Dino (Arduino Compatible) Board Manual (Demo)

Table of Contents

Chapter1. Overview and Board Description

1.1. Introduction

Arduino is an open-source based on a simple I/O board and a development environment that implements the processing/wiring language. Arduino can be used to develop stand-alone interactive objects or can be connected to software on your computer.

Dino (Arduino Compatible) Board is a microcontroller board based on the ATmega328 microcontroller with duemilanove bootloader, flash memory 32KB, EEPROM 1KB, SRAM 2KB, clock speed 16MHz. Supports Windows, Mac OS X, Linux. Open source. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs with the standard arduino pin headers will be developed with other arduino boards and includes MAX232 to drive the RS232 signal interface with your computer and includes the DIP switch SPST to disable auto reset and green LED (D13) and includes IC 78L33 voltage regulator outputs a steady and stable 3.3VDC output for your other developments and includes resistors have tolerance ±1% and includes capacitors 100nF are polyester type.

ATmega328 microcontroller is MCU AVR® Atmel 32K FLASH 28-PDIP, Program memory size 32K x 8, RAM size 2K x 8, Number of I/O = 23, Speed 20MHz, Oscillator type = Internal, Program memory type = FLASH, EEPROM size = 1K x 8, Core processor = AVR, Data converters = A/D 6x10b, Core size 8 bit, Operating temperature -40°C ~ 85°C, Connectivity = I^2C, SPI, UART/USART, Peripherals = Brown-out Detect/Reset, POR, PWM, WDT, Voltage Supply (Vcc/Vdd) = 1.8V ~ 5.5 V

Application For Use With

1. ATSTK600-TQFP32-ND – STK600 SOCKET/ADAPTER32-TQFP.
2. ATSTK600-ND – DEV KIT FOR AVR/AVR32.
3. ATAVRDRAGON-ND – KIT DRAGON 32KB FLASH MEM AVR.
4. ATAVRISP2-ND – PROGRAMMER AVR IN SYSTEM.

1.2. Board Feature

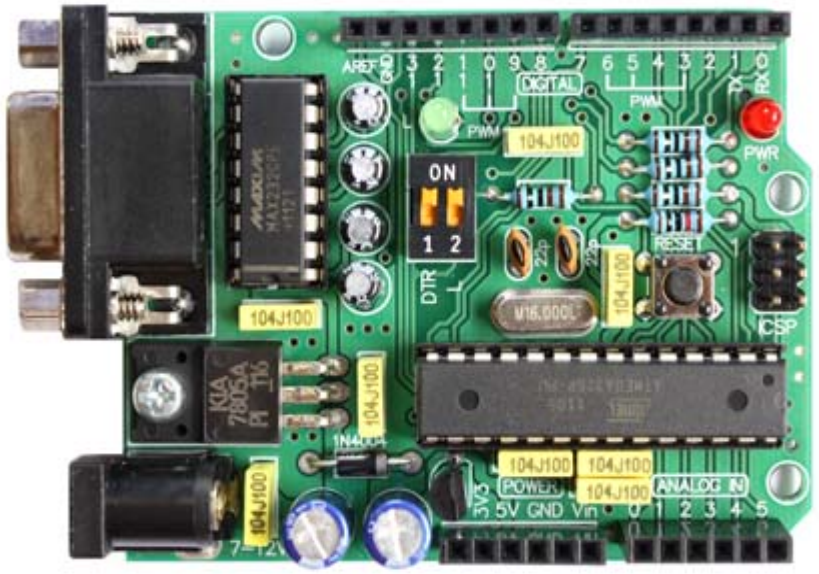


Figure1.2.1

1.2.1. **ATmega328** 28pin DIP microcontroller with Duemilanove bootloader.
1.2.2. ATmega328 includes 32KB memory, 1KB EEPROM, 2KB SRAM.
1.2.3. Quartz crystal 16MHz.
1.2.4. Standard ICSP 6pins will be developed with AVR ISP.
1.2.5. Interface with computer and upload program via RS232 port.
1.2.6. The operating voltage of the ATmega328 microcontroller is 5V.
1.2.7. The operating voltage of the Dino (Arduino Compatible) Board is 7-12V.
1.2.8. Digital input / output are 14pins (PWM 6channels).
1.2.9. Analog input is 6pins.
1.2.10. **DIP Switch SPST** to disable auto reset and the green LED (D13).
1.2.11. MAX232 to drive the RS232 signal interface with computer.
1.2.12. Includes the Standard Arduino Pin Header - 8 pins & 6 pins (Female) will be stacked with external devices or other arduino boards.
1.2.13. On-board includes IC 78L33 voltage regulator outputs a steady and stable 3.3VDC output for your other developments.
1.2.14. Includes resistors have **tolerance ±1%.**
1.2.15. Includes capacitors 100nF are **Polyester type.**
1.2.16. Board Dimension is 53.3mm(Width) * 68.6mm(Long) * 15.0mm(High).

1.3. Board Description

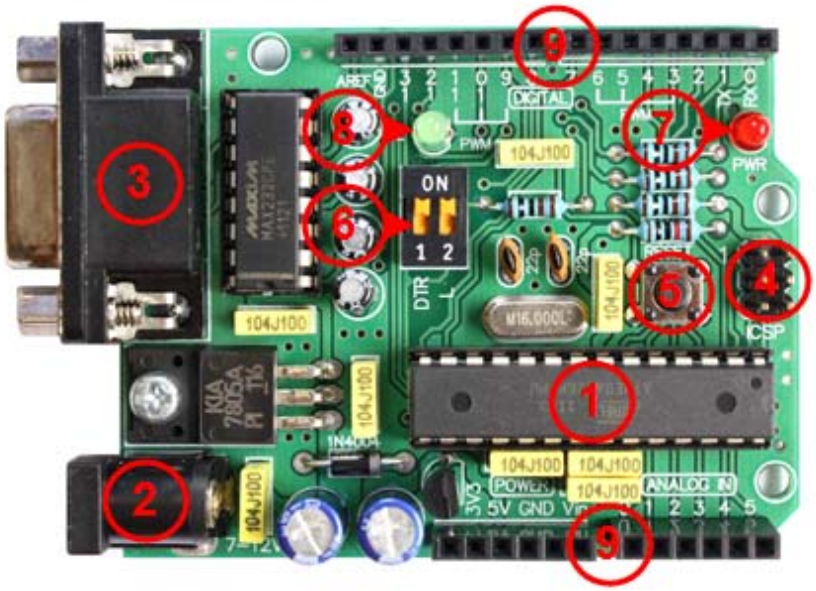
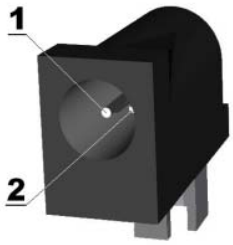


Figure1.3.1

No.1 is ATmega328 microcontroller.
No.2 is DC Jack pole will be supplied power into the Dino (Arduino Compatible) Board which operating voltage is 7-12VDC as figure 1.3.2 (Outer pole is negative pole and Inner pole is positive pole)



PIN #	Signal Name
1	7-12Vdc
2	GND

Figure1.3.2

No.3 is RS232 port will be connected with computer and upload program into the Dino (Arduino Compatible) Board.
No.4 is Standard ICSP 6pins will be programmed bootloader with AVR ISP.
No.5 is Reset switch will be reset operation of microcontroller.

No.6 is DIP switch SPST to disable auto reset (Position1: DTR) and green LED (Position2: L).

a) Position1 (DTR) will be set "**ON**" to write program to develop the Dino (Arduino Compatible) Board.

b) Position1 (DTR) will be set "**OFF**" to run program after completely wrote program and to protect the Dino (Arduino Compatible) Board is reset by itself while run program which may be cause come from RS232 signal.

c) Position2 (L) will be set "**ON**" to enable green LED (D13).

d) Position2 (L) will be set "**OFF**" to disable green LED (D13).

No.7 is PWR-LED (Red LED) will be lighted when power is supplied into the Dino (Arduino Compatible) Board.

No.8 is Green LED (D13) will be tested operation of the Dino (Arduino Compatible) Board.

No.9 is the Standard Arduino Pin Header - 8 pins & 6 pins (Female) will be stacked with external devices or other arduino boards.

Chapter2. Getting Started

2.1. Safety Instruction

Observe the following safety guideline when connection and using your Dino (Arduino Compatible) Board as follow:

2.1.1. Place your Dino (Arduino Compatible) Board on an insulation surface and treat it carefully. The Dino (Arduino Compatible) Board can be damaged if dropped.
2.1.2. Put your Dino (Arduino Compatible) Board in a location with low humidity and a minimum of dust.
2.1.3. Never use your Dino (Arduino Compatible) Board if the DC Jack cable has been damaged. Do not allow anything to rest on the DC Jack cable, and keep the cable away from where people could trip over it.
2.1.4. Never insert anything metallic into the Dino (Arduino Compatible) Board. Doing so may create the danger of electric shock.
2.1.5. To avoid electric shock, never touch the inside of the Dino (Arduino Compatible) Board.
2.1.6. Dino (Arduino Compatible) Board is provided for ventilation. To prevent overheating, these openings should not be blocked or covered. Also, avoid using the Dino (Arduino Compatible) Board on a bed, sofa, rug, or other soft surface.
2.1.7. Do not expose the Dino (Arduino Compatible) Board to rain or use it near water. If the Dino (Arduino Compatible) Board accidentally gets wet, unplug (DC Jack cable, RS232 cable) it and you can clean the exterior of the Dino (Arduino Compatible) Board with a dry cloth when necessary, but be sure to unplug (DC Jack cable, RS232 cable) the Dino (Arduino Compatible) Board first.

2.2. Install the Arduino Software

The software to development is contained in a free CD. The software name is “arduino-1.0.1”. If user need to more information or the latest version program you can be downloaded on website arduino.cc.

Install the Arduino Software as the following:

2.2.1. Insert a free CD into the CD-ROM Drive.

2.2.2. Copy the Arduino Software from a free CD is choose folder “Arduino Software\Windows\arduino-1.0.1” into drive “C:\Program Files” as figure2.2.1.

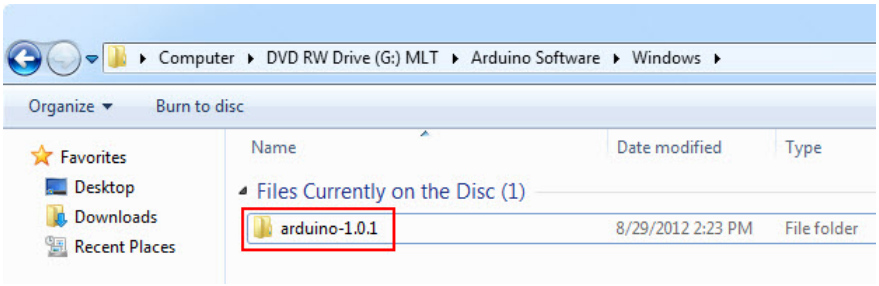


Figure2.2.1

2.2.3. After already copied this folder “arduino-1.0.1” then create shortcut of this program “arduino-1.0.1” on your desktop is right-click on icon **“arduino”** then select “Send To>Desktop (create shortcut)” as figure2.2.2

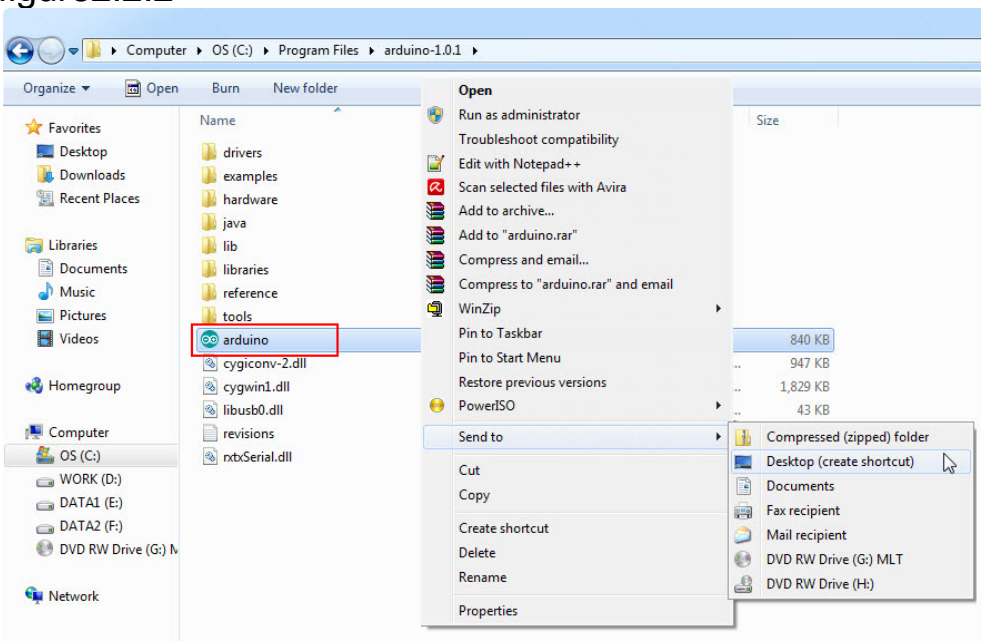


Figure2.2.2

2.2.4. After already created the shortcut then it will be shown

“Shortcut to arduino” on your desktop.

2.3. Starting Dino (Arduino Compatible) Board with Blink Program

After completely installed the arduino program then will be tested the Dino (Arduino Compatible) Board is open an example program (Blink program) then compile and upload program into the Dino (Arduino Compatible) Board as following:

2.3.1. Connect the Dino (Arduino Compatible) Board to your computer via RS232 cable and power supply 7-12VDC via DC Jack pole **(Outer pole is negative pole and Inner pole is positive pole)** then PWR-LED (Red LED) will be lighted as figure2.3.1 and choose DIP switch position1 (DTR) & position2 (L) are "**ON**" as figure2.3.1.

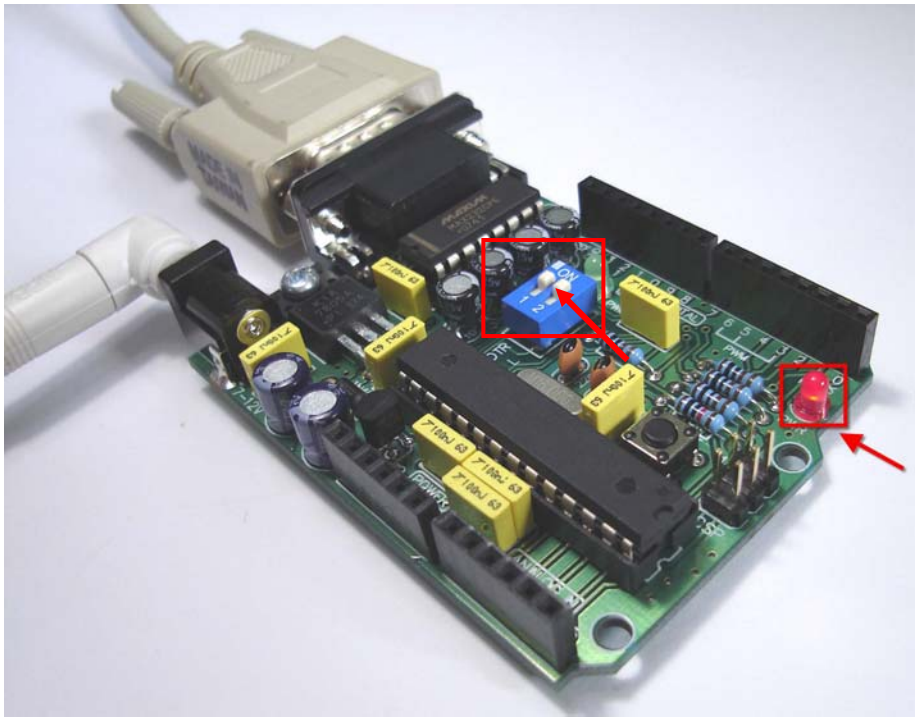


Figure2.3.1

2.3.8. If the C language code is correct and not found data error then information will be shown “Done compiling” and “Binary sketch size” as figure2.3.9.

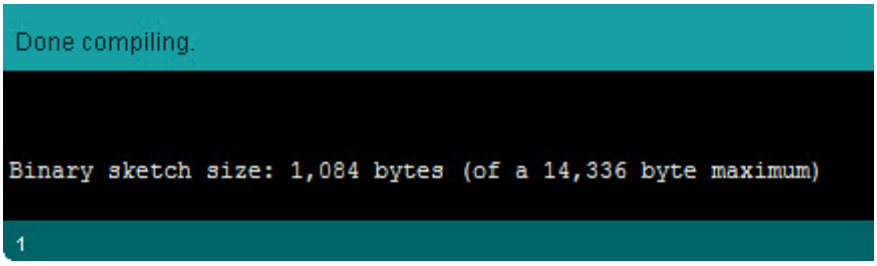


Figure2.3.9

2.3.9. Choose “File > Upload to I/O Board” or click icon as figure2.3.10 to upload program into the Dino (Arduino Compatible) Board.

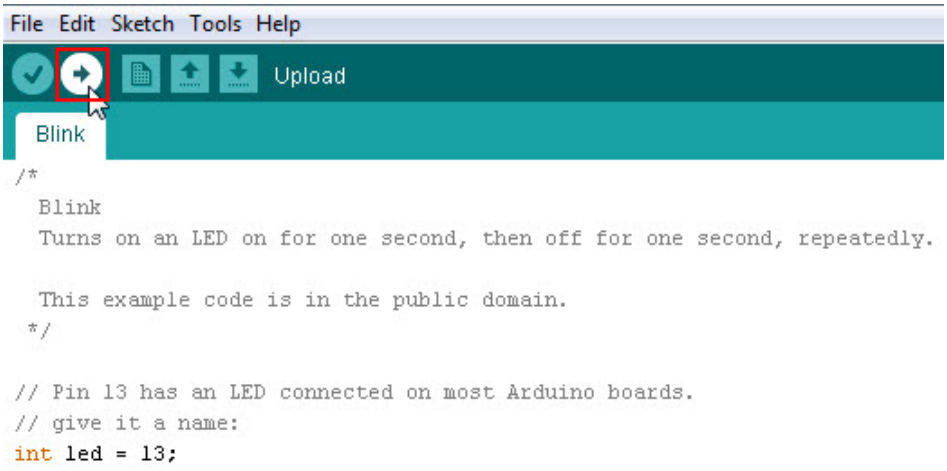


Figure2.3.10

2.3.10. If completely uploaded an example program (Blink program) then information will be shown “Done uploading” and “Binary sketch size” as figure2.1.11 then green LED (D13 port) will be displayed blink with the rate is ON=1sec. and OFF=1sec. continuously.

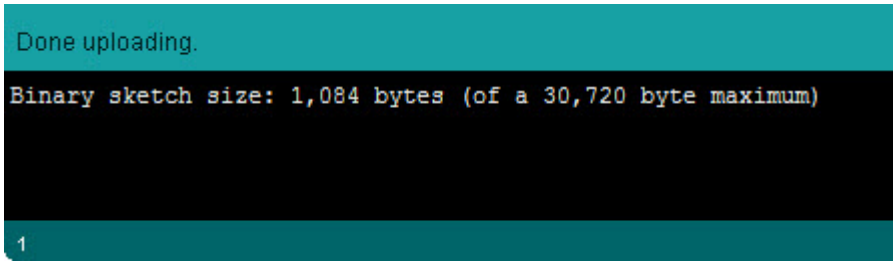
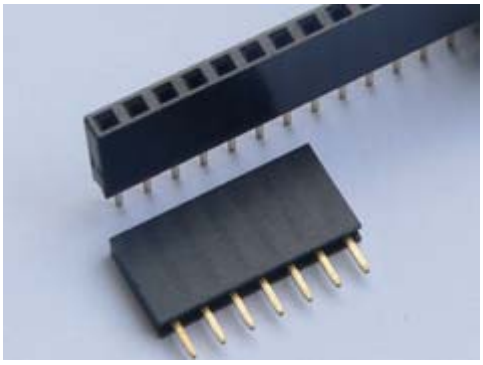


Figure2.3.11

Chapter3. Datasheet

3.1. P.C. Board Socket 1*8 pins Female



Product Part No.: FHSS08G10/RH
Description: P.C. Board Socket 1*8 pins Female.
Product Feature: Single Low 2.54mm 8 pins.

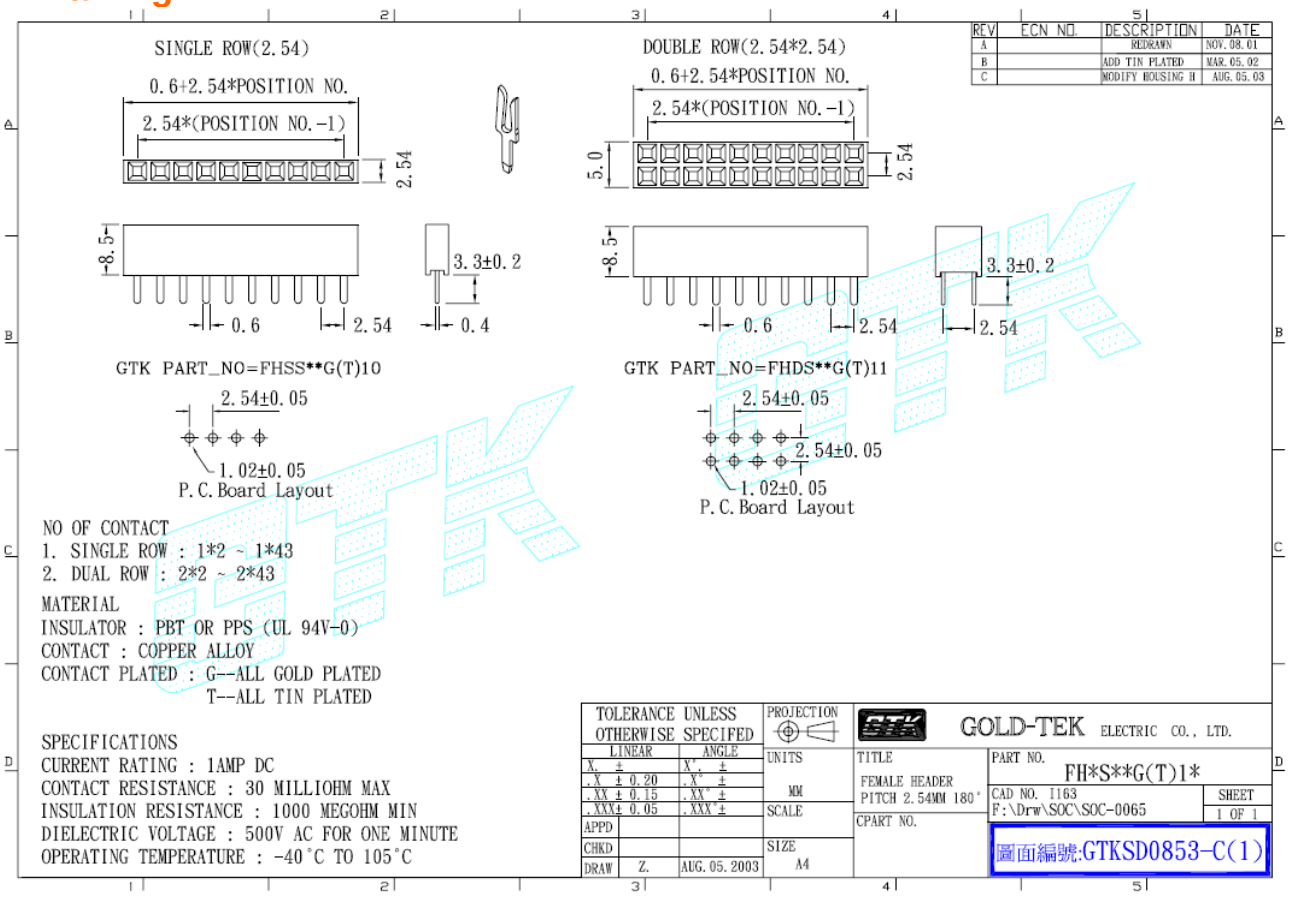
Specification

Connector Type	Female Header
Pin Type	Straight
Number of Pin	8
Number of Row	Single
Pitch	2.54mm.
Gender	Female
Series	FH Series

Product Information

Product Category	Connectors
Family	Pin Header & Female PCB Connectors
Product Part No.	FHSS08G10/RH
Manufacturer	GTK
Weight (Gram)	0.8

Drawing


SINGLE ROW(2.54)
0.6+2.54*POSITION NO.
2.54*(POSITION NO.-1)
2.54
8.5
0.6
2.54
3.3±0.2
0.4
GTK PART_NO=FHSS**G(T)10
2.54±0.05
1.02±0.05
P.C.Board Layout
DOUBLE ROW(2.54*2.54)
0.6+2.54*POSITION NO.
2.54*(POSITION NO.-1)
5.0
2.54
8.5
0.6
2.54
3.3±0.2
2.54
GTK PART_NO=FHDS**G(T)11
2.54±0.05
2.54±0.05
1.02±0.05
P.C.Board Layout
NO OF CONTACT
1. SINGLE ROW : 1*2 ~ 1*43
2. DUAL ROW : 2*2 ~ 2*43
MATERIAL
INSULATOR : PBT OR PPS (UL 94V-0)
CONTACT : COPPER ALLOY
CONTACT PLATED : G--ALL GOLD PLATED
T--ALL TIN PLATED
SPECIFICATIONS
CURRENT RATING : 1AMP DC
CONTACT RESISTANCE : 30 MILLIOHM MAX
INSULATION RESISTANCE : 1000 MEGOHM MIN
DIELECTRIC VOLTAGE : 500V AC FOR ONE MINUTE
OPERATING TEMPERATURE : -40°C TO 105°C
REV ECN NO. DESCRIPTION DATE
A REDRAWN NOV. 08. 01
B ADD TIN PLATED MAR. 05. 02
C MODIFY HOUSING H AUG. 05. 03
TOLERANCE UNLESS OTHERWISE SPECIFED
LINEAR ANGLE
X ± X° ±
.X ± 0.20 .X° ±
.XX ± 0.15 .XX° ±
.XXX± 0.05 .XXX°±
APPD
CHKD
DRAW Z. AUG. 05. 2003
PROJECTION
UNITS MM
SCALE
SIZE A4
GOLD-TEK ELECTRIC CO., LTD.
TITLE
FEMALE HEADER
PITCH 2.54MM 180°
CPART NO.
PART NO. FH*S**G(T)1*
CAD NO. 1163
F:\Drw\SOC\SOC-0065
SHEET 1 OF 1
圖面編號:GTKSD0853-C(1)

3.2. D-SUB Connector 9 pins Female

Product Part No.: DEL09SBTK2YS/RH
Description: D-SUB Connector 9 pins Female.
Product Feature: Right Angle Type PCB Mount.

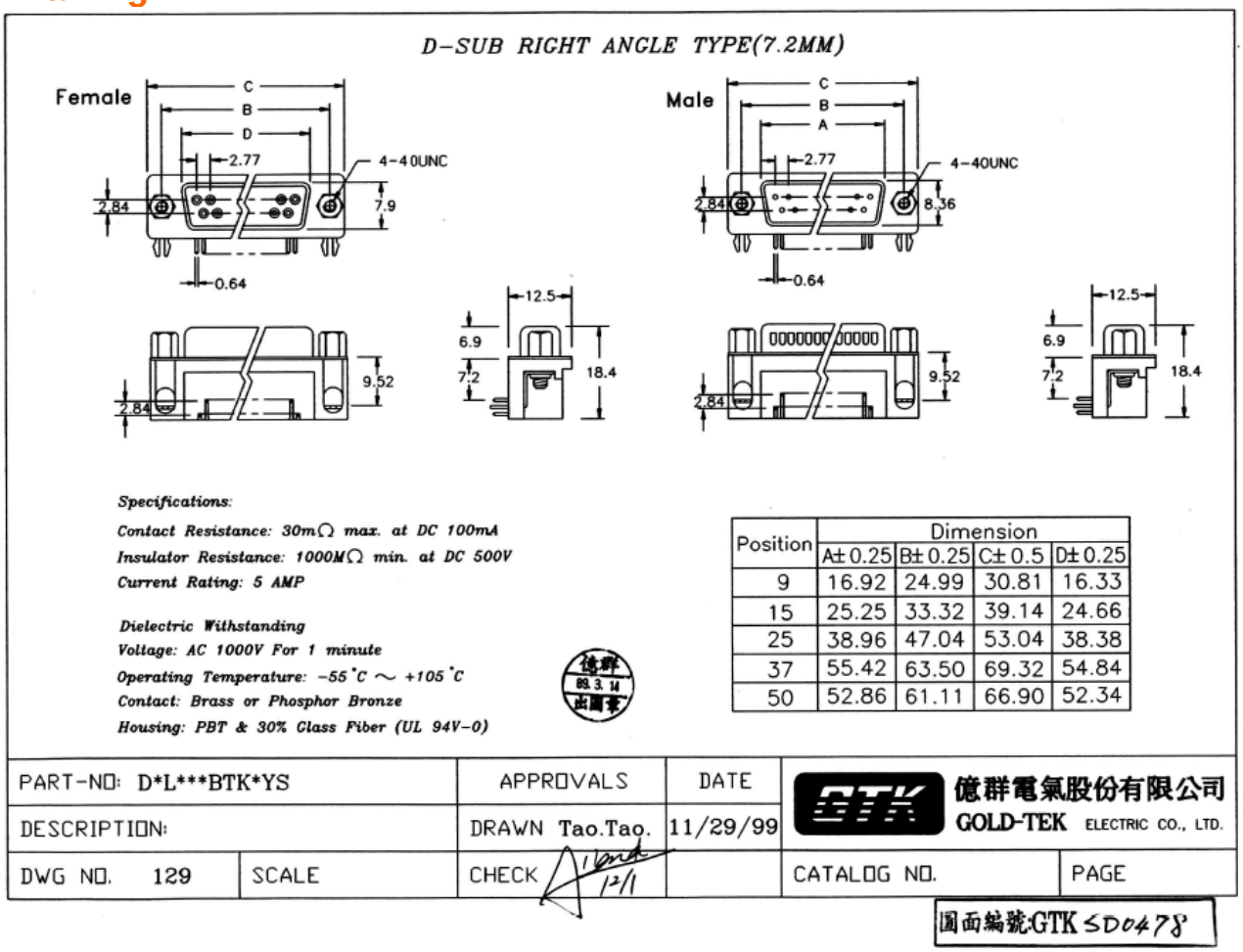
Specification

Connector Type	Female
Number of Contact	9
Contact Termination	Through Hole/Right Angle
Number of Rows	2
Insulator Color	Black
Contact Finish	Brass or phosphor bronze

Product Information

Product Category	Connectors
Family	D-Sub Connectors
Product Part No.	DEL09SBTK2YS/RH
Manufacturer	GTK
Weight (Gram)	8

Drawing



Specifications:

Contact Resistance: 30mΩ max. at DC 100mA
Insulator Resistance: 1000MΩ min. at DC 500V
Current Rating: 5 AMP

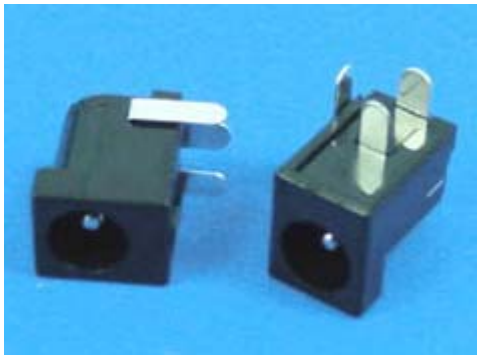
Dielectric Withstanding
Voltage: AC 1000V For 1 minute
Operating Temperature: -55°C ~ +105°C
Contact: Brass or Phosphor Bronze
Housing: PBT & 30% Class Fiber (UL 94V-0)

Position	Dimension			
	A± 0.25	B± 0.25	C± 0.5	D± 0.25
9	16.92	24.99	30.81	16.33
15	25.25	33.32	39.14	24.66
25	38.96	47.04	53.04	38.38
37	55.42	63.50	69.32	54.84
50	52.86	61.11	66.90	52.34

PART-NO: D*L***BTK*YS		APPROVALS	DATE	億群電氣股份有限公司 GOLD-TEK ELECTRIC CO., LTD.	
DESCRIPTION:		DRAWN Tao.Tao.	11/29/99		
DWG NO. 129	SCALE	CHECK		CATALOG NO.	PAGE

圖面編號:GTK SD0478

3.3. DC Jack: 0.3A, 30VDC, ROHS, Wealth



Product Part No.: DS-012BPC-ROHS
Description: DC Jack: 0.3A, 30VDC, ROHS, Wealth.
Product Feature: DC Power Jack: 0.3A, 30VDC, DIA. = 2.0mm.ROHS.

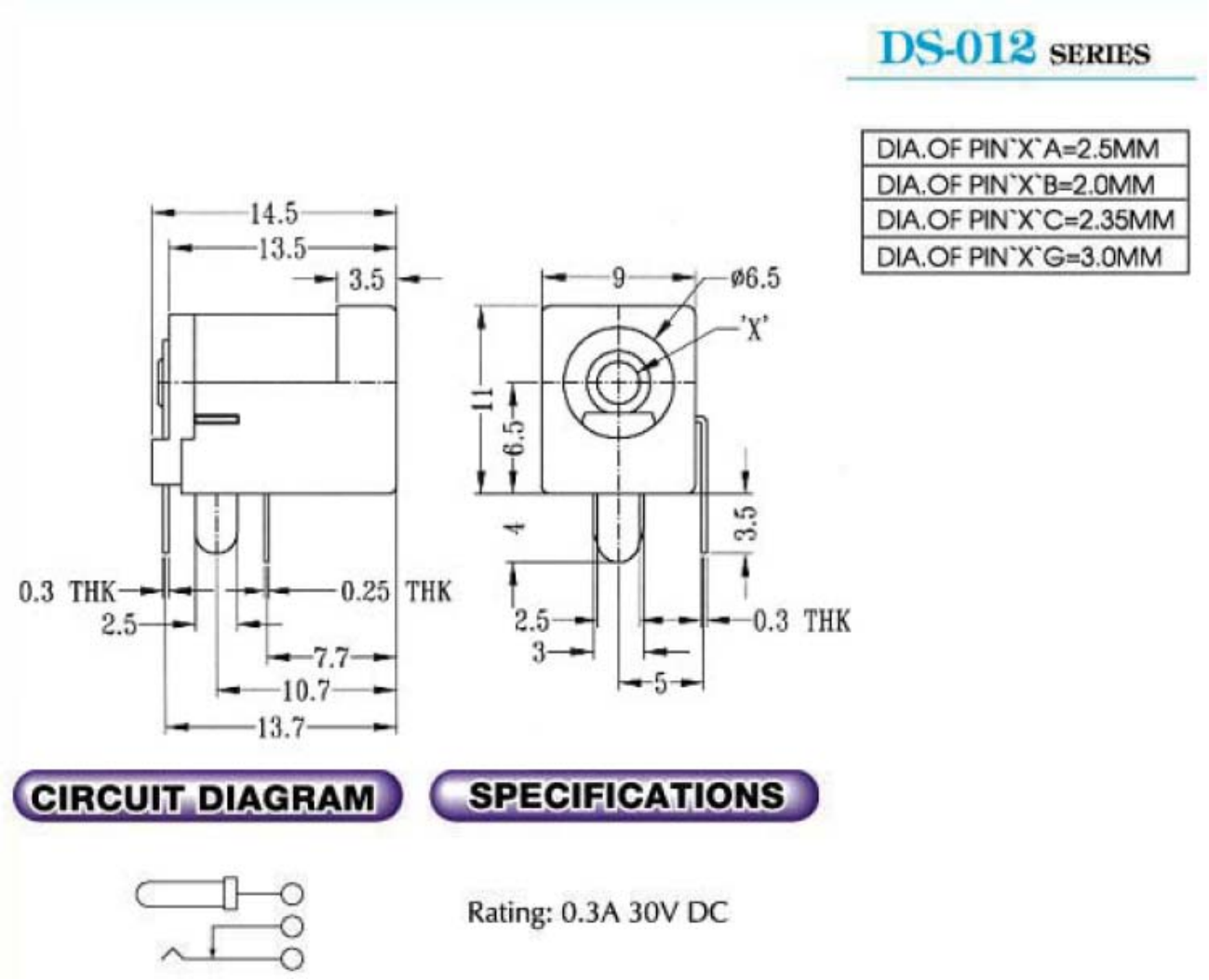
Specification

Connector Type	DC Power Jack
Diameter	2.0mm.
Gender	Male
Current Rating	0.3A 30VDC

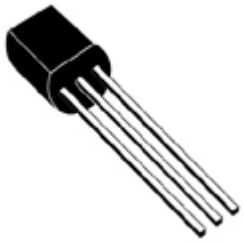
Product Information

Product Category	Connectors
Family	Main Power Plugs, Inlet & Outlet
Product Part No.	DS-012BPC-ROHS
Manufacturer	Wealth Metal
Weight (Gram)	1.5

Drawing


DS-012 SERIES
DIA.OF PIN`X`A=2.5MM
DIA.OF PIN`X`B=2.0MM
DIA.OF PIN`X`C=2.35MM
DIA.OF PIN`X`G=3.0MM
14.5
13.5
3.5
9
ø6.5
'X'
11
6.5
4
3.5
0.3 THK
0.25 THK
2.5
7.7
10.7
13.7
2.5
3
5
0.3 THK
CIRCUIT DIAGRAM
SPECIFICATIONS
Rating: 0.3A 30V DC

3.4. IC: Regulator +3.3V 0.1A, ST.



Product Part No.: L78L33ACZ
Description: IC: Regulator +3.3V 0.1A, ST.
Product Feature: Positive Voltage Regulator +3.3V 100mA.

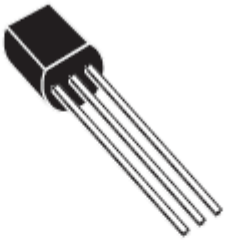
Specification

Current	100mA
Regulator Topology	Positive Fixed
Regulator Type	Linear
Output Voltage	3.3V
Feature	Thermal Overload Protection

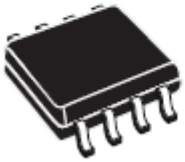
Product Information

Product Category	Integrated Circuit (ICs)
Family	Voltage Regulators
Product Part No.	L78L33ACZ
Manufacturer	SGS-THOMSON
Package/Case	TO-92
Weight (Gram)	0.3

More Information
L78L00 Series
Positive voltage regulators.



TO-92



SO-8

SOT-89

3.4.1. Feature summary

- Output current up to 100 mA.
- Output voltages of 3.3; 5; 6; 8; 9; 12; 15; 18; 24V.
- Thermal overload protection.
- Short circuit protection.
- No external components are required.
- Available in either ±5% (AC) or ±10% (C) Selection.

3.4.2. Description

The L78L00 series of three-terminal positive regulators employ internal current limiting and thermal shutdown, making them essentially indestructible. If adequate heat-sink is provided, they can deliver up to 100 mA output current. They are intended as fixed voltage regulators in a wide range of applications including local or oncard regulation for elimination of noise and distribution problems associated with single-point regulation.

In addition, they can be used with power pass elements to make high-current voltage regulators. The L78L00 series used as Zener diode/resistor combination replacement, offers an effective output impedance improvement of typically two orders of magnitude, along with lower quiescent current and lower noise.

3.4.3. Schematic diagram

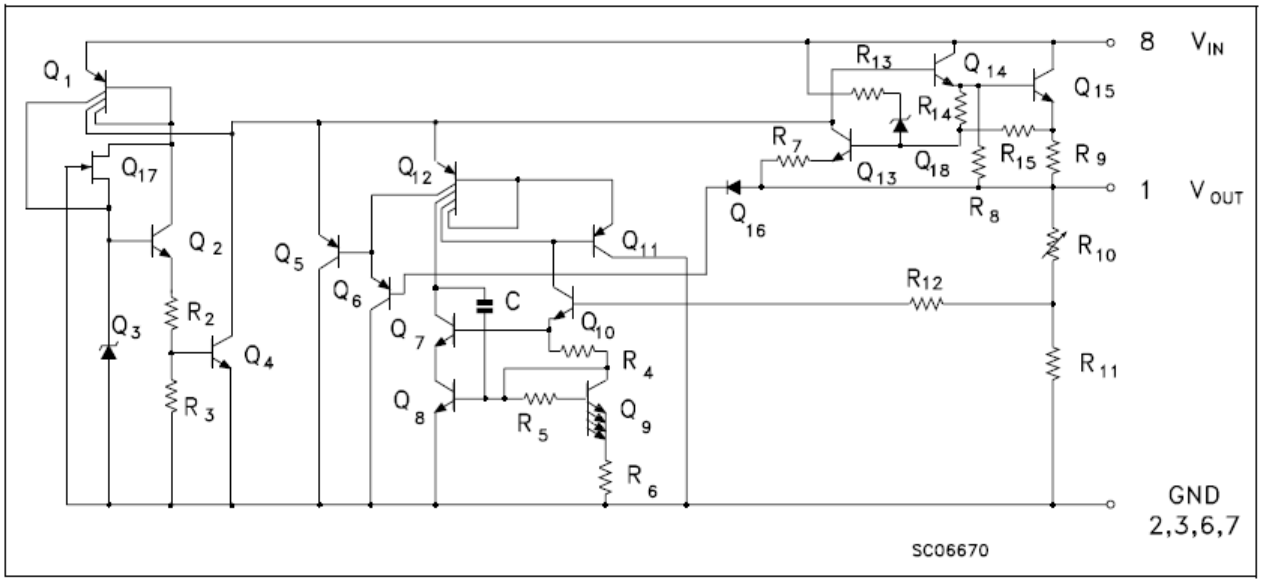


Figure3.4.1. Schematic

3.4.4. Pin configuration

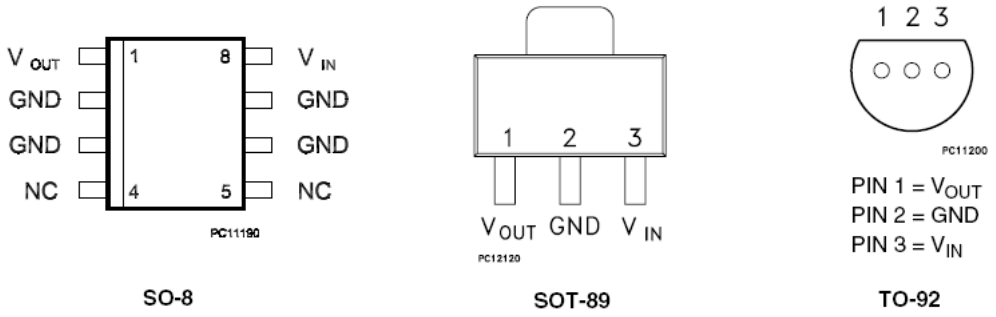


Figure3.4.2. Pin Connection (top view, bottom view for TO-92)

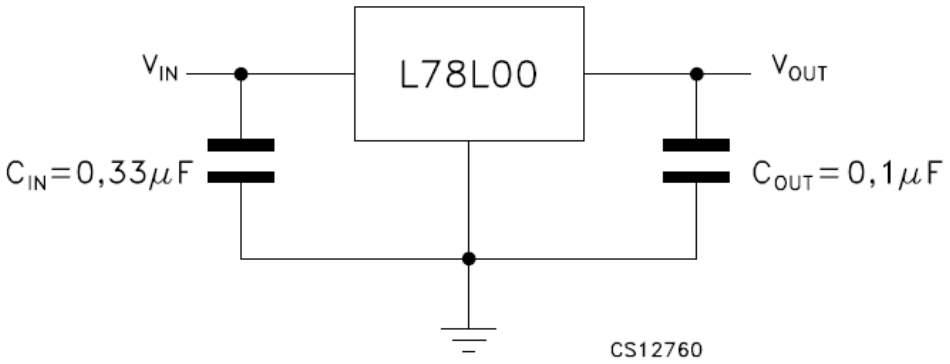


Figure3.4.3. Test circuits

3.4.5. Maximum ratings

Symbol	Parameter		Value	Unit
V_I	DC Input voltage	V_O= 3.3 to 9V	30	V
		V_O= 12 to 15V	35	
		V_O= 18 to 24V	40	
I_O	Output current		100	mA
P_D	Power dissipation		Internally Limited (1)	mW
T_{STG}	Storage temperature range		-65 to 150	°C
T_{OP}	Operating junction temperature range	for L7800AC	0 to 150	°C
		for L7800AB	-40 to 125	

Table3.4.1. Absolute maximum ratings

3.4.5.1. Our SO-8 package used for Voltage Regulators is modified internally to have pins 2, 3, 6 and 7 electrically communed to the die attach flag. This particular frame decreases the total thermal resistance of the package and increases its ability to dissipate power when an appropriate area of copper on the printed circuit board is available for heat-sinking. The external dimensions are the same as for the standard SO-8.

Symbol	Parameter	SO-8	TO-92	SOT-89	Unit
R_{thJC}	Thermal resistance junction-case. (Max)	20		15	°C/W
R_{thJA}	Thermal resistance junction-ambient. (Max)	55 (1)	200		°C/W

Table3.4.2. Thermal Data

3.4.5.2. Considering 6cm^2 of copper Board heat-sink.

3.4.6. Electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	3.036	3.3	3.564	V
V_O	Output voltage	I_O = 1 to 40 mA, V_I = 5.3 to 20 V	2.97		3.63	V
		I_O = 1 to 70 mA, V_I = 8.3 V	2.97		3.63	
ΔV_O	Line regulation	V_I = 5.3 to 20 V, T_J = 25°C			150	mV
		V_I = 6.3 to 20 V, T_J = 25°C			100	
ΔV_O	Load regulation	I_O = 1 to 100 mA, T_J = 25°C			60	mV
		I_O = 1 to 40 mA, T_J = 25°C			30	
I_d	Quiescent current	T_J = 25°C			6	mA
		T_J = 125°C			5.5	mA
ΔI_d	Quiescent current change	I_O = 1 to 40 mA			0.2	mA
		V_I = 6.3 to 20 V			1.5	
eN	Output noise voltage	B =10Hz to 100KHz, T_J = 25°C		40		µV
SVR	Supply voltage rejection	V_I = 6.3 to 16.3 V, f = 120Hz I_O = 40 mA, T_J = 25°C	41	49		dB
V_d	Dropout voltage			1.7		V

Table3.4.3. Electrical characteristics of L78L33C (refer to the test circuits, TJ = 0 to 125°C, VI = 8.3V, IO = 40 mA, CI = 0.33 µF, CO = 0.1 µF unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	4.6	5	5.4	V
V_O	Output voltage	I_O = 1 to 40 mA, V_I = 7 to 20 V	4.5		5.5	V
		I_O = 1 to 70 mA, V_I = 10 V	4.5		5.5	
ΔV_O	Line regulation	V_I = 8.5 to 20 V, T_J = 25°C			200	mV
		V_I = 9 to 20 V, T_J = 25°C			150	
ΔV_O	Load regulation	I_O = 1 to 100 mA, T_J = 25°C			60	mV
		I_O = 1 to 40 mA, T_J = 25°C			30	
I_d	Quiescent current	T_J = 25°C			6	mA
		T_J = 125°C			5.5	mA
ΔI_d	Quiescent current change	I_O = 1 to 40 mA			0.2	mA
		V_I = 8 to 20 V			1.5	
eN	Output noise voltage	B =10Hz to 100KHz, T_J = 25°C		40		µV
SVR	Supply voltage rejection	V_I = 9 to 20 V, f = 120Hz I_O = 40 mA, T_J = 25°C	40	49		dB
V_d	Dropout voltage			1.7		V

Table3.4.4. Electrical characteristics of L78L05C (refer to the test circuits, TJ = 0 to 125°C, VI = 10V, IO = 40 mA, CI = 0.33 µF, CO = 0.1 µF unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	5.52	6	6.48	V
V_O	Output voltage	I_O = 1 to 40 mA, V_I = 8.5 to 20 V	5.4		6.6	V
		I_O = 1 to 70 mA, V_I = 12 V	5.4		6.6	
ΔV_O	Line regulation	V_I = 8.5 to 20 V, T_J = 25°C			200	mV
		V_I = 9 to 20 V, T_J = 25°C			150	
ΔV_O	Load regulation	I_O = 1 to 100 mA, T_J = 25°C			60	mV
		I_O = 1 to 40 mA, T_J = 25°C			30	
I_d	Quiescent current	T_J = 25°C			6	mA
		T_J = 125°C			5.5	mA
ΔI_d	Quiescent current change	I_O = 1 to 40 mA			0.2	mA
		V_I = 8 to 20 V			1.5	
eN	Output noise voltage	B =10Hz to 100KHz, T_J = 25°C		50		µV
SVR	Supply voltage rejection	V_I = 9 to 20 V, f = 120Hz I_O = 40 mA, T_J = 25°C	38	46		dB
V_d	Dropout voltage			1.7		V

Table3.4.5. Electrical characteristics of L78L06C (refer to the test circuits, TJ = 0 to 125°C, VI = 12V, IO = 40 mA, CI = 0.33 µF, CO = 0.1 µF unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	7.36	8	8.64	V
V_O	Output voltage	I_O = 1 to 40 mA, V_I = 8.5 to 20 V	7.2		8.8	V
		I_O = 1 to 70 mA, V_I = 12 V	7.2		8.8	
ΔV_O	Line regulation	V_I = 8.5 to 20 V, T_J = 25°C			200	mV
		V_I = 9 to 20 V, T_J = 25°C			150	
ΔV_O	Load regulation	I_O = 1 to 100 mA, T_J = 25°C			80	mV
		I_O = 1 to 40 mA, T_J = 25°C			40	
I_d	Quiescent current	T_J = 25°C			6	mA
		T_J = 125°C			5.5	mA
ΔI_d	Quiescent current change	I_O = 1 to 40 mA			0.2	mA
		V_I = 8 to 20 V			1.5	
eN	Output noise voltage	B =10Hz to 100KHz, T_J = 25°C		60		µV
SVR	Supply voltage rejection	V_I = 9 to 20 V, f = 120Hz I_O = 40 mA, T_J = 25°C	36	45		dB
V_d	Dropout voltage			1.7		V

Table3.4.6. Electrical characteristics of L78L08C (refer to the test circuits, TJ = 0 to 125°C, VI = 14V, IO = 40 mA, CI = 0.33 µF, CO = 0.1 µF unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	8.28	9	9.72	V
V_O	Output voltage	I_O = 1 to 40 mA, V_I = 11.5 to 23 V	8.1		9.9	V
		I_O = 1 to 70 mA, V_I = 15 V	8.1		9.9	
ΔV_O	Line regulation	V_I = 11.5 to 23 V, T_J = 25°C			250	mV
		V_I = 12 to 23 V, T_J = 25°C			200	
ΔV_O	Load regulation	I_O = 1 to 100 mA, T_J = 25°C			80	mV
		I_O = 1 to 40 mA, T_J = 25°C			40	
I_d	Quiescent current	T_J = 25°C			6	mA
		T_J = 125°C			5.5	mA
ΔI_d	Quiescent current change	I_O = 1 to 40 mA			0.2	mA
		V_I = 12 to 23 V			1.5	
eN	Output noise voltage	B =10Hz to 100KHz, T_J = 25°C		70		µV
SVR	Supply voltage rejection	V_I = 12 to 23 V, f = 120Hz I_O = 40 mA, T_J = 25°C	36	44		dB
V_d	Dropout voltage			1.7		V

Table3.4.7. Electrical characteristics of L78L09C (refer to the test circuits, TJ = 0 to 125°C, VI = 15V, IO = 40 mA, CI = 0.33 µF, CO = 0.1 µF unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	9.2	10	10.8	V
V_O	Output voltage	I_O = 1 to 40 mA, V_I = 12.5 to 23 V	9		11	V
		I_O = 1 to 70 mA, V_I = 16 V	9		11	
ΔV_O	Line regulation	V_I = 12.5 to 23 V, T_J = 25°C			230	mV
		V_I = 13 to 23 V, T_J = 25°C			170	
ΔV_O	Load regulation	I_O = 1 to 100 mA, T_J = 25°C			80	mV
		I_O = 1 to 40 mA, T_J = 25°C			40	
I_d	Quiescent current	T_J = 25°C			6	mA
		T_J = 125°C			5.5	mA
ΔI_d	Quiescent current change	I_O = 1 to 40 mA			0.1	mA
		V_I = 13 to 23 V			1.5	
eN	Output noise voltage	B =10Hz to 100KHz, T_J = 25°C		60		µV
SVR	Supply voltage rejection	V_I = 14 to 23 V, f = 120Hz I_O = 40 mA, T_J = 25°C	37	45		dB
V_d	Dropout voltage			1.7		V

Table3.4.8. Electrical characteristics of L78L10C (refer to the test circuits, TJ = 0 to 125°C, VI = 16V, IO = 40 mA, CI = 0.33 µF, CO = 0.1 µF unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	11.1	12	12.9	V
V_O	Output voltage	I_O = 1 to 40 mA, V_I = 14.5 to 27 V	10.8		13.2	V
		I_O = 1 to 70 mA, V_I = 19 V	10.8		13.2	
ΔV_O	Line regulation	V_I = 14.5 to 27 V, T_J = 25°C			250	mV
		V_I = 16 to 27 V, T_J = 25°C			200	
ΔV_O	Load regulation	I_O = 1 to 100 mA, T_J = 25°C			100	mV
		I_O = 1 to 40 mA, T_J = 25°C			50	
I_d	Quiescent current	T_J = 25°C			6.5	mA
		T_J = 125°C			6	mA
ΔI_d	Quiescent current change	I_O = 1 to 40 mA			0.2	mA
		V_I = 16 to 27 V			1.5	
eN	Output noise voltage	B =10Hz to 100KHz, T_J = 25°C		80		µV
SVR	Supply voltage rejection	V_I = 15 to 25 V, f = 120Hz I_O = 40 mA, T_J = 25°C	36	42		dB
V_d	Dropout voltage			1.7		V

Table3.4.9. Electrical characteristics of L78L12C (refer to the test circuits, TJ = 0 to 125°C, VI = 19V, IO = 40 mA, CI = 0.33 µF, CO = 0.1 µF unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	13.8	15	16.2	V
V_O	Output voltage	I_O = 1 to 40 mA, V_I = 17.5 to 30 V	13.5		16.5	V
		I_O = 1 to 70 mA, V_I = 23 V	13.5		16.5	
ΔV_O	Line regulation	V_I = 17.5 to 30 V, T_J = 25°C			300	mV
		V_I = 20 to 30 V, T_J = 25°C			250	
ΔV_O	Load regulation	I_O = 1 to 100 mA, T_J = 25°C			150	mV
		I_O = 1 to 40 mA, T_J = 25°C			75	
I_d	Quiescent current	T_J = 25°C			6.5	mA
		T_J = 125°C			6	mA
ΔI_d	Quiescent current change	I_O = 1 to 40 mA			0.2	mA
		V_I = 20 to 30 V			1.5	
eN	Output noise voltage	B =10Hz to 100KHz, T_J = 25°C		90		µV
SVR	Supply voltage rejection	V_I = 18.5 to 28.5 V, f = 120Hz I_O = 40 mA, T_J = 25°C	33	39		dB
V_d	Dropout voltage			1.7		V

Table3.4.10. Electrical characteristics of L78L15C (refer to the test circuits, TJ = 0 to 125°C, VI = 23V, IO = 40 mA, CI = 0.33 µF, CO = 0.1 µF unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	16.6	18	19.4	V
V_O	Output voltage	I_O = 1 to 40 mA, V_I = 22 to 33 V	16.2		19.8	V
		I_O = 1 to 70 mA, V_I = 27 V	16.2		19.8	
ΔV_O	Line regulation	V_I = 22 to 33 V, T_J = 25°C			320	mV
		V_I = 22 to 33 V, T_J = 25°C			270	
ΔV_O	Load regulation	I_O = 1 to 100 mA, T_J = 25°C			170	mV
		I_O = 1 to 40 mA, T_J = 25°C			85	
I_d	Quiescent current	T_J = 25°C			6.5	mA
		T_J = 125°C			6	mA
ΔI_d	Quiescent current change	I_O = 1 to 40 mA			0.2	mA
		V_I = 23 to 33 V			1.5	
eN	Output noise voltage	B =10Hz to 100KHz, T_J = 25°C		120		µV
SVR	Supply voltage rejection	V_I = 23 to 33 V, f = 120Hz I_O = 40 mA, T_J = 25°C	32	38		dB
V_d	Dropout voltage			1.7		V

Table3.4.11. Electrical characteristics of L78L18C (refer to the test circuits, TJ = 0 to 125°C, VI = 27V, IO = 40 mA, CI = 0.33 µF, CO = 0.1 µF unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	18.4	20	21.6	V
V_O	Output voltage	I_O = 1 to 40 mA, V_I = 24 to 33 V	18		22	V
		I_O = 1 to 70 mA, V_I = 29 V	18		22	
ΔV_O	Line regulation	V_I = 22.5 to 34 V, T_J = 25°C			330	mV
		V_I = 24 to 34 V, T_J = 25°C			280	
ΔV_O	Load regulation	I_O = 1 to 100 mA, T_J = 25°C			180	mV
		I_O = 1 to 40 mA, T_J = 25°C			90	
I_d	Quiescent current	T_J = 25°C			6.5	mA
		T_J = 125°C			6	mA
ΔI_d	Quiescent current change	I_O = 1 to 40 mA			0.2	mA
		V_I = 25 to 33 V			1.5	
eN	Output noise voltage	B =10Hz to 100KHz, T_J = 25°C		120		µV
SVR	Supply voltage rejection	V_I = 25 to 35 V, f = 120Hz I_O = 40 mA, T_J = 25°C	31	38		dB
V_d	Dropout voltage			1.7		V

Table3.4.12. Electrical characteristics of L78L20C (refer to the test circuits, TJ = 0 to 125°C, VI = 29V, IO = 40 mA, CI = 0.33 µF, CO = 0.1 µF unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	22.1	24	25.9	V
V_O	Output voltage	I_O = 1 to 40 mA, V_I = 27 to 38 V	21.6		26.4	V
		I_O = 1 to 70 mA, V_I = 33 V	21.6		26.4	
ΔV_O	Line regulation	V_I = 27 to 38 V, T_J = 25°C			350	mV
		V_I = 28 to 38 V, T_J = 25°C			300	
ΔV_O	Load regulation	I_O = 1 to 100 mA, T_J = 25°C			200	mV
		I_O = 1 to 40 mA, T_J = 25°C			100	
I_d	Quiescent current	T_J = 25°C			6.5	mA
		T_J = 125°C			6	mA
ΔI_d	Quiescent current change	I_O = 1 to 40 mA			0.2	mA
		V_I = 28 to 38 V			1.5	
eN	Output noise voltage	B =10Hz to 100KHz, T_J = 25°C		200		µV
SVR	Supply voltage rejection	V_I = 29 to 35 V, f = 120Hz I_O = 40 mA, T_J = 25°C	30	37		dB
V_d	Dropout voltage			1.7		V

Table3.4.13. Electrical characteristics of L78L24C (refer to the test circuits, TJ = 0 to 125°C, VI = 33V, IO = 40 mA, CI = 0.33 µF, CO = 0.1 µF unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	3.168	3.3	3.432	V
V_O	Output voltage	I_O = 1 to 40 mA, V_I = 5.3 to 20 V	3.135		3.465	V
		I_O = 1 to 70 mA, V_I = 8.3 V	3.135		3.465	
ΔV_O	Line regulation	V_I = 5.3 to 20 V, T_J = 25°C			150	mV
		V_I = 6.3 to 20 V, T_J = 25°C			100	
ΔV_O	Load regulation	I_O = 1 to 100 mA, T_J = 25°C			60	mV
		I_O = 1 to 40 mA, T_J = 25°C			30	
I_d	Quiescent current	T_J = 25°C			6	mA
		T_J = 125°C			5.5	mA
ΔI_d	Quiescent current change	I_O = 1 to 40 mA			0.1	mA
		V_I = 6.3 to 20 V			1.5	
eN	Output noise voltage	B =10Hz to 100KHz, T_J = 25°C		40		µV
SVR	Supply voltage rejection	V_I = 6.3 to 16.3 V, f = 120Hz I_O = 40 mA, T_J = 25°C	41	49		dB
V_d	Dropout voltage			1.7		V

Table3.4.14. Electrical characteristics of L78L33AB and L78L33AC (refer to the test circuits, VI = 8.3V, IO = 40 mA, CI = 0.33 µF, CO = 0.1 µF, TJ = 0 to 125°C for L78L33AC, TJ = -40 to 125°C for L78L33AB, unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	4.8	5	5.2	V
V_O	Output voltage	I_O = 1 to 40 mA, V_I = 7 to 20 V	4.75		5.25	V
		I_O = 1 to 70 mA, V_I = 10 V	4.75		5.25	
ΔV_O	Line regulation	V_I = 7 to 20 V, T_J = 25°C			150	mV
		V_I = 8 to 20 V, T_J = 25°C			100	
ΔV_O	Load regulation	I_O = 1 to 100 mA, T_J = 25°C			60	mV
		I_O = 1 to 40 mA, T_J = 25°C			30	
I_d	Quiescent current	T_J = 25°C			6	mA
		T_J = 125°C			5.5	mA
ΔI_d	Quiescent current change	I_O = 1 to 40 mA			0.1	mA
		V_I = 8 to 20 V			1.5	
eN	Output noise voltage	B =10Hz to 100KHz, T_J = 25°C		40		µV
SVR	Supply voltage rejection	V_I = 8 to 18 V, f = 120Hz I_O = 40 mA, T_J = 25°C	41	49		dB
V_d	Dropout voltage			1.7		V

Table3.4.15. Electrical characteristics of L78L05AB and L78L05AC (refer to the test circuits, VI = 10V, IO = 40 mA, CI = 0.33 µF, CO = 0.1 µF, TJ = 0 to 125°C for L78L05AC, TJ = -40 to 125°C for L78L05AB, unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	5.76	6	6.24	V
V_O	Output voltage	I_O = 1 to 40 mA, V_I = 8.5 to 20 V	5.7		6.3	V
		I_O = 1 to 70 mA, V_I = 12 V	5.7		6.3	
ΔV_O	Line regulation	V_I = 8.5 to 20 V, T_J = 25°C			150	mV
		V_I = 9 to 20 V, T_J = 25°C			100	
ΔV_O	Load regulation	I_O = 1 to 100 mA, T_J = 25°C			60	mV
		I_O = 1 to 40 mA, T_J = 25°C			30	
I_d	Quiescent current	T_J = 25°C			6	mA
		T_J = 125°C			5.5	mA
ΔI_d	Quiescent current change	I_O = 1 to 40 mA			0.1	mA
		V_I = 9 to 20 V			1.5	
eN	Output noise voltage	B =10Hz to 100KHz, T_J = 25°C		50		µV
SVR	Supply voltage rejection	V_I = 9 to 20 V, f = 120Hz I_O = 40 mA, T_J = 25°C	39	46		dB
V_d	Dropout voltage			1.7		V

Table3.4.16. Electrical characteristics of L78L06AB and L78L06AC (refer to the test circuits, VI = 12V, IO = 40 mA, CI = 0.33 µF, CO = 0.1 µF, TJ = 0 to 125°C for L78L06AC, TJ = -40 to 125°C for L78L06AB, unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	7.68	8	8.32	V
V_O	Output voltage	I_O = 1 to 40 mA, V_I = 10.5 to 23 V	7.6		8.4	V
		I_O = 1 to 70 mA, V_I = 14 V	7.6		8.4	
ΔV_O	Line regulation	V_I = 10.5 to 23 V, T_J = 25°C			175	mV
		V_I = 11 to 23 V, T_J = 25°C			125	
ΔV_O	Load regulation	I_O = 1 to 100 mA, T_J = 25°C			80	mV
		I_O = 1 to 40 mA, T_J = 25°C			40	
I_d	Quiescent current	T_J = 25°C			6	mA
		T_J = 125°C			5.5	mA
ΔI_d	Quiescent current change	I_O = 1 to 40 mA			0.1	mA
		V_I = 11 to 23 V			1.5	
eN	Output noise voltage	B =10Hz to 100KHz, T_J = 25°C		60		µV
SVR	Supply voltage rejection	V_I = 12 to 23 V, f = 120Hz I_O = 40 mA, T_J = 25°C	37	45		dB
V_d	Dropout voltage			1.7		V

Table3.4.17. Electrical characteristics of L78L08AB and L78L08AC (refer to the test circuits, VI = 14V, IO = 40 mA, CI = 0.33 µF, CO = 0.1 µF, TJ = 0 to 125°C for L78L08AC, TJ = -40 to 125°C for L78L08AB, unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	8.64	9	9.36	V
V_O	Output voltage	I_O = 1 to 40 mA, V_I = 11.5 to 23 V	8.55		9.45	V
		I_O = 1 to 70 mA, V_I = 15 V	8.55		9.45	
ΔV_O	Line regulation	V_I = 11.5 to 23 V, T_J = 25°C			225	mV
		V_I = 12 to 23 V, T_J = 25°C			150	
ΔV_O	Load regulation	I_O = 1 to 100 mA, T_J = 25°C			80	mV
		I_O = 1 to 40 mA, T_J = 25°C			40	
I_d	Quiescent current	T_J = 25°C			6	mA
		T_J = 125°C			5.5	mA
ΔI_d	Quiescent current change	I_O = 1 to 40 mA			0.1	mA
		V_I = 12 to 23 V			1.5	
eN	Output noise voltage	B =10Hz to 100KHz, T_J = 25°C		70		µV
SVR	Supply voltage rejection	V_I = 12 to 23 V, f = 120Hz I_O = 40 mA, T_J = 25°C	37	44		dB
V_d	Dropout voltage			1.7		V

Table3.4.18. Electrical characteristics of L78L09AB and L78L09AC (refer to the test circuits, VI = 15V, IO = 40 mA, CI = 0.33 µF, CO = 0.1 µF, TJ = 0 to 125°C for L78L09AC, TJ = -40 to 125°C for L78L09AB, unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	9.6	10	10.4	V
V_O	Output voltage	I_O = 1 to 40 mA, V_I = 12.5 to 23 V	9.5		10.5	V
		I_O = 1 to 70 mA, V_I = 16 V	9.5		10.5	
ΔV_O	Line regulation	V_I = 12.5 to 23 V, T_J = 25°C			230	mV
		V_I = 13 to 23 V, T_J = 25°C			170	
ΔV_O	Load regulation	I_O = 1 to 100 mA, T_J = 25°C			80	mV
		I_O = 1 to 40 mA, T_J = 25°C			40	
I_d	Quiescent current	T_J = 25°C			6	mA
		T_J = 125°C			5.5	mA
ΔI_d	Quiescent current change	I_O = 1 to 40 mA			0.1	mA
		V_I = 13 to 23 V			1.5	
eN	Output noise voltage	B =10Hz to 100KHz, T_J = 25°C		60		µV
SVR	Supply voltage rejection	V_I = 14 to 23 V, f = 120Hz I_O = 40 mA, T_J = 25°C	37	45		dB
V_d	Dropout voltage			1.7		V

Table3.4.19. Electrical characteristics of L78L10AB and L78L10AC (refer to the test circuits, VI = 16V, IO = 40 mA, CI = 0.33 µF, CO = 0.1 µF, TJ = 0 to 125°C for L78L10AC, TJ = -40 to 125°C for L78L10AB, unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	11.5	12	12.5	V
V_O	Output voltage	I_O = 1 to 40 mA, V_I = 14.5 to 27 V	11.4		12.6	V
		I_O = 1 to 70 mA, V_I = 19 V	11.4		12.6	
ΔV_O	Line regulation	V_I = 14.5 to 27 V, T_J = 25°C			250	mV
		V_I = 16 to 27 V, T_J = 25°C			200	
ΔV_O	Load regulation	I_O = 1 to 100 mA, T_J = 25°C			100	mV
		I_O = 1 to 40 mA, T_J = 25°C			50	
I_d	Quiescent current	T_J = 25°C			6.5	mA
		T_J = 125°C			6	mA
ΔI_d	Quiescent current change	I_O = 1 to 40 mA			0.1	mA
		V_I = 16 to 27 V			1.5	
eN	Output noise voltage	B =10Hz to 100KHz, T_J = 25°C		80		µV
SVR	Supply voltage rejection	V_I = 15 to 25 V, f = 120Hz I_O = 40 mA, T_J = 25°C	37	42		dB
V_d	Dropout voltage			1.7		V

Table3.4.20. Electrical characteristics of L78L12AB and L78L12AC (refer to the test circuits, VI = 19V, IO = 40 mA, CI = 0.33 µF, CO = 0.1 µF, TJ = 0 to 125°C for L78L12AC, TJ = -40 to 125°C for L78L12AB, unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	14.4	15	15.6	V
V_O	Output voltage	I_O = 1 to 40 mA, V_I = 17.5 to 30 V	14.25		15.75	V
		I_O = 1 to 70 mA, V_I = 23 V	14.25		15.75	
ΔV_O	Line regulation	V_I = 17.5 to 30 V, T_J = 25°C			300	mV
		V_I = 20 to 30 V, T_J = 25°C			250	
ΔV_O	Load regulation	I_O = 1 to 100 mA, T_J = 25°C			150	mV
		I_O = 1 to 40 mA, T_J = 25°C			75	
I_d	Quiescent current	T_J = 25°C			6.5	mA
		T_J = 125°C			6	mA
ΔI_d	Quiescent current change	I_O = 1 to 40 mA			0.1	mA
		V_I = 20 to 30 V			1.5	
eN	Output noise voltage	B =10Hz to 100KHz, T_J = 25°C		90		µV
SVR	Supply voltage rejection	V_I = 18.5 to 28.5 V, f = 120Hz I_O = 40 mA, T_J = 25°C	34	39		dB
V_d	Dropout voltage			1.7		V

Table3.4.21. Electrical characteristics of L78L15AB and L78L15AC (refer to the test circuits, VI = 23V, IO = 40 mA, CI = 0.33 µF, CO = 0.1 µF, TJ = 0 to 125°C for L78L15AC, TJ = -40 to 125°C for L78L15AB, unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	17.3	18	18.7	V
V_O	Output voltage	I_O = 1 to 40 mA, V_I = 22 to 33 V	17.1		18.9	V
		I_O = 1 to 70 mA, V_I = 27 V	17.1		18.9	
ΔV_O	Line regulation	V_I = 22 to 33 V, T_J = 25°C			320	mV
		V_I = 22 to 33 V, T_J = 25°C			270	
ΔV_O	Load regulation	I_O = 1 to 100 mA, T_J = 25°C			170	mV
		I_O = 1 to 40 mA, T_J = 25°C			85	
I_d	Quiescent current	T_J = 25°C			6.5	mA
		T_J = 125°C			6	mA
ΔI_d	Quiescent current change	I_O = 1 to 40 mA			0.1	mA
		V_I = 23 to 33 V			1.5	
eN	Output noise voltage	B =10Hz to 100KHz, T_J = 25°C		120		µV
SVR	Supply voltage rejection	V_I = 23 to 33 V, f = 120Hz I_O = 40 mA, T_J = 25°C	33	38		dB
V_d	Dropout voltage			1.7		V

Table3.4.22. Electrical characteristics of L78L18AB and L78L18AC (refer to the test circuits, VI = 27V, IO = 40 mA, CI = 0.33 µF, CO = 0.1 µF, TJ = 0 to 125°C for L78L18AC, TJ = -40 to 125°C for L78L18AB, unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	19.2	20	20.8	V
V_O	Output voltage	I_O = 1 to 40 mA, V_I = 24 to 33 V	19		21	V
		I_O = 1 to 70 mA, V_I = 29 V	19		21	
ΔV_O	Line regulation	V_I = 22.5 to 34 V, T_J = 25°C			330	mV
		V_I = 24 to 34 V, T_J = 25°C			280	
ΔV_O	Load regulation	I_O = 1 to 100 mA, T_J = 25°C			180	mV
		I_O = 1 to 40 mA, T_J = 25°C			90	
I_d	Quiescent current	T_J = 25°C			6.5	mA
		T_J = 125°C			6	mA
ΔI_d	Quiescent current change	I_O = 1 to 40 mA			0.1	mA
		V_I = 25 to 33 V			1.5	
eN	Output noise voltage	B =10Hz to 100KHz, T_J = 25°C		120		µV
SVR	Supply voltage rejection	V_I = 25 to 35 V, f = 120Hz I_O = 40 mA, T_J = 25°C	32	38		dB
V_d	Dropout voltage			1.7		V

Table3.4.23. Electrical characteristics of L78L20AB and L78L20AC (refer to the test circuits, VI = 29V, IO = 40 mA, CI = 0.33 µF, CO = 0.1 µF, TJ = 0 to 125°C for L78L20AC, TJ = -40 to 125°C for L78L20AB, unless otherwise specified)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	23	24	25	V
V_O	Output voltage	I_O = 1 to 40 mA, V_I = 27 to 38 V	22.8		25.2	V
		I_O = 1 to 70 mA, V_I = 33 V	22.8		25.2	
ΔV_O	Line regulation	V_I = 27 to 38 V, T_J = 25°C			350	mV
		V_I = 28 to 38 V, T_J = 25°C			300	
ΔV_O	Load regulation	I_O = 1 to 100 mA, T_J = 25°C			200	mV
		I_O = 1 to 40 mA, T_J = 25°C			100	
I_d	Quiescent current	T_J = 25°C			6.5	mA
		T_J = 125°C			6	mA
ΔI_d	Quiescent current change	I_O = 1 to 40 mA			0.1	mA
		V_I = 28 to 38 V			1.5	
eN	Output noise voltage	B =10Hz to 100KHz, T_J = 25°C		200		µV
SVR	Supply voltage rejection	V_I = 29 to 33 V, f = 120Hz I_O = 40 mA, T_J = 25°C	31	37		dB
V_d	Dropout voltage			1.7		V

Table3.4.24. Electrical characteristics of L78L24AB and L78L24AC (refer to the test circuits, VI = 33V, IO = 40 mA, CI = 0.33 µF, CO = 0.1 µF, TJ = 0 to 125°C for L78L24AC, TJ = -40 to 125°C for L78L24AB, unless otherwise specified)

3.4.7. Typical performance

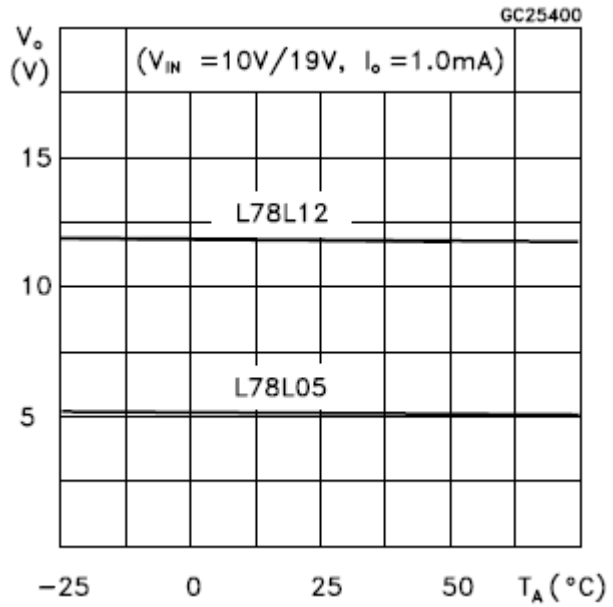


Figure3.4.4. L78L05/12 Output voltage vs ambient temperature

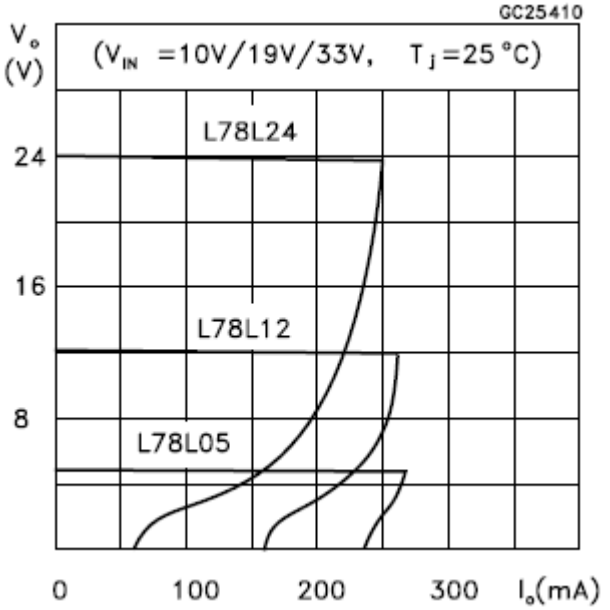


Figure3.4.5. L78L05/12/24 Load characteristics

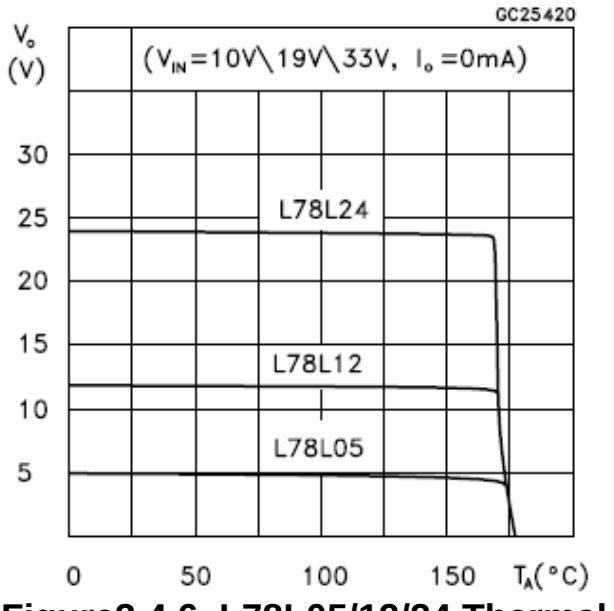


Figure3.4.6. L78L05/12/24 Thermal shutdown

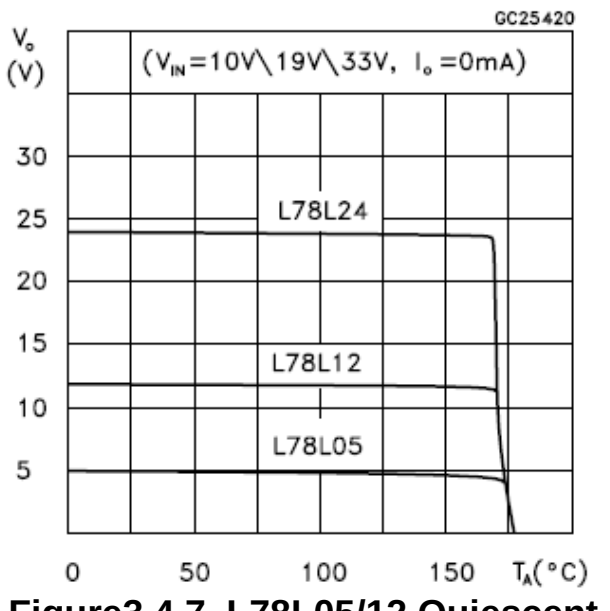


Figure3.4.7. L78L05/12 Quiescent current vs output current

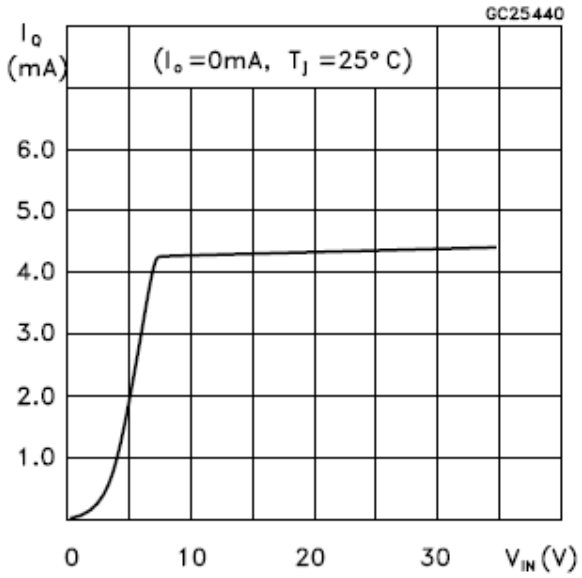


Figure3.4.8. L78L05 Quiescent current vs input voltage

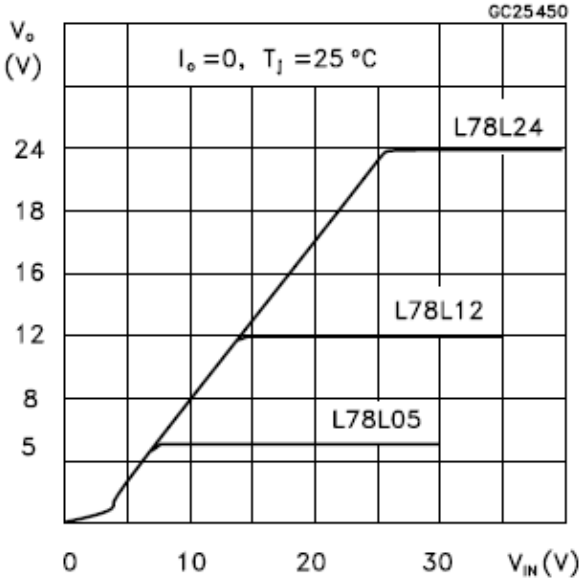


Figure3.4.9. L78L05/12/24 Output characteristics

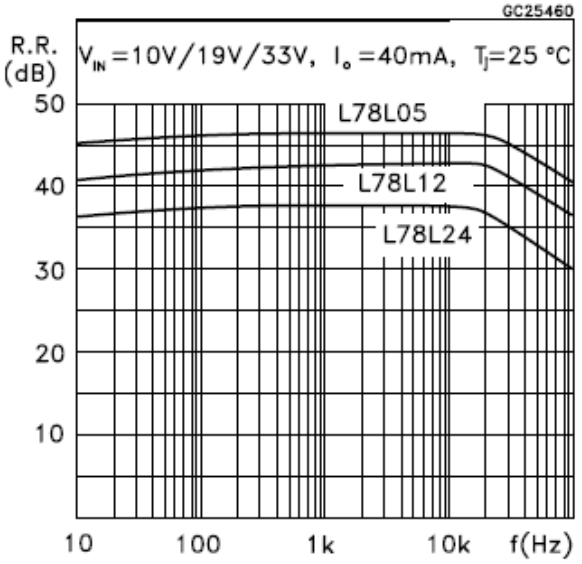


Figure3.4.10. L78L05/12/24 Ripple rejection

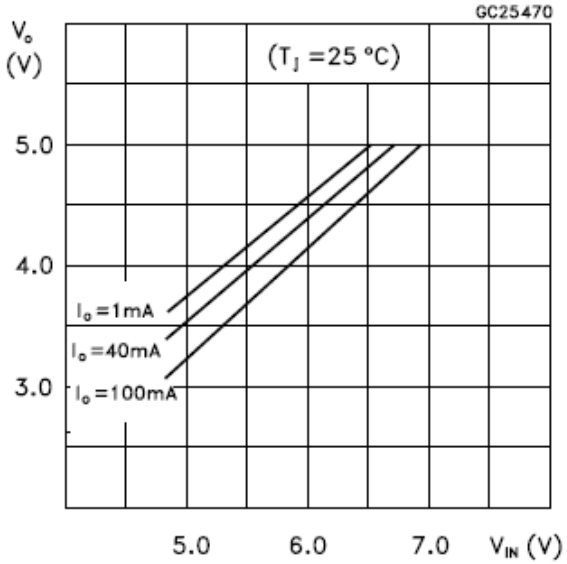


Figure3.4.11. L78L05 Dropout characteristics

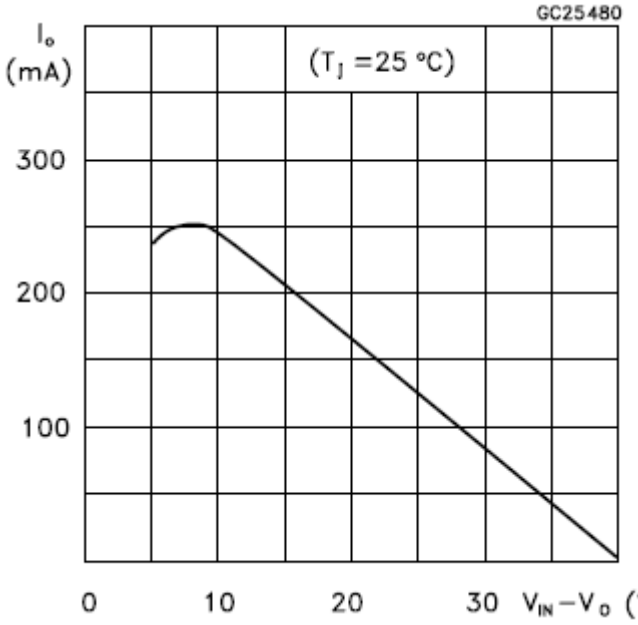


Figure3.4.12. L78L00 Series short circuit output current

3.4.8. Typical application

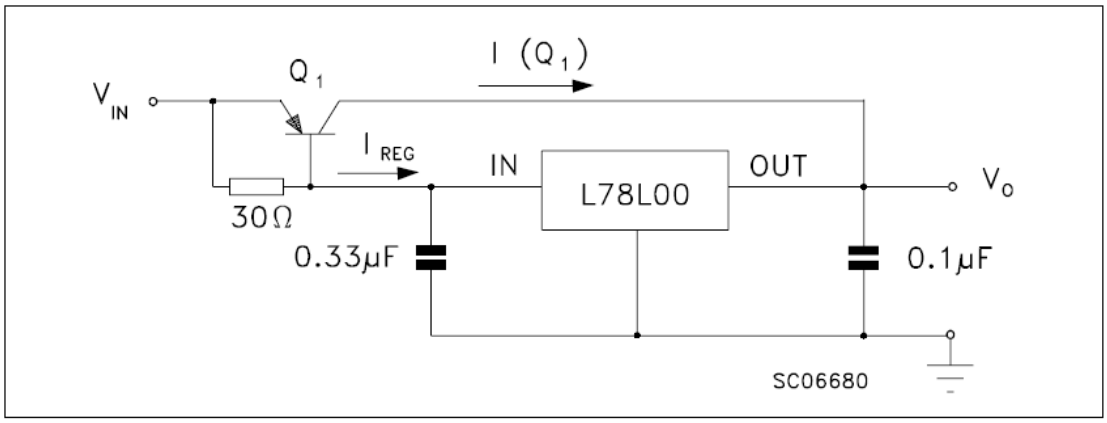


Figure3.4.13. High output current short circuit protected

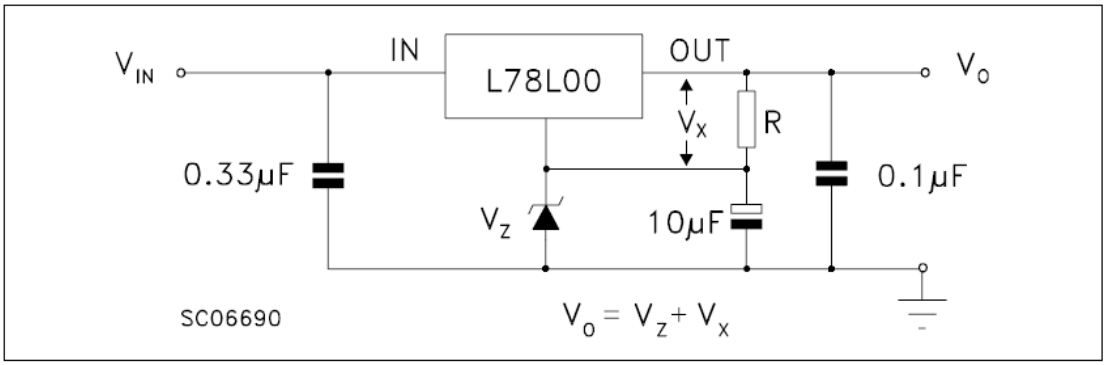


Figure3.4.14. Edit boost circuit

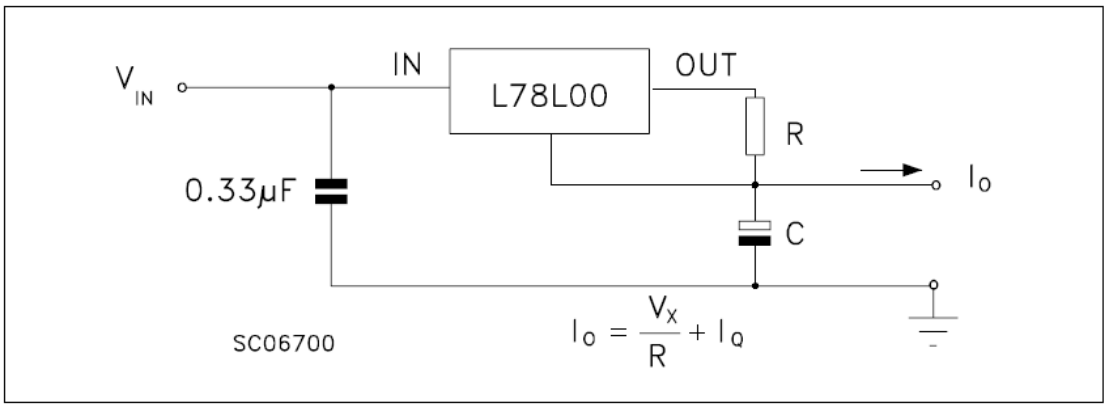


Figure3.4.15. Current regulator

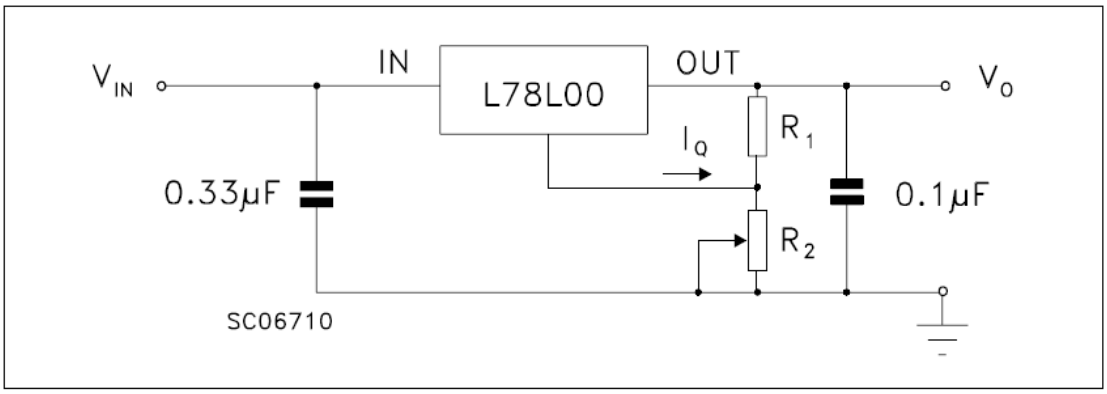
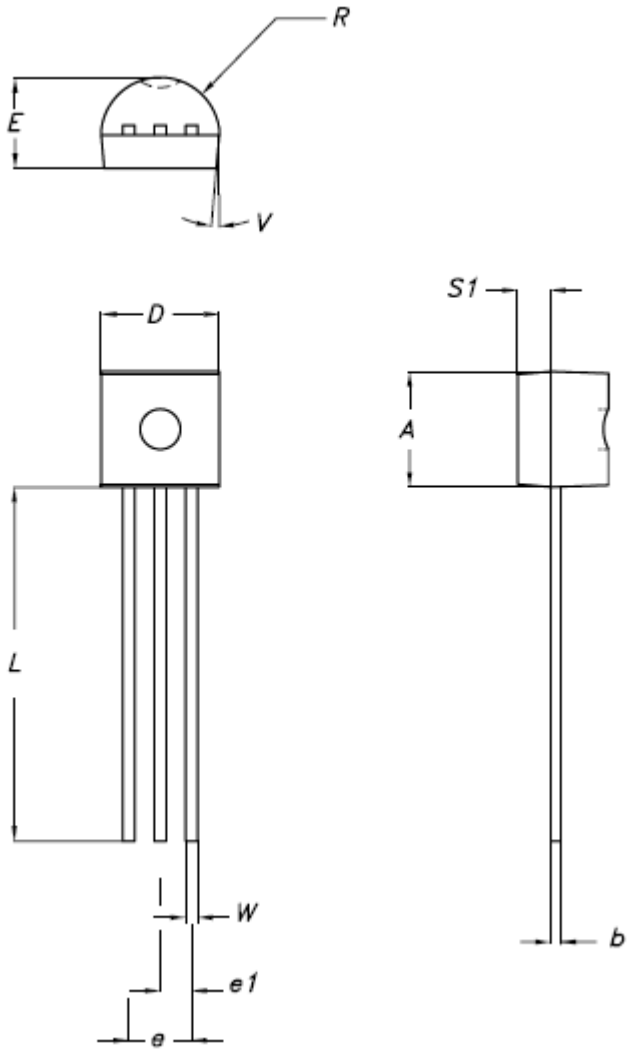


Figure3.4.16. Adjustable output regulator

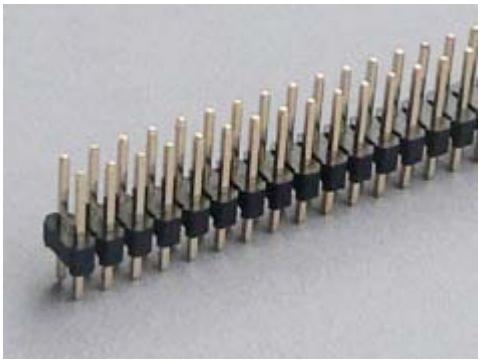
3.4.9. Package mechanical data

TO-92 MECHANICAL DATA

DIM.	mm.			mils		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.32		4.95	170.1		194.9
b	0.36		0.51	14.2		20.1
D	4.45		4.95	175.2		194.9
E	3.30		3.94	129.9		155.1
e	2.41		2.67	94.9		105.1
e1	1.14		1.40	44.9		55.1
L	12.7		15.49	500.0		609.8
R	2.16		2.41	85.0		94.9
S1	0.92		1.52	36.2		59.8
W	0.41		0.56	16.1		22.0
α		5°			5°	


R
E
V
D
S1
A
L
W
e1
e
b

3.5. Pin Header Connector 80 pins.



Product Part No.: PHDS80G11/RH
Description: Pin Header Connector 80 pins.
Product Feature: Dual Row Straight Type 80 pins.

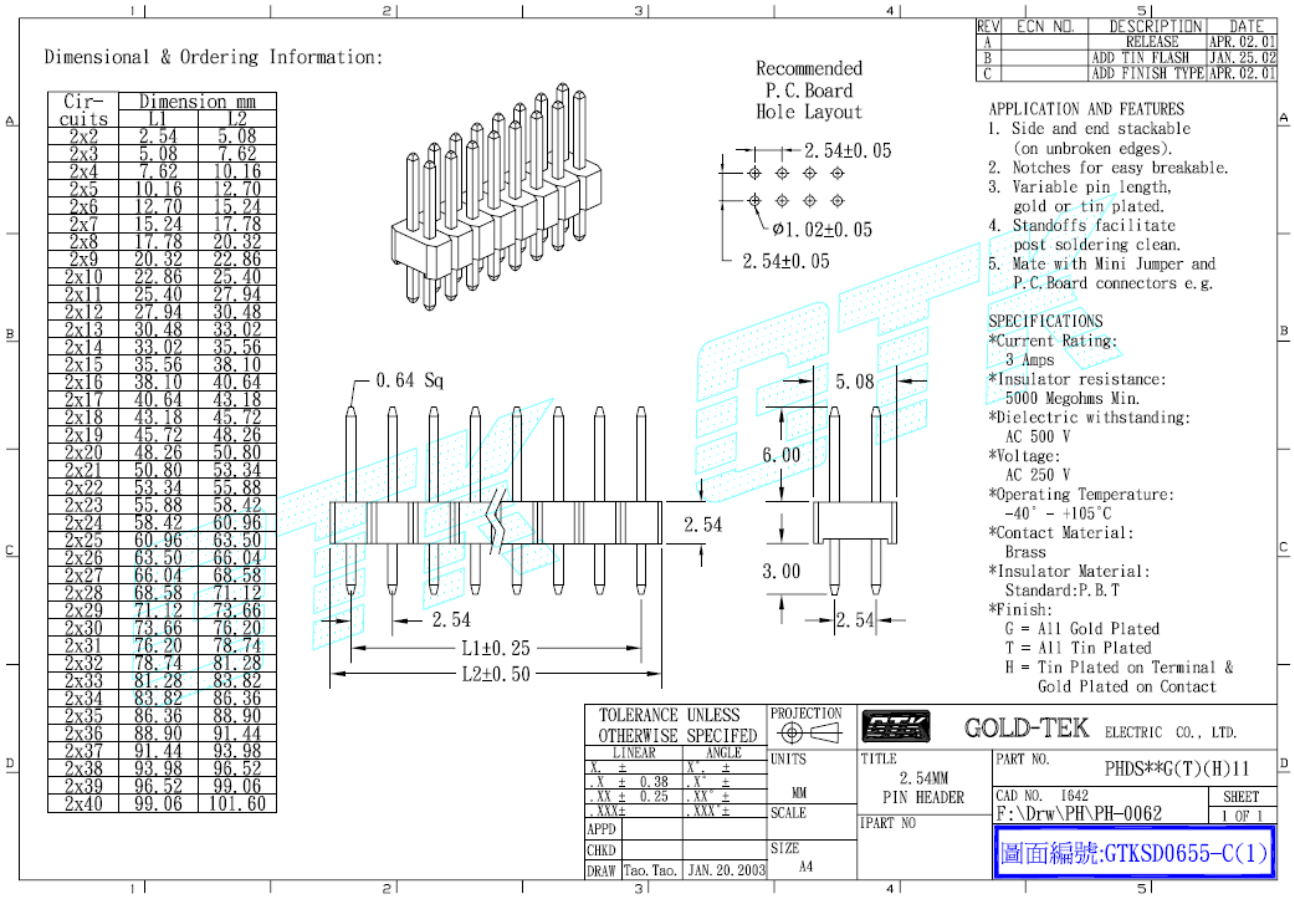
Specification

Connector Type	Pin Header Strip
Pin Type	Straight
Number of Pin	80
Number of Row	Double
Pitch	2.54mm.
Gender	Male

Product Information

Product Category	Connectors
Family	Pin Header & Female PCB Connectors
Product Part No.	PHDS80G11/RH
Manufacturer	GTK
Weight (Gram)	4.4

Drawing



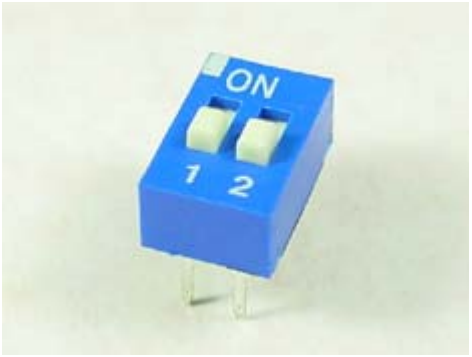
Cir-cuits	Dimension mm L1	L2
2x2	2.54	5.08
2x3	5.08	7.62
2x4	7.62	10.16
2x5	10.16	12.70
2x6	12.70	15.24
2x7	15.24	17.78
2x8	17.78	20.32
2x9	20.32	22.86
2x10	22.86	25.40
2x11	25.40	27.94
2x12	27.94	30.48
2x13	30.48	33.02
2x14	33.02	35.56
2x15	35.56	38.10
2x16	38.10	40.64
2x17	40.64	43.18
2x18	43.18	45.72
2x19	45.72	48.26
2x20	48.26	50.80
2x21	50.80	53.34
2x22	53.34	55.88
2x23	55.88	58.42
2x24	58.42	60.96
2x25	60.96	63.50
2x26	63.50	66.04
2x27	66.04	68.58
2x28	68.58	71.12
2x29	71.12	73.66
2x30	73.66	76.20
2x31	76.20	78.74
2x32	78.74	81.28
2x33	81.28	83.82
2x34	83.82	86.36
2x35	86.36	88.90
2x36	88.90	91.44
2x37	91.44	93.98
2x38	93.98	96.52
2x39	96.52	99.06
2x40	99.06	101.60

REV	ECN NO.	DESCRIPTION	DATE
A		RELEASE	APR. 02. 01
B		ADD TIN FLASH	JAN. 25. 02
C		ADD FINISH TYPE	APR. 02. 01

TOLERANCE UNLESS OTHERWISE SPECIFIED			
LINEAR		ANGLE	
X ±		X° ±	
.X ± 0.38		.X° ±	
.XX ± 0.25		.XX° ±	
.XXX ±		.XXX° ±	
APPD			
CHKD			
DRAW	Tao. Tao.	JAN. 20. 2003	

PROJECTION | UNITS: MM | SCALE | SIZE: A4 | TITLE | IPART NO | PART NO. | CAD NO. 1642 | SHEET

3.6. DIP Switch 2 positions.



Product Part No.: EDS102SZ
Description: DIP Switch 2 positions.
Product Feature: DIP Switch 2 positions, Silver plated contacts.

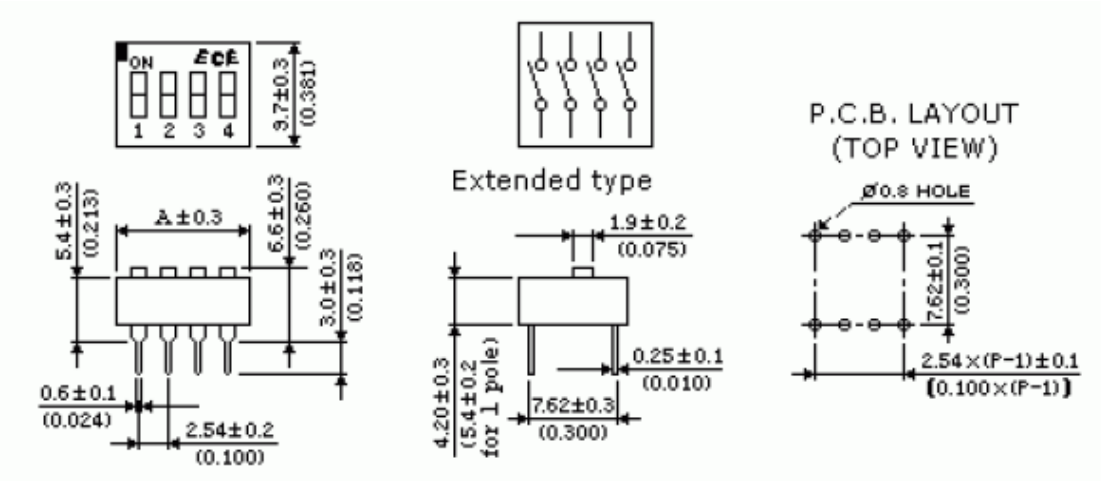
Specification

Number of Positions	2
Circuit	SPST
Switch Feature	Silver or Tin Plated Contacts
Switch Type	Top Actuated Slide
Mounting Type	Through Hole

Product Information

Product Category	Switches
Family	Dip Switch
Product Part No.	EDS102SZ
Weight (Gram)	0.4

Drawing



Dimension A

Positions	2
A	6.7 (0.264)

Unit: mm (inch)

3.7. Tact Switch 50mA 12VDC.

Product Part No.: TC-0102-X-ROHS
Description: DC Jack: Tact Switch 50mA 12VDC.
Product Feature: DC12V., 50mA, 4.3mm, Tact Switch.

Specification

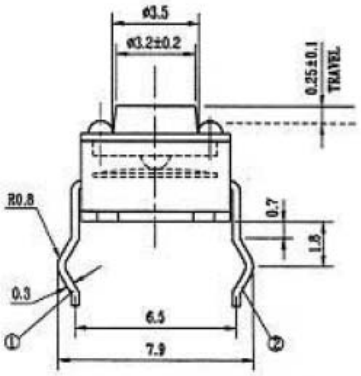
Circuit	SPST-NO
Switch Function	Off-Mom
Mounting Type	Through Hole
Contact Rating	50mA
Size / Dimension	6*6mm.
Stem Length	4.3mm.

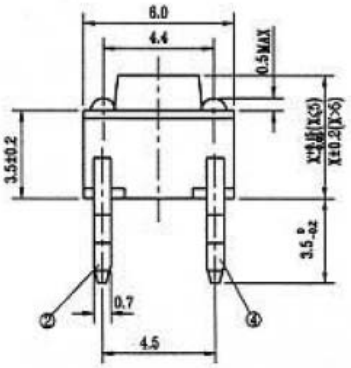
Product Information

Product Category	Switches, Key Pad
Family	Tact Switches
Product Part No.	TC-0102-X-ROHS
Manufacturer	Wealth Metal
Weight (Gram)	0.2

Drawing

TC-0102 SERIES

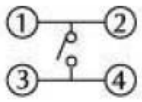




MODEL NO.	Stem length(mm)
TC-0102	4.3
TC-0103	5
TC-0104	7
TC-0105	7.3
TC-0106	8
TC-0107	8.5
TC-0108	9.5
TC-0109	12.5
TC-A109	13.0
TC-0110	13.5
TC-0111	17

CODE	OPERATING FORCE (gf)
T	100 ± 30
V	130 ± 30
X	160 ± 50
W	170 ± 50
Y	190 ± 50
Z	250 ± 100
N	350 ± 100

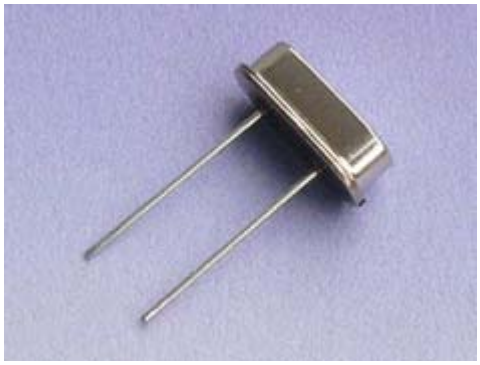
CIRCUIT DIAGRAM



SPECIFICATIONS

1. RATING : DC 12V 50mA
2. TRAVEL : 0.25 ± 0.1mm
3. CONTACT RESISTANCE 100 mΩ MAX

3.8. X-TAL 16.00MHz.



Product Part No.: HC49S-16M-LF
Description: DC Jack: X-TAL 16.00MHz.
Product Feature: Crystal 16.00MHz. HC-49/S, Lead Free.

Specification

Frequency	16.0000MHz
Load Capacitance (pF)	-
Frequency Tolerance (ppm)	-
Oscilation Mode	Fundamental

Product Information

Product Category	Crystals / Oscillators
Family	Crystals
Product Part No.	HC49S-16M-LF
Manufacturer	MEC
Weight (Gram)	0.4

3.8.1. Features

The HC49S is Metal Package with resistance, Weld Sealed, Lead-free compliance, high reliable, tight tolerance and stability.

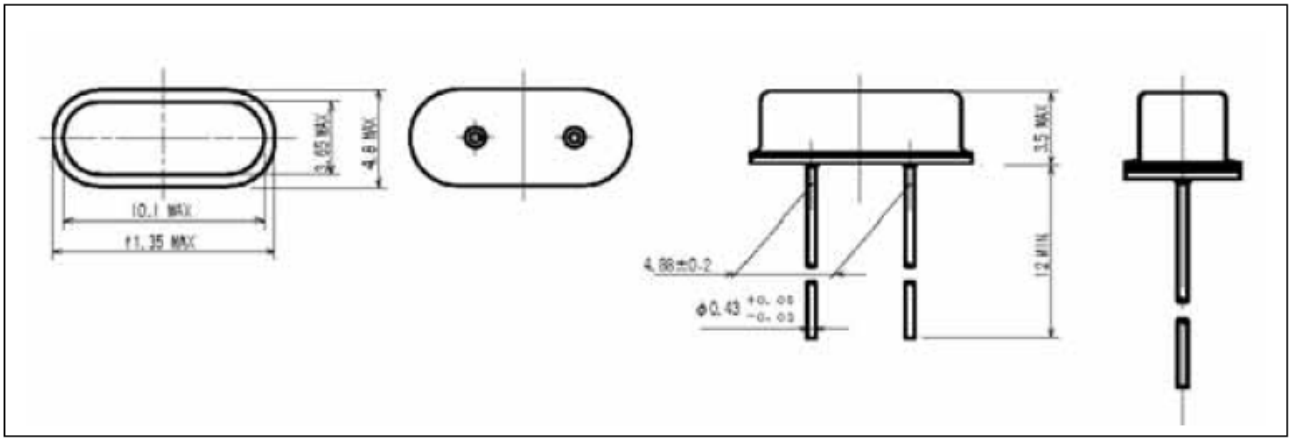


Figure3.8.1. Outline Diagram

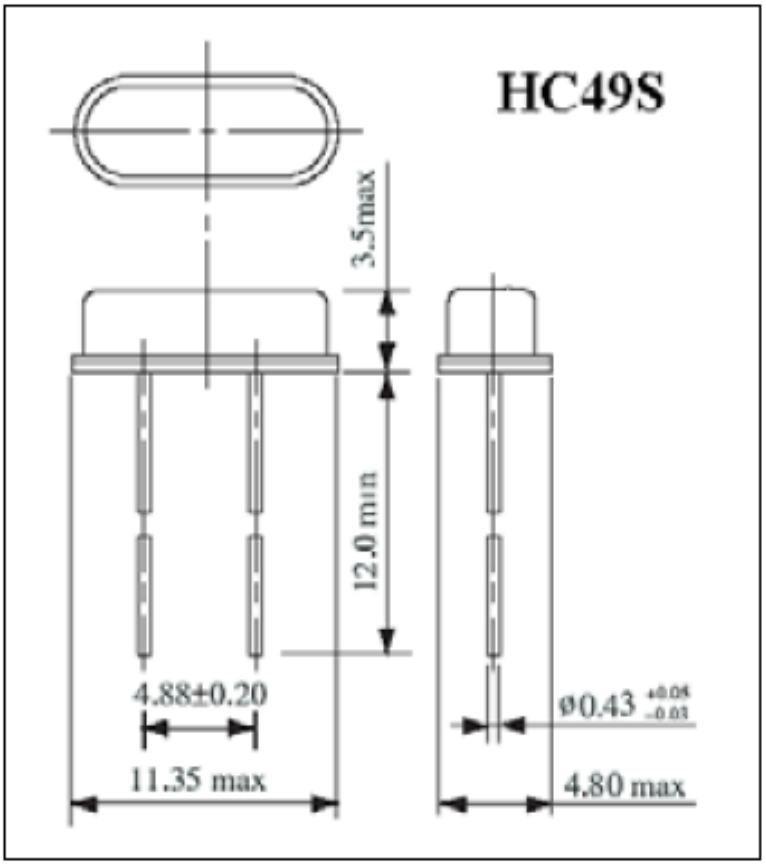


Figure3.8.2. External Dimension (Unit: mm)

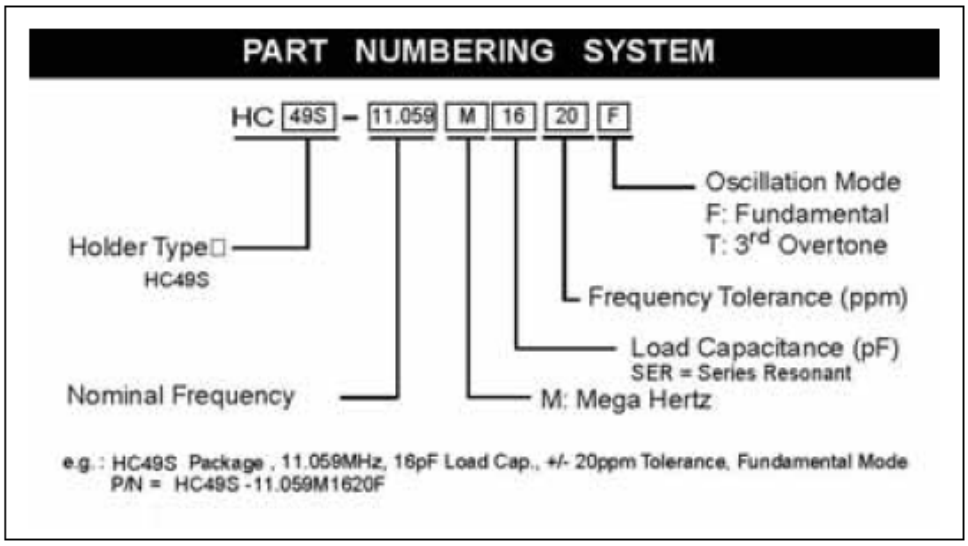


Table3.8.1. Part Numbering System

Nominal Frequency Range	3.500MHZ — 40.000MHz	26.000MHZ — 105.000MHz
Vibration Mode	Fundamental	Third Overtone
Temperature Stability at 25°C	+/-20PPM: +/-30PPM: +/-50PPM: +/-100PPM	
Frequency Tolerance at 25°C	+/-10PPM: +/-20PPM: +/- 30PPM: +/-50PPM:	
Load Capacitance	Series, 10pF, 12pF, 16pF, 18pF, 20pF	
Operating Temperature Range	-10°C — +60°C : -20°C — +70°C : -40°C — +85°C	
Storage Temperature Range	-40°C — +85°C	
Drive Level	10uW (100uW max.)	
Aging Rate at 25°C	+/-5 PPM per year Max	

Table3.8.2. Generic Specification

Nominal Frequency Range	Equivalent Series Resistance	
	AT cut Fundamental	AT cut Third Overtone
3.500MHZ — 3.799MH	150 Ohm Max	
3.800MHZ — 4.099MHz	120 Ohm Max	
4.100MHZ — 4.999MHz	100 Ohm Max	
5.000MHZ — 5.999MHz	80 Ohm Max	
6.000MHZ — 7.999MHz	70 Ohm Max	
8.000MHZ — 9.999MHz	60 Ohm Max	
10.000MHZ — 11.999MH	50 Ohm Max	
12.000MHZ — 27.999MHz	40 Ohm Max	
28.000MHZ — 40.000MH	30 Ohm Max	
26.000MHZ — 39.999MHz		100 Ohm Max
40.000MHZ — 105.000MHz		80 Ohm Max

Table3.8.3. Frequency Range and ESR

3.8.2. Application

Microprocessor Clock, Network Card, A/V Card, Cable Modem, Disc Drive, Hand-held products, Notebook Computer, Bluetooth, Mp3 Player.

3.9. LED DIA = 3mm. Red Transparent, LIGITEK.

Product Part No.: LH2041
Description: DC Jack: LED DIA = 3mm. Red Transparent, LIGITEK.
Product Feature: Standard LED 3mm.Round, Red Transparent Lens Color.

Specification

Color	Red
Len Epoxy Color	Red Transparent
Case Style	Round 3mm.
Voltage Rating	1.7-2.6V
Wavelength	697nm.
Features	Red
View Angle	30

Product Information

Product Category	Optoelectronics
Family	LEDs - Discrete
Product Part No.	LH2041
Manufacturer	LIGITEK Electronics
Weight (Gram)	0.2

3.10. LED DIA = 3mm. Green Transparent, LIGITEK.

Product Part No.: LG2041
Description: DC Jack: LED DIA = 3mm. Green Transparent, LIGITEK.
Product Feature: Standard LED 3mm.Round, Green Transparent Lens Color.

Specification

Color	Green
Len Epoxy Color	Green Transparent
Case Style	Round 3mm.
Voltage Rating	1.7-2.6V
Wavelength	565nm.
Features	Green
View Angle	30

Product Information

Product Category	Optoelectronics
Family	LEDs - Discrete
Product Part No.	LG2041
Manufacturer	LIGITEK Electronics
Weight (Gram)	0.2

3.11. Socket DIP Solder 16 pins.

Product Part No.: ISS16T1/03/RH
Description: Socket DIP Solder 16 pins.
Product Feature: I.C. Socket DIP Solder Type 16 pins.

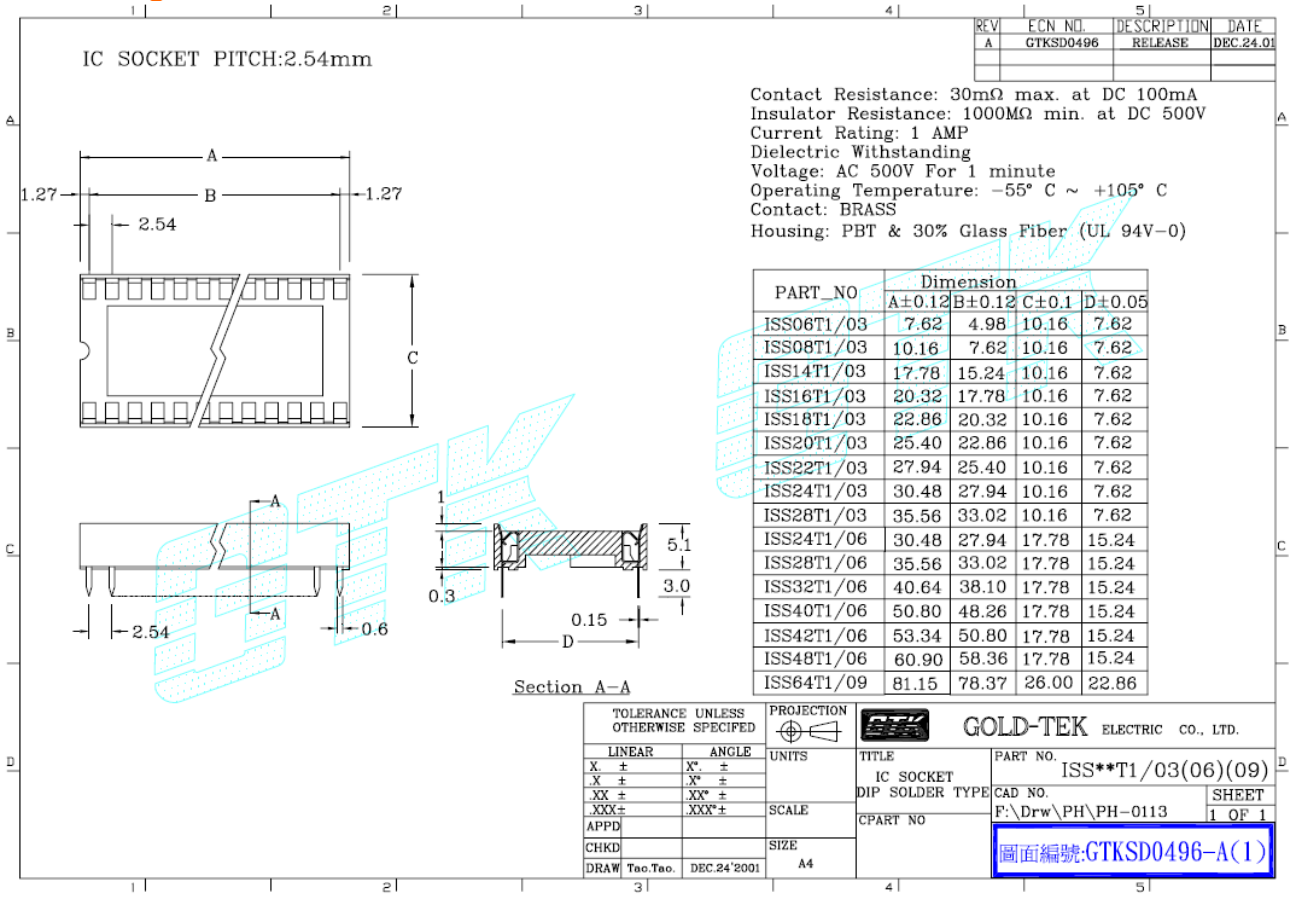
Specification

Row to Row Distance	7.62mm.
Contact Termination	Through Hole
Number of Pins	16
Pin Length	2.9mm.
Pitch	2.54mm.
Contact Type	Dual Wipe Contact

Product Information

Product Category	Sockets
Family	DIP Sockets
Product Part No.	ISS16T1/03/RH
Manufacturer	GTK
Weight (Gram)	0.8

Drawing



PART_NO	Dimension			
	A±0.12	B±0.12	C±0.1	D±0.05
ISS06T1/03	7.62	4.98	10.16	7.62
ISS08T1/03	10.16	7.62	10.16	7.62
ISS14T1/03	17.78	15.24	10.16	7.62
ISS16T1/03	20.32	17.78	10.16	7.62
ISS18T1/03	22.86	20.32	10.16	7.62
ISS20T1/03	25.40	22.86	10.16	7.62
ISS22T1/03	27.94	25.40	10.16	7.62
ISS24T1/03	30.48	27.94	10.16	7.62
ISS28T1/03	35.56	33.02	10.16	7.62
ISS24T1/06	30.48	27.94	17.78	15.24
ISS28T1/06	35.56	33.02	17.78	15.24
ISS32T1/06	40.64	38.10	17.78	15.24
ISS40T1/06	50.80	48.26	17.78	15.24
ISS42T1/06	53.34	50.80	17.78	15.24
ISS48T1/06	60.90	58.36	17.78	15.24
ISS64T1/09	81.15	78.37	26.00	22.86

3.12. Socket DIP Solder 28 pins.

Product Part No.: ISS28T1/03/RH
Description: Socket DIP Solder 28 pins.
Product Feature: I.C. Socket DIP Solder Type 28 pins.

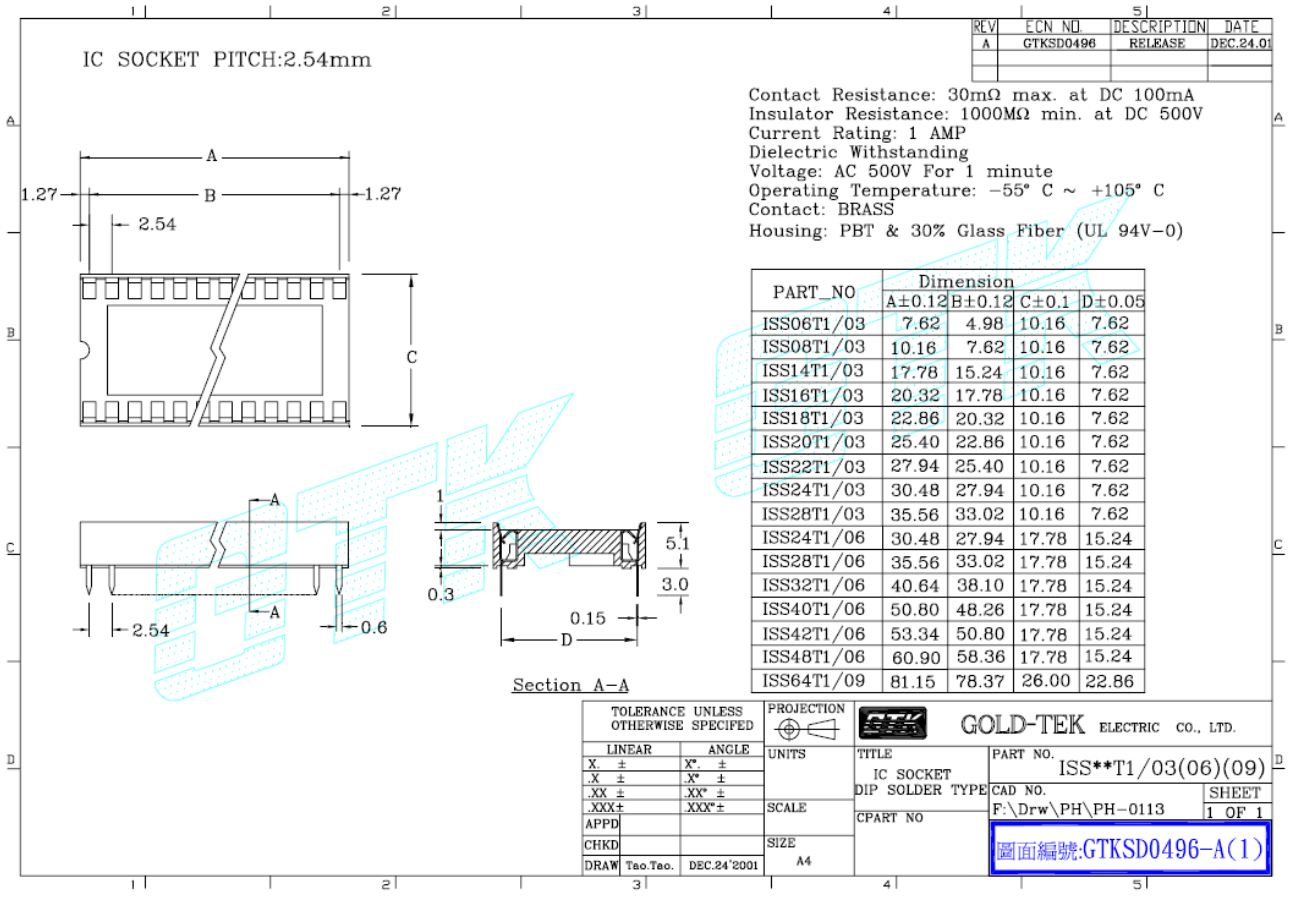
Specification

Row to Row Distance	7.62mm.
Contact Termination	Through Hole
Number of Pins	28
Pin Length	2.9mm.
Pitch	2.54mm.
Contact Type	Dual Wipe Contact

Product Information

Product Category	Sockets
Family	DIP Sockets
Product Part No.	ISS28T1/03/RH
Manufacturer	GTK
Weight (Gram)	1.4

Drawing



PART_NO	Dimension			
	A±0.12	B±0.12	C±0.1	D±0.05
ISS06T1/03	7.62	4.98	10.16	7.62
ISS08T1/03	10.16	7.62	10.16	7.62
ISS14T1/03	17.78	15.24	10.16	7.62
ISS16T1/03	20.32	17.78	10.16	7.62
ISS18T1/03	22.86	20.32	10.16	7.62
ISS20T1/03	25.40	22.86	10.16	7.62
ISS22T1/03	27.94	25.40	10.16	7.62
ISS24T1/03	30.48	27.94	10.16	7.62
ISS28T1/03	35.56	33.02	10.16	7.62
ISS24T1/06	30.48	27.94	17.78	15.24
ISS28T1/06	35.56	33.02	17.78	15.24
ISS32T1/06	40.64	38.10	17.78	15.24
ISS40T1/06	50.80	48.26	17.78	15.24
ISS42T1/06	53.34	50.80	17.78	15.24
ISS48T1/06	60.90	58.36	17.78	15.24
ISS64T1/09	81.15	78.37	26.00	22.86

Chapter4. Index

4.1. Arduino Software Versions

4.1.1. Arduino 1.0.1 version (The latest version includes in a Free CD) support Windows, Mac OS X, Linux (32 bit/64 bit)
4.1.2. Arduino 1.0 version support Windows, Mac OS X, Linux (32 bit/64 bit)
4.1.3. Arduino 0023 version support Windows, Mac OS X, Linux (32 bit/64 bit)
4.1.4. Arduino 0022 version support Windows, Mac OS X, Linux (32 bit/64 bit)
4.1.5. Arduino 0021 version support Windows, Mac OS X, Linux (32 bit)
4.1.6. Arduino 0020 version support Windows, Mac OS X
4.1.7. Arduino 0019 version support Windows, Mac OS X, Linux (32 bit)
4.1.8. Arduino 0018 version support Windows, Mac OS X, Linux (32 bit)
4.1.9. Arduino 0017 version support Windows, Mac OS X, Linux (32 bit)
4.1.10. Arduino 0016 version support Windows, Mac OS X, Linux (32 bit)
4.1.11. Arduino 0015 version support Windows, Mac OS X, Linux (32 bit)
4.1.12. Arduino 0014 version support Windows, Mac OS X
4.1.13. Arduino 0013 version support Windows, Mac OS X, Linux (32bit)
4.1.14. Arduino 0012 version support Windows, Mac OS X, Linux (32bit), Linux (AMD 64bit)
4.1.15. Arduino 0011 version support Mac OS X, Windows, Linux
4.1.16. Arduino 0010 version support Mac OS X, Windows, Linux
4.1.17. Arduino 0009 version support Mac OS X (>= 10.3.9): PPC (10.4, 10.3.9), Intel. Windows. Linux
4.1.18. Arduino 0008 version support Mac OS X (>= 10.3.9) PPC, Intel. Windows
4.1.19. Arduino 0007 version support Mac OS X (>= 10.3.9): PPC, Intel. Windows, Linux
4.1.20. Arduino 0006 version support Mac OS X (>= 10.3.9): PPC, Intel. Windows
4.1.21. Arduino 0005 version support Mac OS X (>= 10.3.9), PPC, Intel. Windows
4.1.22. Arduino 0004 version support Mac OS X (>= 10.3.9). Windows
4.1.23. Arduino 0003 version support Mac OS X PPC / Mac OS X Intel, Windows
4.1.24. Arduino 0002 version support Mac OS X, Windows
4.1.25. Arduino 0001 version support Mac OS X, Windows (with Java / without Java)

4.2. References

4.2.1. www.mlt-group.com
4.2.2. www.arduino.cc
4.2.3. www.atmel.com
4.2.4. www.es.co.th
4.2.5. www.ece.com.tw
4.2.6. www.wealthmetal.com
4.2.7. www.freeduino.org
4.2.8. www.gold-tek.com.tw
4.2.9. www.st.com
4.2.10. www.ligitek.com
4.2.11. www.mecquartz.com

4.3. Contact us

4.3.1. ML-Technology (MLT) sells products on Ebay.
If you will buy our product via Ebay.
Seller ID is **mlt2009.**

4.3.2. ML-Technology (MLT) accepts Paypal payment.
If you will buy our product via Paypal.
Paypal account is mlt@windowslive.com

4.3.3. www.mlt-group.com
Email is mlt@windowslive.com
Tel. 081-027-0918

4.4. Funds Transfer (Bank Transfer)

4.4.1. Kasikorn Bank ; Wangnoi branch , Savings account ,
The account no. 469-2-18796-8

4.4.2. Siam Commercial Bank ; Future Park Rangsit branch ,
Savings account , The account no. 383-2-09377-2