 4A

PULSE-WIDTH-MODULATION CONTROL CIRCUITS



SOP-8



DIP-8

DESCRIPTION

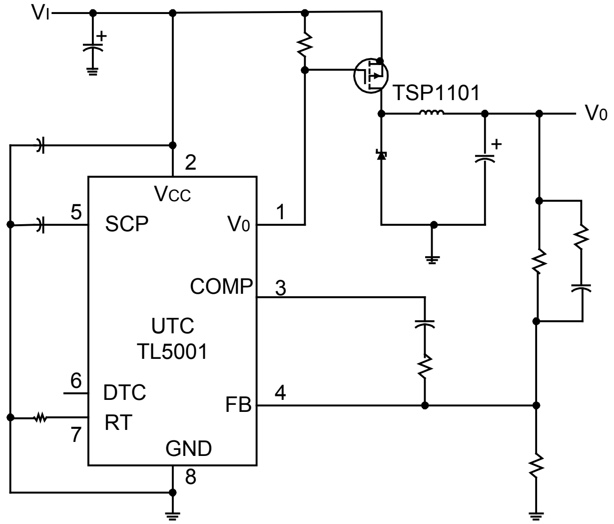
The UTC TL5001 incorporates on a single monolithic chip all the functions required for a pulse-width –modulation (PWM) control circuit. Designed primarily for power-supply control, It contains an error amplifier, a regulator, an oscillator, a PWM comparator with a dead-time-control input, undervoltage lockout (UVLO),short-circuit protection(SCP),and an open-collector output transistor.

The error-amplifier common-mode voltage ranges from 0V to 1.5V. The noninverting input of the error amplifier is connected to a 1-V reference. Dead-time control (DTC) can be set to provide 0% to 100% dead time by connecting an external resistor between DTC and GND. The oscillator frequency is set by terminating RT with an external resistor to GND. During low Vcc conditions, the UVLO circuit turns the output off until Vcc recovers to its normal operating range.

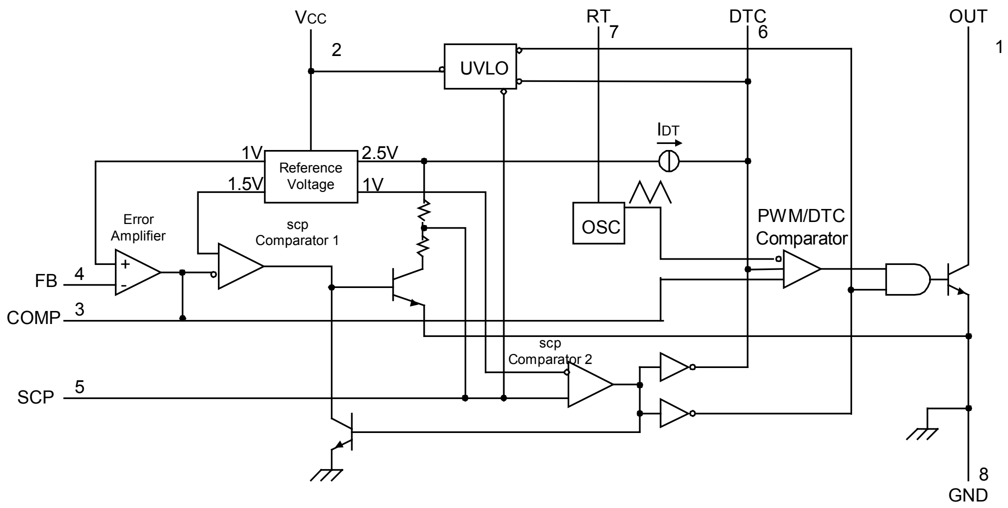
FEATURES

*Complete PWM power control
*3.6-V to 40-V Operation
*Internal Undervoltage-Lockout Circuit
*Internal Short-Circuit Protection
*Oscillator Frequency : 20kHz to 500kHz
*Variable Dead Timer Provides Control Over Total Range

SCHEMATIC FOR TYPICAL APPLICATION



FUNCTIONAL BLOCK DIAGRAM



DETAILED DESCRIPTION

VOLTAGE REFERENCE

A 2.5-V regulator operating from Vcc is used to power the internal circuitry of the TL5001 and as a reference for the error amplifier and SCP circuit. A resistive divider provides a 1-V reference for the error amplifier noninverting input which typically is within 2% of nominal over the operating temperature range.

ERROR AMPLIFIER

The error amplifier compares a sample of the dc-to-dc converter output voltage to the 1-V reference and generates an error signal for the PWM comparator. The dc-to-dc converter output voltage is set by selecting the error –amplifier gain(see Figure 1),using the following expression.

$$V_o=(1+R1/R2)\ (1V)$$

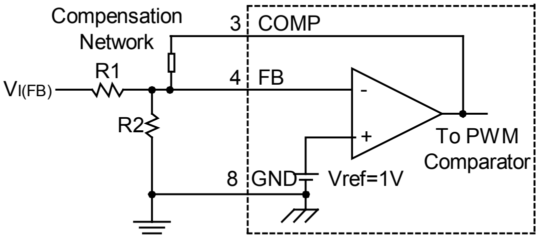


Figure 1.Error-Amplifier Gain Setting

The error-amplifier output is brought out as COMP for use in compensating the dc-to-dc converter control loop for stability. Because the amplifier can only source 45 μA,the total dc load resistance should be 100kΩ or more.

OSCILLATOR/PWM

The oscillator frequency (fosc) can be set between 20kHz and 500kHz by connecting a resistor between RT and GND .Acceptable resistor values range from 15 kΩ to 250 kΩ The oscillator frequency can be determined by using the graph shown in Figure 5.

The oscillator output is a triangular wave with a minimum value of approximately 0.7V and a maximum value of approximately 1.3V. The PWM comparator compares the error-amplifier output voltage and the DTC input voltage to the triangular wave and turns the output transistor off whenever the triangular wave is greater than the lesser of the two inputs.

DEAD TIME CONTORL (DTC)

DTC provides a means of limiting the output –switch duty cycle to a value less than 100%, which is critical for boost and flyback converters. A current source generates a reference current (I_{DT}) at DTC that is nominally equal to the current at the oscillator timing terminal, RT. Connecting a resistor between DTC and GND generates a dead-time reference voltage (V_{DT}), which the PWM/DTC comparator compares to the oscillator triangle wave as described in the previous section. Nominally, the maximum duty cycle is 0% when V_{DT} is 0.7V or less and 100% when V_{DT} is 1.3V or greater. Because the triangle wave amplitude is a function of frequency and the source impedance of RT is relatively high(1250Ω),choosing R_{DT} for a specific maximum duty cycle, D, is accomplished using the following equation and the voltage limits for the frequency in question as found in Figure 11(Voscmax and Voscmin are the maximum and minimum oscillator levels):

$$R_{DT}=(R_t+1250)[D(V_{osc\,max}-V_{osc\,min})+V_{osc\,min}]$$

Where

R_{DT} and Rt are in ohms,D in decimal

Soft start can be implemented by paralleling the DTC resistor with a capacitor (C_{DT}) as shown in Figure 2. During soft start, the voltage at DTC is derived by the following equation:

$$V_{DT} \approx I_{DT} R_{DT} (1 - e^{(-t/R_{DT}C_{DT})})$$

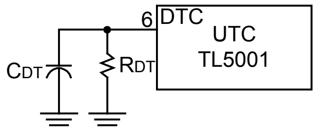


Figure 2. Soft- Start Circuit

If the dc-to-dc converter must be in regulation within a specified period of time, the time constant , $R_{DT}C_{DT}$, should be t0/3 to t0/5.The TL5001 remains off unit $V_{DT} \approx 0.7V$,the minimum ramp value. C_{DT} is discharged every time UVLO or SCP becomes active.

UNDERVOLTAGE-LOCKOUT (UVLO) PROTECTION

The undervoltage-lockout circuit turns the output transistor off and resets the SCP latch whenever the supply voltage drops too low (approximately 3V at 25℃) for proper operation. A hysteresis voltage of 200mV eliminates false triggering on noise and chattering.

SHORT-CIRCUIT PROTECTION (SCP)

The TL5001 includes short-circuit protection (see Figure 3),which turns the power switch off to prevent damage when the converter output is shorted. When activated, The SCP prevents the switch from being turned on until the internal latching circuit is reset. The circuit is reset by reducing the input voltage until UVLO becomes active or until the SCP terminal is pulled to ground externally.

When a short circuit occurs, the error-amplifier output at COMP rises to increase the power-switch duty cycle in an attempt to maintain the output voltage. SCP comparator 1 starts an RC timing circuit when COMP exceeds 1.5V.If the short is removed and the error-amplifier output drops below 1.5V before time out, normal converter operation continues. If the fault is still present at the end of the time-out period, the time sets the latching circuit and turns off the TL5001 output transistor.

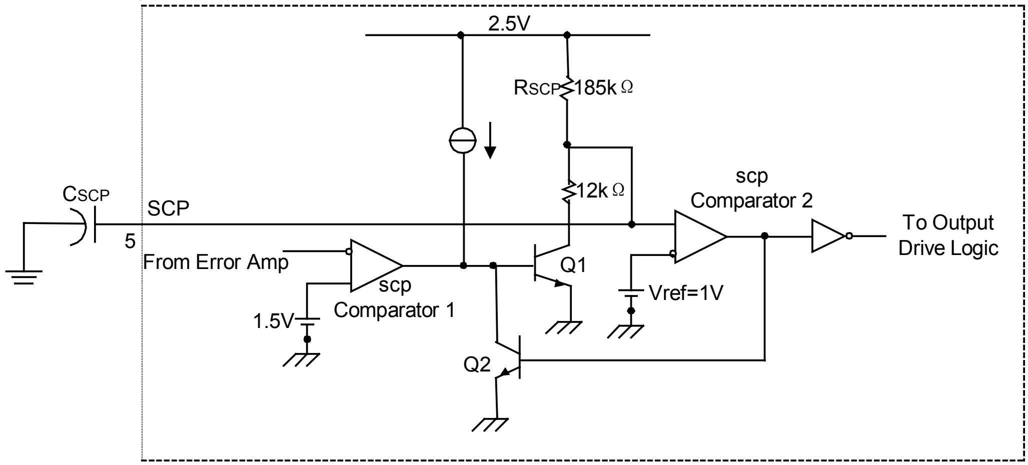


Figure 3.SCP Circuit

The timer operates by charging an external capacitor (Cscp),connected between the SCP terminal and ground, towards 2.5V through a 185kΩ resistor (Rscp).The circuit begins charging from an initial voltage of approximately 185mV and times out when capacitor voltage reaches 1V.The output of SCP comparator 2 then goes high, turns on Q2,and latches the timer circuit. The expression for setting the SCP time period is derived from the following equation:

$$V_{scp} = (2.5-0.185)(1-e^{-t/\tau})+0.185$$

Where

τ=RscpCscp

The end of the time-out period, tscp, occurs when Vscp=1V. Solving for Cscp yields:

Cscp=12.46*tscp

Where

t is in seconds,C in μF

tscp must be much longer (generally 10 to 15 times) than the converter start-up period or the converter will not start.

OUTPUT TRANSISTOR

The output of the TL5001 is an open-collector transistor with a maximum collector current rating of 21mA and a voltage rating of 51V.The output is turned on under the following conditions: the oscillator triangle wave is lower than both the DTC voltage and the error-amplifier output voltage, the UVLO circuit is inactive, and the short-circuit protection circuit is inactive.

ABSOLUTE MAXIMUM RATINGS OVER OPERATING FREE-AIR TEMPERATURE RANGE (unless otherwise noted)*

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage (note 1)	V_{CC}	41	V
Amplifier Input Voltage	$V_{I(FB)}$	20	V
Output Voltage	V_O	51	V
Output Current	I_O	21	mA
Output Peak Current	$I_{O(peak)}$	100	mA
Continuous Total Power Dissipation	See dissipation rating table		
Operating Ambient Temperature Range	T_A	-20 to 85	°C
Storage Temperature Range	T_{stg}	-65 to 150	°C
Lead Temperature 1.6mm(1/16 inch) from Case for 10 Seconds.	T_{case}	260	°C

Note 1: All voltage values are with respect to the network ground terminal.

*Stresses beyond those listed under" absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under" recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

DISSIPATION RATING TABLE

PACKAGE	$T_A \le 25°C$ POWER RATING	DERATING FACTOR ABOVE T_A=25°C	T_A=70°C POWER RATING	T_A=70°C POWER RATING	T_A=70°C POWER RATING
SOP-8	725mW	5.8mW/°C	464mW	377mW	145mW
DIP-8	1000mW	8.0mW/°C	640mW	520mW	200mW

RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN	MAX	UNIT
Supply Voltage	V_{CC}	3.6	40	V
Amplifier Input Voltage	$V_{I(FB)}$	0	1.5	V
Output Voltage	$V_{O,}$ OUT		50	V
Output Current	$I_{O,}$ OUT		20	mA
COMP Source Current			45	μA
COMP dc Load Resistance		100		kΩ
Oscillator Timing resistor	Rt	15	250	kΩ
Oscillator Frequency	fosc	20	500	kHz
Operating Ambient Temperature Range	T_A	-20	85	°C

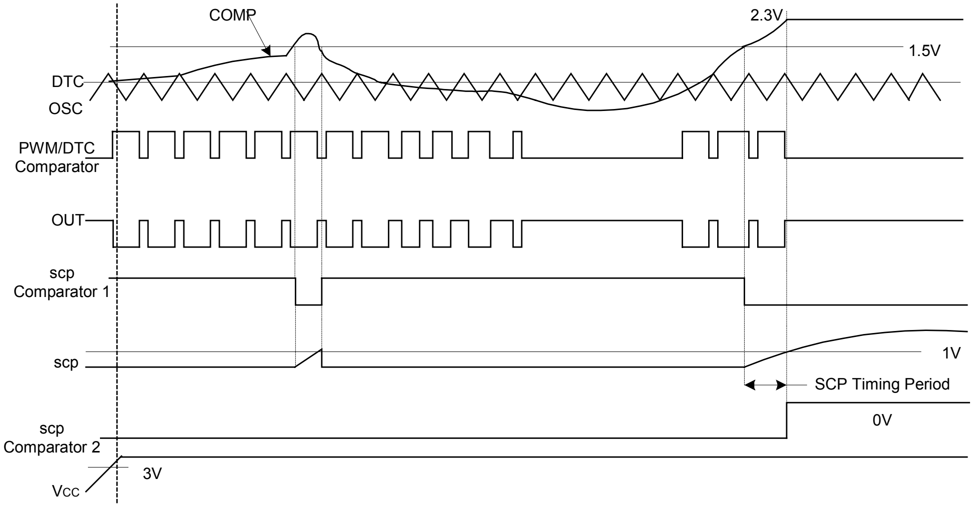
ELECTRICAL CHARACTERISTICS OVER RECOMMENDED OPERATING FREE-AIR TEMPERATURE RANGE (Vcc=6V, fosc=100kHz, all typical values at T_A=25°C, unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Reference					
Output Voltage	COMP Connected to FB	0.95	1	1.05	V
Input Regulation	Vcc=3.6V to 40V		2	12.5	mV
Output Voltage Change with Temperature	TA= -20°C to 25°C	-10	-1	10	mV/V
	TA= 25°C to 85°C	-10	2	10	
Undervoltage Lockout					
Upper Threshold Voltage	TA= 25°C		3		V
Lower Threshold Voltage	TA= 25°C		2.8		V
Hysteresis	TA= 25°C	100	200		mV
Reset Threshold Voltage	TA= 25°C	2.1	2.55		V
Short Circuit Protection					
SCP Threshold voltage	TA= 25°C	0.95	1.00	1.05	V
SCP Voltage, Latched	No pullup	140	185	230	mV
SCP voltage, UVLO Standby	No pullup		60	120	mV
Input Source Current	TA= 25°C	-10	-15	-20	μA
SCP Comparator 1 Threshold Voltage			1.5		V
Oscillator					
Frequency	Rt=100kΩ		100		kHz
Standard Deviation of Frequency			15		kHz
Frequency Change with Voltage	Vcc=3.6V to 40V		1		kHz
Frequency Change with Temperature	TA= -40°C to 25°C	-4	-0.4	4	kHz
	TA= -20°C to 25°C	-4	-0.4	4	kHz
	TA= 25°C to 85°C	-4	-0.2	4	kHz
Voltage at RT			1		V
Dead-time Control					
Output (source) Current	V(DT)=1.5V	0.9*IRT (NOTE)		1.1*IRT (NOTE)	μA
Input Threshold Voltage	Duty cycle=0%	0.5	0.7		V
	Duty cycle=100%		1.3	1.5	
Error Amplifier					
Input Voltage	Vcc=3.6V to 40V	0		1.5	V

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input Bias Current				-160	-500	nA
Output Voltage Swing	Positive		1.5	2.3		V
	Negative			0.3	0.4	V
Open-loop Voltage Amplification				80		dB
Unity-gain Bandwidth				1.5		MHz
Output (sink) Current		$V_{I(FB)}$=1.2V, COMP=1V	100	600		µA
Output (source) Current		$V_{I(FB)}$=0.8V, COMP=1V	-45	-70		µA
Output						
Output Saturation Voltage		Io=10mA		1.5	2	V
Off-state Current		Vo=50V,Vcc=0			10	µA
		Vo=50V			10	
Short-circuit Output Current		Vo=6V		40		mA
Total Device						
Standby Supply Current (Off state)				1	1.5	mA
Average Supply Current		Rt=100kΩ		1.4	2.1	mA

Note: Output source current at RT

PARAMETER MEASUREMENT INFORMATION



NOTE A:The waveforms show timing characteristics for an intermittent short circuit and a longer short circuit that is sufficient to activate SCP.

Figure 4. PWM Timing Diagram

TYPICAL CHARACTERISTICS

Figure 5 Oscillator Frequency vs Timing Resistance

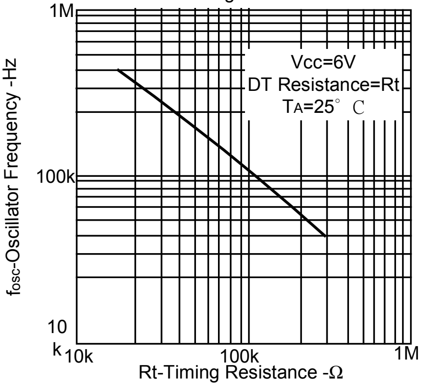


Figure 6 Oscillator Frequency vs Ambient Temperature

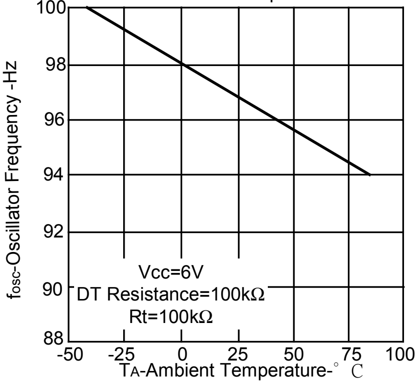


Figure 7 Reference Output Voltage vs Power -Supply Voltage

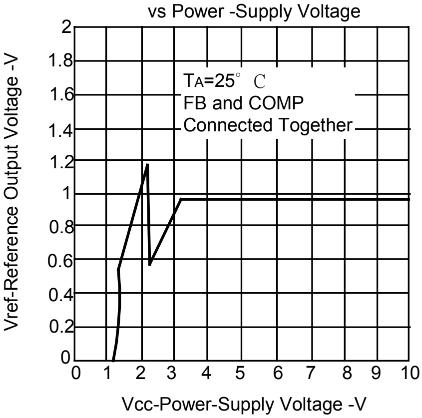


Figure 8 Reference Output Voltage Fluctuation vs Ambient Temperature

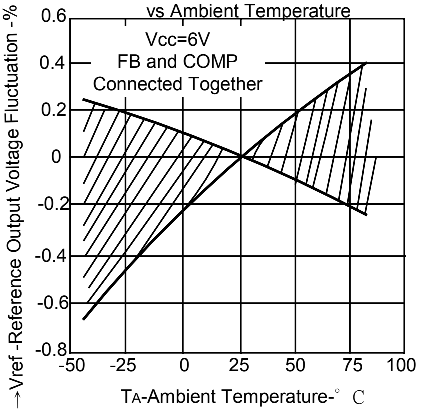


Figure 9 Average Supply Current vs Power -Supply Voltage

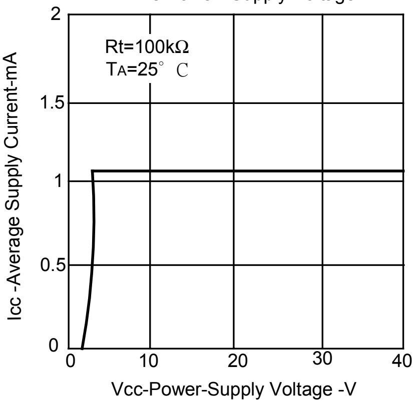


Figure 10 Average Supply Current vs Ambient Temperature

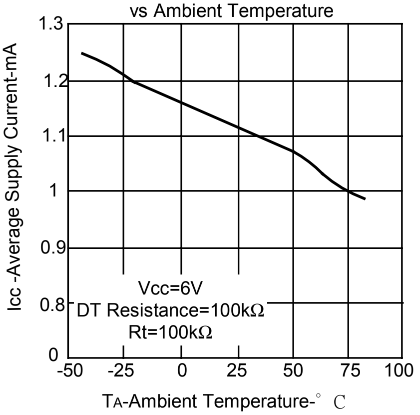


Figure 11 PWM Triangle Wave Amplitude Voltage vs Oscillator Frequency

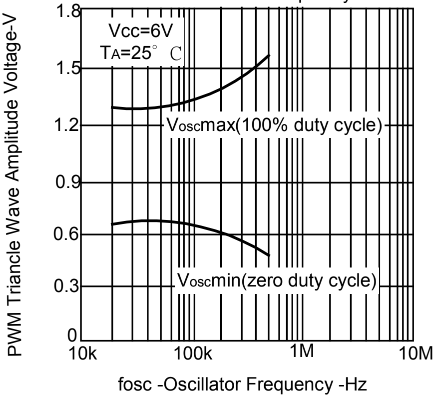


Figure 12 Error Amplifier Output Voltage vs Output(Sink)Current

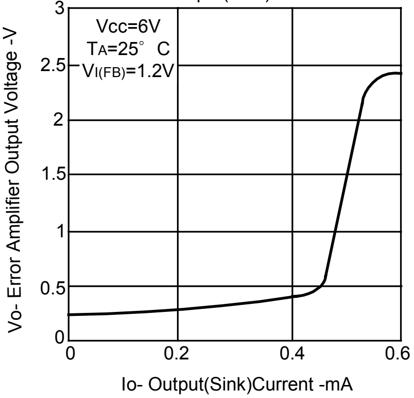


Figure 13 Error Amplifier Output Voltage vs Output(Source)Current

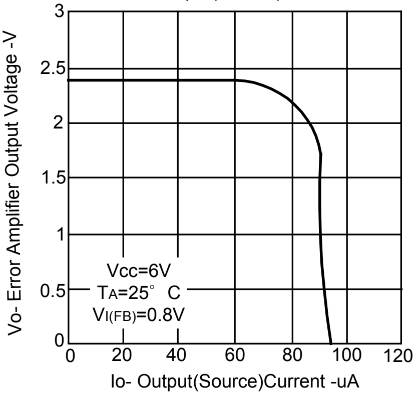


Figure 14 Error Amplifier Output Voltage vs Ambient Temperature

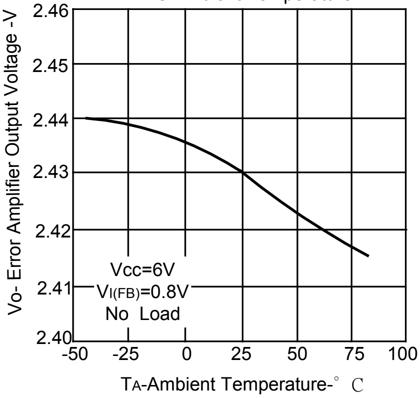


Figure 15 Error Amplifier Output Voltage vs Ambient Temperature

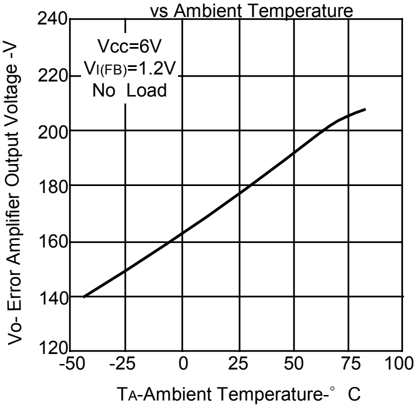
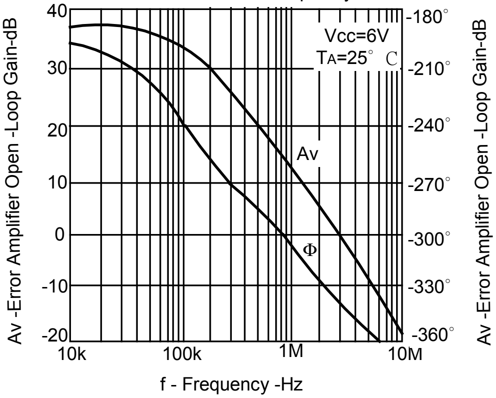


Figure 16 Error Amplifier Open-Loop Gain and Phase Shift vs Frequency



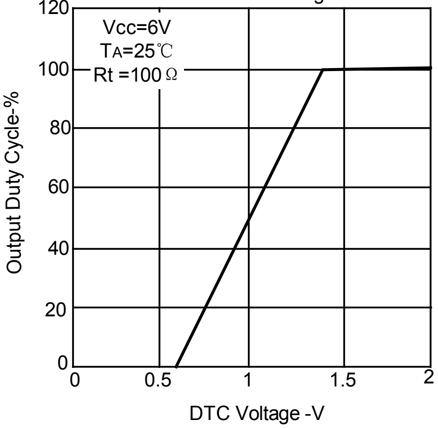


Figure 17 Output Duty Cycle vs DTC Voltage

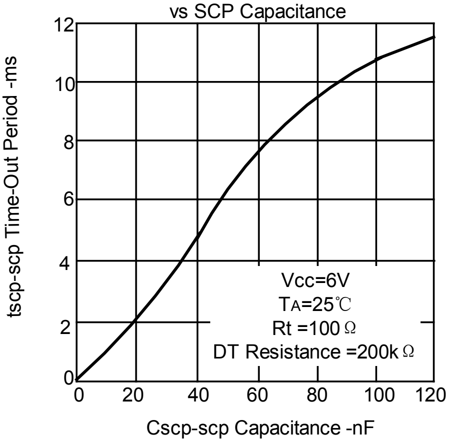


Figure 18 Scp-Time-Output Period vs SCP Capacitance

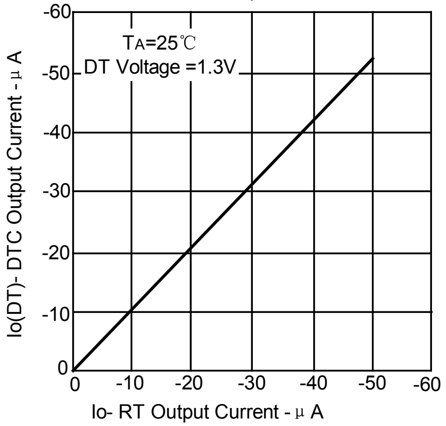


Figure 19 DTC Output Current vs RT Output Current

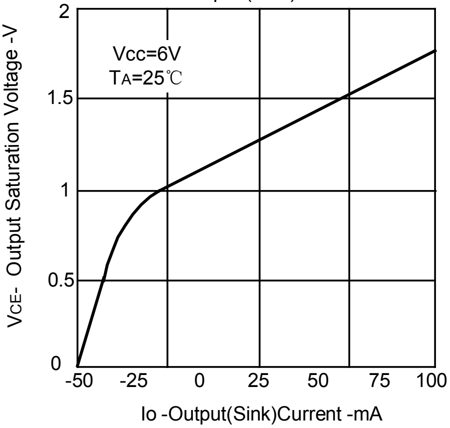
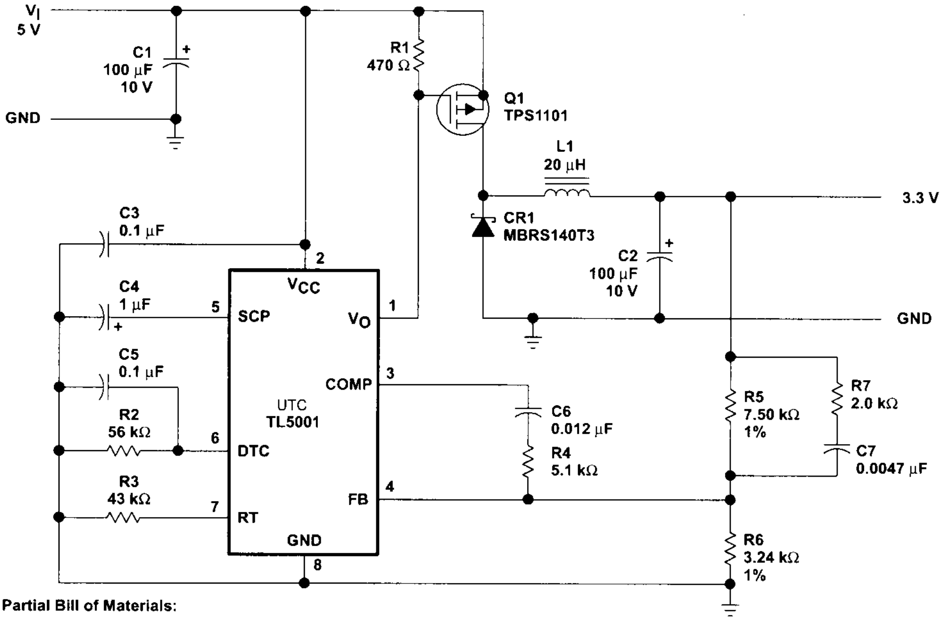


Figure 20 Output Saturation Voltage vs Output (Sink) Current

APPLICATION INFORMATION



Partial Bill of Materials:

Q1	TPS1101	Texas Instruments
LI	CTX20-1 or 23 turns of #28 wire on Micrometals No. T50-26B core	Coiltronics
C1	TPSD107M010R0100	AVX
C2	TPSD107M010R0100	AVX
CR1	MBRS140T3	Motorola

NOTES:
A. Frequency = 200 kHz
B. Duty cycle = 90% max
C. Soft-start time constant (TC) = 5.6 ms
D. SCP TC = 70 msA

Figure 21. Step-Down Converter

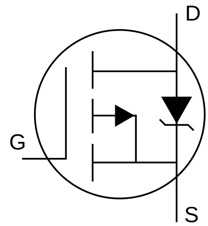
International
IOR Rectifier

PD - 9.1485B

IRF9Z34N

HEXFET® Power MOSFET

- Advanced Process Technology
- Dynamic dv/dt Rating
- 175°C Operating Temperature
- Fast Switching
- P-Channel
- Fully Avalanche Rated



V_{DSS} = -55V

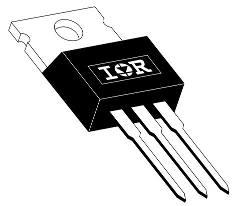
$R_{DS(on)}$ = 0.10Ω

I_D = -19A

Description

Fifth Generation HEXFETs from International Rectifier utilize advanced processing techniques to achieve extremely low on-resistance per silicon area. This benefit, combined with the fast switching speed and ruggedized device design that HEXFET Power MOSFETs are well known for, provides the designer with an extremely efficient and reliable device for use in a wide variety of applications.

The TO-220 package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 50 watts. The low thermal resistance and low package cost of the TO-220 contribute to its wide acceptance throughout the industry.



TO-220AB

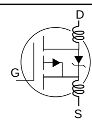
Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ -10V	-19	
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ -10V	-14	A
I_{DM}	Pulsed Drain Current ①	-68	
P_D @T_C = 25°C	Power Dissipation	68	W
	Linear Derating Factor	0.45	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy②	180	mJ
I_{AR}	Avalanche Current①	-10	A
E_{AR}	Repetitive Avalanche Energy①	6.8	mJ
dv/dt	Peak Diode Recovery dv/dt ③	-5.0	V/ns
T_J	Operating Junction and	-55 to + 175	
T_{STG}	Storage Temperature Range		°C
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	
	Mounting torque, 6-32 or M3 screw	10 lbf•in (1.1N•m)	

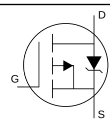
Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	——	2.2	
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.50	——	°C/W
$R_{\theta JA}$	Junction-to-Ambient	——	62	

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	-55	–––	–––	V	V_{GS} = 0V, I_D = -250µA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	–––	-0.05	–––	V/°C	Reference to 25°C, I_D = -1mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	–––	–––	0.10	Ω	V_{GS} = -10V, I_D = -10A ④
$V_{GS(th)}$	Gate Threshold Voltage	-2.0	–––	-4.0	V	V_{DS} = V_{GS}, I_D = -250µA
g_{fs}	Forward Transconductance	4.2	–––	–––	S	V_{DS} = 25V, I_D = -10A
I_{DSS}	Drain-to-Source Leakage Current	–––	–––	-25	µA	V_{DS} = -55V, V_{GS} = 0V
		–––	–––	-250		V_{DS} = -44V, V_{GS} = 0V, T_J = 150°C
I_{GSS}	Gate-to-Source Forward Leakage	–––	–––	100	nA	V_{GS} = 20V
	Gate-to-Source Reverse Leakage	–––	–––	-100		V_{GS} = -20V
Q_g	Total Gate Charge	–––	–––	35	nC	I_D = -10A
Q_{gs}	Gate-to-Source Charge	–––	–––	7.9		V_{DS} = -44V
Q_{gd}	Gate-to-Drain ("Miller") Charge	–––	–––	16		V_{GS} = -10V, See Fig. 6 and 13 ④
$t_{d(on)}$	Turn-On Delay Time	–––	13	–––	ns	V_{DD} = -28V
t_r	Rise Time	–––	55	–––		I_D = -10A
$t_{d(off)}$	Turn-Off Delay Time	–––	30	–––		R_G = 13Ω
t_f	Fall Time	–––	41	–––		R_D = 2.6Ω, See Fig. 10 ④
L_D	Internal Drain Inductance	–––	4.5	–––	nH	Between lead, 6mm (0.25in.) from package and center of die contact 
L_S	Internal Source Inductance	–––	7.5	–––		
C_{iss}	Input Capacitance	–––	620	–––	pF	V_{GS} = 0V
C_{oss}	Output Capacitance	–––	280	–––		V_{DS} = -25V
C_{rss}	Reverse Transfer Capacitance	–––	140	–––		f = 1.0MHz, See Fig. 5

Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	–––	–––	-19	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	–––	–––	-68		
V_{SD}	Diode Forward Voltage	–––	–––	-1.6	V	T_J = 25°C, I_S = -10A, V_{GS} = 0V ④
t_{rr}	Reverse Recovery Time	–––	54	82	ns	T_J = 25°C, I_F = -10A
Q_{rr}	Reverse RecoveryCharge	–––	110	160	nC	di/dt = -100A/µs ④
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by L_S+L_D)				

Notes:

① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11)

② Starting T_J = 25°C, L = 3.6mH R_G = 25Ω, I_{AS} = -10A. (See Figure 12)

③ I_{SD} ≤ -10A, di/dt ≤ -290A/µs, V_{DD} ≤ $V_{(BR)DSS}$, T_J ≤ 175°C

④ Pulse width ≤ 300µs; duty cycle ≤ 2%.

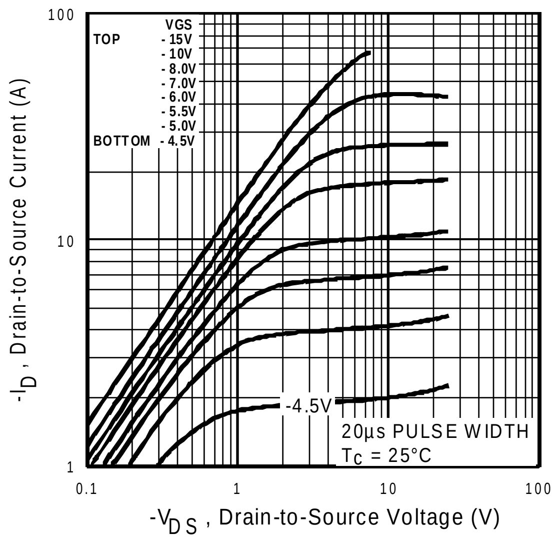


Fig 1. Typical Output Characteristics

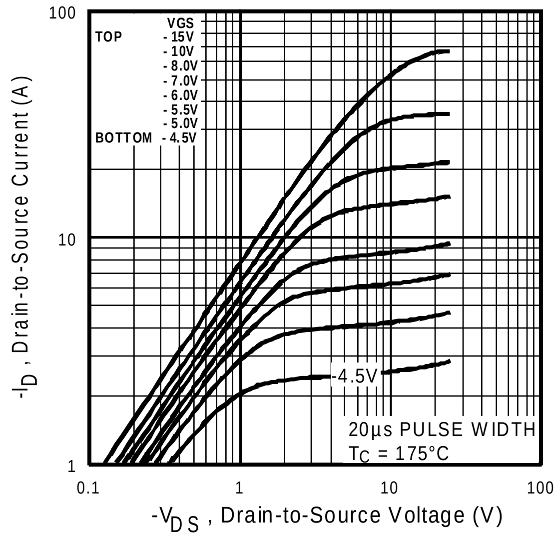


Fig 2. Typical Output Characteristics

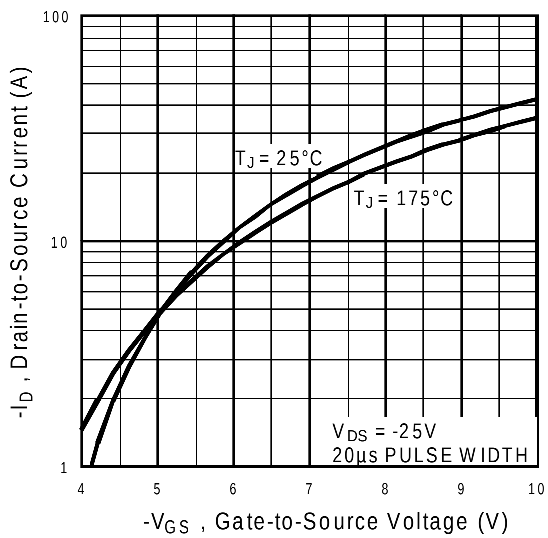


Fig 3. Typical Transfer Characteristics

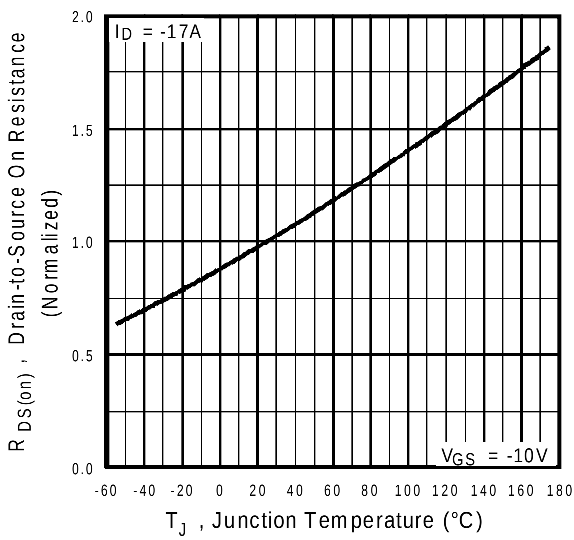


Fig 4. Normalized On-Resistance Vs. Temperature

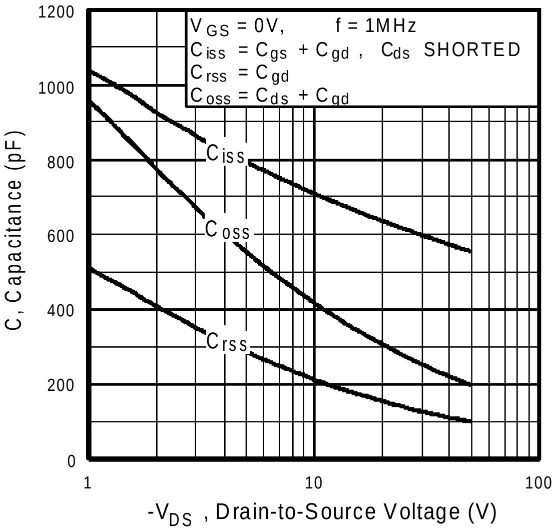


Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage

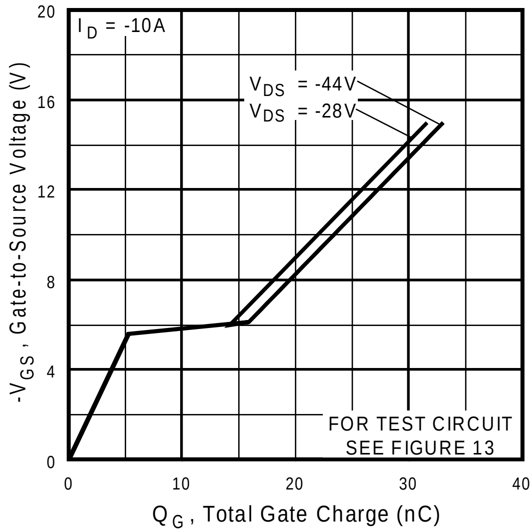


Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage

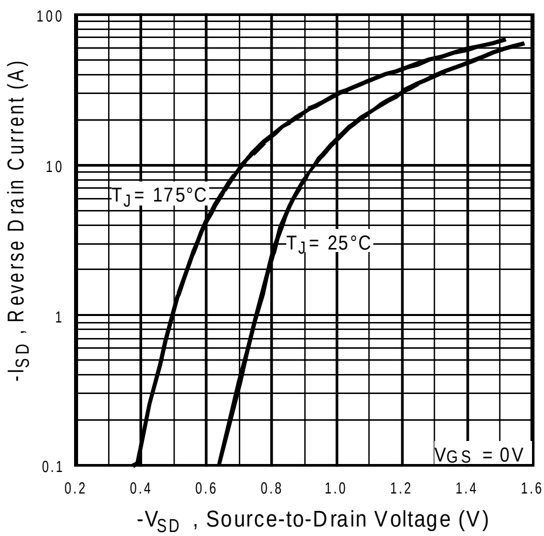


Fig 7. Typical Source-Drain Diode Forward Voltage

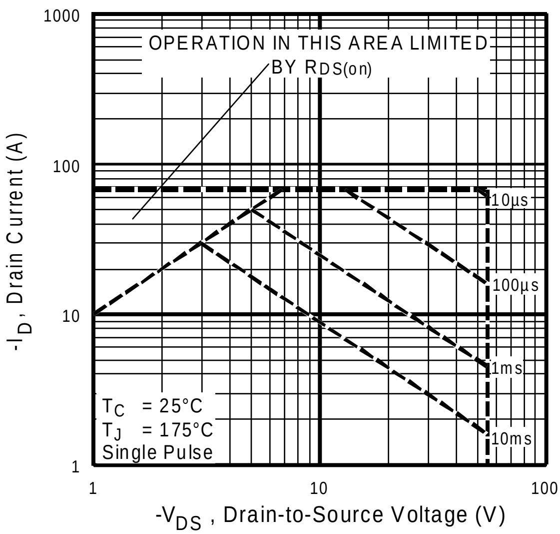


Fig 8. Maximum Safe Operating Area

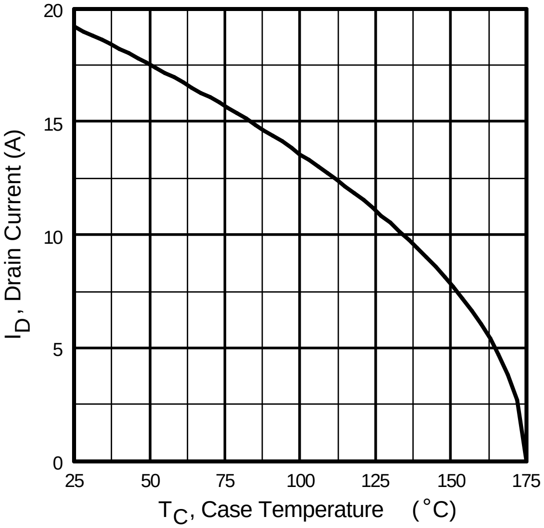


Fig 9. Maximum Drain Current Vs. Case Temperature

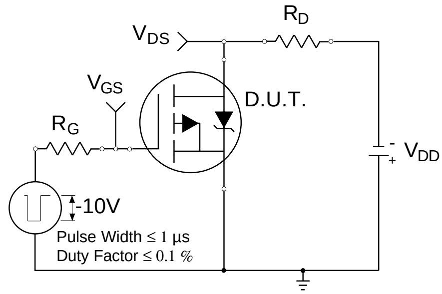


Fig 10a. Switching Time Test Circuit

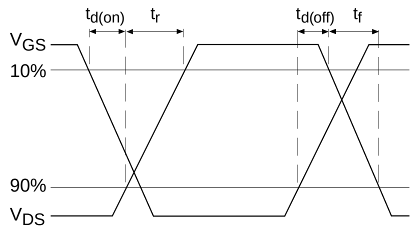


Fig 10b. Switching Time Waveforms

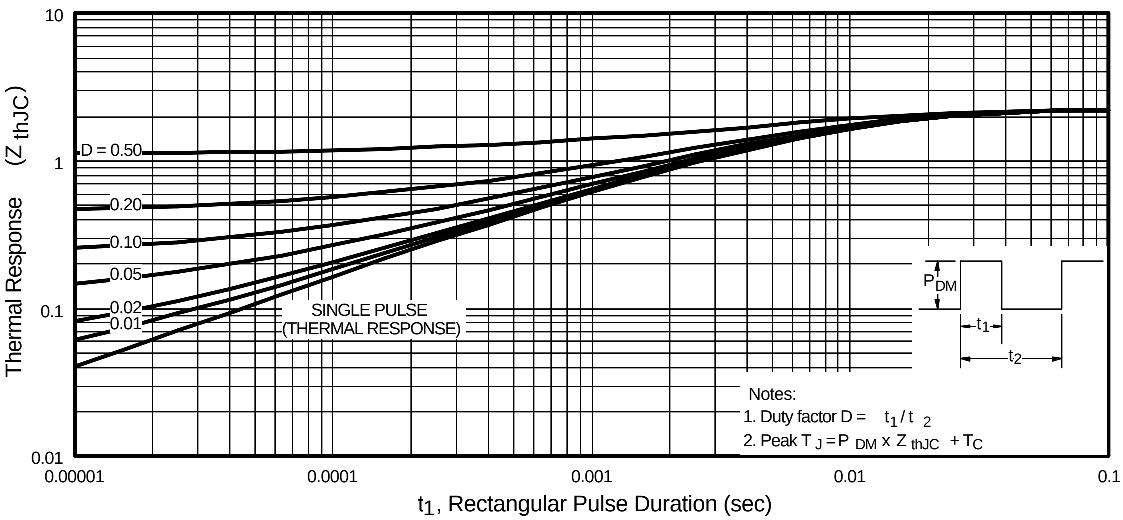


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

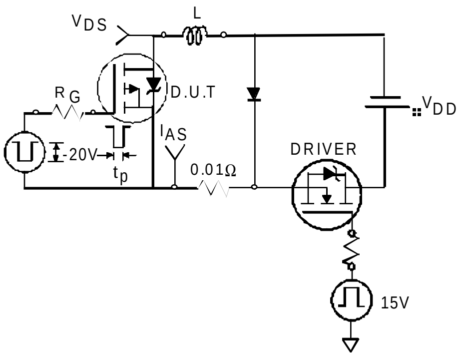


Fig 12a. Unclamped Inductive Test Circuit

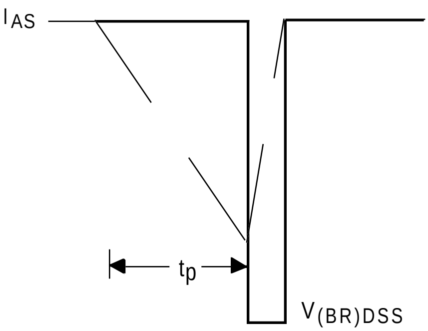


Fig 12b. Unclamped Inductive Waveforms

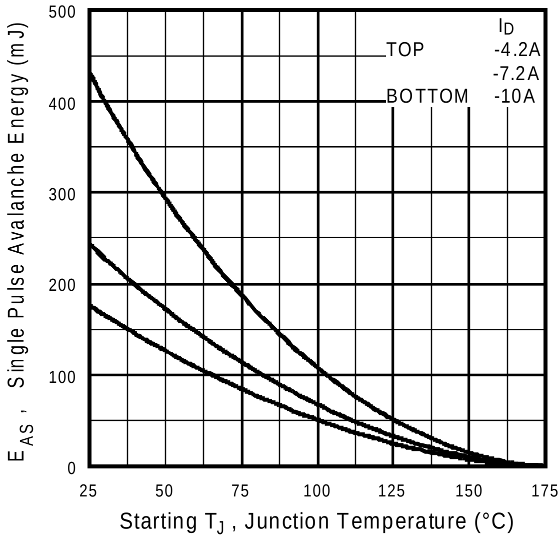


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

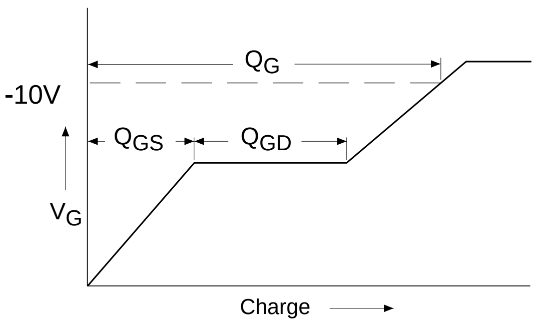


Fig 13a. Basic Gate Charge Waveform

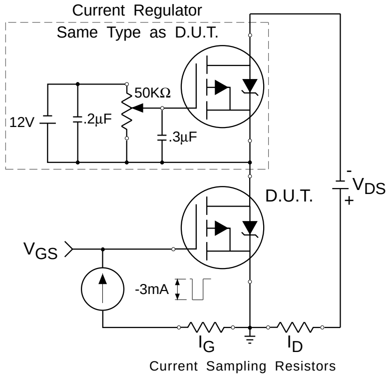
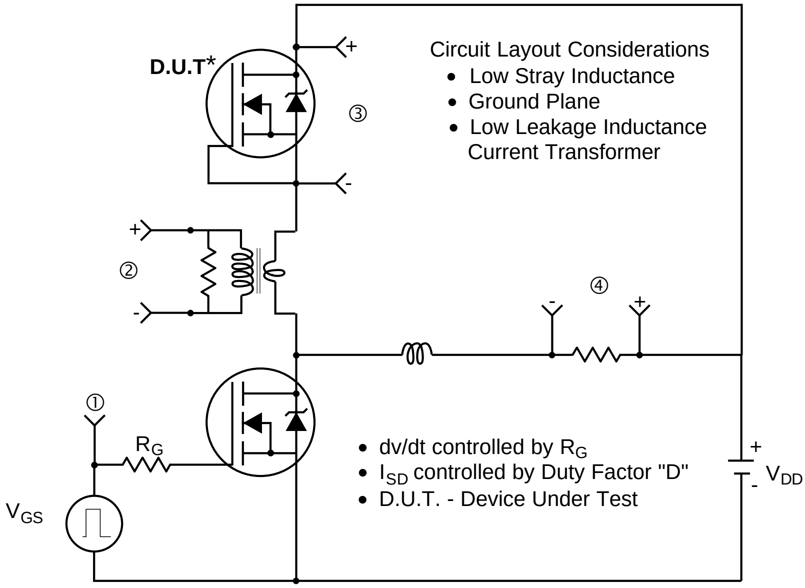
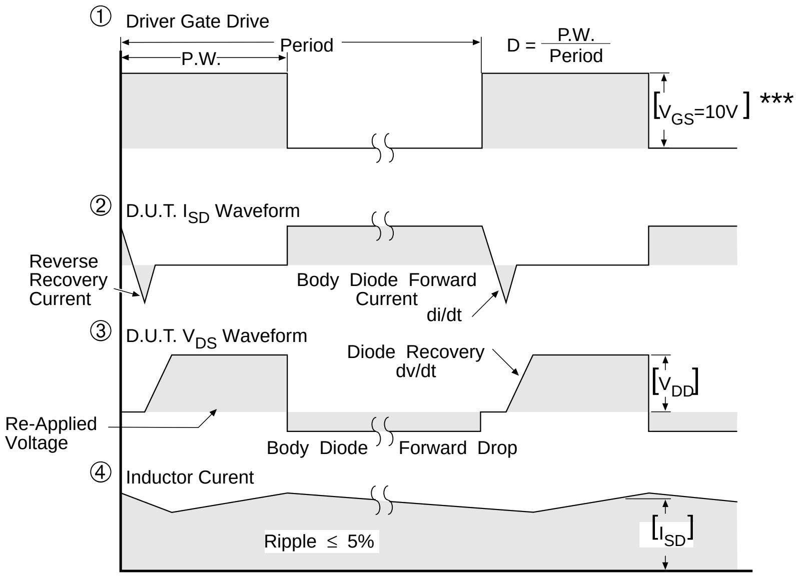


Fig 13b. Gate Charge Test Circuit

Peak Diode Recovery dv/dt Test Circuit



* Reverse Polarity of D.U.T for P-Channel



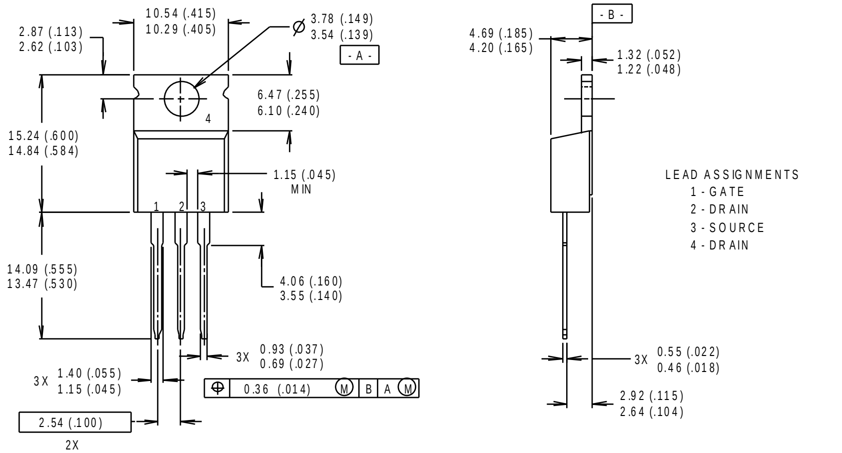
*** V_{GS} = 5.0V for Logic Level and 3V Drive Devices

Fig 14. For P-Channel HEXFETS

Package Outline

TO-220AB Outline

Dimensions are shown in millimeters (inches)



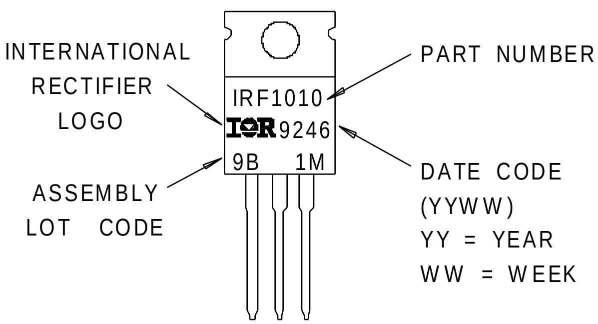
NOTES:

1 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
2 CONTROLLING DIMENSION : INCH
3 OUTLINE CONFORMS TO JEDEC OUTLINE TO-220AB.
4 HEATSINK & LEAD MEASUREMENTS DO NOT INCLUDE BURRS.

Part Marking Information

TO-220AB

EXAMPLE : THIS IS AN IRF1010
WITH ASSEMBLY
LOT CODE 9B1M



International
IOR Rectifier

WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, Tel: (310) 322 3331
EUROPEAN HEADQUARTERS: Hurst Green, Oxted, Surrey RH8 9BB, UK Tel: ++ 44 1883 732020
IR CANADA: 7321 Victoria Park Ave., Suite 201, Markham, Ontario L3R 2Z8, Tel: (905) 475 1897
IR GERMANY: Saalburgstrasse 157, 61350 Bad Homburg Tel: ++ 49 6172 96590
IR ITALY: Via Liguria 49, 10071 Borgaro, Torino Tel: ++ 39 11 451 0111
IR FAR EAST: K&H Bldg., 2F, 30-4 Nishi-Ikebukuro 3-Chome, Toshima-Ku, Tokyo Japan 171 Tel: 81 3 3983 0086
IR SOUTHEAST ASIA: 315 Outram Road, #10-02 Tan Boon Liat Building, Singapore 0316 Tel: 65 221 8371

LITE-ON SEMICONDUCTOR

SBL1630CT thru 1660CT

SCHOTTKY BARRIER RECTIFIERS

REVERSE VOLTAGE **- 30** to **60** Volts
FORWARD CURRENT **- 16** Amperes

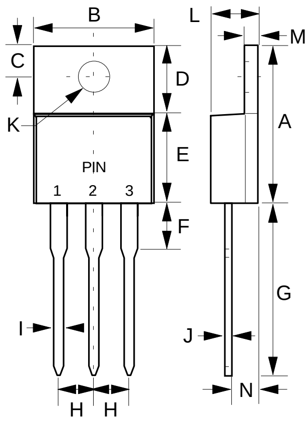
FEATURES

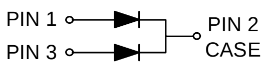
- Metal of silicon rectifier,majority carrier conducton
- Guard ring for transient protection
- Low power loss, high efficiency
- High current capability, low VF
- High surge capacity
- Plastic package has UL flammability classification 94V-0
- For use in low voltage,high frequency inverters,free whelling,and polarity protection applications

MECHANICAL DATA

- Case : TO-220AB molded plastic
- Polarity : As marked on the body
- Weight : 0.08 ounces, 2.24 grams
- Mounting position : Any

TO-220AB





TO-220AB		
DIM.	MIN.	MAX.
A	14.22	15.88
B	9.65	10.67
C	2.54	3.43
D	5.84	6.86
E	8.26	9.28
F	-	6.35
G	12.70	14.73
H	2.29	2.79
I	0.51	1.14
J	0.30	0.64
K	3.53 ∅	4.09 ∅
L	3.56	4.83
M	1.14	1.40
N	2.03	2.92
All Dimensions in millimeter		

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Ratings at 25℃ ambient temperature unless otherwise specified.
Single phase, half wave, 60HZ, resistive or inductive load.
For capacitive load, derate current by 20%

CHARACTERISTICS	SYMBOL	SBL 1630CT	SBL 1635CT	SBL 1640CT	SBL 1645CT	SBL 1650CT	SBL 1660CT	UNIT
Maximum Recurrent Peak Reverse Voltage	V_{RRM}	30	35	40	45	50	60	V
Maximum RMS Voltage	V_{RMS}	21	24.5	28	31.5	35	42	V
Maximum DC Blocking Voltage	V_{DC}	30	35	40	45	50	60	V
Maximum Average Forward Rectified Current (See Fig.1) @T_C=95℃	$I_{(AV)}$	16						A
Peak Forward Surge Current 8.3ms single half sine-wave superimposed on rated load (JEDEC METHOD)	I_{FSM}	250						A
Maximum Forward Voltage at 8A DC (Note 1)	V_F	0.55				0.7		V
Maximum DC Reverse Current at Rated DC Blocking Voltage @T_J =25°C / @T_J =100°C	I_R	0.5 50						mA
Typical Junction Capacitance (Note 2)	C_J	350						pF
Typical Thermal Resistance (Note 3)	$R_{\theta JC}$	2.5						°C/W
Operating Temperature Range	T_J	-55 to +125						°C
Storage Temperature Range	T_{STG}	-55 to +150						°C

NOTES : 1. 300us Pulse Width, 2% Duty Cycle.
2. Measured at 1.0MHz and applied reverse voltage of 4.0V DC.
3.Thermal Resistance Junction to Case.

REV. 3, 13-Sep-2001, KTHC03

FIG.1 - FORWARD CURRENT DERATING CURVE

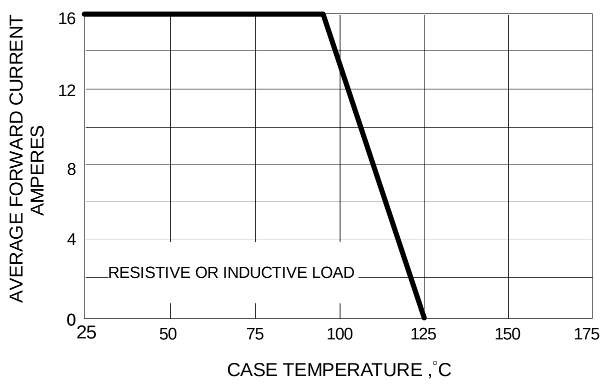


FIG.2 - MAXIMUM NON-REPETITIVE SURGE CURRENT

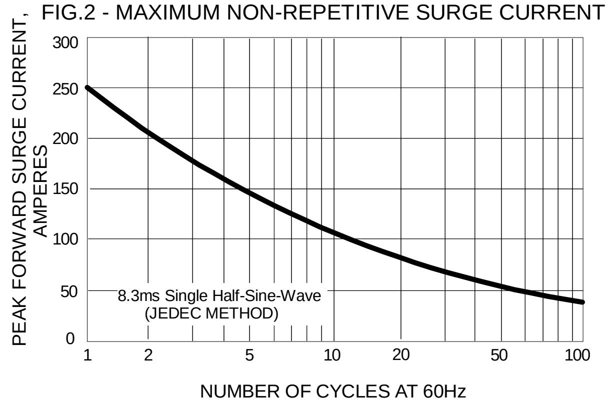


FIG.3 - TYPICAL REVERSE CHARACTERISTICS

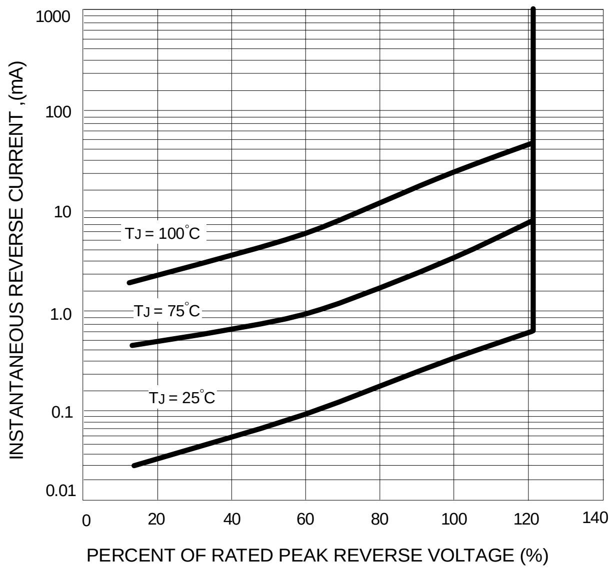


FIG.4 - TYPICAL FORWARD CHARACTERISTICS

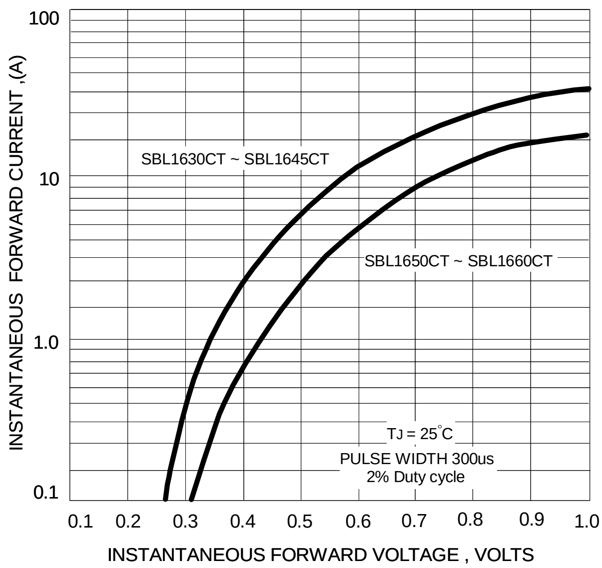
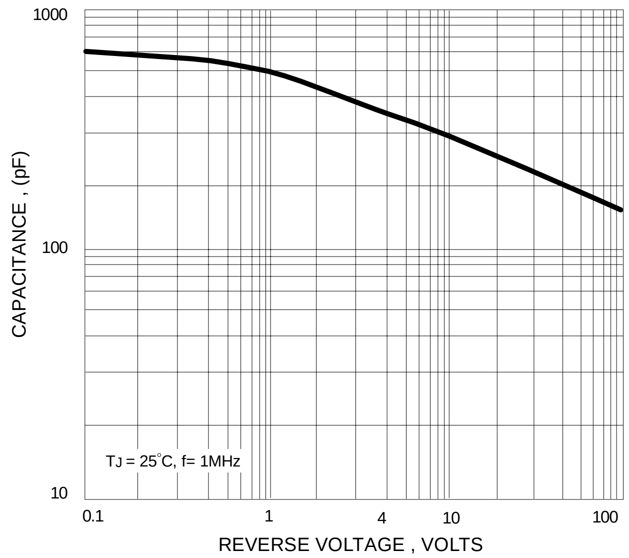


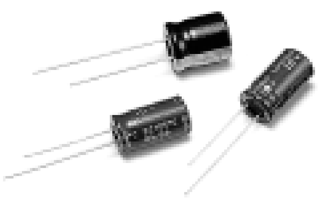
FIG.5 - TYPICAL JUNCTION CAPACITANCE



Miniature Size Aluminum Electrolytic Capacitors

SC [For Low Impedance and Low E.S.R Suitable for Output of Mother Board]

105°C Single-Ended Lead Aluminum Electrolytic Capacitors For High Frequency Applications



DESCRIPTION

Used in switching regulator applications in computers. Especially for high frequency.

Low impedance and E.S.R., high permissible ripple current at high frequency and higher operating temperature (-40ºC to +105ºC).

High Temperature Load Life at 105ºC for 3000 Hours

For Detail Specifications, Please Refer to Engineering Bulletin No. 2063

ELECTRICAL CHARACTERISTICS

Working Voltage : 6.3 ~ 100V

Operating Temperature : -40º ~ +105ºC

Rate Capacitance Range : 4.7 ~ 15000µF

Capacitance Tolerance : -20 ~ +20%

DC Leakage Current (µA) : I = 0.01 CV(µA) or 3µA Whichever is greater.
(Measurements shall be Made After a 2 Minute Charge at Rated Working Voltage)

Dissipation Factor : at 120 Hz, 25ºC

WV (V) :	6.3	10	16	25	35	50	63	80	100
D.F (%) :	15	14	12	10	10	8	8	7	7

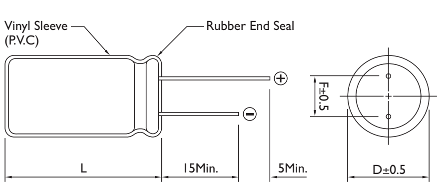
For capacitor whose capacitance exceeds 1000µF. The value of D.F(%) is increased by 2% for every addition of 1000µF.

WV (V) :		6.3	10	16	25	35	50	63	100
Impedance :	Z - 40°C / Z + 20°C	10	8	5	4	4	4	4	4

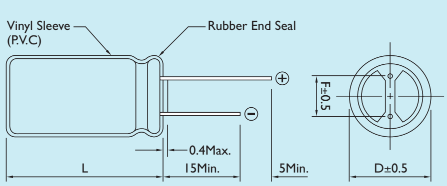
Load Life : 3000 Hours at 105ºC Assured with Full Rated Maximum Ripple Current Applied
5 x 11 ~ 10 x 12 : Life = 2000 Hours
10 x 15 or Higher : Life = 3000 Hours
(a) Capacitance Change : Within 20% of Initial Value
(b) Dissipation Factor : Not Exceed 200% of Initial Requirement
(c) Leakage Current : Not Exceed the Initial Requirement

Shelf Life : 1000 Hours, No Voltage Applied, at 105ºC
(a) Capacitance Change : Within 20% of Initial Value
(b) Dissipation Factor : Not Exceed 200 % of Initial Requirement
(c) Leakage Current : Not Exceed 200% of Initial Requirement

DIAGRAM OF DIMENSIONS



G.R.Y.



L ≤ 12 L + 1.5Max.
13 ≤ L ≤ 15 $L^{+1.0}_{-0.5}$
L ≥ 16 L + 2.0Max.

Dimensions : mm

Dø	F	dø
4.0	1.5	0.45
5.0	2.0	0.5
6.0	2.5	
8.0	3.5	
10.0	5.0	0.6
12.0		
13.0		
16.0	7.5	0.8
18.0		
22.0	10.0	0.8

CASE SIZE OF STANDARD PRODUCTS Dø ≥ 6mm with Safety Vent at Can Bottom

D x L : mm

CAP. (μF)	RATED VOLTAGE W V							
	6.3 (8)	10 (13)	16 (20)	25 (32)	35 (44)	50 (63)	63 (79)	100 (125)
4.7					5 x 11	5 x 11	5 x 11	5 x 11
6.8					5 x 11	5 x 11	5 x 11	5 x 11
10					5 x 11	5 x 11	5 x 11	6 x 11
15					5 x 11	5 x 11	5 x 11	6 x 11
22					5 x 11	5 x 11	6 x 11	8 x 11
33					5 x 11	6 x 11	6 x 11	8 x 15
47				5 x 11	6 x 11	6 x 11	8 x 11	10 x 15
68			5 x 11	6 x 11	6 x 11	8 x 11	8 x 11	10 x 19
100		5 x 11	5 x 11	6 x 11	8 x 11	8 x 15	8 x 20	13 x 20
120		5 x 11	6 x 11	8 x 11	8 x 11	8 x 20	10 x 15	13 x 25
150	5 x 11	6 x 11	6 x 11	8 x 11	8 x 15	10 x 12	10 x 15	13 x 25
220	6 x 11	6 x 11	8 x 11	8 x 15	10 x 12	10 x 15	10 x 19	16 x 25
330	8 x 11	8 x 11	8 x 15	8 x 20	10 x 19	10 x 19	13 x 20	16 x 32
470	8 x 11	8 x 15	10 x 12	10 x 15	10 x 19	13 x 20	13 x 25	18 x 36
680	8 x 15	10 x 12	10 x 15	10 x 19	13 x 20	13 x 25	16 x 25	
820	8 x 20	10 x 15	10 x 19	10 x 19	13 x 20	16 x 25	16 x 32	
1000	8 x 20	8 x 20	10 x 19	13 x 20	13 x 25	16 x 25	16 x 32	
1200	10 x 15	10 x 19	13 x 20	13 x 25	16 x 25	16 x 32	16 x 36	
1500	10 x 19	10 x 19	13 x 20	16 x 25	16 x 25	16 x 36	18 x 36	
2200	13 x 20	13 x 20	13 x 25	16 x 32	16 x 36	18 x 40		
3300	13 x 25	13 x 25	16 x 25	16 x 36	18 x 36			
4700	16 x 25	16 x 25	16 x 36	18 x 36				
6800	16 x 32	16 x 36	18 x 36					
8200	16 x 32	18 x 36						
10000	16 x 36							
15000	18 x 36							

PERMISSIBLE RIPPLE CURRENT AT 10K~100KHZ, 105ºC mA, rms

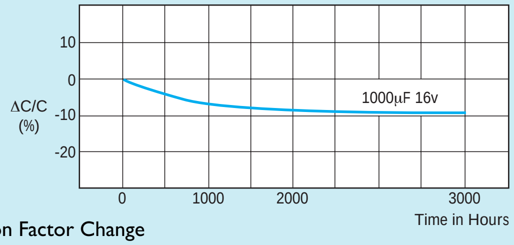
μF	W V 6.3	10	16	25	35	50	63	100
4.7					115	115	115	120
6.8					120	120	120	140
10					140	140	140	200
15					170	180	200	250
22					190	200	250	300
33					200	250	300	450
47				150	250	300	450	550
68			150	200	300	450	550	650
100		150	200	250	450	550	650	800
120		200	250	300	550	650	800	1050
150	200	250	300	550	650	800	1050	1300
220	250	300	550	750	800	1050	1300	1400
330	400	550	750	800	1050	1300	1400	1550
470	550	750	800	1050	1300	1400	1550	1700
680	700	800	1050	1100	1400	1550	1700	1900
820	750	1050	1100	1250	1550	1700	1900	2100
1000	800	1080	1250	1450	1700	1900	2100	2550
1200	1000	1250	1450	1600	1900	2100	2550	2800
1500	1250	1450	1600	2000	2100	2550	2800	
2200	1450	1600	2000	2200	2550	2800		
3300	1700	2000	2200	2550	2800			
4700	1800	2200	2550	2800				
6800	2000	2550	2800					
8200	2350	2800						
10000	2550							
15000	3000							

IMPEDANCE AT 100KHZ, 25ºC Ohm

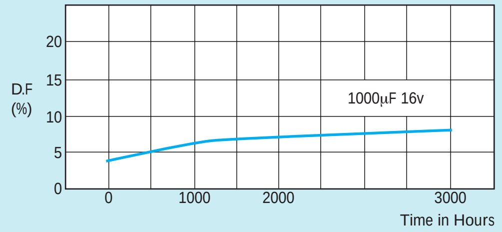
μF	W V 6.3	10	16	25	35	50	63	100
4.7					1.200	2.00	2.20	2.00
6.8					1.000	1.85	2.00	1.85
10					0.900	1.70	1.85	1.50
15					0.690	1.20	1.70	1.20
22					0.420	0.70	1.20	0.79
33					0.420	0.60	0.90	0.59
47				0.420	0.370	0.52	0.70	0.35
68			0.420	0.370	0.220	0.35	0.52	0.24
100		0.420	0.370	0.220	0.140	0.25	0.35	0.18
120		0.370	0.320	0.200	0.130	0.21	0.30	0.15
150	0.420	0.320	0.220	0.140	0.100	0.16	0.20	0.11
220	0.320	0.220	0.140	0.100	0.069	0.10	0.15	0.071
330	0.180	0.140	0.100	0.069	0.044	0.072	0.10	0.049
470	0.140	0.100	0.085	0.064	0.039	0.060	0.064	0.038
680	0.100	0.085	0.064	0.039	0.038	0.050	0.052	0.028
820	0.085	0.064	0.044	0.039	0.034	0.040	0.048	0.025
1000	0.069	0.065	0.039	0.038	0.029	0.039	0.042	0.025
1200	0.064	0.044	0.038	0.029	0.028	0.025	0.036	0.025
1500	0.044	0.039	0.034	0.028	0.024	0.025	0.033	
2200	0.043	0.038	0.028	0.024	0.019	0.025		
3300	0.035	0.028	0.024	0.019	0.019			
4700	0.028	0.024	0.019	0.019				
6800	0.024	0.019	0.019					
8200	0.019	0.019						
10000	0.019							
15000	0.019							

LOAD LIFE

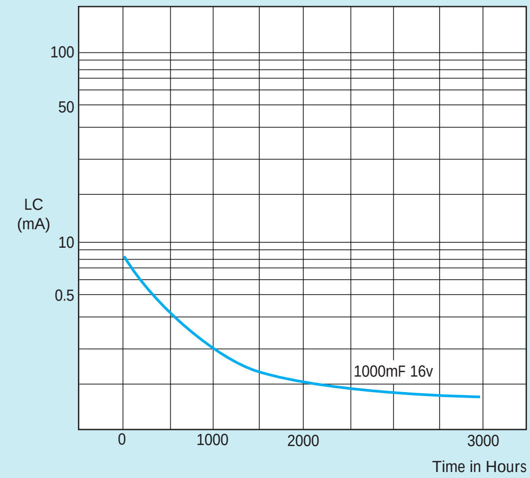
Capacitance Change Ratio



Dissipation Factor Change



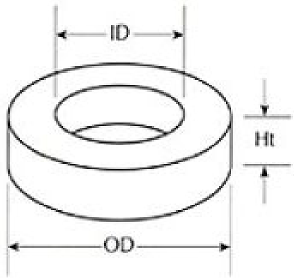
Leakage Current Change

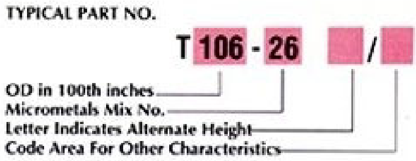


Toroidal Cores T80 thru T90

COLOR CODE

-2	Red/Clear
-8	Yellow/Red
-14	Black/Red
-18	Green/Red
-19	Red/Green
-26	Yellow/White
-30	Green/Gray
-34	Gray/Blue
-35	Yellow/Gray
-38	Gray/Black
-40	Green/Yellow
-45	Black/Black
-52	Green/Blue





							MAGNETIC DIMENSIONS
MICROMETALS	A_L	OD	ID	Ht	ℓ	A	V
Part No.	nH/N²	in/mm	in/mm	in/mm	cm	cm²	cm³
T80-2	5.5	.795/20.2	.495/12.6	.250/6.35	5.14	0.231	1.19
T80-8/90	18						
T80-14	7.4						
T80-18	31						
T80-19	31						
T80-26	46						
T80-38	48						
T80-40	39.5						
T80-45	56						
T80-52	42						
T80-8B/90	29.5	.795/20.2	.495/12.6	.375/9.53	5.14	0.347	1.78
T80-14B	11						
T80-18B	46.5						
T80-19B	46.5						
T80-26B	71						
T80-38B	72						
T80-40B	59						
T80-45B	84						
T80-52B	63						
T80-26D	92	.795/20.2	.495/12.6	.500/12.7	5.14	0.453	2.33
T80-40D	79						
T80-52D	83						
T90-8/90	30	.900/22.9	.550/14.0	.375/9.53	5.78	0.395	2.28
T90-18	47						
T90-19	47						
T90-26	70						
T90-38	73						
T90-40	57						
T90-45	85						
T90-52	64						

MICROMETALS INDUCTORS FOR POWER FILTER APPLICATIONS

DC BIASED OUTPUT FILTER INDUCTANCE ANALYSIS

CORE PART NUMBER	T80-52	X 1	NO. IN STACK
WIRE GAGE / STRANDS	1.0 mm	X 1	
NUMBER OF TURNS	31		
DC BIAS CURRENT	4.0	AMPERES	
PEAK INDUCTOR VOLTAGE	12.0	VOLTS	
DC OUTPUT VOLTAGE	5.5	VOLTS	
FREQUENCY	100	K Hz	
AMBIENT TEMPERATURE	27	°C	

ELECTRICAL PROPERTIES

INDUCTANCE	30.56	uH	CORE LOSS	0.267	W
DC RESISTANCE	16.80m	Ω	COPPER LOSS	0.269	W
AC RESISTANCE	16.80m	Ω	TOTAL LOSSES	0.535	W
RIPPLE CURRENT	1.23	A p-p			
DC BIAS	30.3	Oe	SURFACE AREA	13.72	cm^2
AC FLUX DENSITY	263	Gauss	TEMP RISE	21.16	°C
PERCENT PERM	76	%	TIME TO 115% LOSS	300K	Hrs
CORE AL VALUE	42	nH	LIFE LIMIT	100M	Hrs

MECHANICAL PROPERTIES

CORE OD	0.795	in	WIRE DIA	0.043	in
CORE ID	0.495	in	WIRE LENGTH	2.400	ft
CORE HEIGHT	0.250	in	WIRE WEIGHT	0.012	lb
CORE WEIGHT	0.018	lb	WINDOW FILL	19.6	%
CORE VOLUME	1.187	cm^3	WOUND OD	0.878	in
MAGNETIC Ac	0.231	cm^2	WOUND HEIGHT	0.333	in
MAGNETIC Lm	5.140	cm