MSW03

16 Channels Digital/Analog High Voltage Transceiver

June 2009 *Rev 5.1*

GENERAL DESCRIPTION

The MSW03 are 16 channels transceiver for high voltage, high precision application, which integrate 16 independent solid state relays in a small package LQFP44.

The MSW03 provide 16 channels with a variable input voltage range, from -40V to 20V up to -5V to 55V, to have much flexibility for HV application, due to an ultra low input leakage current.
The MSW03 offer the possibility to switch on/off the channels in parallel through the SWITCH_CTR PIN, using slope controlled function, in case of low EMI and noise injection through the line are required.
The MSW03 integrate a safety function, the over temperature control to switch off all relays in case of high power dissipation.

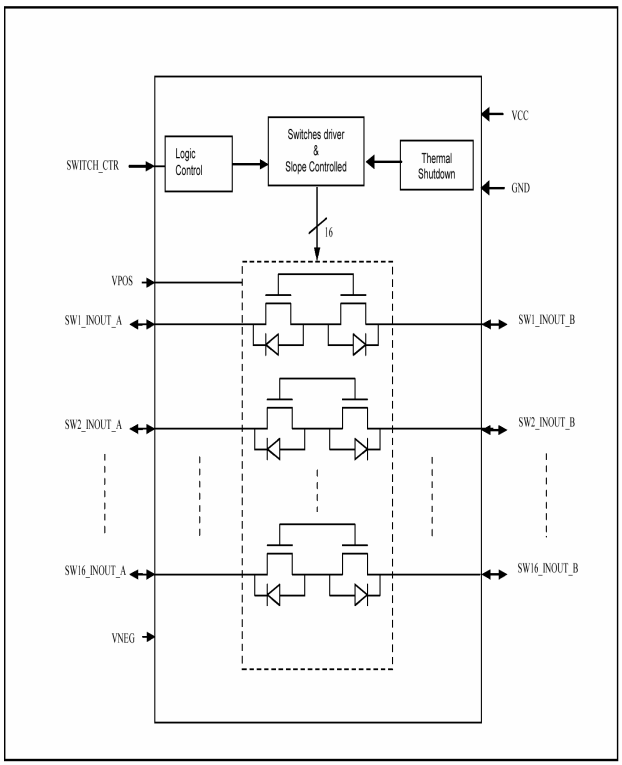
FEATURES

- 16 CHANNELS HIGH VOLTAGE and HIGH PRECISION CAPABILITIES (20 Ohm RdsON)
- ULTRA LOW INPUT LEAKAGE
- TRASLABLE INPUT VOLTAGE RANGE FROM [-5V to 55V] DOWN TO [–40V to 20V]
- REDUCED CHARGE INJECTION THROUGH SLOPE CONTROLLED
- OVERTEMPERATURE PROTECTION
- VERY LONG LIFE

APPLICATION

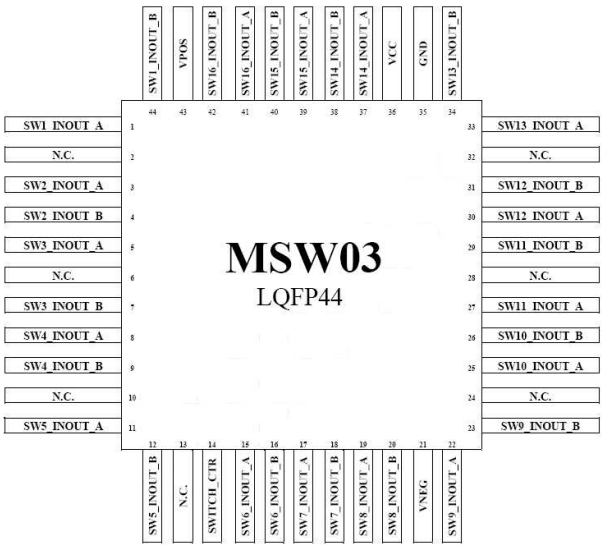
- PRINTERS, INDUSTRIAL, AUTOMOTIVE, MEMS
- MEASUREMENT AND RELIABILITY, ATE EQUIPEMENT AND BURN-IN APPLICATIONS

Functional Block Diagram

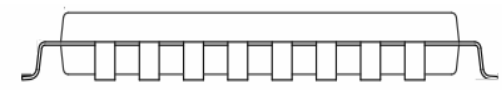


Pin Configurations

TOP SIDE



LATERAL SIDE



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1. Pin Description

PIN	I/O	NAME	FUNCTION
1	I/O	SW1_INOUT_A	Signal switch IN/OUT
2	N.C	-	Not connected
3	I/O	SW2_INOUT_A	Signal switch IN/OUT
4	I/O	SW2_INOUT_B	Signal switch IN/OUT
5	I/O	SW3_INOUT_A	Signal switch IN/OUT
6	N.C	-	Not connected
7	I/O	SW3_INOUT_B	Signal switch IN/OUT
8	I/O	SW4_INOUT_A	Signal switch IN/OUT
9	I/O	SW4_INOUT_B	Signal switch IN/OUT
10	N.C	-	Not connected
11	I/O	SW5_INOUT_A	Signal switch IN/OUT
12	I/O	SW5_INOUT_B	Signal switch IN/OUT
13	N.C	-	Not connected
14	I	SWITCH_CTR	Signal switch IN/OUT
15	I/O	SW6_INOUT_A	Signal switch IN/OUT
16	I/O	SW6_INOUT_B	Signal switch IN/OUT
17	I/O	SW7_INOUT_A	Signal switch IN/OUT
18	I/O	SW7_INOUT_B	Signal switch IN/OUT
19	I/O	SW8_INOUT_A	Signal switch IN/OUT
20	I/O	SW8_INOUT_B	Signal switch IN/OUT
21	Supply	VNEG	Negative power supply
22	I/O	SW9_INOUT_A	Signal switch IN/OUT
23	I/O	SW9_INOUT_B	Signal switch IN/OUT
24	N.C	-	Not connected
25	I/O	SW10_INOUT_A	Signal switch IN/OUT
26	I/O	SW10_INOUT_B	Signal switch IN/OUT
27	I/O	SW11_INOUT_A	Signal switch IN/OUT
28	N.C	-	Not connected
29	I/O	SW11_INOUT_B	Signal switch IN/OUT
30	I/O	SW12_INOUT_A	Signal switch IN/OUT
31	I/O	SW12_INOUT_B	Signal switch IN/OUT
32	N.C	-	Not connected
33	I/O	SW13_INOUT_A	Signal switch IN/OUT
34	I/O	SW13_INOUT_B	Signal switch IN/OUT
35	GND	GND	Ground
36	Supply	VCC	5V external supply
37	I/O	SW14_INOUT_A	Signal switch IN/OUT
38	I/O	SW14_INOUT_B	Signal switch IN/OUT
39	I/O	SW15_INOUT_A	Signal switch IN/OUT
40	I/O	SW15_INOUT_B	Signal switch IN/OUT
41	I/O	SW16_INOUT_A	Signal switch IN/OUT
42	I/O	SW16_INOUT_B	Signal switch IN/OUT
43	Supply	VPOS	Positive power supply
44	I/O	SW1_INOUT_B	Signal switch IN/OUT

2. Absolute Maximum Ratings

PIN NAME	PARAMETER	MIN	MAX	UNIT
SW1_INOUT_A/B	VSW1_INOUT	VNEG – 0.3	VNEG + 70	V
SW2_INOUT_A/B	VSW2_INOUT	VNEG – 0.3	VNEG + 70	V
SW3_INOUT_A/B	VSW3_INOUT	VNEG – 0.3	VNEG + 70	V
SW4_INOUT_A/B	VSW4_INOUT	VNEG – 0.3	VNEG + 70	V
SW5_INOUT_A/B	VSW5_INOUT	VNEG – 0.3	VNEG + 70	V
SW6_INOUT_A/B	VSW6_INOUT	VNEG – 0.3	VNEG + 70	V
SW7_INOUT_A/B	VSW7_INOUT	VNEG – 0.3	VNEG + 70	V
SW8_INOUT_A/B	VSW8_INOUT	VNEG – 0.3	VNEG + 70	V
SW9_INOUT_A/B	VSW9_INOUT	VNEG – 0.3	VNEG + 70	V
SW10_INOUT_A/B	VSW10_INOUT	VNEG – 0.3	VNEG + 70	V
SW11_INOUT_A/B	VSW11_INOUT	VNEG – 0.3	VNEG + 70	V
SW12_INOUT_A/B	VSW12_INOUT	VNEG – 0.3	VNEG + 70	V
SW13_INOUT_A/B	VSW13_INOUT	VNEG – 0.3	VNEG + 70	V
SW14_INOUT_A/B	VSW14_INOUT	VNEG – 0.3	VNEG + 70	V
SW15_INOUT_A/B	VSW15_INOUT	VNEG – 0.3	VNEG + 70	V
SW16_INOUT_A/B	VSW16_INOUT	VNEG – 0.3	VNEG + 70	V
GND	VGND	VNEG - 0.3	VNEG + 70	V
VCC	VVCC	GND – 0.3	5.5V	V
VNEG	VVNEG	-40	GND + 0.3	V
VPOS	VVPOS	VNEG – 0.3	VNEG + 70	V
SWITCH_CTR	VSWITCH_CTR	-0.3	VCC + 0.3	V
	TJ	-40	150	C

3. Electrical and Thermal characteristics

Power Current Consumption

(VCC: from 3.2V to 5.5V, VNEG: from -40 to -5V, VPOS between 15V and VNEG + 70V, TJ= 0°C to +125°C unless otherwise specified)

Pin	Symbol	Parameter	Test condition	min	typ	max	Unit
VCC	I_VCC_-5/65	Current consumption		-	1.2	1.5	mA
VPOS	I_VPOS	Current consumption	Switches OFF	-	0.7	1.5	mA
			Switches ON	-	1.8	2.6	mA
VNEG	I_VNEG	Current consumption	Switches OFF	-2.3	-1.1	-	mA
			Switches ON	-3.4	-2.2	-	mA
VPOS	Clamp_VPOS	Clamp voltage on VPOS supply	VNEG=0V	72		76	V

Switches general features

(VCC: from 3.2V to 5.5V, VNEG: from -40 to -5V, VPOS between 15V and VNEG + 70V, TJ= 0C to +125C unless otherwise specified)

Pin	Symbol	Parameter	Test condition	min	typ	max	Unit
SWi_INOUT_A/B	RONP	On resistance	IIN = 50mA, Tj<80C		20	30	Ohm
SWi_INOUT_A/B	RONP_FR	On resistance	IIN = 50mA, Tj<125C			35	Ohm
SWi_INOUT_A/B	ICAPOFF	Input capacitance	Switch off		5		pF
SWi_INOUT_A/B	ICAPON	Input capacitance	Switch on		10		pF
SWi_INOUT_A/B	ILEAKOFF	Leakage current	Switch off, Tj=27°C			10	pA
SWi_INOUT_A/B	ILEAKOFF80	Leakage current	Switch off, Tj<80°C			90	pA
SWi_INOUT_A/B	ILEAKON	Leakage current	Switch on, Tj=27°C			50	pA
SWi_INOUT_A/B	ILEAKON80	Leakage current	Switch on, Tj<80°C			100	pA
SWi_INOUT_A/B	TON	Switch enable time	Switches in ON condition with minimum activation threshold			5	us
			Switches in ON condition with overdrive on activation threshold (RdsON=20Ohm)			20	us
SWi_INOUT_A/B	TOFF	Switch disable time	DC Input			10	us
			AC Large signal on input pins during transient ON/OFF phase			20	us
	TDelay	Delay time between off command and higher noise injection immunity (note1)		20		80	us

Note1: see paragraph 4.2

Switches Dynamic Characteristics

(Typical values are at T_J=27°C unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
OFF-ISOLATION (Note1)	V_{ISO}	f = 5MHz, R_L = 1KΩ, C_L = 15pF	-	-55	-	dB
		f = 5MHz, R_L = 50Ω		-79		dB
Charge Injection (Note1)	Qinj	VPOS = 65V, VNEG = -5V, VIN = VPOS-10V, CL = 10pF	-	56	-	pC
		VPOS = 15V, VNEG = -5V, VIN = VPOS-10V, CL = 10pF	-	25	-	pC
		VPOS = 30V, VNEG = -40V, VIN = VPOS-10V, CL = 10pF	-	59	-	pC
		VPOS = 65V, VNEG = -5V, VIN = VPOS-10V, CL = 100pF	-	77	-	pC
		VPOS = 15V, VNEG = -5V, VIN = VPOS-10V, CL = 100pF	-	36	-	pC
		VPOS = 30V, VNEG = -40V, VIN = VPOS-10V, CL = 100pF	-	75	-	pC

Note1: Guaranteed by design

Transceiver control

(VNEG: from -40 to -5V, VPOS between 15V and VNEG + 70V TJ= 0°C to +125°C unless otherwise specified)

Pin	Symbol	Parameter	Test condition	min	typ	max	Unit
SWITCH_CTR	SW_TH_L	Input threshold low	T_A = 25°C, V_{CC} = 5V			0.3VCC	V
SWITCH_CTR	SW_TH_H	Input threshold high	T_A = 25°C, V_{CC} = 5V	0.7VCC		VCC	V
SWITCH_CTR	SW_HY	Input hysteresis	T_A = 25°C, V_{CC} = 5V	200	500	800	mV
SWITCH_CTR	SW_PU	Pull up resistor	T_A = 25°C, V_{CC} = 5V		100		kOhm

Power on reset and Overtemperature protection circuit

(VCC: from 3.2V to 55V, VNEG: from -40 to -5V, VPOS between 15V and VNEG + 70V TJ= 0°C to +125°C unless otherwise specified)

Pin	Symbol	Parameter	Test condition	min	typ	max	Unit
VNEG	VNEGON_TH	VNEG reset threshold			-3.5		V
	TW	Thermal protection temperature		150		190	C
	TWH	Thermal protection temperature hysteresis			10		C

5. Functional description

MSW03 integrates 16 solid state relays connected as transceiver capable to work with high voltage signals (up to 55V). The relays (SW1_INOUT_A/B to SW16_INOUT_A/B) (20 Ohm Rds-0n) are dedicated for high voltage high precision application, due to ultra low leakage current and parasitic capacitances.
Input voltage range for this all the relays are traslable between (-40V to 20V) and (-5V to 55V) changing power supply value.
All the relays are controlled by digital signal, SWITCH_CTR, active low.
Over-temperature protection is integrated in order to switch off all the switches in case of excessive temperature due to the internal high power dissipation.
Slope controlled transient are provided for relays switching (on-off, off-on) to reduce noise injection and EMI emissions with high voltage swing.

4.1 Power supply

MSW03 Transceiver needs three external voltages (VCC, VNEG and VPOS). VCC is the 5V input voltage for digital and analog circuits.
VPOS and VNEG are necessary to supply switches drivers and their values fix the operating range for the IN/OUT signal to transmit between VNEG and VPOS-10V.
VNEG is the negative power supply, set by user in the range -5V to -40V.
VPOS voltage can change from a minimum of 15V (not referred to VNEG) to a maximum of VNEG + 70V.

4.2 Transceiver control

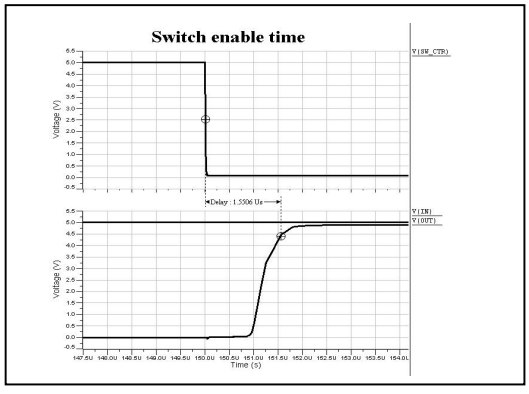
The MSW03 status is controlled by means of a dedicated input digital (SWITCH_CONTROL).

If SWITCH CONTROL voltage is low transceiver is switched on and all channels are closed to transmit input signals.
Input pin SWITCH_CONTROL has an internal pull up so in case of voltage high or pin left floating all channels are disabled leaving high impedance at both input/output pins.

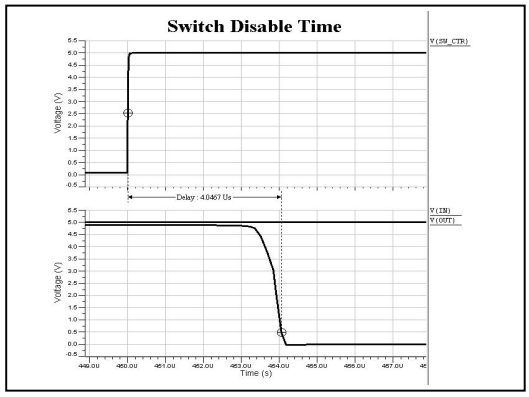
To reduce noise injection and EMI emissions, the switching on/off phases are both slope controlled.

Moreover to guarantee an higher off-isolation due to internal parasitic capacitances, MSW03 has a dedicate circuitry enabled after controlled switching off phases (TDelay)

6. Typical timing characteristic



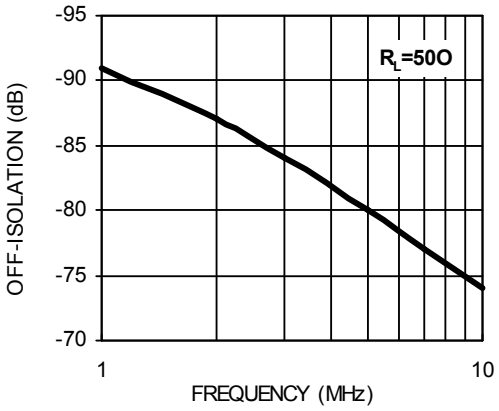
Typical condition
VPOS=15V, VNEG=-5V, T=27°C and Rload=1KOhm



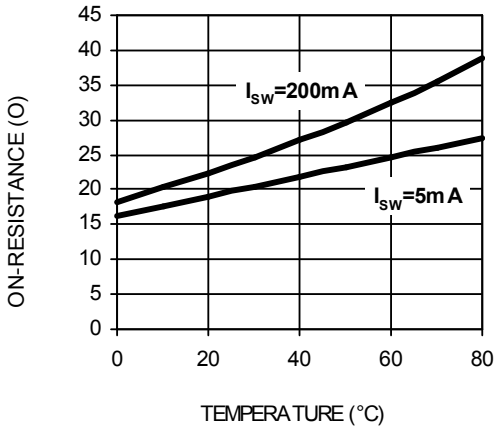
Typical condition
VPOS=15V, VNEG=-5V, T=27°C and Rload=1KOhm

7. Typical operating characteristic

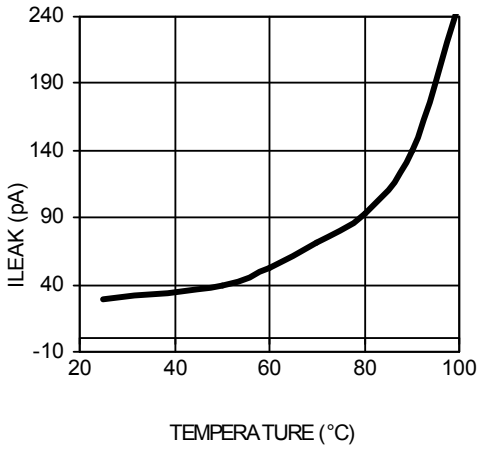
OFF-ISOLATION vs. FREQUENCY



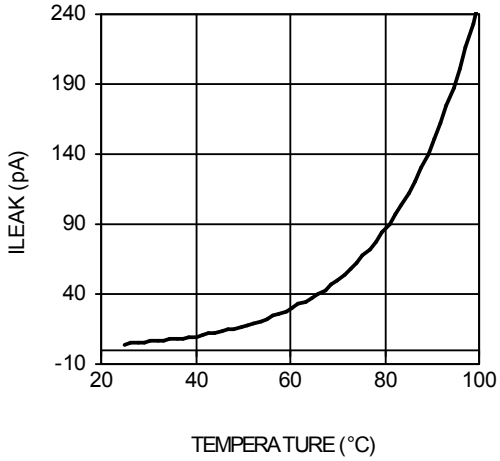
ON-RESISTANCE vs. TEMPERATURE



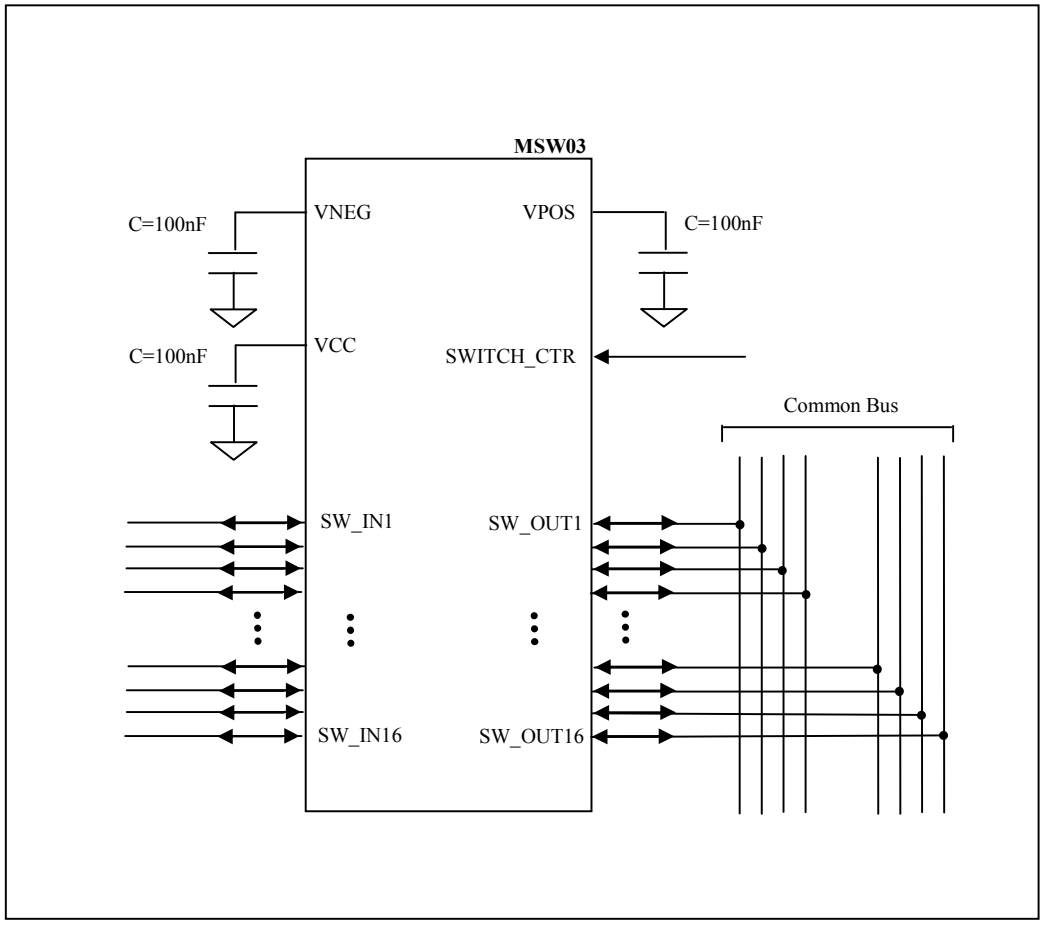
Leakage Current - ON condition
Vpos=15v Vneg=-5v Vin=0v



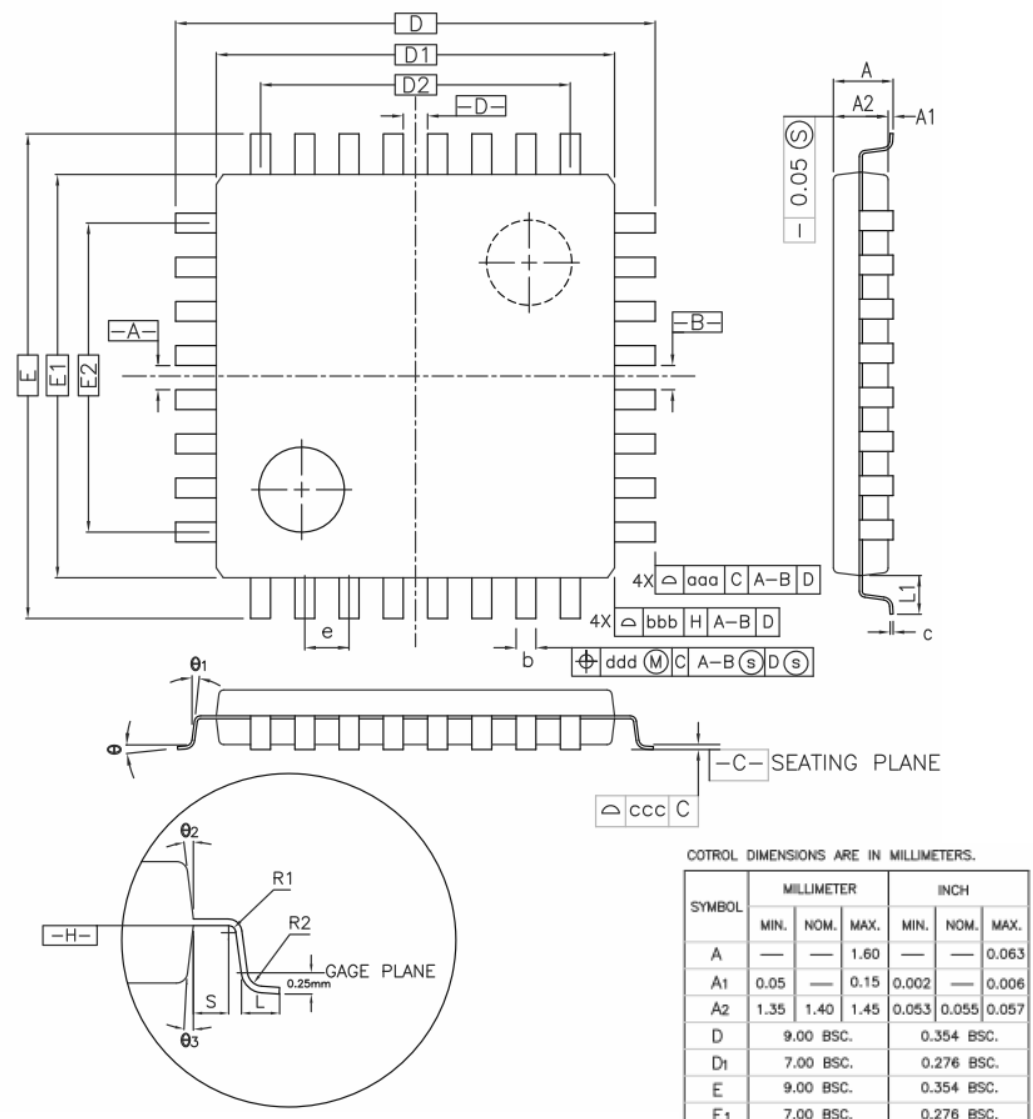
Leakage Current - OFF condition
Vpos=15v
Vneg=-5v Vin=0v



7. Typical application



8. Package Information



COTROL DIMENSIONS ARE IN MILLIMETERS.

SYMBOL	MILLIMETER			INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	—	—	1.60	—	—	0.063
A1	0.05	—	0.15	0.002	—	0.006
A2	1.35	1.40	1.45	0.053	0.055	0.057
D	9.00 BSC.			0.354 BSC.		
D1	7.00 BSC.			0.276 BSC.		
E	9.00 BSC.			0.354 BSC.		
E1	7.00 BSC.			0.276 BSC.		
R2	0.08	—	0.20	0.003	—	0.008
R1	0.08	—	—	0.003	—	—
θ	0°	3.5°	7°	0°	3.5°	7°
θ1	0°	—	—	0°	—	—
θ2	11°	12°	13°	11°	12°	13°
θ3	11°	12°	13°	11°	12°	13°
c	0.09	—	0.20	0.004	—	0.008
L	0.45	0.60	0.75	0.018	0.024	0.030
L1	1.00 REF			0.039 REF		
S	0.20	—	—	0.008	—	—

9. Revision history

Spec Revision	Date	Authors
MSW03_datasheet_1.0	*January 2005*	*G. Tarroboiro/E.Consani*
MSW03_datasheet_2.0	*January 2006*	*G. Tarroboiro/E.Consani*
MSW03_datasheet_3.0	*May 2006*	*G. Tarroboiro*
MSW03_datasheet_4.1	*April 2007*	*E.Consani*
MSW03_datasheet_4.2	*October 2008*	*G. Tarroboiro/E.Consani*
MSW03_datasheet_5.0	*June 2009*	*M.Bagnoli/G.Basile/E.Consani*
MSW03_datasheet_5.1	*June 2009*	*E.Consani/G.Amelio*
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