MOSFETs Silicon P-/N-Channel MOS

SSM6L820R

1. Applications

- Power Management Switches

2. Features

(1) AEC-Q101 qualified (Please see the orderable part number list)

(2) Low drain-source on-resistance

Q1 N-channel:

$R_{DS(ON)}$ = 39.1 mΩ (max) (@V_{GS} = 4.5 V)

$R_{DS(ON)}$ = 53 mΩ (max) (@V_{GS} = 2.5 V)

$R_{DS(ON)}$ = 82 mΩ (max) (@V_{GS} = 1.8 V)

Q2 P-channel:

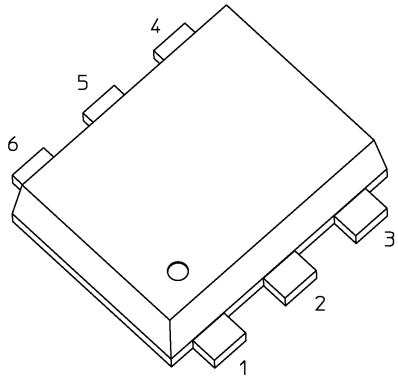
$R_{DS(ON)}$ = 45 mΩ (max) (@V_{GS} = -10 V)

$R_{DS(ON)}$ = 56 mΩ (max) (@V_{GS} = -4.5 V)

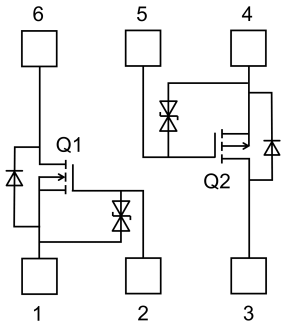
$R_{DS(ON)}$ = 76 mΩ (max) (@V_{GS} = -2.5 V)

$R_{DS(ON)}$ = 157 mΩ (max) (@V_{GS} = -1.8 V)

3. Packaging and Internal Circuit



TSOP6F



1: Source 1
2: Gate 1
3: Drain 2
4: Source 2
5: Gate 2
6: Drain 1

4. Orderable part number

Orderable part number	AEC-Q101		Note	
SSM6L820R,LF	—		General Use	
SSM6L820R,LXGF	YES	(Note 1)	Unintended Use	(Note 1)
SSM6L820R,LXHF	YES		Automotive Use	

Note 1: For more information, please contact our sales or use the inquiry form on our website.

Start of commercial production
2018-11

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5. Absolute Maximum Ratings (Note)

5.1. Q1 Absolute Maximum Ratings (Unless otherwise specified, T_a = 25 °C)

Characteristics			Symbol	Rating	Unit
Drain-source voltage			V_{DSS}	30	V
Gate-source voltage			V_{GSS}	+12/-8	
Drain current (DC)		(Note 1)	I_D	4	A
Drain current (pulsed)	(t ≤ 10 ms)	(Note 1), (Note 2)	I_{DP}	10	

Note 1: Ensure that the channel temperature does not exceed 150 °C.
Note 2: Pulse width (PW) ≤ 10 ms, duty ≤ 1 %

5.2. Q2 Absolute Maximum Ratings (Unless otherwise specified, T_a = 25 °C)

Characteristics			Symbol	Rating	Unit
Drain-source voltage			V_{DSS}	-20	V
Gate-source voltage			V_{GSS}	-12/+6	
Drain current (DC)		(Note 1)	I_D	-4	A
Drain current (pulsed)	(t ≤ 10 ms)	(Note 1), (Note 2)	I_{DP}	-10	

Note 1: Ensure that the channel temperature does not exceed 150 °C.
Note 2: Pulse width (PW) ≤ 10 ms, duty ≤ 1 %

5.3. Absolute Maximum Ratings (Unless otherwise specified, T_a = 25 °C) (Q1, Q2 Common)

Characteristics			Symbol	Rating	Unit
Power dissipation		(Note 1)	P_D	1.4	W
Power dissipation	(t ≤ 10 s)	(Note 1)		1.8	
Channel temperature			T_{ch}	150	°C
Storage temperature			T_{stg}	-55 to 150	

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings.
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 1: Device mounted on an FR4 board.(total rating)
(25.4 mm × 25.4 mm × 1.6 mm, Cu pad: 645 mm^2)

Note: The MOSFETs in this device are sensitive to electrostatic discharge. When handling this device, the worktables, operators, soldering irons and other objects should be protected against anti-static discharge.

Note: The channel-to-ambient thermal resistance, $R_{th(ch-a)}$, and the drain power dissipation, P_D, vary according to the board material, board area, board thickness and pad area. When using this device, be sure to take heat dissipation fully into account.

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6. Electrical Characteristics

6.1. Q1 Static Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	V_{DS} = 0 V, V_{GS} = 10/-8 V	—	—	±10	μA
Drain cut-off current		I_{DSS}	V_{DS} = 24 V, V_{GS} = 0 V	—	—	1	
Drain-source breakdown voltage		$V_{(BR)DSS}$	I_D = 1 mA, V_{GS} = 0 V	30	—	—	V
Drain-source breakdown voltage	(Note 1)	$V_{(BR)DSX}$	I_D = 1 mA, V_{GS} = -12 V	18	—	—	
Gate threshold voltage	(Note 2)	V_{th}	V_{DS} = 3 V, I_D = 1 mA	0.4	—	1	
Drain-source on-resistance	(Note 3)	$R_{DS(ON)}$	I_D = 2.0 A, V_{GS} = 4.5 V	—	30	39.1	mΩ
			I_D = 1.0 A, V_{GS} = 2.5 V	—	37	53	
			I_D = 0.5 A, V_{GS} = 1.8 V	—	46	82	

Note 1: If a reverse bias is applied between gate and source, this device enters $V_{(BR)DSX}$ mode. Note that the drain-source breakdown voltage is lowered in this mode.

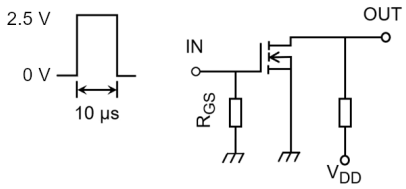
Note 2: Let V_{th} be the voltage applied between gate and source that causes the drain current (I_D) to below (1 mA for this device). Then, for normal switching operation, $V_{GS(ON)}$ must be higher than V_{th}, and $V_{GS(OFF)}$ must be lower than V_{th}. This relationship can be expressed as: $V_{GS(OFF)} < V_{th} < V_{GS(ON)}$.
Take this into consideration when using the device.

Note 3: Pulse measurement.

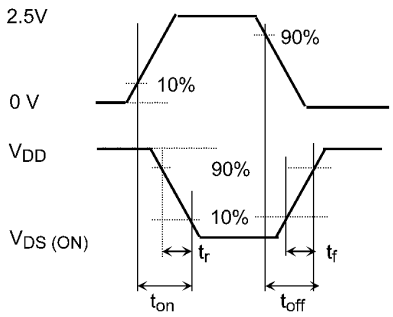
6.2. Q1 Dynamic Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Input capacitance	C_{iss}	V_{DS} = 15 V , V_{GS} = 0 V, f = 1 MHz	—	310	—	pF
Reverse transfer capacitance	C_{rss}		—	20	—	
Output capacitance	C_{oss}		—	52	—	
Switching time (turn-on time)	t_{on}	V_{DD} = 15 V, I_D = 1 A, V_{GS} = 0 to 2.5 V, R_{GS} = 4.7 Ω Duty ≤ 1%, V_{IN}: tr, tf < 5 ns Common source, see Chapter 6.3	—	26	—	ns
Switching time (turn-off time)	t_{off}		—	17.0	—	

6.3. Q1 Switching Time Test Circuit



Switching Time Test Circuit



Input Waveform/Output Waveform

6.4. Q1 Gate Charge Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Total gate charge (gate-source plus gate-drain)	Q_g	V_{DD} = 15 V, I_D = 4.0 A, V_{GS} = 4.5 V	—	3.2	—	nC
Gate-source charge 1	Q_{gs1}		—	0.5	—	
Gate-drain charge	Q_{gd}		—	0.7	—	

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6.5. Q1 Source-Drain Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Diode forward voltage	(Note 1)	V_{DSF}	I_{DR} = 4 A, V_{GS} = 0 V	—	0.8	1.2	V

Note 1: Pulse measurement.

6.6. Q2 Static Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	V_{DS} = 0 V, V_{GS} = +6/-10 V	—	—	±1	μA
Drain cut-off current		I_{DSS}	V_{DS} = -20 V, V_{GS} = 0 V	—	—	-1	
Drain-source breakdown voltage		$V_{(BR)DSS}$	I_D = -1 mA, V_{GS} = 0 V	-20	—	—	V
Drain-source breakdown voltage	(Note 1)	$V_{(BR)DSX}$	I_D = -1 mA, V_{GS} = 8 V	-12	—	—	
Gate threshold voltage	(Note 2)	V_{th}	V_{DS} = -3 V, I_D = -1 mA	-0.5	—	-1.2	
Drain-source on-resistance	(Note 3)	$R_{DS(ON)}$	I_D = -3.5 A, V_{GS} = -10 V	—	36	45	mΩ
			I_D = -3.0 A, V_{GS} = -4.5 V	—	44	56	mΩ
			I_D = -2.0 A, V_{GS} = -2.5 V	—	60	76	
			I_D = -0.5 A, V_{GS} = -1.8 V	—	83	157	

Note 1: If a reverse bias is applied between gate and source, this device enters $V_{(BR)DSX}$ mode. Note that the drain-source breakdown voltage is lowered in this mode.

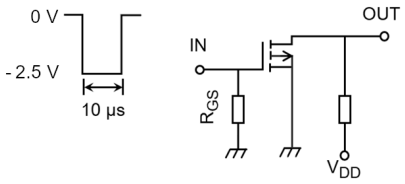
Note 2: Let V_{th} be the voltage applied between gate and source that causes the drain current (I_D) to below (-1 mA for this device). Then, for normal switching operation, $V_{GS(ON)}$ must be higher than V_{th}, and $V_{GS(OFF)}$ must be lower than V_{th}. This relationship can be expressed as: $V_{GS(OFF)} < V_{th} < V_{GS(ON)}$.
Take this into consideration when using the device.

Note 3: Pulse measurement.

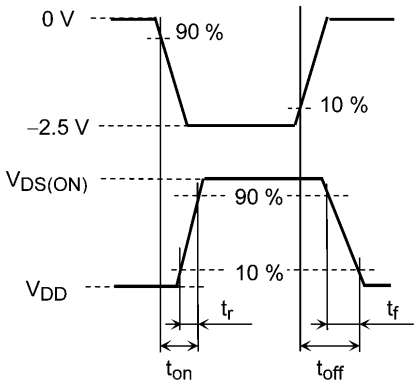
6.7. Q2 Dynamic Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Input capacitance	C_{iss}	V_{DS} = -10 V , V_{GS} = 0 V, f = 1 MHz	—	480	—	pF
Reverse transfer capacitance	C_{rss}		—	76	—	
Output capacitance	C_{oss}		—	90	—	
Switching time (turn-on time)	t_{on}	V_{DD} = -10 V, I_D = -0.5 A, V_{GS} = 0 to -2.5 V, R_{GS} = 4.7 Ω Duty ≤ 1 %, V_{IN}: t_r,t_f < 5 ns, Common source, see Chapter 6.8	—	21	—	ns
Switching time (turn-off time)	t_{off}		—	54	—	

6.8. Q2 Switching Time Test Circuit



Switching Time Test Circuit



Input Waveform/Output Waveform

6.9. Q2 Gate Charge Characteristics (Unless otherwise specified, T_a = 25 °C)

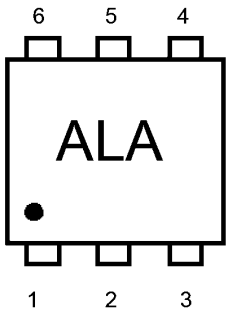
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Total gate charge (gate-source plus gate-drain)	Q_g	V_{DD} = -10 V, I_D = -4.0 A, V_{GS} = -4.5 V	—	6.7	—	nC
Gate-source charge 1	Q_{gs1}		—	0.95	—	
Gate-drain charge	Q_{gd}		—	1.50	—	

6.10. Q2 Source-Drain Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Diode forward voltage	(Note 1)	V_{DSF}	I_{DR} = 4 A, V_{GS} = 0 V	—	0.87	1.2	V

Note 1: Pulse measurement.

7. Marking



Marking

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8. Characteristics Curves (Note)

8.1. Q1 Characteristics Curves

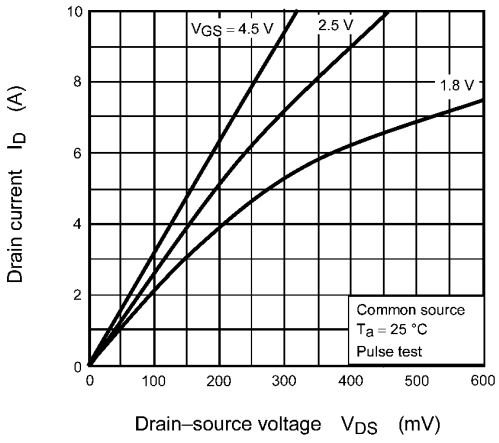


Fig. 8.1.1 I_D - V_{DS}

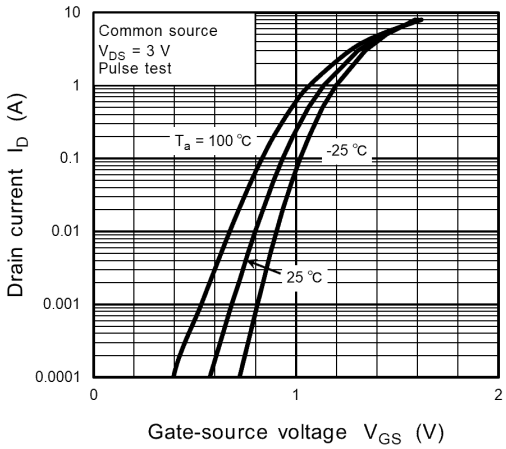


Fig. 8.1.2 I_D - V_{GS}

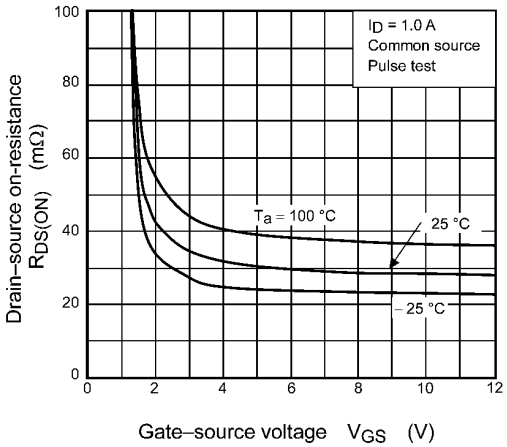


Fig. 8.1.3 $R_{DS(ON)}$ - V_{GS}

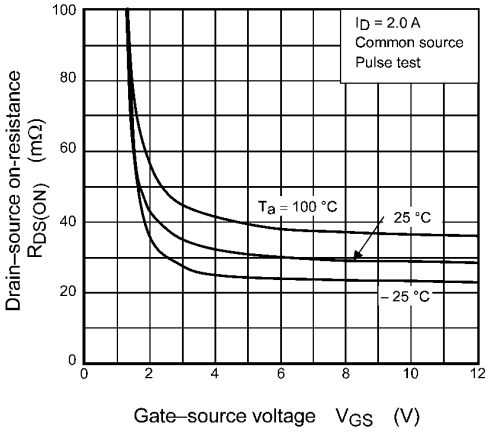


Fig. 8.1.4 $R_{DS(ON)}$ - V_{GS}

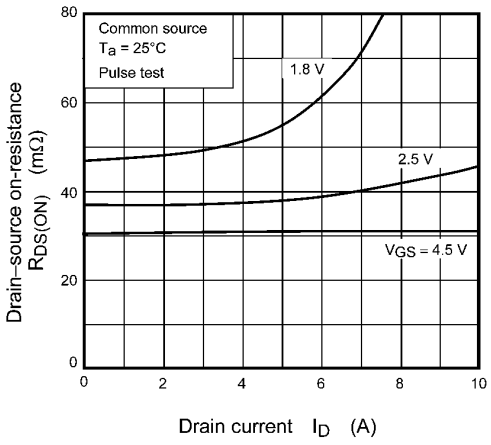


Fig. 8.1.5 $R_{DS(ON)}$ - I_D

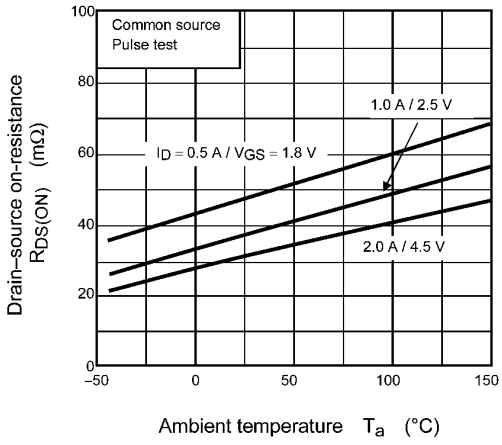


Fig. 8.1.6 $R_{DS(ON)}$ - T_a

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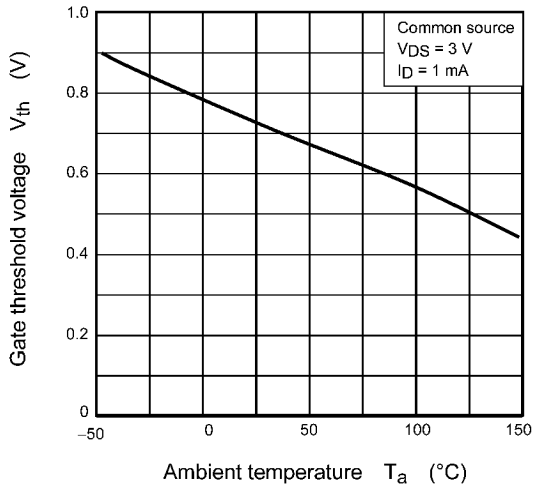


Fig. 8.1.7 V_{th} - T_a

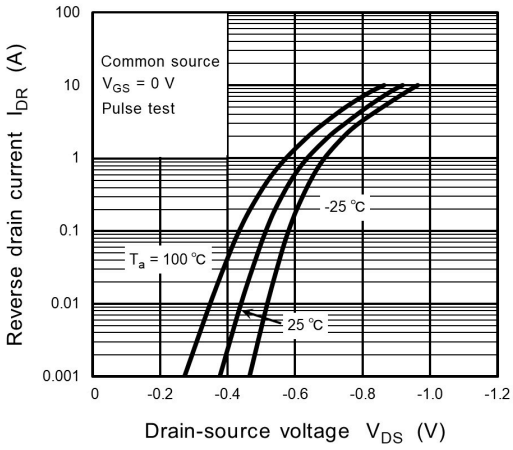


Fig. 8.1.8 I_{DR} - V_{DS}

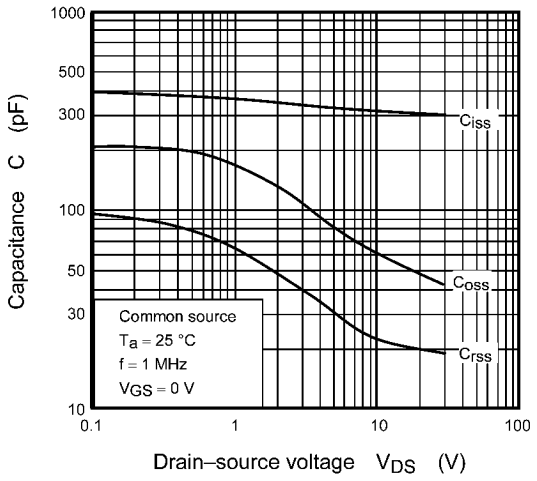


Fig. 8.1.9 C - V_{DS}

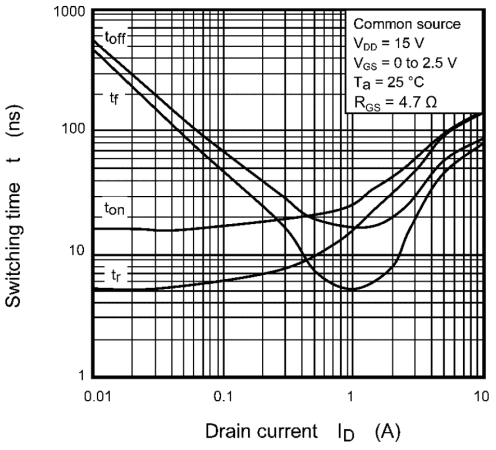


Fig. 8.1.10 t - I_D

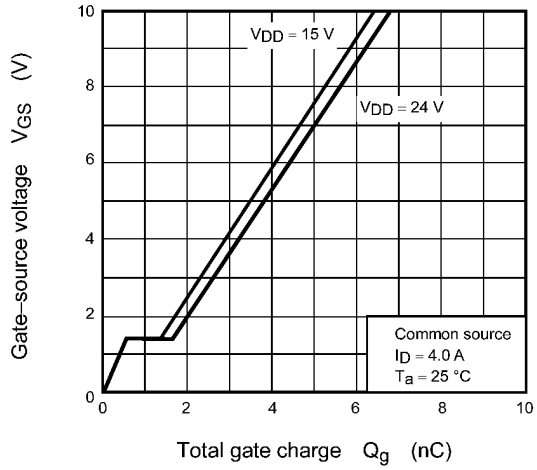


Fig. 8.1.11 Dynamic Input Characteristics

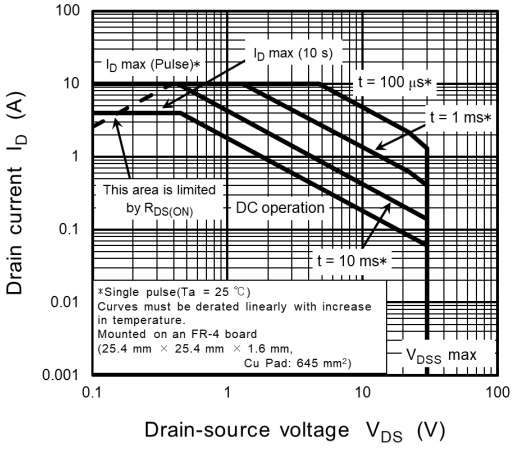


Fig. 8.1.12 Safe Operating Area

8.2. Q2 Characteristics Curves

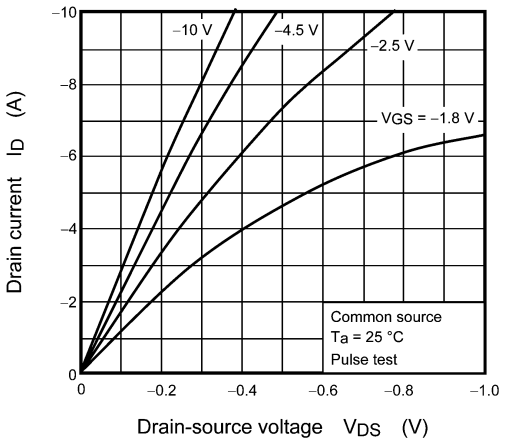


Fig. 8.2.1 I_D - V_{DS}

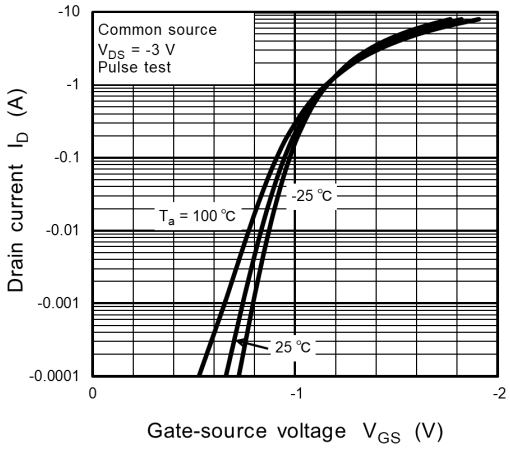


Fig. 8.2.2 I_D - V_{GS}

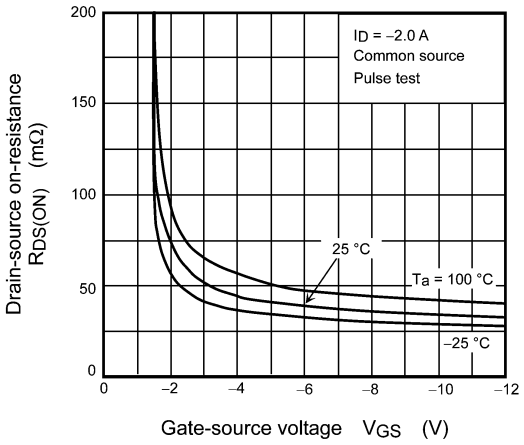


Fig. 8.2.3 $R_{DS(ON)}$ - V_{GS}

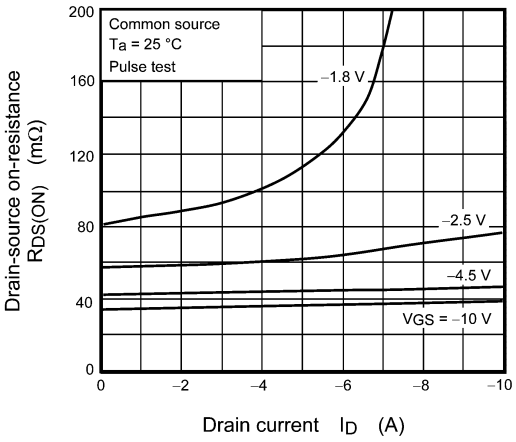


Fig. 8.2.4 $R_{DS(ON)}$ - I_D

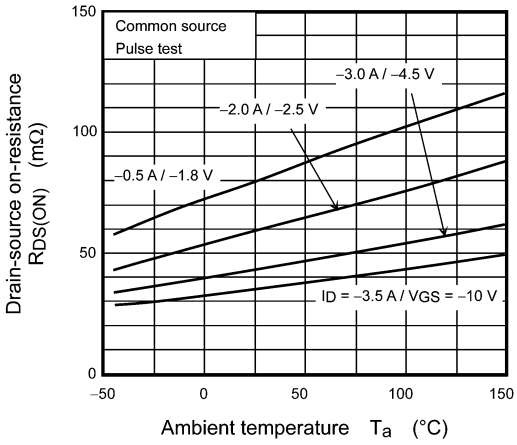


Fig. 8.2.5 $R_{DS(ON)}$ - T_a

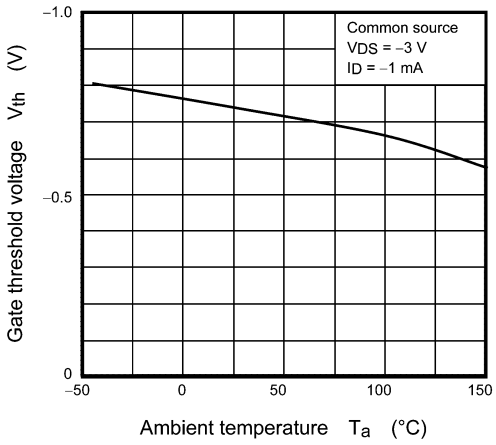


Fig. 8.2.6 V_{th} - T_a

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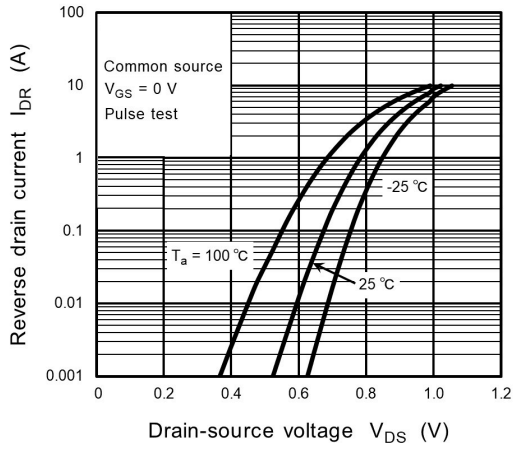


Fig. 8.2.7 I_{DR} - V_{DS}

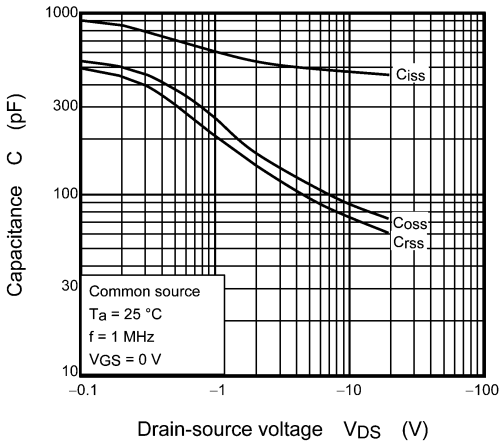


Fig. 8.2.8 C - V_{DS}

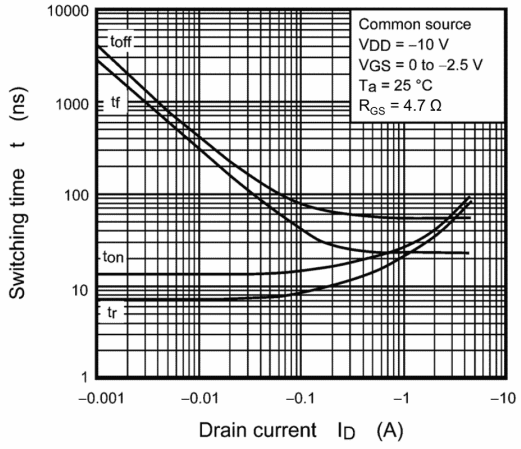


Fig. 8.2.9 t - I_D

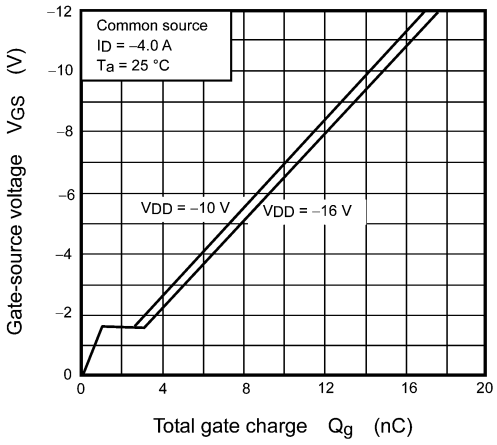


Fig. 8.2.10 Dynamic Input Characteristics

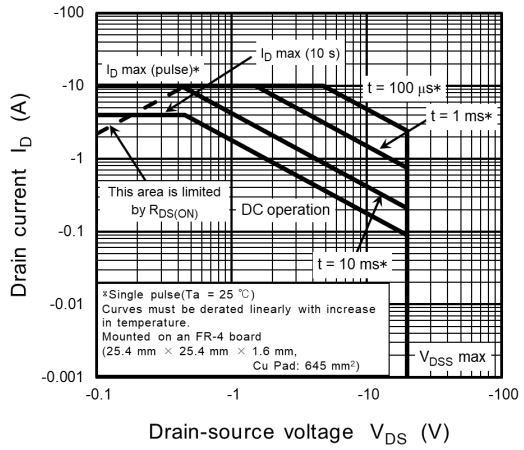


Fig. 8.2.11 Safe Operating Area

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8.3. Characteristics Curves (Q1, Q2 Common)

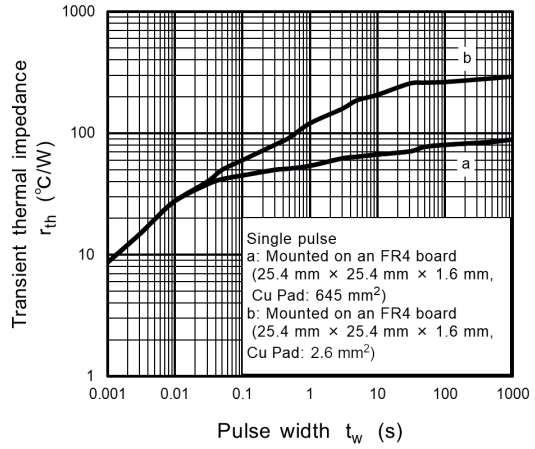


Fig. 8.3.1 r_{th} - t_w

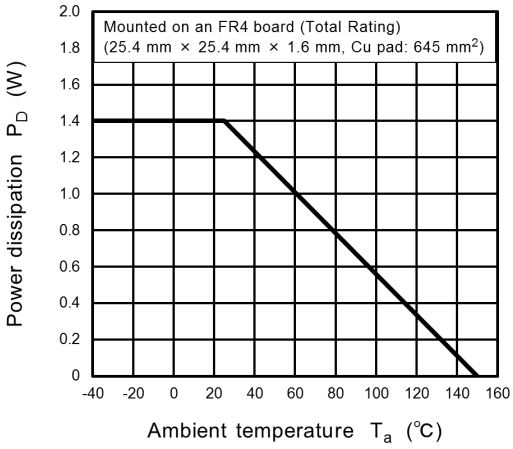


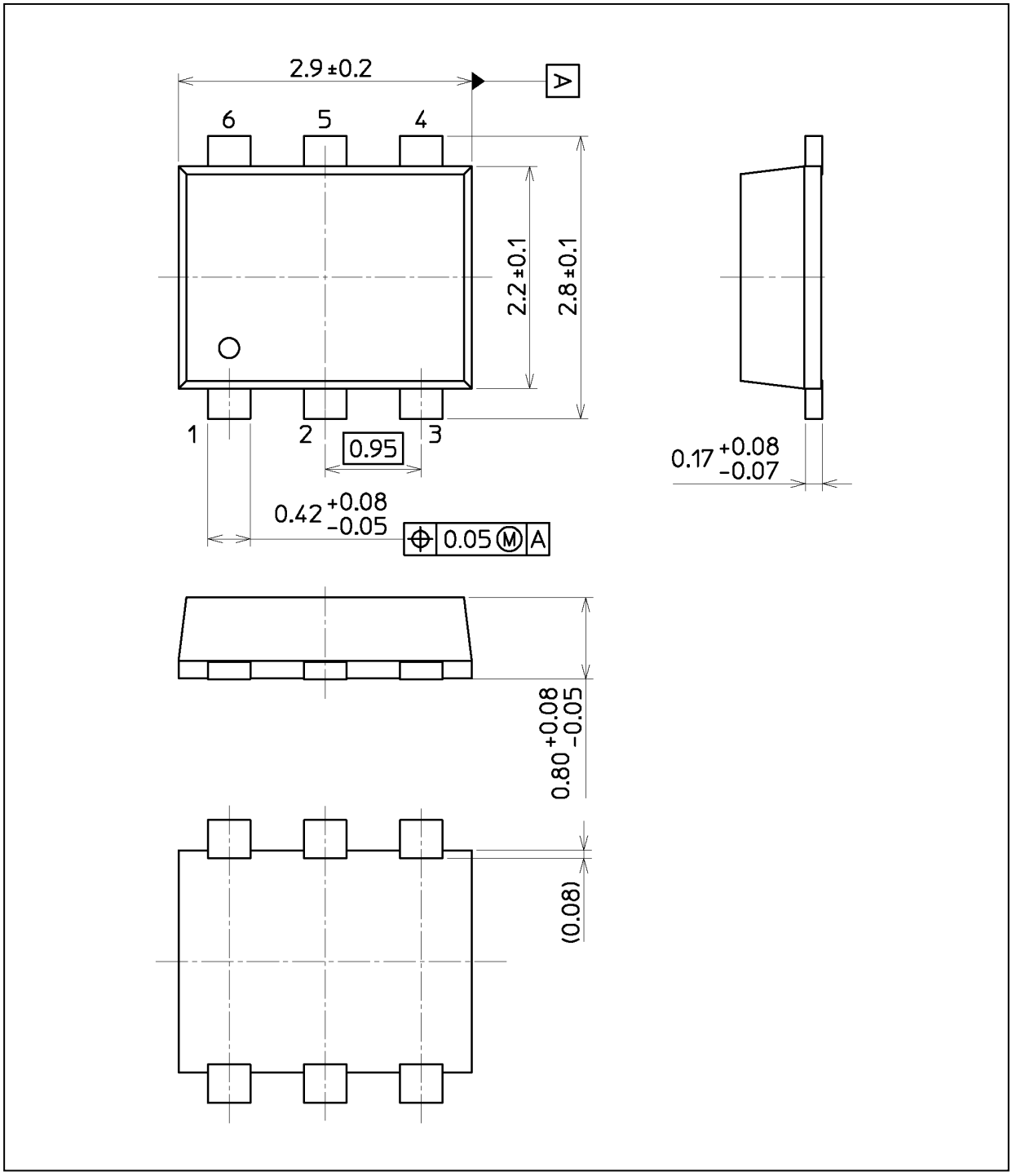
Fig. 8.3.2 P_D - T_a

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

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Package Dimensions

Unit: mm



Weight: 0.016 g (typ.)

Package Name(s)
Nickname: TSOP6F

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