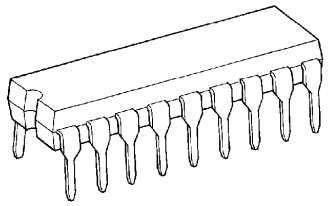
TOSHIBA BIPOLAR DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

ULN2803AP, ULN2803AFW, ULN2804AP, ULN2804AFW

8CH DARLINGTON SINK DRIVER

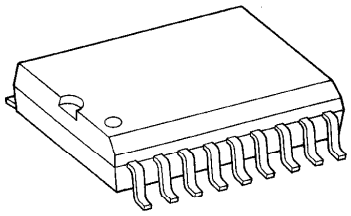
The ULN2803AP / AFW Series are high-voltage, high-current darlington drivers comprised of eight NPN darlington pairs.
All units feature integral clamp diodes for switching inductive loads.
Applications include relay, hammer, lamp and display (LED) drivers.

ULN2803AP
ULN2804AP



DIP18-P-300-2.54F

ULN2803AFW
ULN2804AFW



SOL18-P-300-1.27

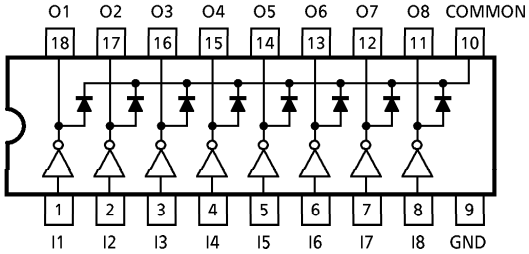
Weight
DIP18-P-300-2.54F : 1.478g (Typ.)
SOL18-P-300-1.27 : 0.48g (Typ.)

FEATURES

- Output current (single output)
  500mA (Max.) (ULN2803AP / AFW series)
- High sustaining voltage output
  50V (Min.) (ULN2803AP / AFW series)
- Output clamp diodes
- Inputs compatible with various types of logic.
- Package type-AP : DIP-18pin
- Package type-AFW : SOL-18pin

TYPE	INPUT BASE RESISTOR	DESIGNATION
ULN2803AP / AFW	2.7kΩ	TTL, 5V CMOS
ULN2804AP / AFW	10.5kΩ	6~15V PMOS, CMOS

PIN CONNECTION (TOP VIEW)



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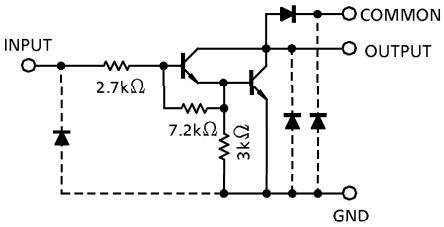
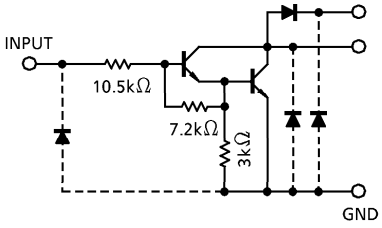
SCHEMATICS (EACH DRIVER)

ULN2803AP / AFW



ULN2804AP / AFW



(Note) The input and output parasitic diodes cannot be used as clamp diodes.

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Output Sustaining Voltage		$V_{CE\ (SUS)}$	−0.5~50	V
Output Current		I_{OUT}	500	mA / ch
Input Voltage		V_{IN}	−0.5~30	V
Clamp Diode Reverse Voltage		V_R	50	V
Clamp Diode Forward Current		I_F	500	mA
Power Dissipation	AP	P_D	1.47	W
	AFW		0.92 / 1.31 (Note)	
Operating Temperature		T_{opr}	−40~85	°C
Storage Temperature		T_{stg}	−55~150	°C

(Note) On Glass Epoxy PCB (75 × 114 × 1.6mm Cu 20%)

RECOMMENDED OPERATING CONDITIONS (Ta = −40~85°C)

CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Sustaining Voltage		$V_{CE\ (SUS)}$		0	—	50	V
Output Current	AP	I_{OUT}	T_{pw} = 25ms, Duty = 10%, 8 Circuits	0	—	347	mA / ch
			T_{pw} = 25ms, Duty = 50%, 8 Circuits	0	—	123	
	AFW		T_{pw} = 25ms, Duty = 10%, 8 Circuits	0	—	268	
			T_{pw} = 25ms, Duty = 50%, 8 Circuits	0	—	90	
Input Voltage		V_{IN}		0	—	30	V
Input Voltage (Output On)	ULN2803AP / AFW	$V_{IN\ (ON)}$		3.5	—	30	V
	ULN2804AP / AFW			8	—	30	
Clamp Diode Reverse Voltage		V_R		—	—	50	V
Clamp Diode Forward Current		I_F		—	—	400	mA
Power Dissipation	AP	P_D	Ta = 85°C	—	—	0.76	W
	AFW		Ta = 85°C (Note)	—	—	0.48	

(Note) On Glass Epoxy PCB (75 × 114 × 1.6mm Cu 20%)

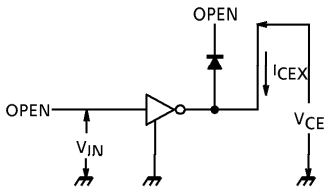
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Leakage Current		I_{CEX}	1	V_{CE} = 50V	Ta = 25°C	—	—	50	μA
				V_{CE} = 50V	Ta = 85°C	—	—	100	
	ULN2804AP / AFW			V_{CE} = 50V	V_{IN} = 1V	—	—	500	
Collector-Emitter Saturation Voltage		V_{CE} (sat)	2	I_{OUT} = 350mA, I_{IN} = 500μA		—	1.3	1.6	V
				I_{OUT} = 200mA, I_{IN} = 350μA		—	1.1	1.3	
				I_{OUT} = 100mA, I_{IN} = 250μA		—	0.9	1.1	
Input Current	ULN2803AP / AFW	I_{IN} (ON)	2	V_{IN} = 3.85V		—	0.93	1.35	mA
	ULN2804AP / AFW			V_{IN} = 5V		—	0.35	0.5	
				V_{IN} = 12V		—	1.0	1.45	
		I_{IN} (OFF)	4	I_{OUT} = 500μA, Ta = 85°C		50	65	—	μA
Input Voltage (Output On)	ULN2803AP / AFW	V_{IN} (ON)	5	V_{CE} = 2V, I_{OUT} = 200mA		—	—	2.4	V
				V_{CE} = 2V, I_{OUT} = 250mA		—	—	2.7	
				V_{CE} = 2V, I_{OUT} = 300mA		—	—	3.0	
	ULN2804AP / AFW			V_{CE} = 2V, I_{OUT} = 125mA		—	—	5.0	
				V_{CE} = 2V, I_{OUT} = 200mA		—	—	6.0	
				V_{CE} = 2V, I_{OUT} = 275mA		—	—	7.0	
				V_{CE} = 2V, I_{OUT} = 350mA		—	—	8.0	
DC Current Transfer Ratio		h_{FE}	2	V_{CE} = 2V, I_{OUT} = 350mA		1000	—	—	
Clamp Diode Reverse Current		I_R	6	Ta = 25°C (Note)		—	—	50	μA
				Ta = 85°C (Note)		—	—	100	
Clamp Diode Forward Voltage		V_F	7	I_F = 350mA		—	—	2.0	V
Input Capacitance		C_{IN}	—			—	15	—	pF
Turn-On Delay		t_{ON}	8	R_L = 125Ω, V_{OUT} = 50V		—	0.1	—	μs
Turn-Off Delay		t_{OFF}		R_L = 125Ω, V_{OUT} = 50V		—	0.2	—	

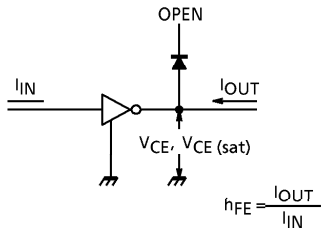
(Note) $V_R = V_R$ MAX.

TEST CIRCUIT

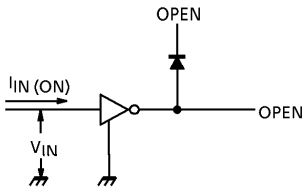
1. I_{CEX}



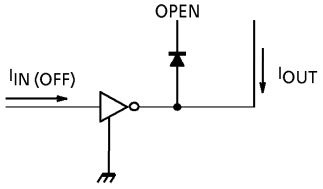
2. $V_{CE\ (sat)}$, h_{FE}



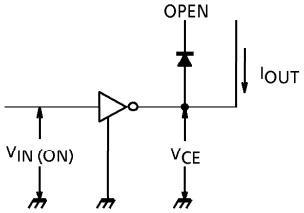
3. $I_{IN\ (ON)}$



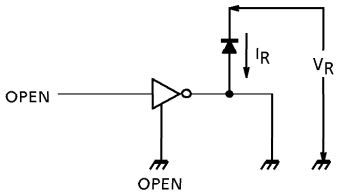
4. $I_{IN\ (OFF)}$



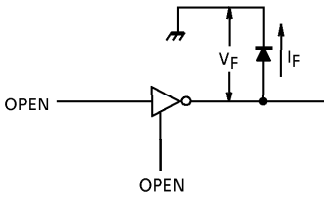
5. $V_{IN\ (ON)}$



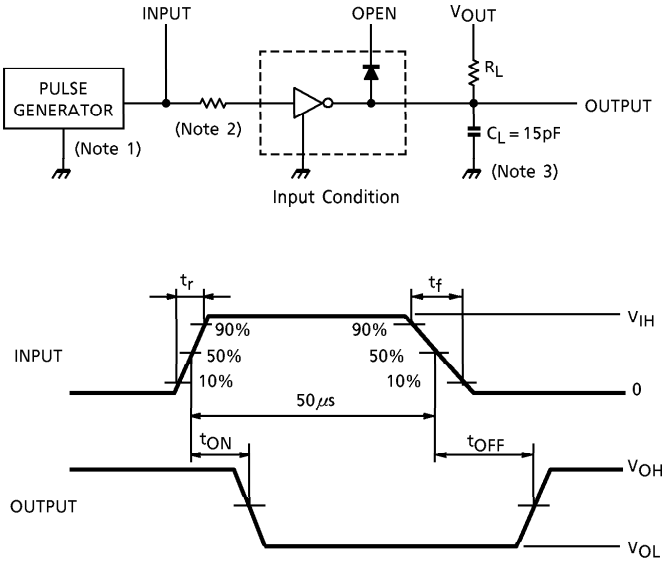
6. I_R



7. V_F



8. t_{ON}, t_{OFF}



(Note 1) Pulse Width 50μs, Duty Cycle 10%
Output Impedance 50Ω, $t_r \leqq$ 5ns, $t_f \leqq$ 10ns

(Note 2) See below.

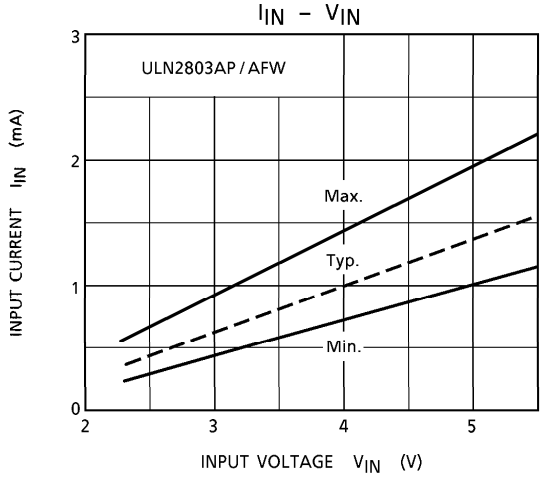
INPUT CONDITION

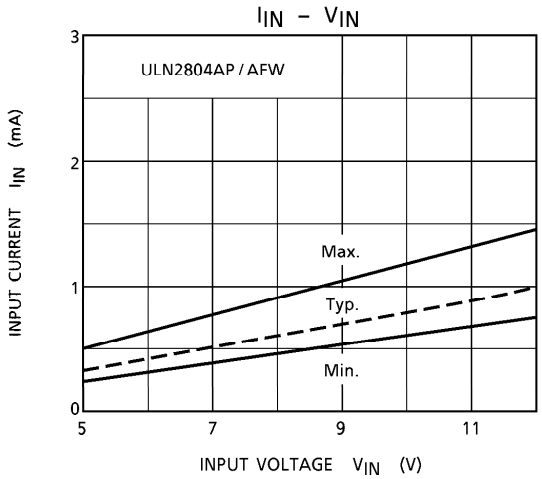
TYPE NUMBER	R1	V_{IH}
ULN2803AP / AFW	0Ω	3V
ULN2804AP / AFW	0Ω	8V

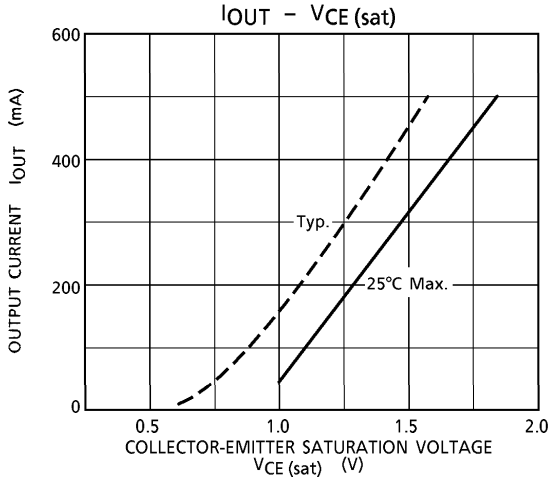
(Note 3) C_L includes probe and jig capacitance

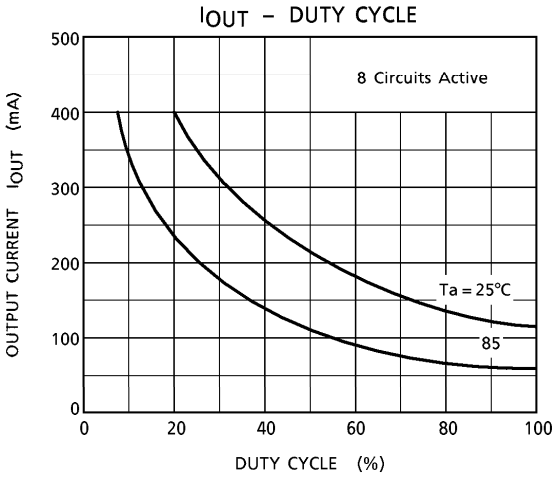
PRECAUTIONS for USING

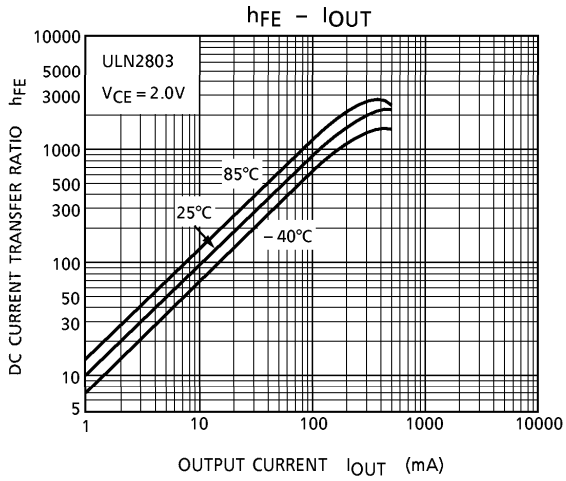
Utmost care is necessary in the design of the output line, COMMON and GND line since IC may be destroyed due to short-circuit between outputs, air contamination fault, or fault by improper grounding.

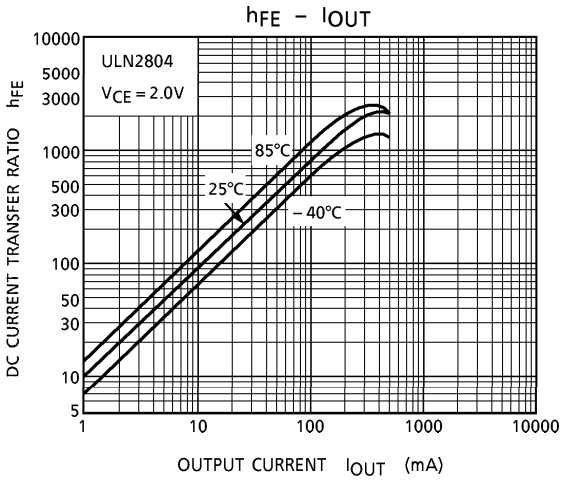

IIN – VIN
ULN2803AP / AFW
Max.
Typ.
Min.
INPUT CURRENT IIN (mA)
INPUT VOLTAGE VIN (V)
0
1
2
3
2
3
4
5

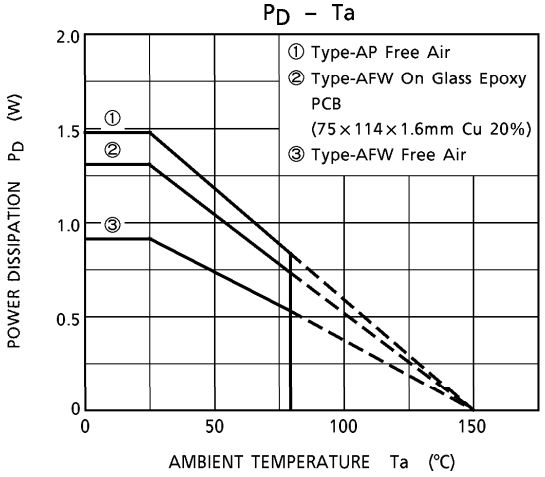

IIN – VIN
ULN2804AP / AFW
Max.
Typ.
Min.
INPUT CURRENT IIN (mA)
INPUT VOLTAGE VIN (V)
0
1
2
3
5
7
9
11


IOUT – VCE (sat)
Typ.
25°C Max.
OUTPUT CURRENT IOUT (mA)
COLLECTOR-EMITTER SATURATION VOLTAGE
VCE (sat) (V)
0
200
400
600
0.5
1.0
1.5
2.0


IOUT – DUTY CYCLE
8 Circuits Active
Ta = 25°C
85
OUTPUT CURRENT IOUT (mA)
DUTY CYCLE (%)
0
100
200
300
400
500
0
20
40
60
80
100


hFE – IOUT
ULN2803
VCE = 2.0V
85°C
25°C
– 40°C
DC CURRENT TRANSFER RATIO hFE
OUTPUT CURRENT IOUT (mA)
5
10
30
50
100
300
500
1000
3000
5000
10000
1
10
100
1000
10000

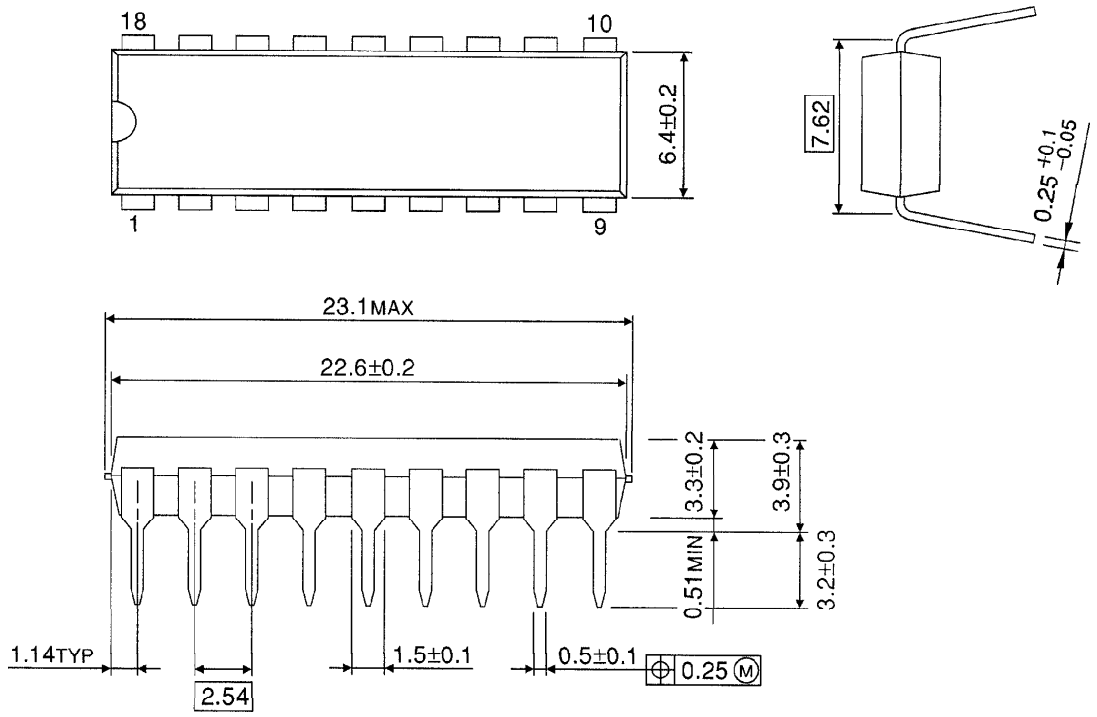

hFE – IOUT
ULN2804
VCE = 2.0V
85°C
25°C
– 40°C
DC CURRENT TRANSFER RATIO hFE
OUTPUT CURRENT IOUT (mA)
5
10
30
50
100
300
500
1000
3000
5000
10000
1
10
100
1000
10000


PD – Ta
① Type-AP Free Air
② Type-AFW On Glass Epoxy PCB
(75×114×1.6mm Cu 20%)
③ Type-AFW Free Air
POWER DISSIPATION PD (W)
2.0
1.5
1.0
0.5
0
①
②
③
0
50
100
150
AMBIENT TEMPERATURE Ta (°C)

OUTLINE DRAWING

DIP18-P-300-2.54F

Unit : mm

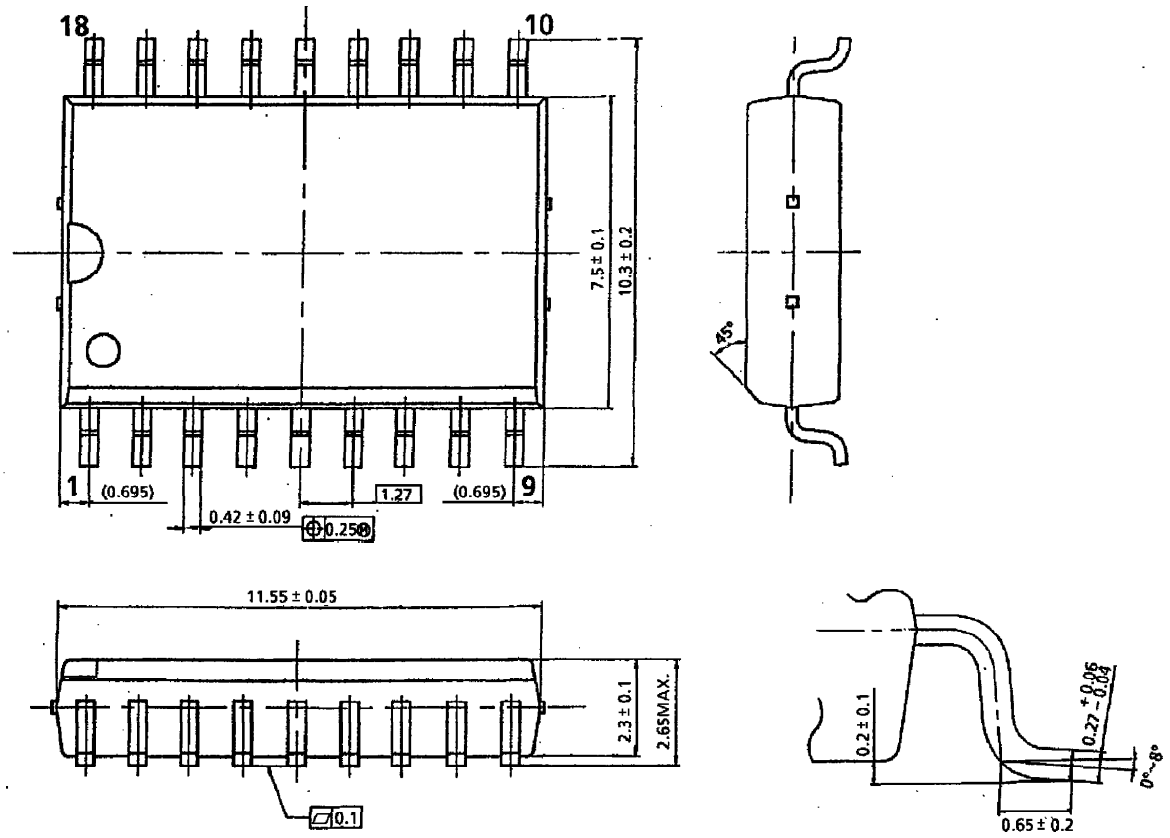


Weight : 1.478g (Typ.)

OUTLINE DRAWING

SOL18-P-300-1.27

Unit : mm



Weight : 0.48g (Typ.)