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FSUSB42 — Low-Power, Two-Port, High-Speed, USB2.0 (480Mbps) UART Switch

Features

- Low On Capacitance: 3.7 pF Typical
- Low On Resistance: 3.9 Ω Typical
- Low Power Consumption: 1 µA Maximum
  - 15 µA Maximum I_{CCT} over an Expanded Voltage Range (V_{IN}=1.8 V, V_{CC}=4.4 V)
- Wide -3 db Bandwidth: > 720 MHz
- Packaged in:
  - 10-Lead UMLP (1.4 x 1.8 mm)
  - 10-Lead MSOP
- 8 kV ESD Rating, >16 kV Power / GND ESD Rating
- Over-Voltage Tolerance (OVT) on all USB Ports Up to 5.25 V without External Components

Applications

- Cell phone, PDA, Digital Camera, and Notebook
- LCD Monitor, TV, and Set-Top Box

Description

The FSUSB42 is a bi-directional, low-power, two-port, high-speed, USB2.0 switch. Configured as a double-pole, double-throw switch (DPDT) switch, it is optimized for switching between any combination of high-speed (480 Mbps) or Full-Speed (12 Mbps) sources.

The FSUSB42 is compatible with the requirements of USB2.0 and features an extremely low on capacitance (C_{ON}) of 3.7 pF. The wide bandwidth of this device (720 MHz) exceeds the bandwidth needed to pass the third harmonic, resulting in signals with minimum edge and phase distortion. Superior channel-to-channel crosstalk also minimizes interference.

The FSUSB42 contains special circuitry on the switch I/O pins for applications where the V_{CC} supply is powered-off (V_{CC}=0 V), which allows the device to withstand an over-voltage condition. This device is designed to minimize current consumption even when the control voltage applied to the SEL pin is lower than the supply voltage (V_{CC}). This feature is especially valuable to ultra-portable applications, such as cell phones, allowing for direct interface with the general-purpose I/Os of the baseband processor. Other applications include switching and connector sharing in portable cell phones, PDAs, digital cameras, printers, and notebook computers.

Ordering Information

Part Number	Top Mark	Operating Temperature Range	Package
FSUSB42UMX	HE	-40 to +85°C	10-Lead, Quad, Ultrathin Molded Leadless Package (UMLP), 1.4 x 1.8 mm
FSUSB42MUX	FSUSB42	-40 to +85°C	10-Lead, Molded Small-Outline Package (MSOP) JEDEC MO-187, 3.0 mm Wide

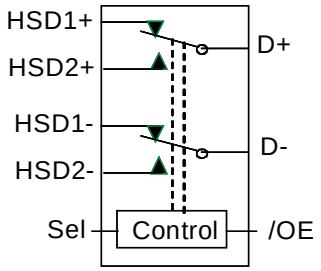


Figure 1. Analog Symbol

October-2017, Rev. 2

Publication Order Number:
FSUSB42/D

Pin Assignments

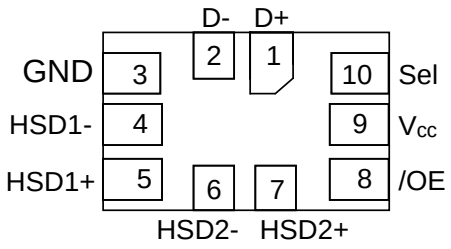


Figure 2. 10-Lead UMLP (Top-Through View)

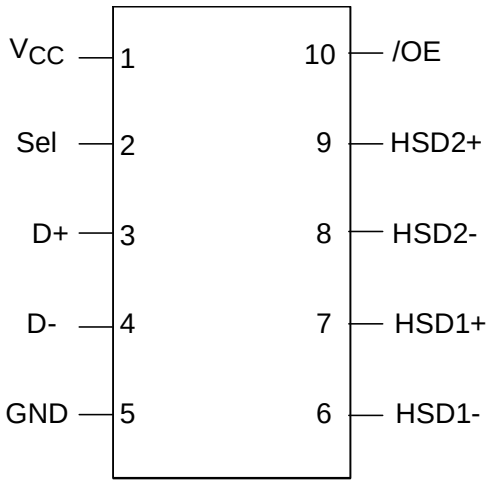


Figure 3. 10-Lead MSOP (Top-Through View)

Pin Definitions

UMLP Pin#	MSOP Pin#	Name	Description
1	3	D+	Common USB Data Bus
2	4	D-	Common USB Data Bus
3	5	GND	Ground
4	6	HSD1-	Multiplexed Source Input 1
5	7	HSD1+	Multiplexed Source Input 1
6	8	HSD2-	Multiplexed Source Input 2
7	9	HSD2+	Multiplexed Source Input 2
8	10	/OE	Switch Enable
9	1	V_{CC}	Supply Voltage
10	2	Sel	Switch Select

Truth Table

SEL	/OE	Function
X	HIGH	Disconnect
LOW	LOW	D+= HSD1+, D-= HSD1-
HIGH	LOW	D+= HSD2+, D-= HSD2-

Notes:
1. LOW $\leq V_{IL}$.
2. HIGH $\geq V_{IH}$.
3. X=Don't Care.

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter		Min.	Max.	Unit
V_{CC}	Supply Voltage		-0.5	5.6	V
V_{CNTRL}	DC Input Voltage (S, /OE)[4]		-0.5	V_{CC}	V
V_{SW}	DC Switch I/O Voltage[4] (VCC=0V)		-0.50	5.25	V
I_{IK}	DC Input Diode Current		-50		mA
I_{OUT}	DC Output Current			100	mA
T_{STG}	Storage Temperature		-65	+150	°C
MSL	Moisture Sensitivity Level (JEDEC J-STD-020A)			1	Level
ESD	Human Body Model, JEDEC: JESD22-A114	All Pins	7		kV
		I/O to GND	8		
		Power to GND	16		
		D+/D-	9		
	IEC 61000-4-2 System on USB Connector Pins D+ & D-	Air Discharge	15		
		Contact	8		
	Charged Device Model, JEDEC: JESD22-C101		2		

Note:

4. The input and output negative ratings may be exceeded if the input and output diode current ratings are observed.

Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. ON Semiconductor does not recommend exceeding them or designing to Absolute Maximum Ratings.

Symbol	Parameter	Min.	Max.	Unit
V_{CC}	Supply Voltage	2.4	4.4	V
V_{CNTRL}	Control Input Voltage (S, /OE)[5]	0	V_{CC}	V
V_{SW}	Switch I/O Voltage	-0.5	4.5	V
T_A	Operating Temperature	-40	+85	°C

Note:

5. The control input must be held HIGH or LOW and it must not float.

DC Electrical Characteristics

All typical value are at T_A=25°C unless otherwise specified.

Symbol	Parameter	Condition	V_{CC} (V)	T_A=- 40°C to +85°C			Unit
				Min.	Typ.	Max.	
V_{IK}	Clamp Diode Voltage	I_{IN}=-18mA	3.0			-1.2	V
V_{IH}	Input Voltage High		2.4 to 3.6	1.3			V
			4.3	1.7			
V_{IL}	Input Voltage Low		2.4 to 3.6			0.5	V
			4.3			0.7	
I_{IN}	Control Input Leakage	V_{SW}=0 to V_{CC}	0 to 4.3	-1		1	µA
I_{OZ}	Off State Leakage	0 ≤ Dn, HSD1n, HSD2n ≤ 3.6 V	4.3	-2		2	µA
I_{OFF}	Power-Off Leakage Current (All I/O Ports)	V_{SW}=0 V to 4.3 V, V_{CC}=0 V Figure 5	0	-2		2	µA
R_{ON}	HS Switch On Resistance(6)	V_{SW}=0.4 V, I_{ON}=-8 mA Figure 4	2.4		4.5	7.5	Ω
			3.0		3.9	6.5	
ΔR_{ON}	HS Delta R_{ON}(7)	V_{SW}=0.4 V, I_{ON}=-8 mA	3.0		0.65		Ω
I_{CC}	Quiescent Supply Current	V_{CNTRL}=0 or V_{CC}, I_{OUT}=0	4.3			1	µA
I_{CCT}	Increase in I_{CC} Current per Control Voltage and V_{CC}	V_{CNTRL}=2.6 V, V_{CC}=4.3 V	4.3			10	µA
		V_{CNTRL}=1.8 V, V_{CC}=4.3 V	4.3			15	µA

Notes:

6. Measured by the voltage drop between HSDn and Dn pins at the indicated current through the switch. On resistance is determined by the lower of the voltage on the two (HSDn or Dn ports).
7. Guaranteed by characterization.

AC Electrical Characteristics

All typical value are for V_{CC}=3.3 V at T_A=25°C unless otherwise specified.

Symbol	Parameter	Condition	V_{CC} (V)	T_A=- 40°C to +85°C			Unit
				Min.	Typ.	Max.	
t_{ON}	Turn-On Time S, /OE to Output	R_L=50 Ω, C_L=5 pF, V_{SW}=0.8 V, Figure 6, Figure 7	2.4		24	40	ns
			3.0 to 3.6		13	30	
t_{OFF}	Turn-Off Time S, /OE to Output	R_L=50 Ω, C_L=5 pF, V_{SW}=0.8 V, Figure 6, Figure 7	2.4		15	35	ns
			3.0 to 3.6		12	25	
t_{PD}	Propagation Delay[8]	C_L=5 pF, R_L=50 Ω, Figure 6, Figure 8	3.3		0.25		ns
t_{BBM}	Break-Before-Make	R_L=50 Ω, C_L=5 pF, V_{SW1}=V_{SW2}=0.8 V, Figure 10	2.4	2.0		10	ns
			3.0 to 3.6	2.0		6.5	
O_{IRR}	Off Isolation	R_L=50 Ω, f=240 MHz, Figure 12	3.0 to 3.6		-30		dB
Xtalk	Non-Adjacent Channel Crosstalk	R_L=50 Ω, f=240 MHz, Figure 13	3.0 to 3.6		-45		dB
BW	-3db Bandwidth	R_L=50 Ω, C_L=0 pF, Figure 11	3.0 to 3.6		720		MHz
		R_L=50 Ω, C_L=5 pF, Figure 11			550		MHz

Note:

8. Guaranteed by characterization.

USB High-Speed-Related AC Electrical Characteristics

All typical value are for V_{CC}=3.3 V at T_A=25°C unless otherwise specified.

Symbol	Parameter	Condition	V_{CC} (V)	T_A=- 40°C to +85°C			Unit
				Min.	Typ.	Max.	
$t_{SK(P)}$	Skew of Opposite Transitions of the Same Output[(9)]	C_L=5 pF, R_L=50 Ω, Figure 9			20		ps
t_J	Total Jitter[(9)]	R_L=50 Ω, C_L=5 pF, t_R=t_F=500 ps (10-90%) at 480 Mbps (PRBS=2^{15} – 1)			200		ps

Note:

9. Guaranteed by characterization.

Capacitance

Symbol	Parameter	Condition	T_A=- 40°C to +85°C			Unit
			Min.	Typ.	Max.	
C_{IN}	Control Pin Input Capacitance	V_{CC}=0 V		1.5		pF
C_{ON}	D+/D- On Capacitance	V_{CC}=3.3 V, /OE=0 V, f=240 MHz, Figure 15		3.7		
C_{OFF}	D1n, D2n Off Capacitance	V_{CC} and /OE=3.3 V, Figure 14		2.0		

Test Diagrams

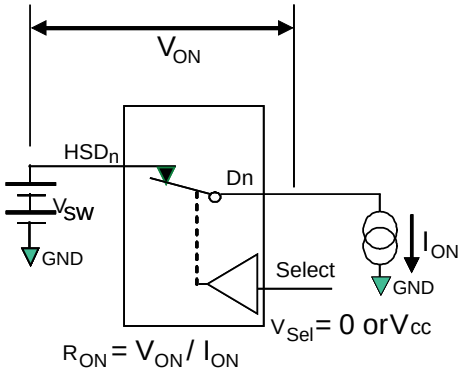
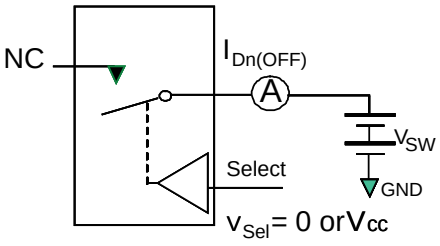
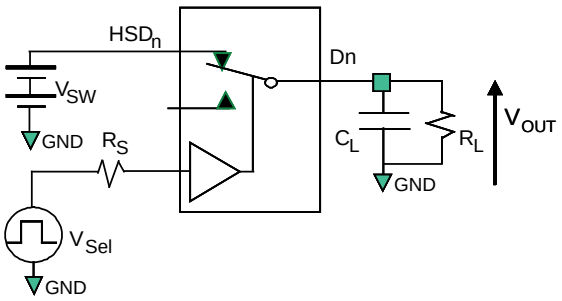


Figure 4. On Resistance



**Each switch port is tested separately

Figure 5. Off Leakage



R_L, R_S, and C_L are functions of the application environment (see AC Tables for specific values)
C_L includes test fixture and stray capacitance.

Figure 6. AC Test Circuit Load

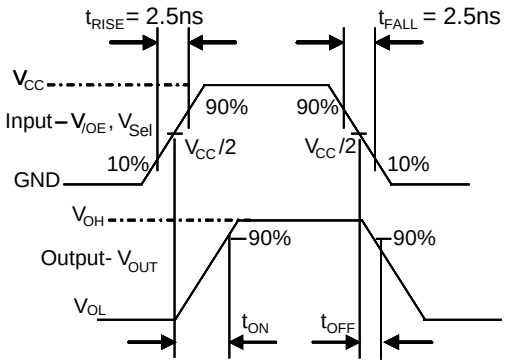


Figure 7. Turn-On / Turn-Off Waveforms

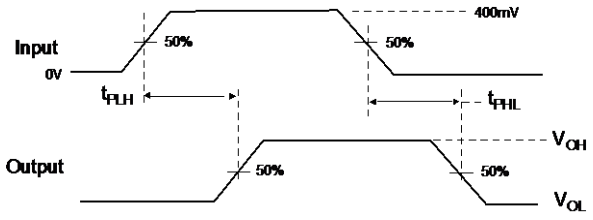


Figure 8. Propagation Delay (t_R t_F – 500 ps)

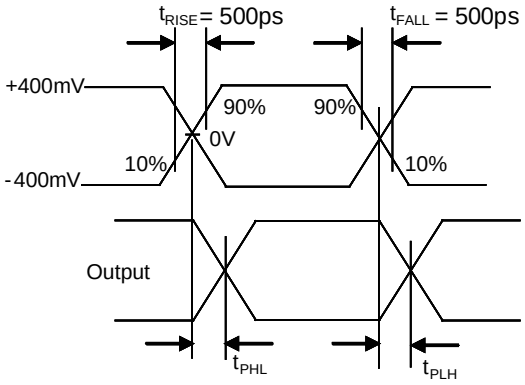
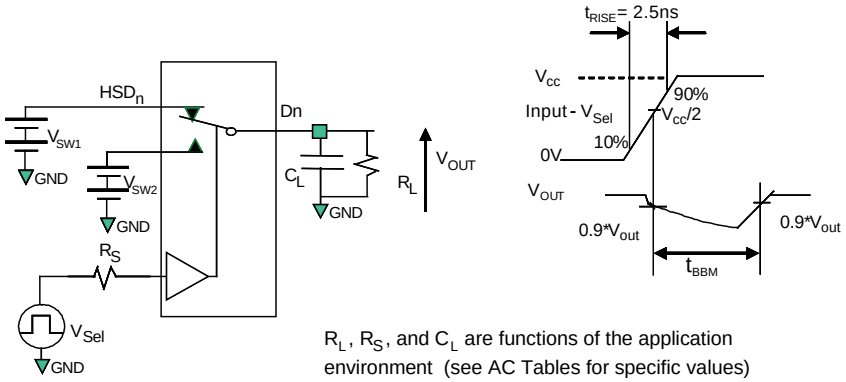


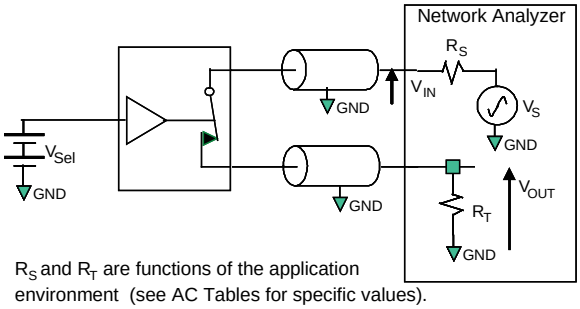
Figure 9. Intra-Pair Skew Test $t_{SK(P)}$

Test Diagrams (Continued)



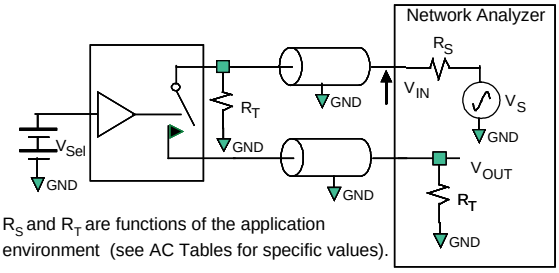
R_L, R_S, and C_L are functions of the application environment (see AC Tables for specific values)
C_L includes test fixture and stray capacitance.

Figure 10. Break-Before-Make Interval Timing



R_S and R_T are functions of the application environment (see AC Tables for specific values).

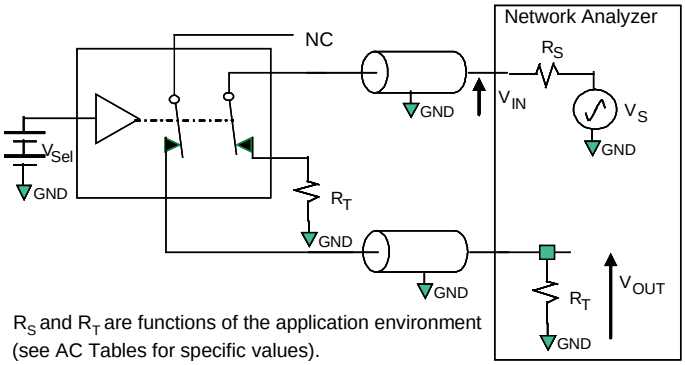
Figure 11. Bandwidth



R_S and R_T are functions of the application environment (see AC Tables for specific values).

Off isolation = 20 Log (V_{OUT} / V_{IN})

Figure 12. Channel Off Isolation



R_S and R_T are functions of the application environment (see AC Tables for specific values).

Crosstalk = 20 Log (V_{OUT} / V_{IN})

Figure 13. Non-Adjacent Channel-to-Channel Crosstalk

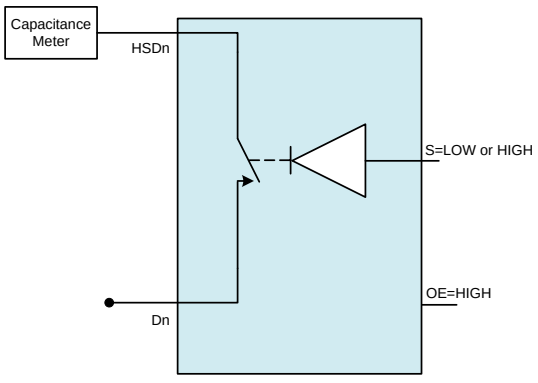


Figure 14. Channel Off Capacitance

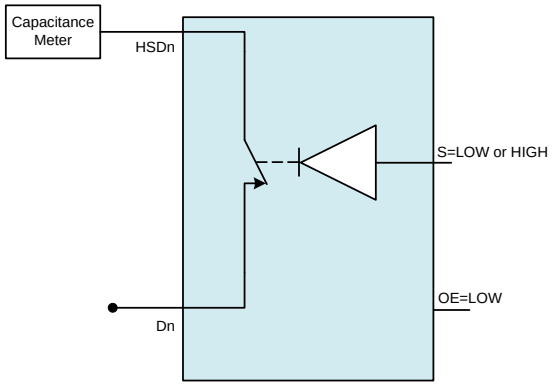
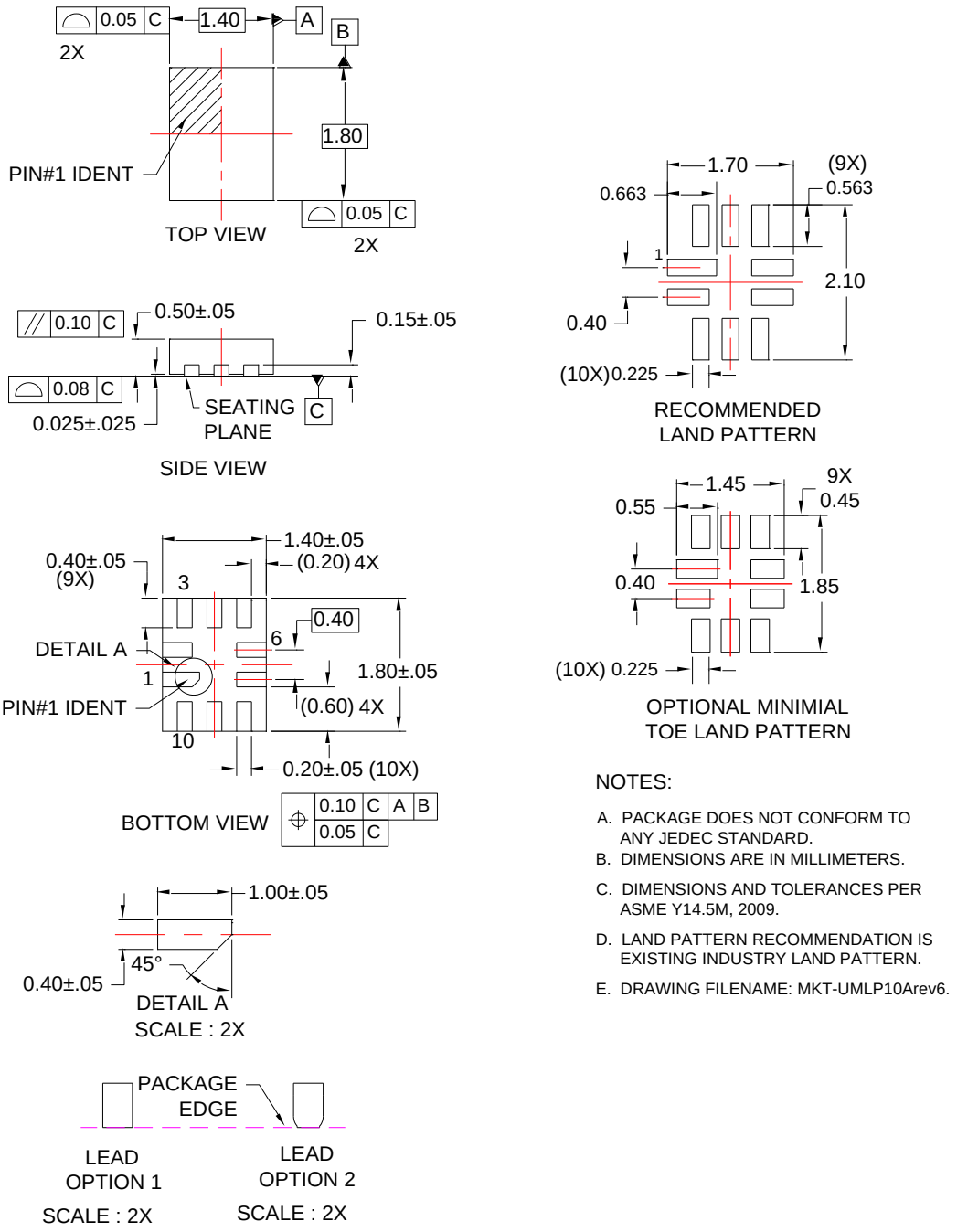


Figure 15. Channel On Capacitance

Physical Dimensions



NOTES:

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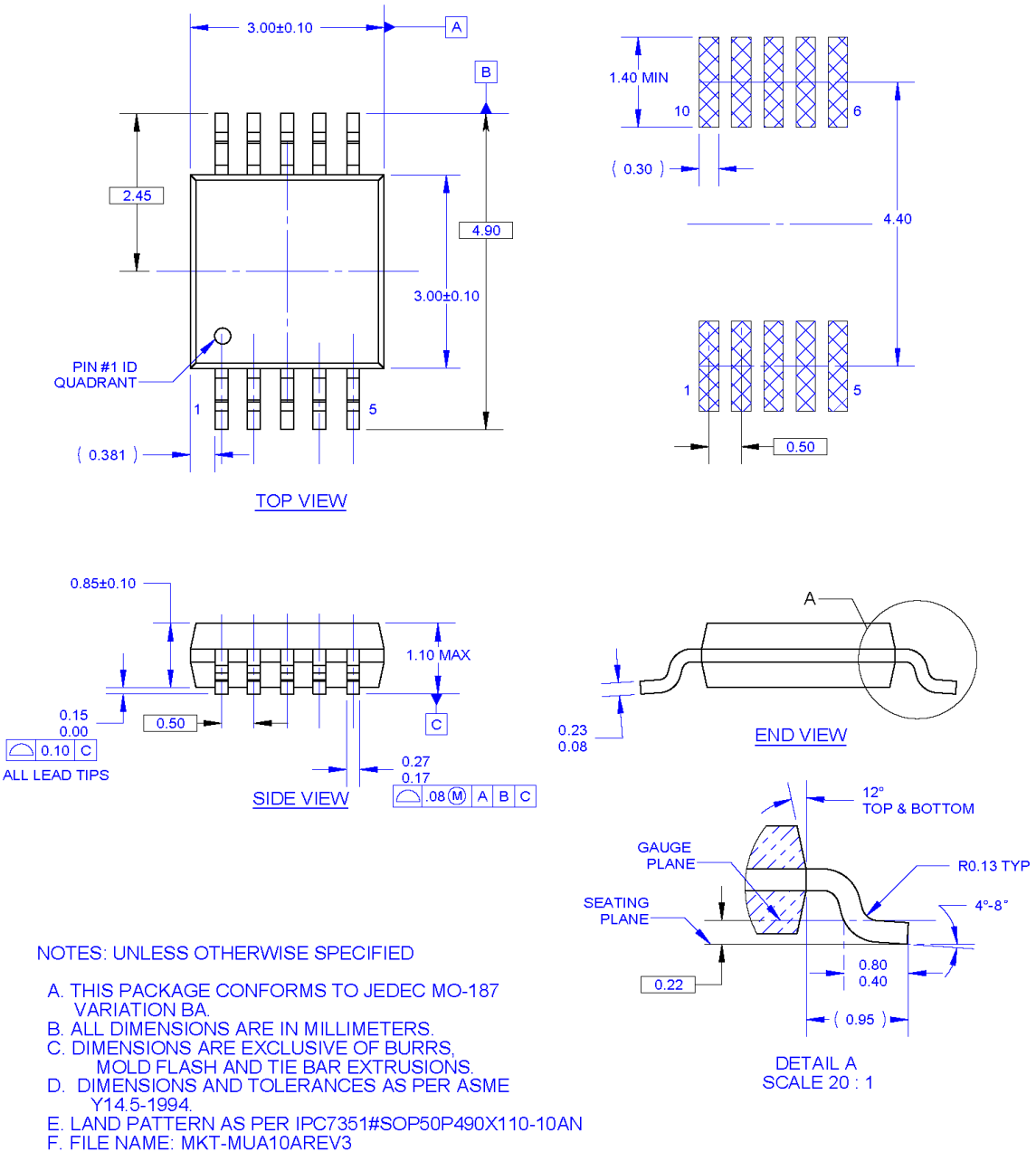
B. DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 2009.
D. LAND PATTERN RECOMMENDATION IS EXISTING INDUSTRY LAND PATTERN.
E. DRAWING FILENAME: MKT-UMLP10Arev6.

Figure 16. 10-Lead, Ultrathin Molded Leadless Package (UMLP)

Physical Dimensions (Continued)



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C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.
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E. LAND PATTERN AS PER IPC7351#SOP50P490X110-10AN
F. FILE NAME: MKT-MUA10AREV3

Figure 17. 10-Lead, Molded Small Outline Package (MSOP)