ภาคผนวก ก.

ข้อมูลอุปกรณ์

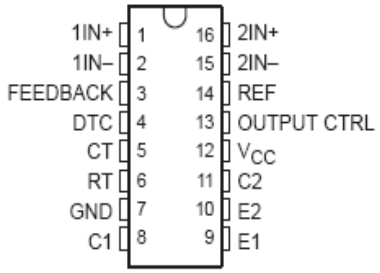
ก. ไอซีเบอร์ TL 494 สำหรับโหมดควบคุมจากแรงดัน

TL494
PULSE-WIDTH-MODULATION CONTROL CIRCUITS

SLVS074B – JANUARY 1983 – REVISED JULY 1999

- Complete PWM Power Control Circuitry
- Uncommitted Outputs for 200-mA Sink or Source Current
- Output Control Selects Single-Ended or Push-Pull Operation
- Internal Circuitry Prohibits Double Pulse at Either Output
- Variable Dead Time Provides Control Over Total Range
- Internal Regulator Provides a Stable 5-V Reference Supply With 5% Tolerance
- Circuit Architecture Allows Easy Synchronization

D, N, NS, OR PW PACKAGE
(TOP VIEW)



description

The TL494 incorporates all the functions required in the construction of a pulse-width-modulation (PWM) control circuit on a single chip. Designed primarily for power-supply control, this device offers the flexibility to tailor the power-supply control circuitry to a specific application.

The TL494 contains two error amplifiers, an on-chip adjustable oscillator, a dead-time control (DTC) comparator, a pulse-steering control flip-flop, a 5-V, 5%-precision regulator, and output-control circuits.

The error amplifiers exhibit a common-mode voltage range from –0.3 V to V_{CC} – 2 V. The dead-time control comparator has a fixed offset that provides approximately 5% dead time. The on-chip oscillator can be bypassed by terminating RT to the reference output and providing a sawtooth input to CT, or it can drive the common circuits in synchronous multiple-rail power supplies.

The uncommitted output transistors provide either common-emitter or emitter-follower output capability. The TL494 provides for push-pull or single-ended output operation, which can be selected through the output-control function. The architecture of this device prohibits the possibility of either output being pulsed twice during push-pull operation.

The TL494C is characterized for operation from 0°C to 70°C. The TL494I is characterized for operation from –40°C to 85°C.

FUNCTION TABLE

INPUT TO OUTPUT CTRL	OUTPUT FUNCTION
V_I = GND	Single-ended or parallel output
V_I = V_{ref}	Normal push-pull operation

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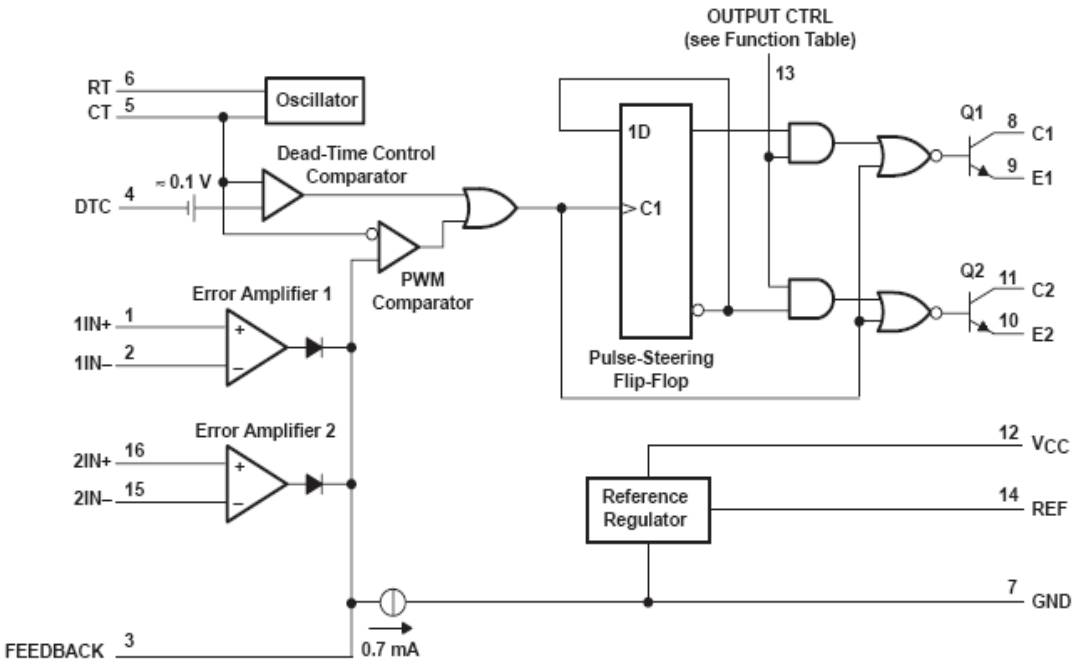
SLVS074B – JANUARY 1983 – REVISED JULY 1999

AVAILABLE OPTIONS

T_A	PACKAGED DEVICES				CHIP FORM (Y)
	SMALL OUTLINE (D)	PLASTIC DIP (N)	SMALL OUTLINE (NS)	SHRINK SMALL OUTLINE (PW)	
0°C to 70°C	TL494CD	TL494CN	TL494CNS	TL494CPW	TL494Y
–40°C to 85°C	TL494ID	TL494IN	—	—	—

The D, NS, and PW packages are available taped and reeled. Add the suffix R to device type (e.g., TL494CDR). Chip forms are tested at 25°C.

functional block diagram



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

		TL494	UNIT
Supply voltage, V_{CC} (see Note 1)		41	V
Amplifier input voltage, V_I		V_{CC}+0.3	V
Collector output voltage, V_O		41	V
Collector output current, I_O		250	mA
Package thermal impedance, θ_{JA} (see Notes 2 and 3)	D package	73	°C
	N package	88	
	NS package	64	
	PW package	108	
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	D, N, or PW package	260	°C
Storage temperature range, T_{stg}		–65 to 150	°C

† 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.

NOTES: 1. All voltage values, except differential voltages, are with respect to the network ground terminal.
2. Maximum power dissipation is a function of $T_J(max)$, θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) – T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can impact reliability.
3. The package thermal impedance is calculated in accordance with JESD 51, except for through-hole packages, which use a trace length of zero.

recommended operating conditions

		TL494		UNIT
		MIN	MAX	
Supply voltage, V_{CC}		7	40	V
Amplifier input voltage, V_I		–0.3	V_{CC}–2	V
Collector output voltage, V_O			40	V
Collector output current (each transistor)			200	mA
Current into feedback terminal			0.3	mA
Oscillator frequency, f_{osc}		1	300	kHz
Timing capacitor, C_T		0.47	10000	nF
Timing resistor, R_T		1.8	500	kΩ
Operating free-air temperature, T_A	TL494C	0	70	°C
	TL494I	–40	85	

TL494
PULSE-WIDTH-MODULATION CONTROL CIRCUITS

SLVS074B – JANUARY 1983 – REVISED JULY 1999

electrical characteristics over recommended operating free-air temperature range, V_{CC} = 15 V, f = 10 kHz (unless otherwise noted)

reference section

PARAMETER	TEST CONDITIONS†	TL494C, TL494I			UNIT
		MIN	TYP‡	MAX	
Output voltage (REF)	I_O = 1 mA	4.75	5	5.25	V
Input regulation	V_{CC} = 7 V to 40 V		2	25	mV
Output regulation	I_O = 1 mA to 10 mA		1	15	mV
Output voltage change with temperature	ΔT_A = MIN to MAX		2	10	mV/V
Short-circuit output current§	REF = 0 V		25		mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ All typical values, except for parameter changes with temperature, are at T_A = 25°C.
§ Duration of the short circuit should not exceed one second.

oscillator section, C_T = 0.01 µF, R_T = 12 kΩ (see Figure 1)

PARAMETER	TEST CONDITIONS†	TL494, TL494I			UNIT
		MIN	TYP‡	MAX	
Frequency			10		kHz
Standard deviation of frequency¶	All values of V_{CC}, CT, RT, and T_A constant		100		Hz/kHz
Frequency change with voltage	V_{CC} = 7 V to 40 V, T_A = 25°C		1		Hz/kHz
Frequency change with temperature#	ΔT_A = MIN to MAX			10	Hz/kHz

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ All typical values, except for parameter changes with temperature, are at T_A = 25°C.
¶ Standard deviation is a measure of the statistical distribution about the mean as derived from the formula:

$$\sigma = \sqrt{\frac{\sum_{n=1}^{N} (x_n - \overline{X})^2}{N - 1}}$$

Temperature coefficient of timing capacitor and timing resistor are not taken into account.

error-amplifier section (see Figure 2)

PARAMETER	TEST CONDITIONS	TL494, TL494I			UNIT
		MIN	TYP‡	MAX	
Input offset voltage	V_O (FEEDBACK) = 2.5 V		2	10	mV
Input offset current	V_O (FEEDBACK) = 2.5 V		25	250	nA
Input bias current	V_O (FEEDBACK) = 2.5 V		0.2	1	µA
Common-mode input voltage range	V_{CC} = 7 V to 40 V	–0.3 to V_{CC}–2			V
Open-loop voltage amplification	ΔV_O = 3 V, R_L = 2 kΩ, V_O = 0.5 V to 3.5 V	70	95		dB
Unity-gain bandwidth	V_O = 0.5 V to 3.5 V, R_L = 2 kΩ		800		kHz
Common-mode rejection ratio	ΔV_O = 40 V, T_A = 25°C	65	80		dB
Output sink current (FEEDBACK)	V_{ID} = –15 mV to –5 V, V (FEEDBACK) = 0.7 V	0.3	0.7		mA
Output source current (FEEDBACK)	V_{ID} = 15 mV to 5 V, V (FEEDBACK) = 3.5 V	–2			mA

‡ All typical values, except for parameter changes with temperature, are at T_A = 25°C.

electrical characteristics over recommended operating free-air temperature range, V_{CC} = 15 V, f = 10 kHz, T_A = 25°C (unless otherwise noted)

reference section

PARAMETER	TEST CONDITIONS†	TL494Y			UNIT
		MIN	TYP†	MAX	
Output voltage (REF)	I_O = 1 mA		5		V
Input regulation	V_{CC} = 7 V to 40 V		2		mV
Output regulation	I_O = 1 mA to 10 mA		1		mV
Short-circuit output current‡	REF = 0 V		25		mA

† All typical values, except for parameter changes with temperature, are at T_A = 25°C.
‡ Duration of the short circuit should not exceed one second.

oscillator section, C_T = 0.01 µF, R_T = 12 kΩ (see Figure 1)

PARAMETER	TEST CONDITIONS†	TL494Y			UNIT
		MIN	TYP†	MAX	
Frequency			10		kHz
Standard deviation of frequency§	All values of V_{CC}, CT, RT, and T_A constant		100		Hz/kHz
Frequency change with voltage	V_{CC} = 7 V to 40 V		1		Hz/kHz

† All typical values, except for parameter changes with temperature, are at T_A = 25°C.
§ Standard deviation is a measure of the statistical distribution about the mean as derived from the formula:

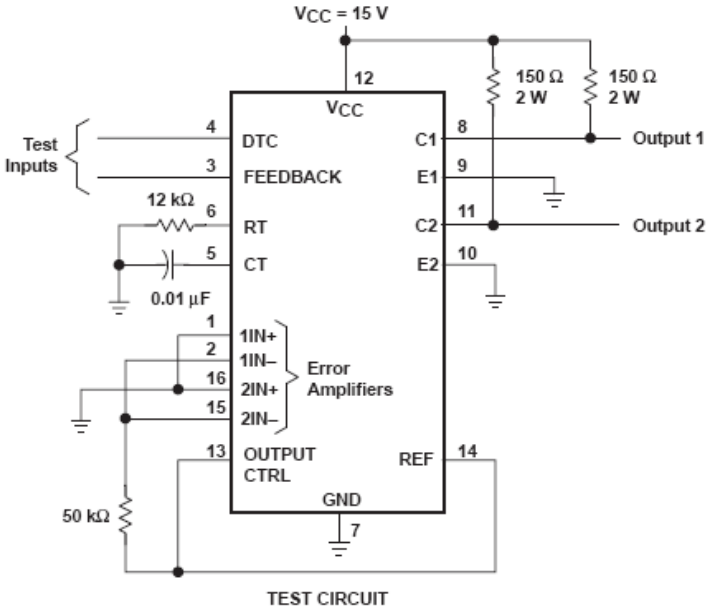
$$\sigma = \sqrt{\frac{\sum_{n=1}^{N} (x_n - \overline{X})^2}{N - 1}}$$

error-amplifier section (see Figure 2)

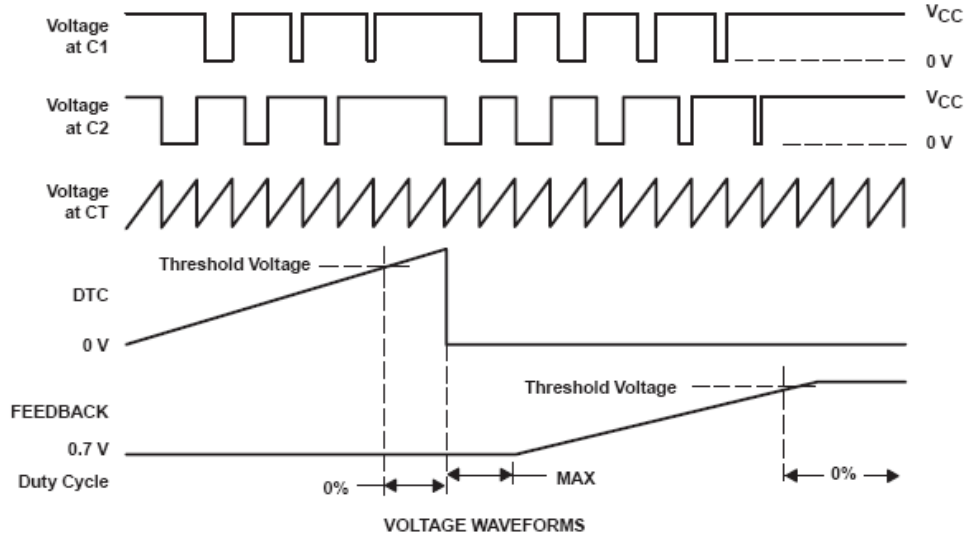
PARAMETER	TEST CONDITIONS		TL494Y			UNIT
			MIN	TYP†	MAX	
Input offset voltage	V_O (FEEDBACK) = 2.5 V			2		mV
Input offset current	V_O (FEEDBACK) = 2.5 V			25		nA
Input bias current	V_O (FEEDBACK) = 2.5 V			0.2		µA
Open-loop voltage amplification	ΔV_O = 3 V,	R_L = 2 kΩ, V_O = 0.5 V to 3.5 V		95		dB
Unity-gain bandwidth	V_O = 0.5 V to 3.5 V,	R_L = 2 kΩ		800		kHz
Common-mode rejection ratio	ΔV_O = 40 V			80		dB
Output sink current (FEEDBACK)	V_{ID} = –15 mV to –5 V,	V (FEEDBACK) = 0.7 V		0.7		mA

† All typical values, except for parameter changes with temperature, are at T_A = 25°C.

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE WAVEFORMS

Figure 1. Operational Test Circuit and Waveforms

PARAMETER MEASUREMENT INFORMATION

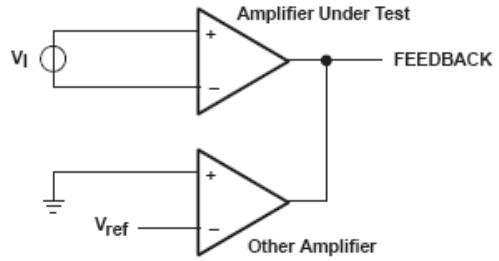
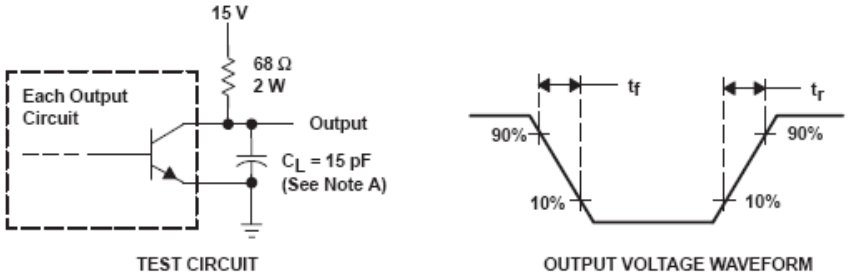
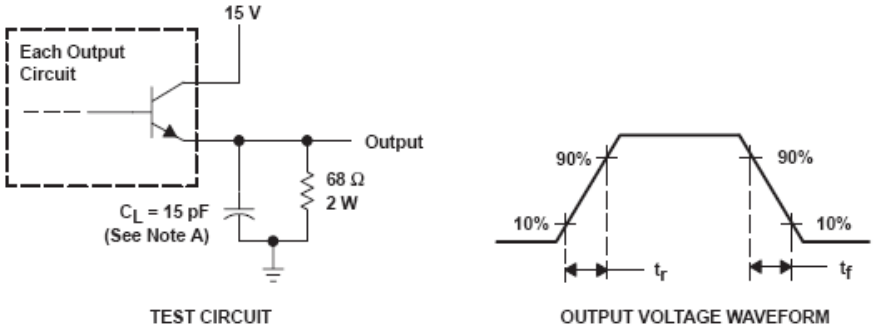


Figure 2. Amplifier Characteristics



NOTE A: C_L includes probe and jig capacitance.

Figure 3. Common-Emitter Configuration



NOTE A: C_L includes probe and jig capacitance.

Figure 4. Emitter-Follower Configuration

PARAMETER MEASUREMENT INFORMATION

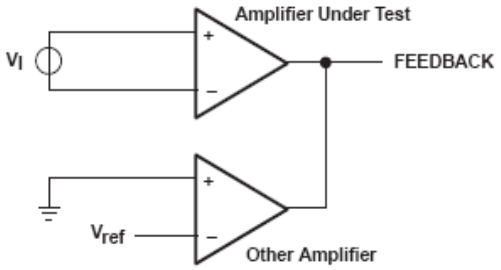
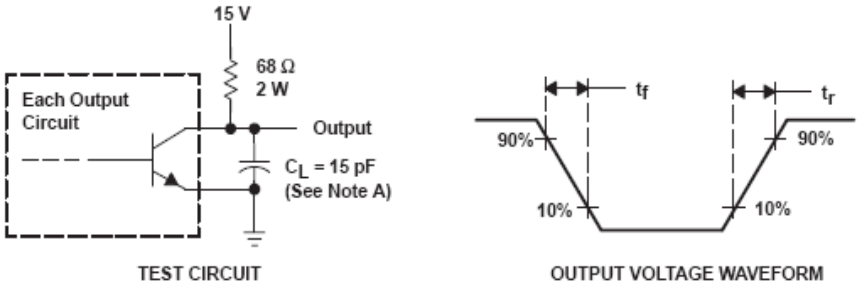
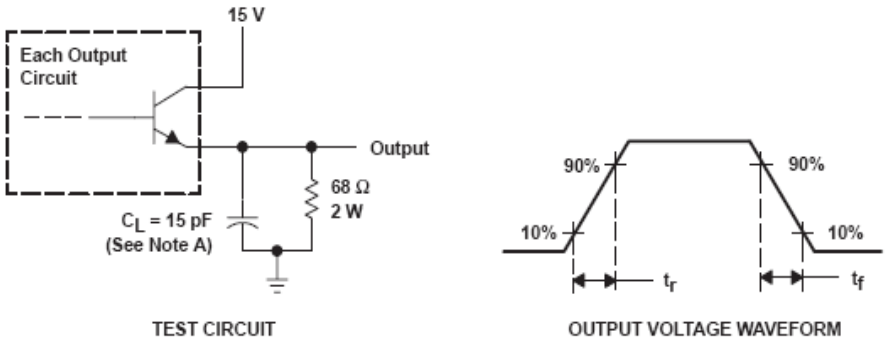


Figure 2. Amplifier Characteristics



NOTE A: C_L includes probe and jig capacitance.

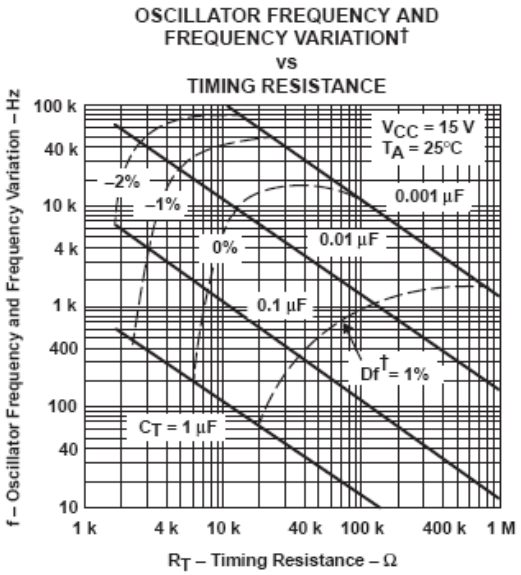
Figure 3. Common-Emitter Configuration



NOTE A: C_L includes probe and jig capacitance.

Figure 4. Emitter-Follower Configuration

TYPICAL CHARACTERISTICS



† Frequency variation (Δf) is the change in oscillator frequency that occurs over the full temperature range.

Figure 5

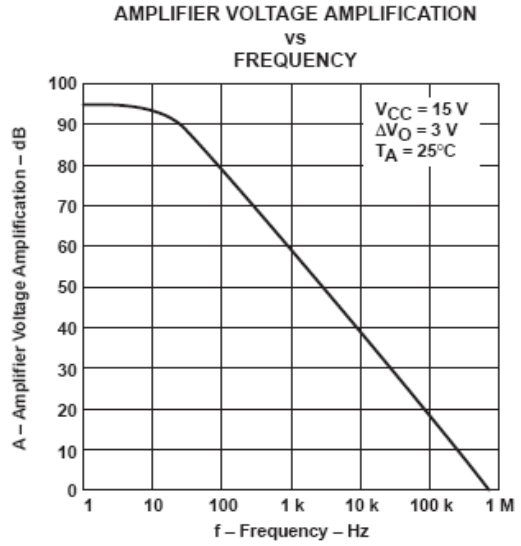


Figure 6

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ข. วงจรภายในมอสเฟต เบอร์ KMB050N60P

KEC **SEMICONDUCTOR**
TECHNICAL DATA

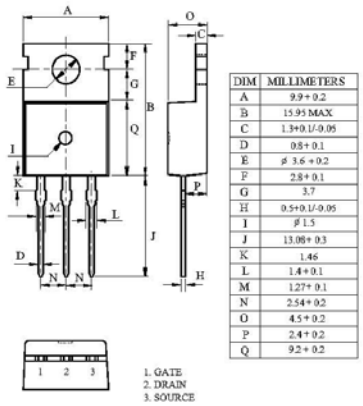
KMB050N60P
N CHANNEL MOS FIELD EFFECT TRANSISTOR

General Description

This planar stripe MOSFET has better characteristics, such as fast switching time, low on resistance, low gate charge and excellent avalanche characteristics. It is mainly suitable for active power factor correction , electronic lamp ballasts based on half bridge topology and switching mode power supplies.

FEATURES

- V_{DSS}= 60V, I_D= 50A
- Drain-Source ON Resistance : $R_{DS(ON)}$=0.022 Ω @V_{GS} = 10V
- Qg(typ.) = 32nC
- Improved dv/dt capacity, high Ruggedness
- Maximum Junction Temperature Range (175℃)

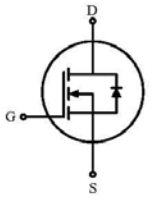


DIM	MILLIMETERS
A	9.9+0.2
B	15.95 MAX
C	1.3+0.1/-0.05
D	0.8+0.1
E	ϕ 3.6 +0.2
F	2.8+0.1
G	3.7
H	0.5+0.1/-0.05
I	ϕ 1.5
J	13.08+0.3
K	1.46
L	1.4+0.1
M	1.27+0.1
N	2.54+0.2
O	4.5+0.2
P	2.4+0.2
Q	9.2+0.2

TO-220AB

MAXIMUM RATING (Tc=25℃)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Drain-Source Voltage		V_{DSS}	60	V
Gate-Source Voltage		V_{GSS}	±20	V
Drain Current	@T_C=25℃	I_D	50	A
	@T_C=100℃		35	
	Pulsed (Note1)	I_{DP}	200	
Single Pulsed Avalanche Energy (Note 2)		E_{AS}	493	mJ
Repetitive Avalanche Energy (Note 1)		E_{AR}	12	mJ
Peak Diode Recovery dv/dt (Note 3)		dv/dt	7.0	V/ns
Drain Power Dissipation	Tc=25℃	P_D	120	W
	Derate above 25℃		0.8	W/℃
Maximum Junction Temperature		T_j	175	℃
Storage Temperature Range		T_{stg}	-55~175	℃
Thermal Characteristics				
Thermal Resistance, Junction-to-Case		R_{thJC}	1.24	℃/W
Thermal Resistance, Case-to-Sink		R_{thCS}	0.5	℃/W
Thermal Resistance, Junction-to-Ambient		R_{thJA}	62.5	℃/W



ELECTRICAL CHARACTERISTICS (Tc=25℃)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Static						
Drain-Source Breakdown Voltage	BV_{DSS}	I_D=250㎂, V_{GS}=0V	60	-	-	V
Breakdown Voltage Temperature Coefficient	$\Delta BV_{DSS}/\Delta T_j$	I_D=250㎂, Referenced to 25℃	-	0.07	-	V/℃
Drain Cut-off Current	I_{DSS}	V_{DS}=60V, V_{GS}=0V,	-	-	10	㎂
Gate Threshold Voltage	V_{th}	V_{DS}=V_{GS}, I_D=250㎂	2.0	-	4.0	V
Gate Leakage Current	I_{GSS}	V_{GS}=±20V, V_{DS}=0V	-	-	±100	nA
Drain-Source ON Resistance	$R_{DS(ON)}$	V_{GS}=10V, I_D=25A	-	0.018	0.022	Ω
Dynamic						
Total Gate Charge	Q_g	V_{DS}= 48V, I_D= 50A V_{GS}=10V (Note4,5)	-	32	42	nC
Gate-Source Charge	Q_{gs}		-	8	-	
Gate-Drain Charge	Q_{gd}		-	12	-	
Turn-on Delay time	$t_{d(on)}$	V_{DD}= 30V I_D=25A R_G= 25 Ω (Note4,5)	-	20	50	ns
Turn-on Rise time	t_r		-	100	210	
Turn-off Delay time	$t_{d(off)}$		-	80	170	
Turn-off Fall time	t_f		-	85	180	
Input Capacitance	C_{iss}	V_{DS}=25V, V_{GS}=0V, f=1.0MHz	-	1050	1365	pF
Reverse Transfer Capacitance	C_{rss}		-	70	90	
Output Capacitance	C_{oss}		-	460	600	
Source-Drain Diode Ratings						
Continuous Source Current	I_S	V_{GS}<V_{th}	-	-	50	A
Pulsed Source Current	I_{SP}		-	-	200	
Diode Forward Voltage	V_{SD}	I_S=50A, V_{GS}=0V	-	-	1.5	V
Reverse Recovery Time	t_{rr}	I_S=50A, V_{GS}=0V, dIs/dt=100A/㎲	-	50	-	ns
Reverse Recovery Charge	Q_{rr}		-	70	-	㎌

Note 1) Repetivity rating : Pulse width limited by junction temperature.

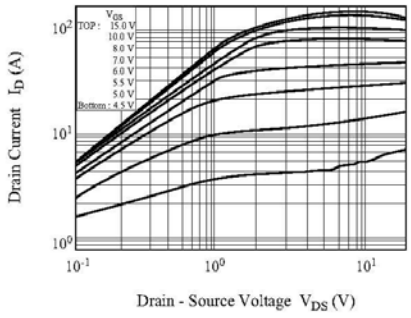
Note 2) L=230 mH, I_S=50A, V_{DD}=25V, R_G=25 Ω, Starting T_j=25 ℃.

Note 3) $I_S \leq$ 50A, dI/dt ≤ 300A/㎲, $V_{DD} \leq BV_{DSS}$, Starting T_j=25 ℃.

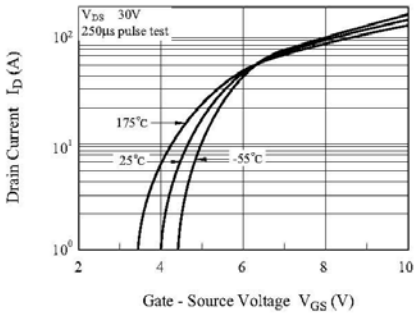
Note 4) Pulse Test : Pulse width < 300㎲, Duty Cycle < 2%.

Note 5) Essentially independent of operating temperature.

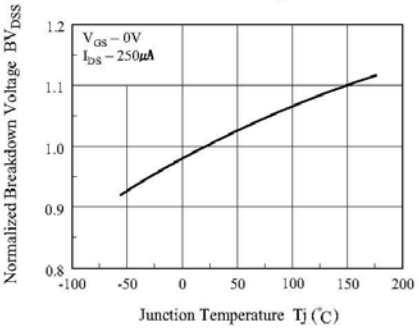
I_D - V_{DS}



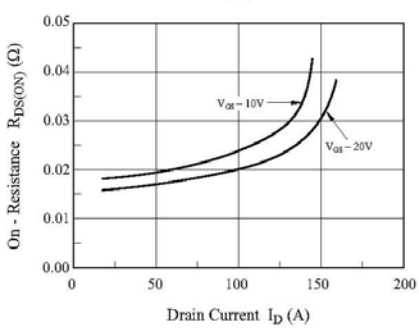
I_D - V_{GS}



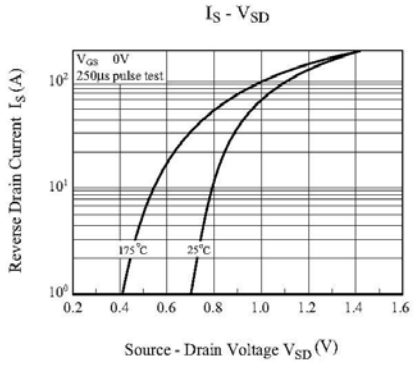
BV_{DSS} - T_j



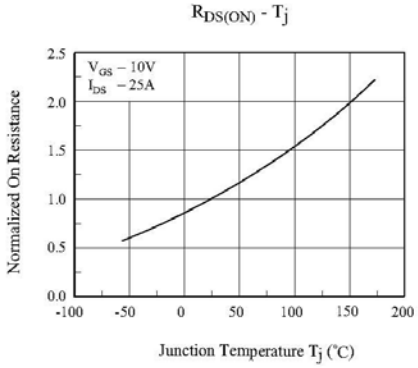
$R_{DS(ON)}$ - I_D



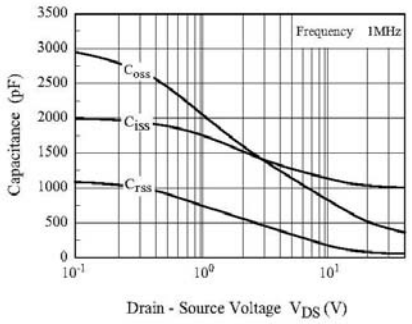
I_S - V_{SD}



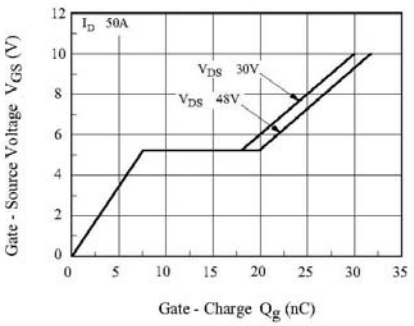
$R_{DS(ON)}$ - T_j



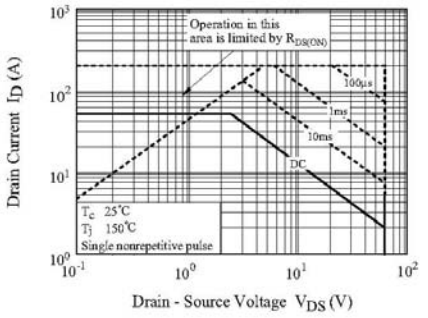
C - V_{DS}



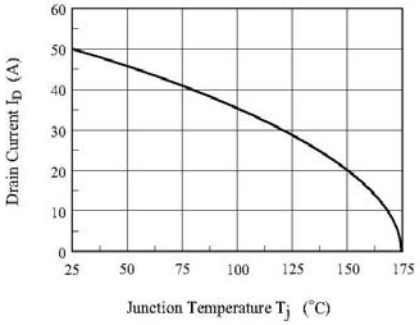
Q_g- V_{GS}



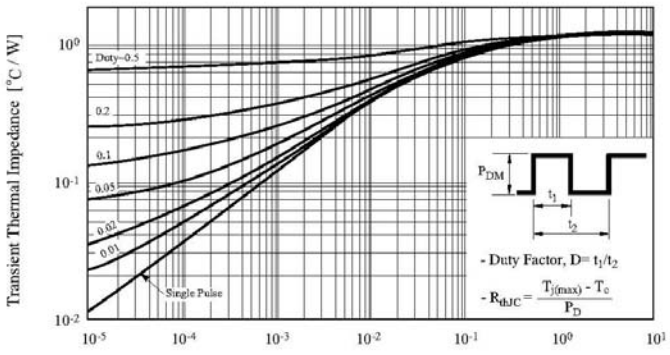
Safe Operation Area



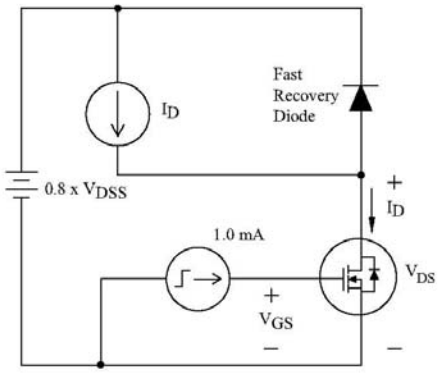
I_D - T_j

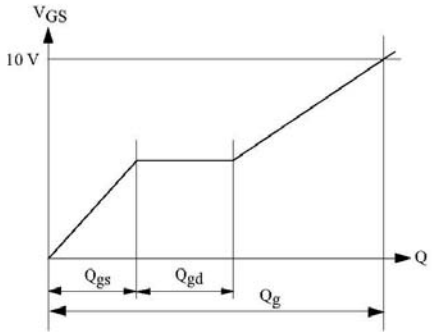


R_{th}

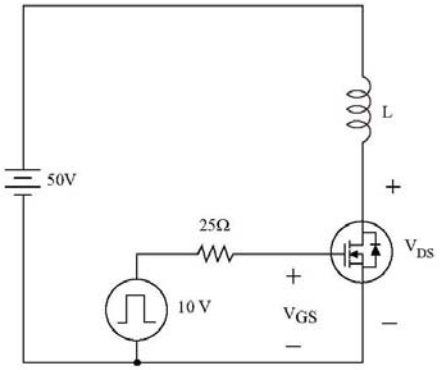


- Gate Charge

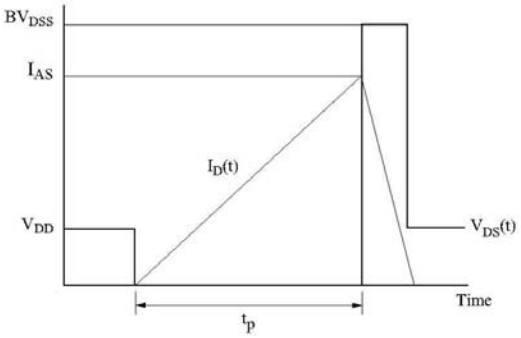




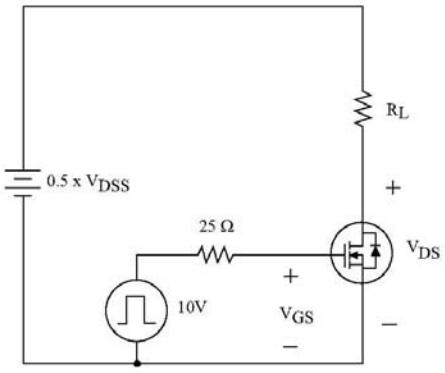
- Single Pulsed Avalanche Energy

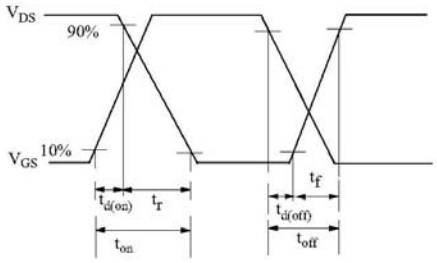


$$E_{AS} = \frac{1}{2} LI_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$



- Resistive Load Switching





- Source - Drain Diode Reverse Recovery and dv /dt