MOSFETs Silicon P-/N-Channel MOS

SSM6L36TU

1. Applications

- High-Speed Switching

2. Features

(1) 1.5-V drive

(2) Low drain-source on-resistance

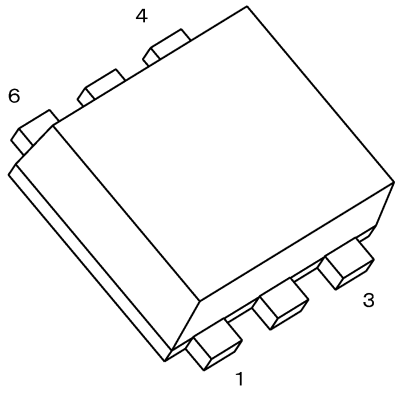
Q1 N-channel:

$R_{DS(ON)}$ = 1.52 mΩ (max) (@V_{GS} = 1.5 V)
$R_{DS(ON)}$ = 1.14 mΩ (max) (@V_{GS} = 1.8 V)
$R_{DS(ON)}$ = 0.85 mΩ (max) (@V_{GS} = 2.5 V)
$R_{DS(ON)}$ = 0.66 mΩ (max) (@V_{GS} = 4.5 V)
$R_{DS(ON)}$ = 0.63 mΩ (max) (@V_{GS} = 5.0 V)

Q2 P-channel:

$R_{DS(ON)}$ = 3.60 mΩ (max) (@V_{GS} = -1.5 V)
$R_{DS(ON)}$ = 2.70 mΩ (max) (@V_{GS} = -1.8 V)
$R_{DS(ON)}$ = 1.60 mΩ (max) (@V_{GS} = -2.8 V)
$R_{DS(ON)}$ = 1.31 mΩ (max) (@V_{GS} = -4.5 V)

3. Packaging and Internal Circuit



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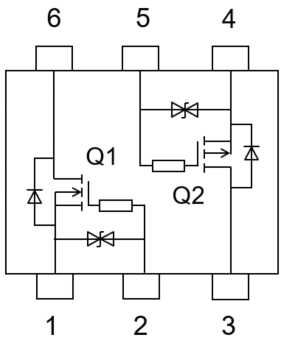


1: Source 1
2: Gate 1
3: Drain 2
4: Source 2
5: Gate 2
6: Drain 1

Start of commercial production
2008-06

4. Absolute Maximum Ratings (Note)

4.1. Q1 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}	±10	V
Drain current (DC)	I_D	500	mA
Drain current (pulsed)	I_{DP}	1000	

4.2. 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}	±8	V
Drain current (DC)	I_D	-330	mA
Drain current (pulsed)	I_{DP}	-660	

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

Characteristics	Note	Symbol	Rating	Unit
Power dissipation	(Note 1)	P_D	500	mW
Channel temperature		T_{ch}	150	°C
Storage temperature		T_{stg}	-55 to 150	°C

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: This transistor is sensitive to electrostatic discharge and should be handled with care.

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.

5. Electrical Characteristics

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

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	V_{GS} = ±10 V, V_{DS} = 0 V	—	—	±1	μA
Drain cut-off current		I_{DSS}	V_{DS} = 20 V, V_{GS} = 0 V	—	—	1	μA
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} = -10 V	12	—	—	
Gate threshold voltage	(Note 2)	V_{th}	V_{DS} = 3 V, I_D = 1 mA	0.35	—	1.0	V
Drain-source on-resistance	(Note 3)	$R_{DS(ON)}$	I_D = 200 mA, V_{GS} = 5.0 V	—	0.46	0.63	Ω
			I_D = 200 mA, V_{GS} = 4.5 V	—	0.51	0.66	
			I_D = 200 mA, V_{GS} = 2.5 V	—	0.66	0.85	
			I_D = 100 mA, V_{GS} = 1.8 V	—	0.81	1.14	
			I_D = 50 mA, V_{GS} = 1.5 V	—	0.95	1.52	
Forward transfer admittance	(Note 3)	$\|Y_{fs}\|$	V_{DS} = 3 V, I_D = 200 mA	420	840	—	mS

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.

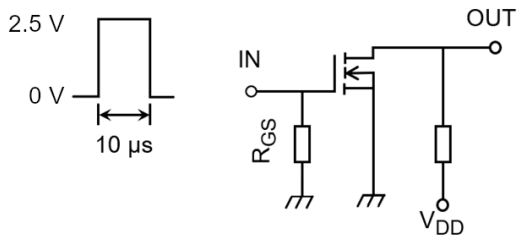
Note 2: Let V_{th} be the voltage applied between gate and source that causes the drain current (I_D) to below (1 mA for this device). Then, for normal switching operation, $V_{GS(ON)}$ must be higher than V_{th}, and $V_{GS(OFF)}$ must be lower than V_{th}. This relationship can be expressed as: $V_{GS(OFF)}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

Note 3: Pulse measurement.

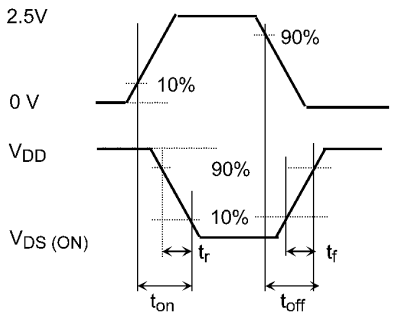
5.2. Q1 Dynamic Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Input capacitance	C_{iss}	V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MHz	—	46	—	pF
Reverse transfer capacitance	C_{rss}		—	7.3	—	
Output capacitance	C_{oss}		—	10.8	—	
Switching time (turn-on time)	t_{on}	V_{DD} = 10 V, I_D = 200 mA V_{GS} = 0 to 2.5 V, R_{GS} = 50 Ω Duty ≤ 1 %, Input: t_r, t_f < 5 ns, Common source, See Chapter 5.3.	—	30	—	ns
Switching time (turn-off time)	t_{off}		—	75	—	

5.3. Q1 Switching Time Test Circuit



Switching Time Test Circuit



Input Waveform/Output Waveform

5.4. 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_{DS} = 10 V, I_D = 0.5 A, V_{GS} = 4.0 V	—	1.23	—	nC
Gate-source charge	Q_{gs}		—	0.60	—	
Gate-drain charge	Q_{gd}		—	0.63	—	

5.5. 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} = 0.5 A, V_{GS} = 0 V	—	0.88	1.2	V

Note 1: Pulse measurement.

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

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	V_{GS} = ±8 V, V_{DS} = 0 V	—	—	±1	μA
Drain cut-off current		I_{DSS}	V_{DS} = -16 V, V_{GS} = 0 V	—	—	-10	
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	-0.3	—	-1.0	V
Drain-source on-resistance	(Note 3)	$R_{DS(ON)}$	I_D = -1000 mA, V_{GS} = -4.5 V	—	0.95	1.31	Ω
			I_D = -80 mA, V_{GS} = -2.8 V	—	1.22	1.60	
			I_D = -40 mA, V_{GS} = -1.8 V	—	1.80	2.70	
			I_D = -0.5 A, V_{GS} = -1.8 V	—	2.23	3.60	
Forward transfer admittance	(Note 3)	$\|Y_{fs}\|$	V_{DS} = -3 V, I_D = -100 mA	190	—	—	mS

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.

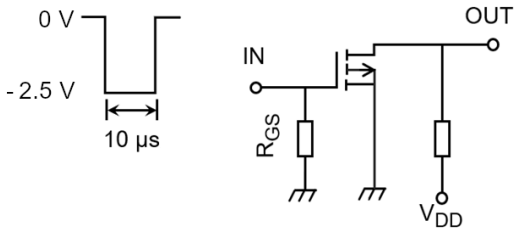
Note 2: Let V_{th} be the voltage applied between gate and source that causes the drain current (I_D) to below (-1 mA for this device). Then, for normal switching operation, $V_{GS(ON)}$ must be higher than V_{th}, and $V_{GS(OFF)}$ must be lower than V_{th}. This relationship can be expressed as: $V_{GS(OFF)}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

Note 3: Pulse measurement.

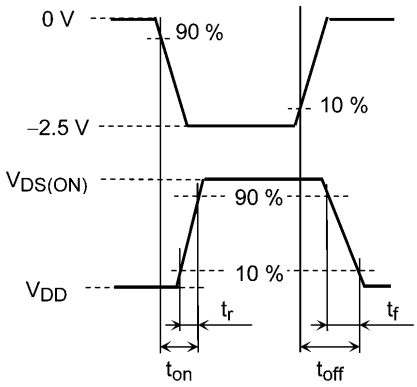
5.7. Q2 Dynamic Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Input capacitance	C_{iss}	V_{DS} = -10 V, V_{GS} = 0 V, f = 1 MHz	—	43	—	pF
Reverse transfer capacitance	C_{rss}		—	6.1	—	
Output capacitance	C_{oss}		—	10.3	—	
Switching time (turn-on time)	t_{on}	V_{DD} = -10 V, I_D = -100 mA, V_{GS} = 0 V to -2.5 V, R_{GS} = 50 Ω, Duty ≤ 1 %, Input: t_r, t_f < 5 ns, Common source, See Chapter 5.3.	—	90	—	ns
Switching time (turn-off time)	t_{off}		—	200	—	

5.8. Q2 Switching Time Test Circuit



Switching Time Test Circuit



Input Waveform/Output Waveform

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

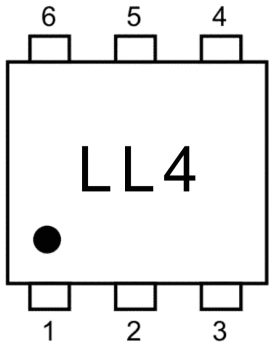
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Total gate charge (gate-source plus gate-drain)	Q_g	V_{DS} = -10 V, I_{DS} = -330 mA, V_{GS} = -4.0 V	—	1.2	—	nC
Gate-source charge	Q_{gs}		—	0.85	—	
Gate-drain charge	Q_{gd}		—	0.35	—	

5.10. 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} = 330 mA, V_{GS} = 0 V	—	0.88	1.2	V

Note 1: Pulse measurement.

6. Marking



7. Characteristics Curves (Note)

7.1. Q1 (N-ch MOSFET) Characteristics Curves

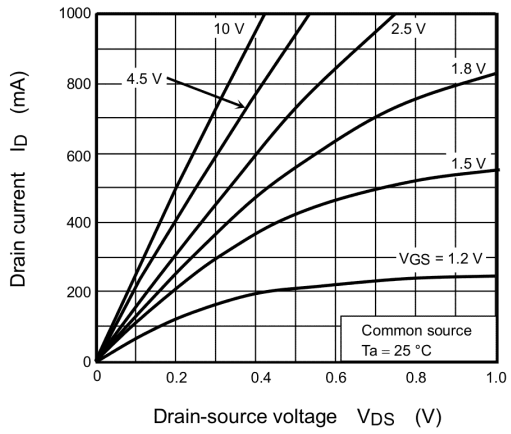


Fig. 7.1.1 I_D - V_{DS}

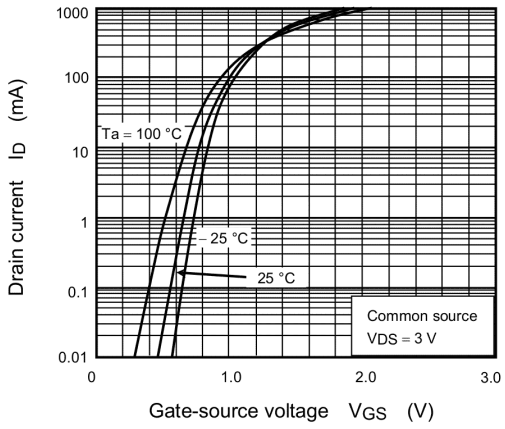


Fig. 7.1.2 I_D - V_{GS}

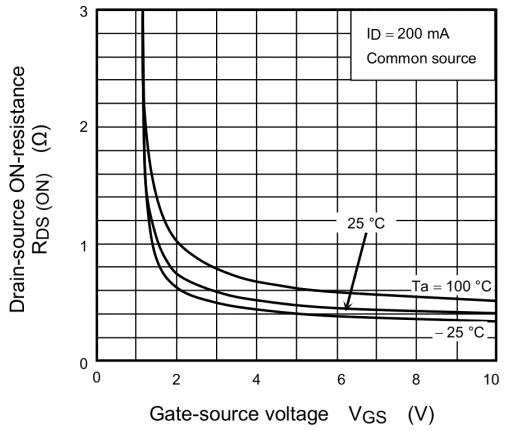


Fig. 7.1.3 $R_{DS(ON)}$ - V_{GS}

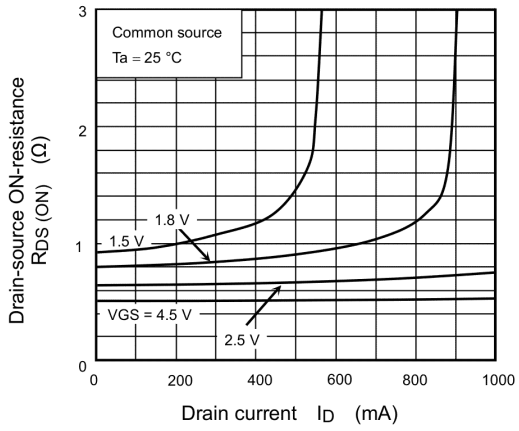


Fig. 7.1.4 $R_{DS(ON)}$ - I_D

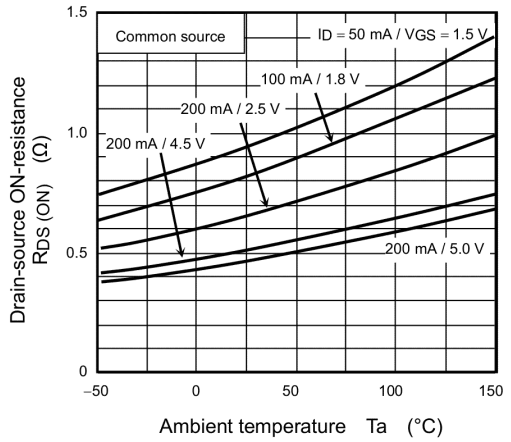


Fig. 7.1.5 $R_{DS(ON)}$ - T_a

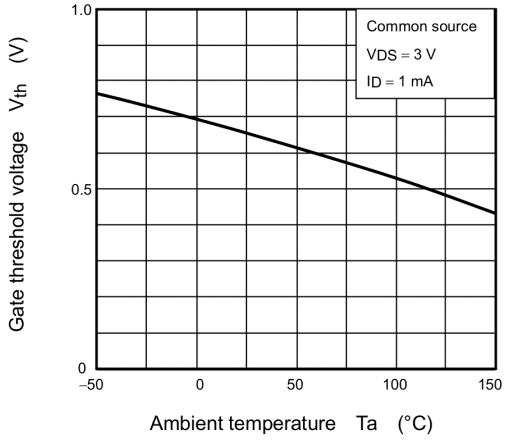


Fig. 7.1.6 V_{th} - T_a

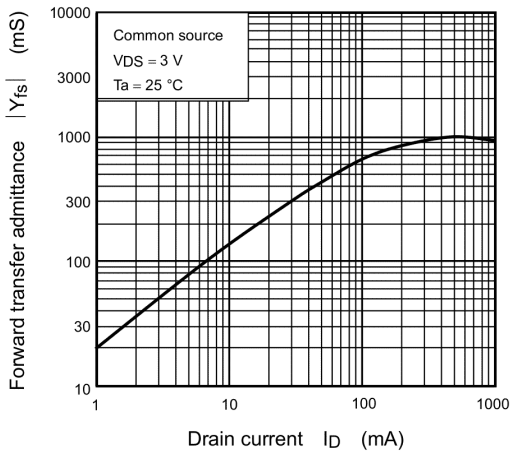


Fig. 7.1.7 $|Y_{fs}|$ - I_D

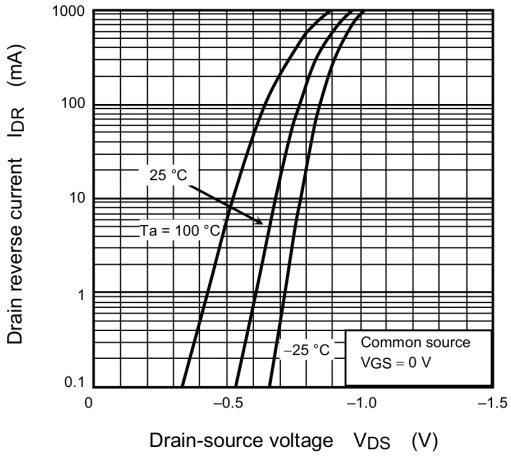


Fig. 7.1.8 I_{DR} - V_{DS}

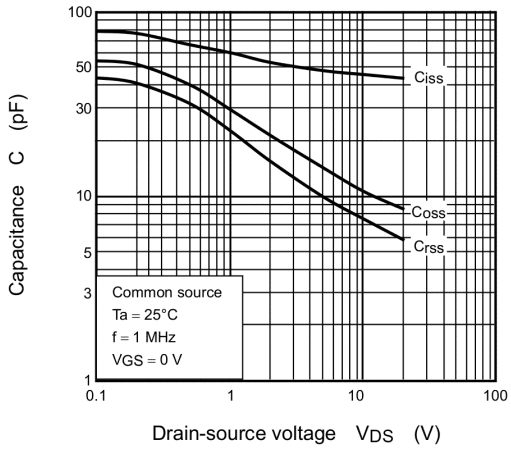


Fig. 7.1.9 C - V_{DS}

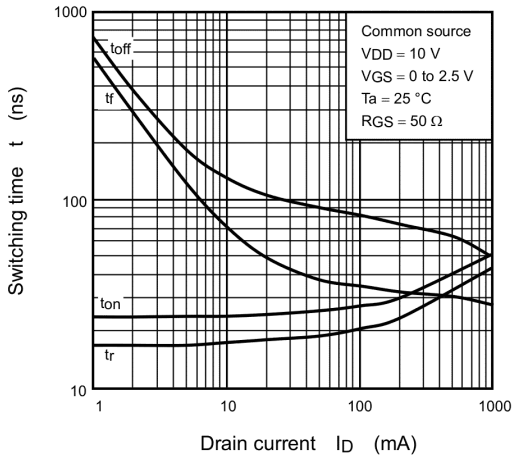


Fig. 7.1.10 t - I_D

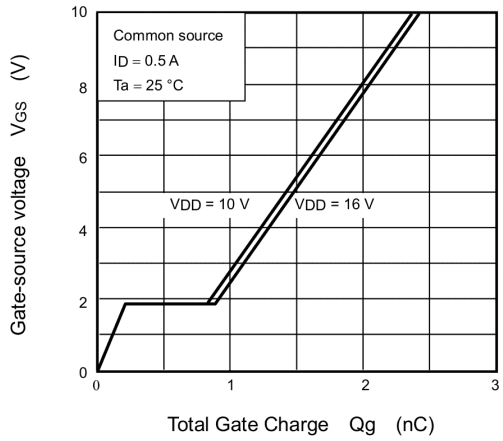


Fig. 7.1.11 Dynamic Input Characteristics

7.2. Q2 (P-ch MOSFET) Characteristics Curves

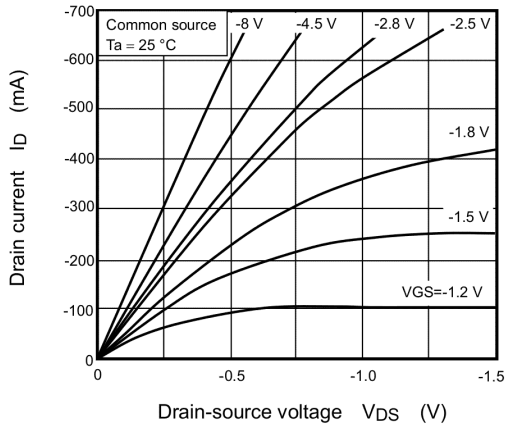


Fig. 7.2.1 I_D - V_{DS}

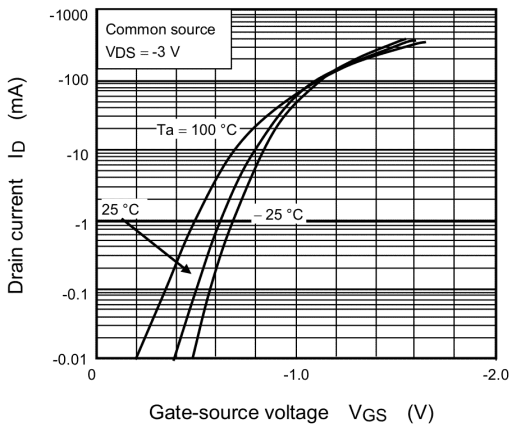


Fig. 7.2.2 I_D - V_{GS}

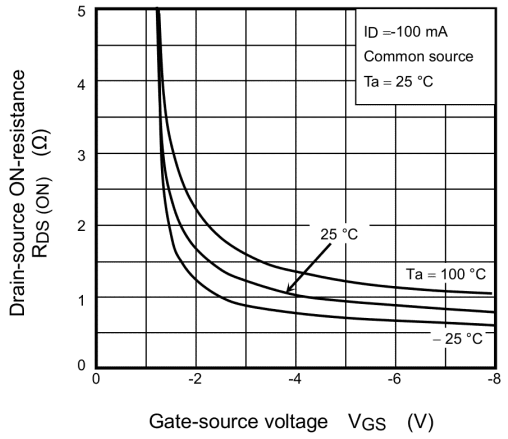


Fig. 7.2.3 $R_{DS(ON)}$ - V_{GS}

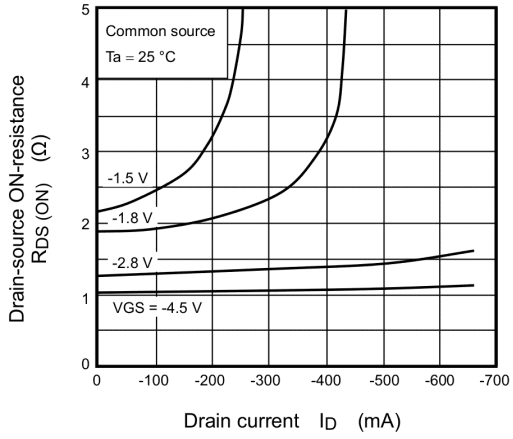


Fig. 7.2.4 $R_{DS(ON)}$ - I_D

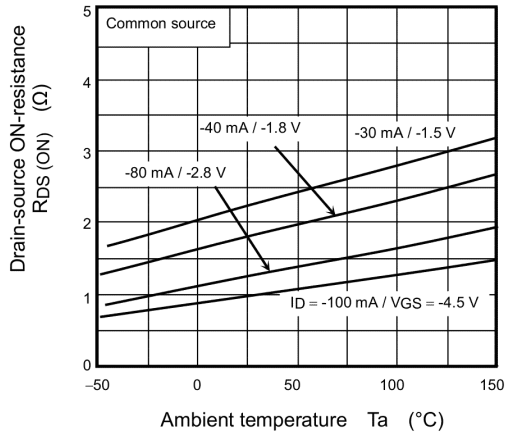


Fig. 7.2.5 $R_{DS(ON)}$ - T_a

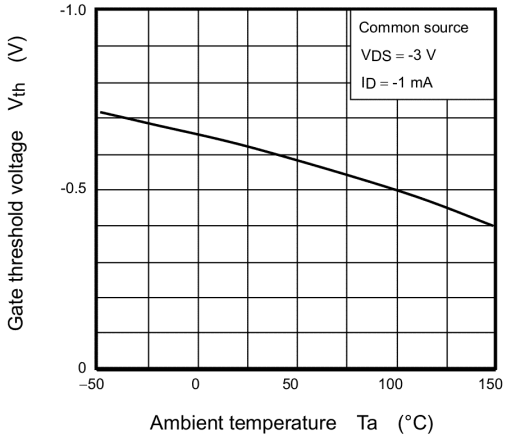


Fig. 7.2.6 V_{th} - T_a

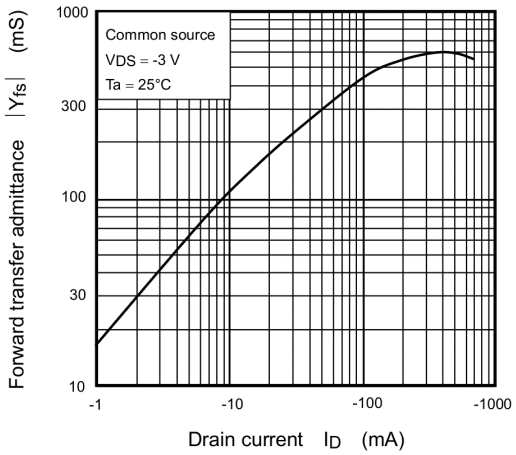


Fig. 7.2.7 $|Y_{fs}|$ - I_D

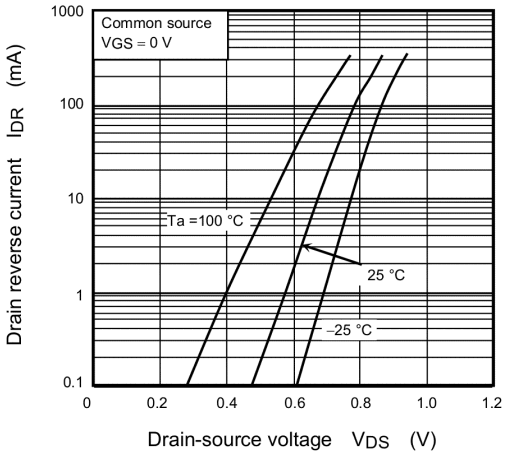


Fig. 7.2.8 I_{DR} - V_{DS}

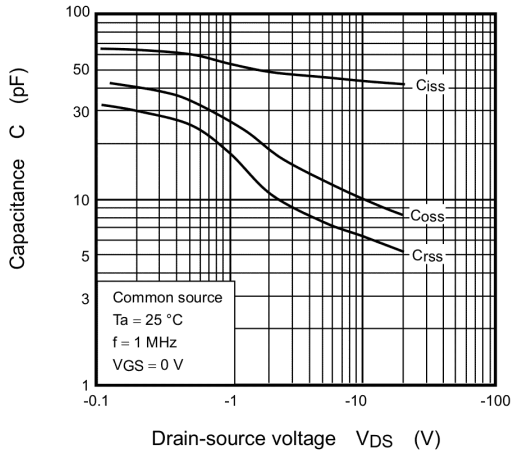


Fig. 7.2.9 C - V_{DS}

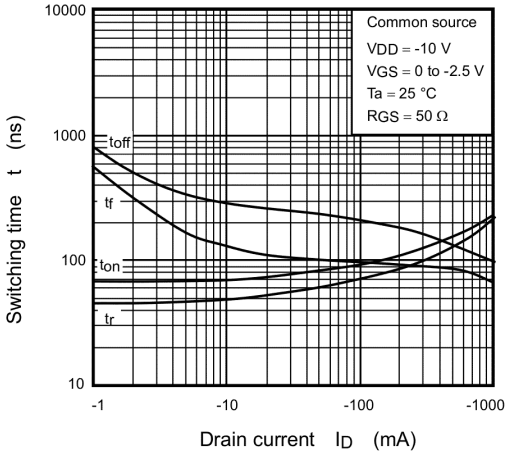


Fig. 7.2.10 t - I_D

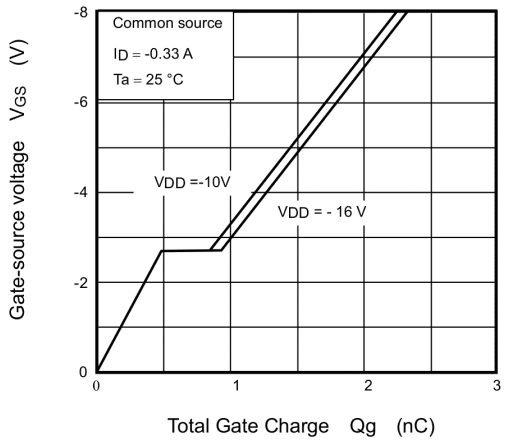


Fig. 7.2.11 Dynamic Input Characteristics

7.3. Characteristics Curves (Q1, Q2 Common)

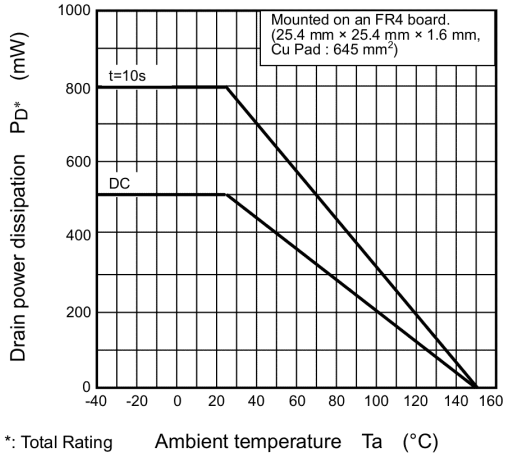
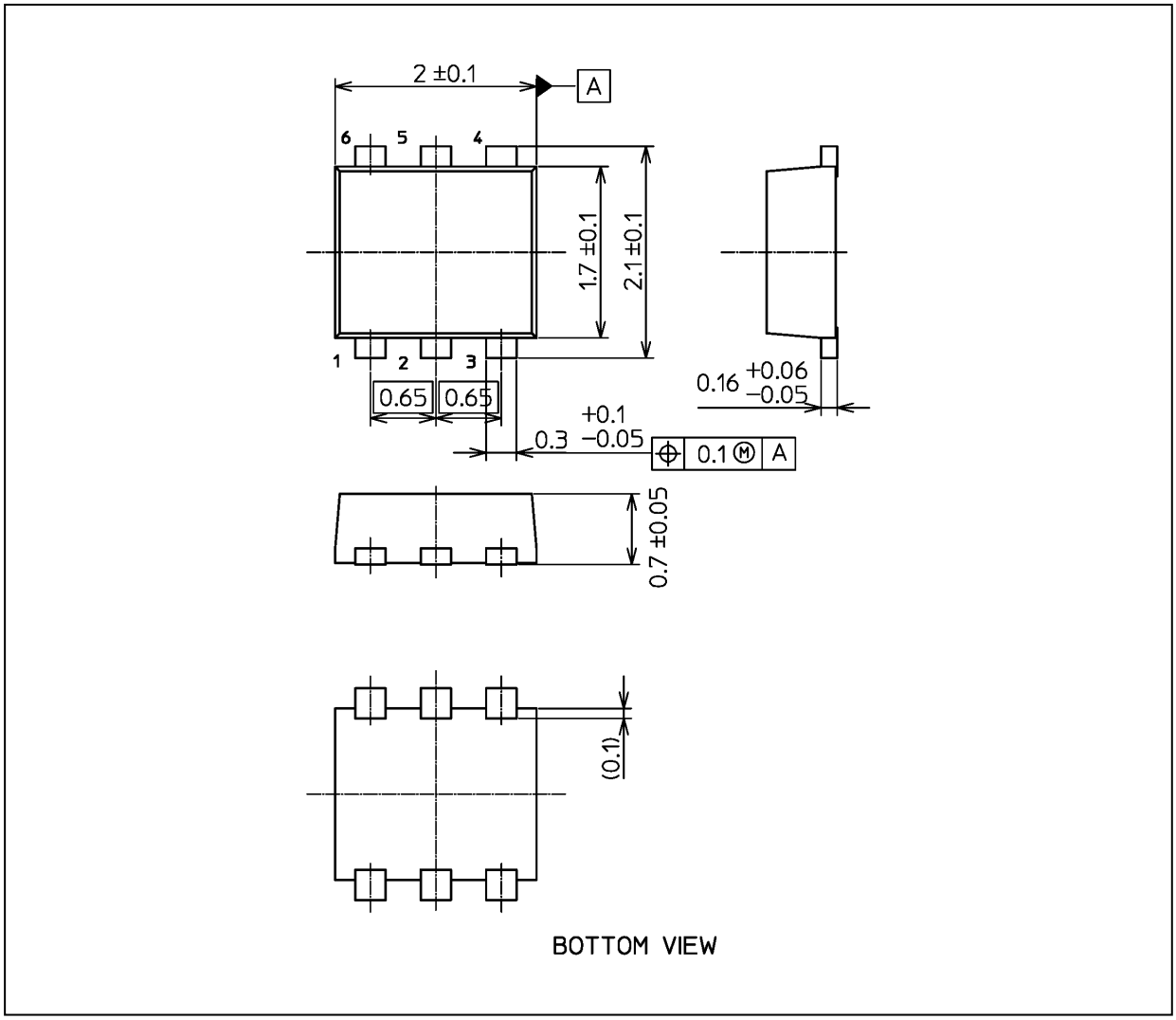


Fig. 7.3.1 P_D - T_a

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

Package Dimensions

Unit: mm



Weight: 7.0 mg (typ.)

Package Name(s)
Nickname: UF6

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