

Electronic component

电子元器件

半导体元器件

元器件工程网
ComponentValley.com

Component Family

元器件族系

Component 元器件

Passive 被动元件

Active 主动元件

Semiconductor 半导体元件

ElectroMechanics 机电元件

Optoelectronics 光电元件

Printed Wire/Circuit board 印制电路板

Wire and cable 线材

Active components sub-family 主动元件子族系

- Active components 主动元件
 - Discrete semiconductor 分立半导体
 - IC 集成电路
 - Hybrid IC 混合集成电路
 - Active oscillator 有源振荡器

Discrete semiconductor group 分立半导体分类

- Discrete semiconductor 分立半导体
 - Diode 二极管
 - Transistor 晶体管
 - Thyristor 晶闸管

Discrete semiconductor group分立半导体分类

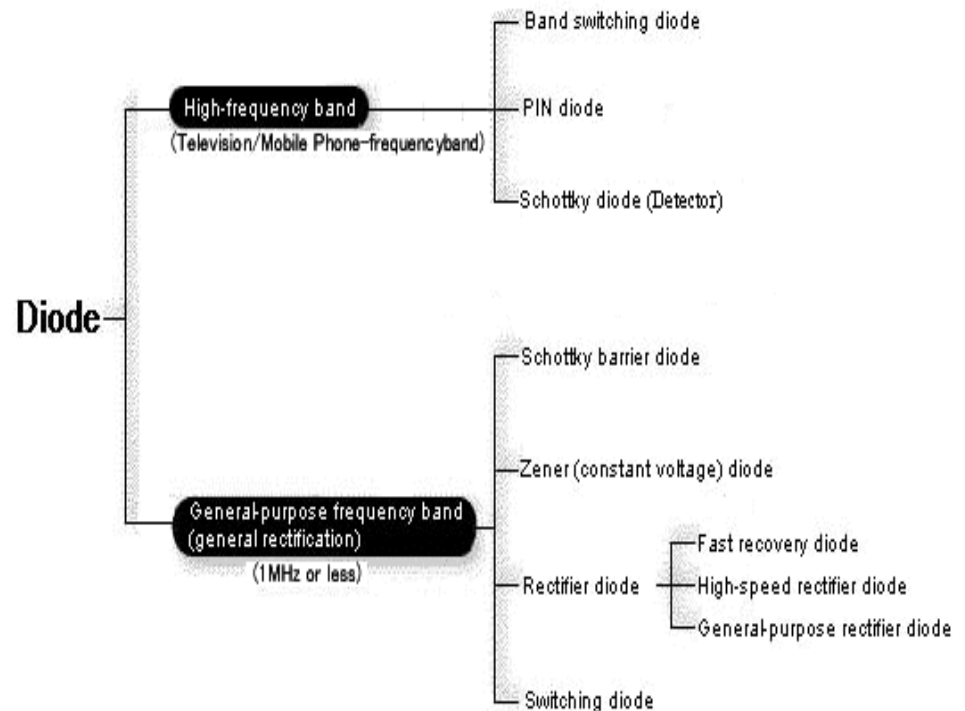
Diode二极管

- Diode二极管
 - Diode can be classified by various type基于不同的分类方式，二极管有不同的分类
 - Classification by working frequency根据工作频率分类
 - Classification by structure根据结构分类
 - Classification by forward current根据正向额定电流分类
 - Classification by integratability根据集成度分类
 - Classification by shape根据组装工艺分类

Discrete semiconductor group 分立半导体分类

Diode 二极管

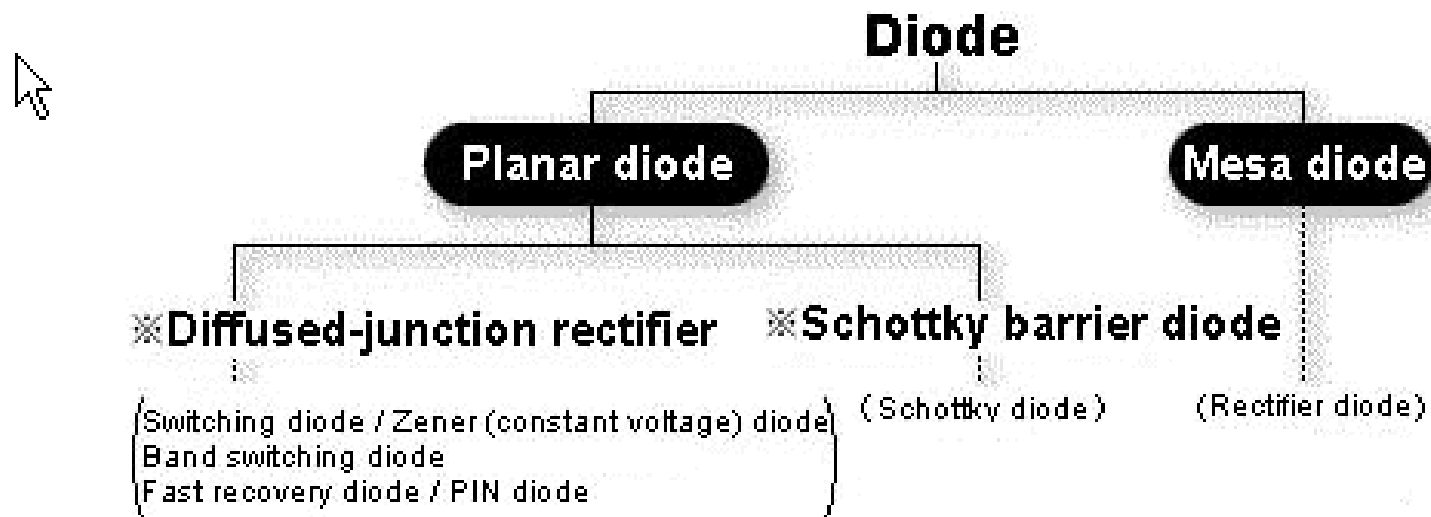
- Classification by working frequency
根据工作频率可分为
 - High-frequency band
高频波段
 - General purpose frequency band 普通波段 ($f \leq 1\text{MHz}$)



Discrete semiconductor group 分立半导体分类

Diode 二极管

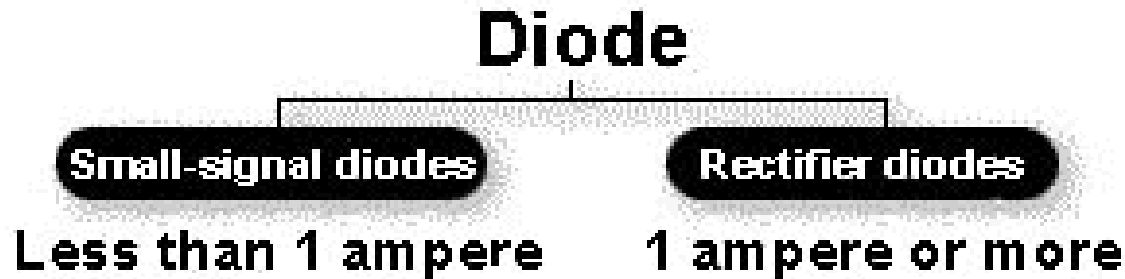
- Classification by structure 根据结构可分为
 - Planar diode 平面型二极管
 - Mesa diode 台面型二极管



Discrete semiconductor group 分立半导体分类

Diode 二极管

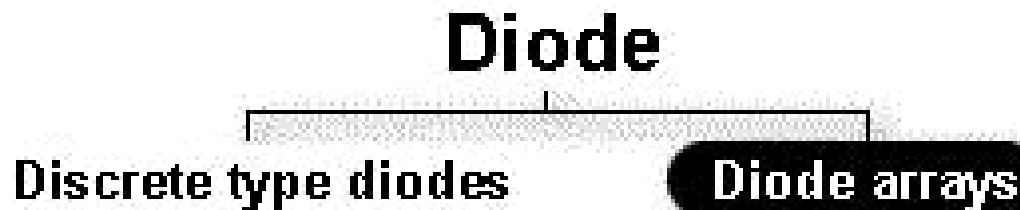
- Classification by forward current 根据正向额定电流可分为
 - Small-signal diode 小信号二极管 ($\leq 1\text{A}$)
 - Rectifier diode 整流二极管 ($> 1\text{A}$)



Discrete semiconductor group 分立半导体分类

Diode 二极管

- Classification by integratability 根据集成度可分为
 - Discrete type diode 分立二极管
 - Diode arrays 二极管阵列



Discrete semiconductor group 分立半导体分类

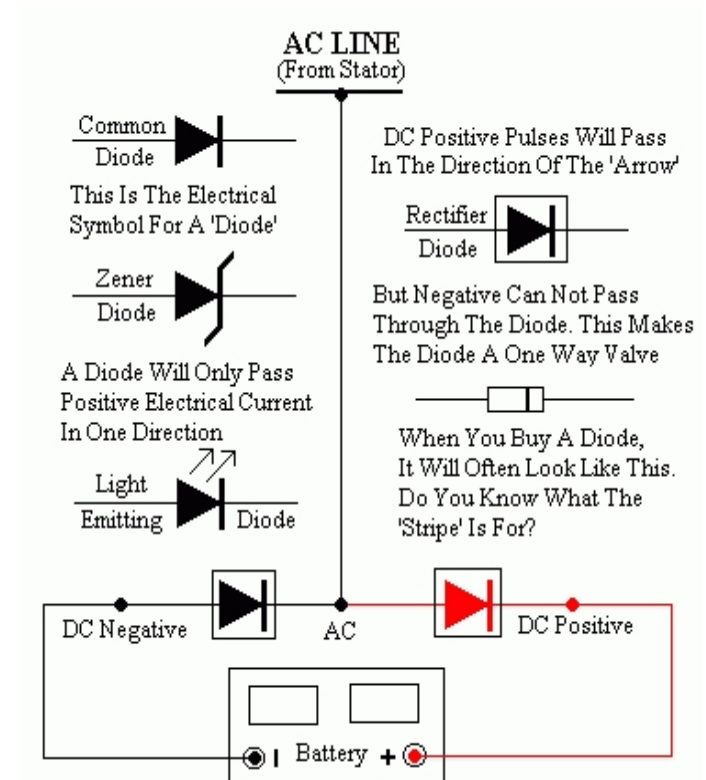
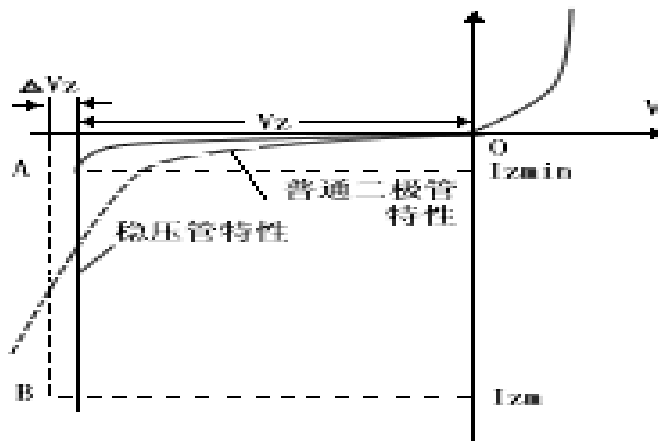
Diode 二极管

- Classification by shape 根据组装工艺可分为
 - THT diode 通孔型二极管
 - SMT diode 贴片型二极管

Discrete semiconductor group 分立半导体分类

Diode 二极管

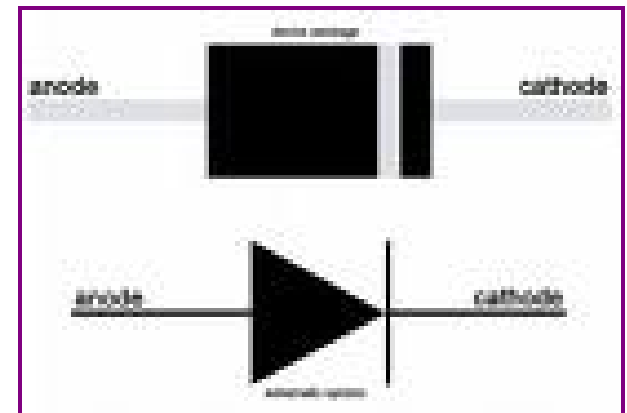
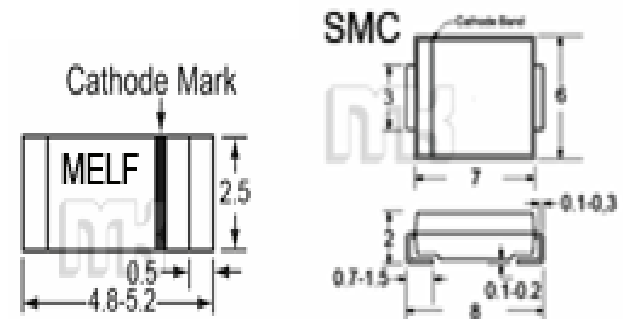
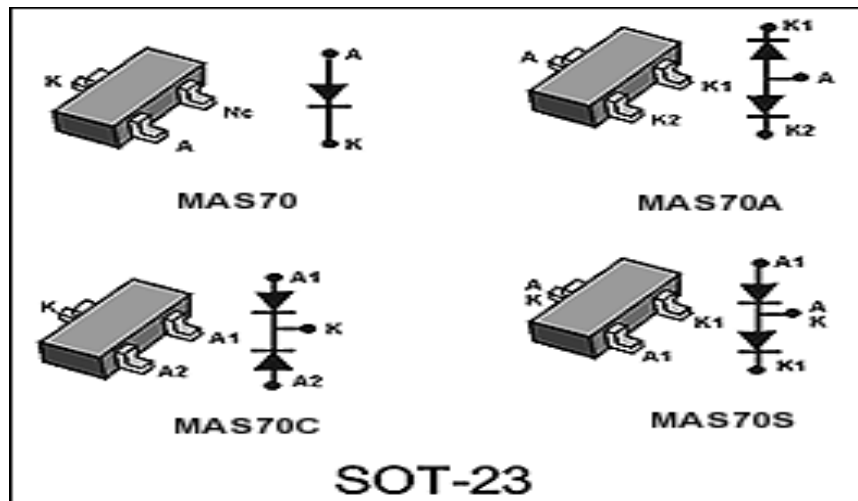
- Diode I-V characteristic 二极管伏安特性
 - Rectifier diode 普通二极管
 - Zener diode 稳压二极管
 - Switch diode 开关二极管



Discrete semiconductor group 分立半导体分类

Diode 二极管

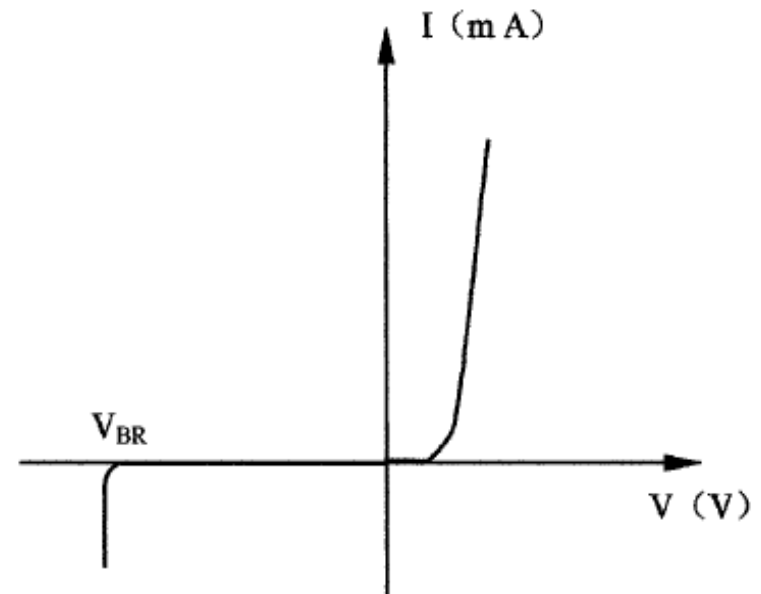
- Diode polarity 二极管是极性元件
 - Marking is cathode 负极标识
 - No marking for bi-directional 双向 TVS 管无极性标识



Discrete semiconductor group 分立半导体分类

Diode 二极管

- Rectify diode 整流二极管
 - Unilateral conductivity 二极管的单向导电性

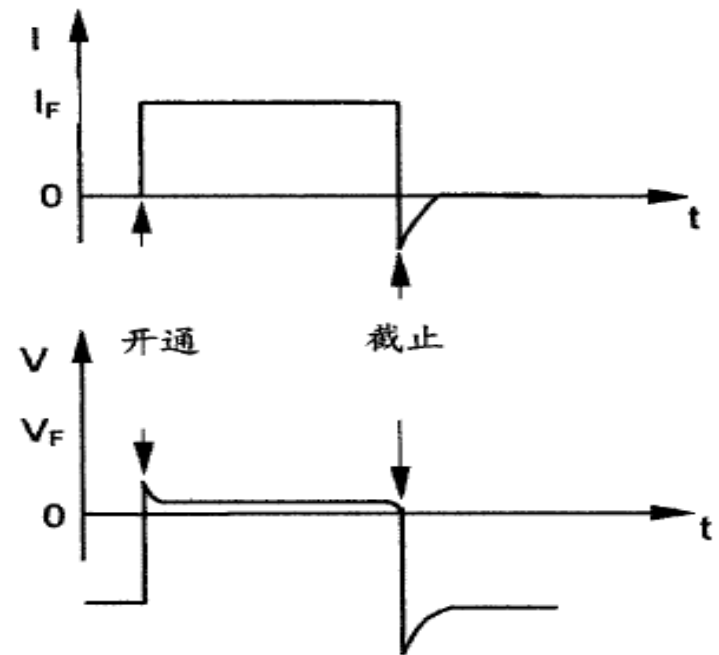


整流二极管的伏安特性曲线

Discrete semiconductor group 分立半导体分类

Diode 二极管

- Switch diode 开关二极管
 - Switch characteristics 二极管的开关特性

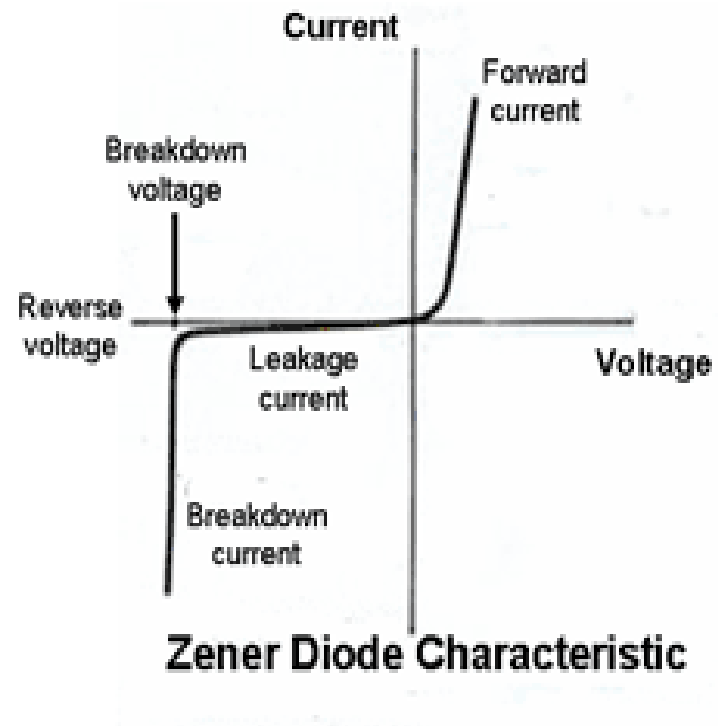


二极管的开通与截止

Discrete semiconductor group 分立半导体分类

Diode 二极管

- Zener diode 稳压二极管
 - Zener diode reverse characteristic 稳压二极管的反向特性



Discrete semiconductor group 分立半导体分类

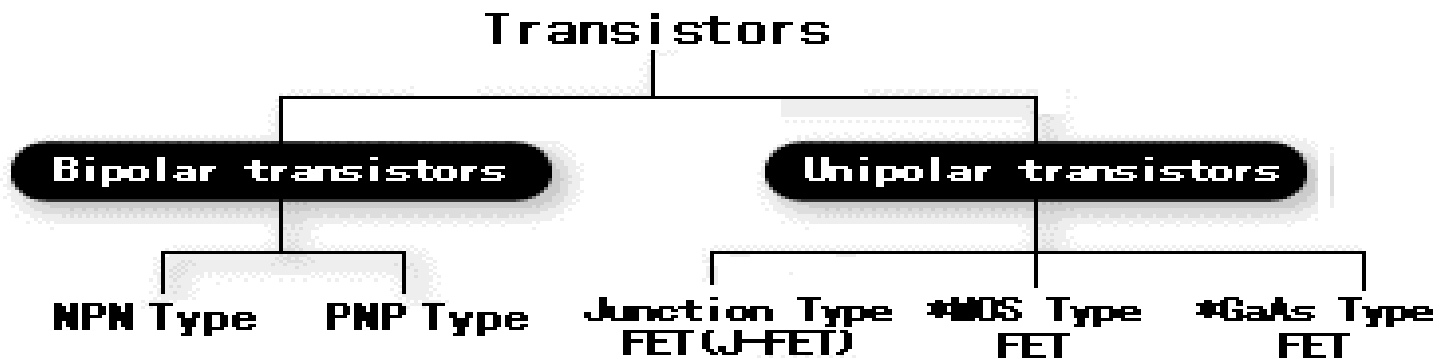
Transistor 晶体管

- Transistor 晶体管
 - Transistor can be classified by various type 根据不同的分类方式，晶体管可分为
 - Classification by construction 根据结构分类
 - Classification by power dissipation 根据功耗分类
 - Classification by integratability 根据集成度分类
 - Classification by shape 根据组装工艺分类

Discrete semiconductor group 分立半导体分类

Transistor 晶体管

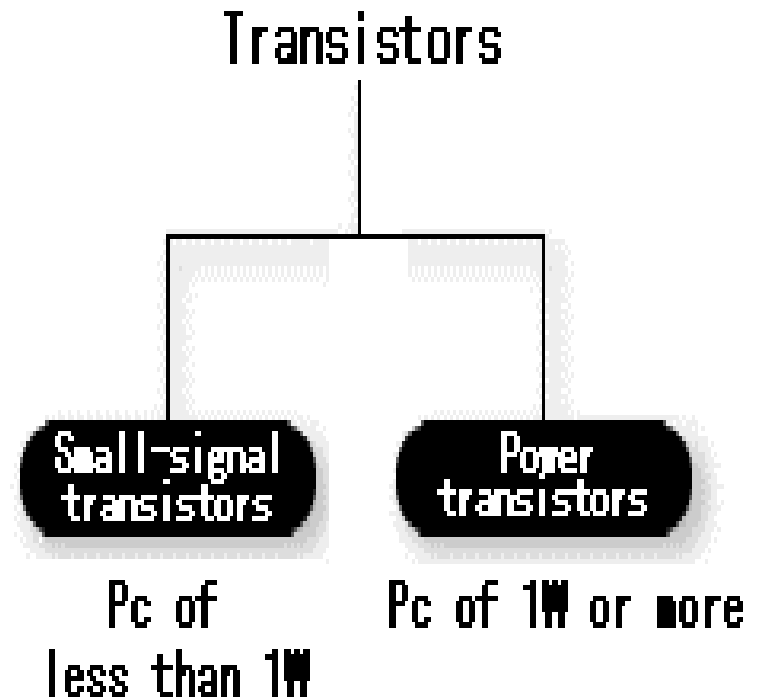
- Classification by construction 根据构造可分为
 - Bipolar transistor 双极性晶体管（三极管）
 - Unipolar transistor/Field effect transistor 单极性晶体管（即 FET 场效应管）



Discrete semiconductor group 分立半导体分类

Transistor 晶体管

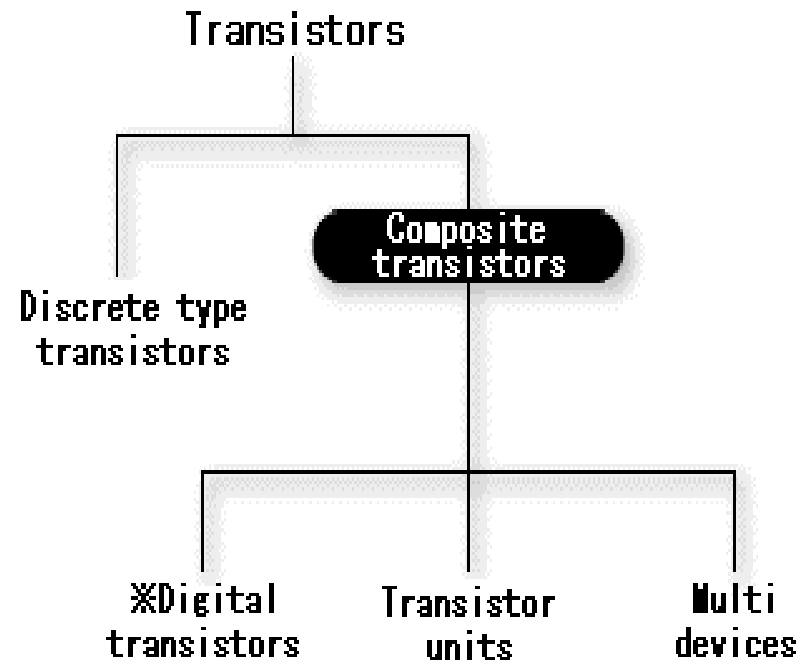
- Classification by power dissipation 根据功耗可分为
 - Small-signal transistor 小信号晶体管 ($<1W$)
 - Power transistor 功率晶体管 ($\geq 1W$)



Discrete semiconductor group 分立半导体分类

Transistor 晶体管

- Classification by integratability 根据集成度可分为
 - Discrete type transistor 分立晶体管
 - Composite transistor 合成晶体管
 - *digital transistor is BRT, this is transistor with built-in resistor



Discrete semiconductor group 分立半导体分类

Transistor 晶体管

- Classification by shape 根据组装工艺可分为
 - THT transistor 通孔型晶体管
 - SMT transistor 贴片型晶体管

Discrete semiconductor group 分立半导体分类

Transistor 晶体管

- Bipolar transistor/Transistor 双极性晶体管即三极管
 - PNP transistor PNP型三极管
 - NPN transistor NPN型三极管

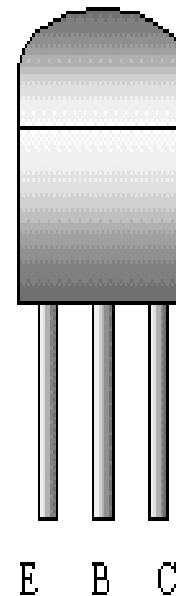
Discrete semiconductor group 分立半导体分类

Transistor 晶体管

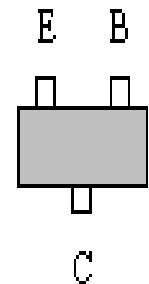
- Transistor pin-out 三极管的脚位
 - For TO-92 and SOT-23, pin-out is generally defined with A figure 对于TO-92和SOT-23封装的三极管脚位通常如右图所示

(A)

TO-92



SOT-23

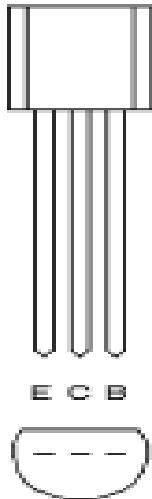


Discrete semiconductor group 分立半导体分类

Transistor 晶体管

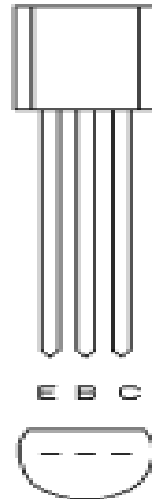
- Various pin-out for various items 不同的型号有不同的脚位

2SC1815
2SA1085



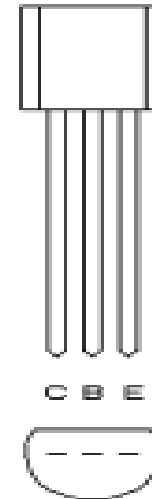
Bottom View

2N3904
2N3906



Bottom View

BC547
BC557



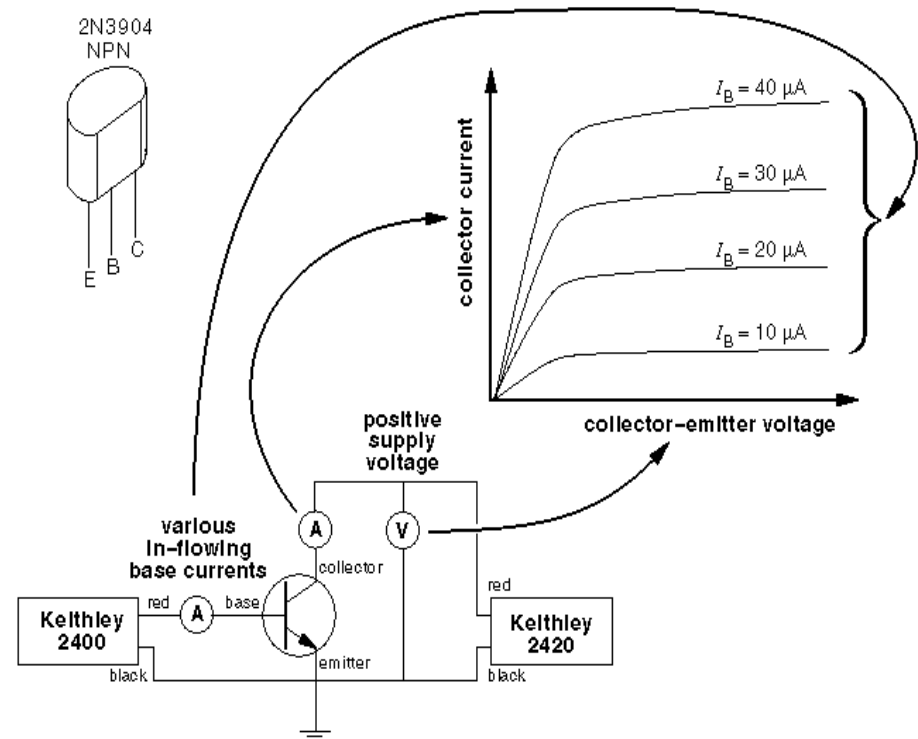
Bottom View

Discrete semiconductor group 分立半导体分类

Transistor 晶体管

- NPN Transistor I-V characteristic NPN 型三极管伏安特性

Trace 2N3904 and other NPN Bipolars

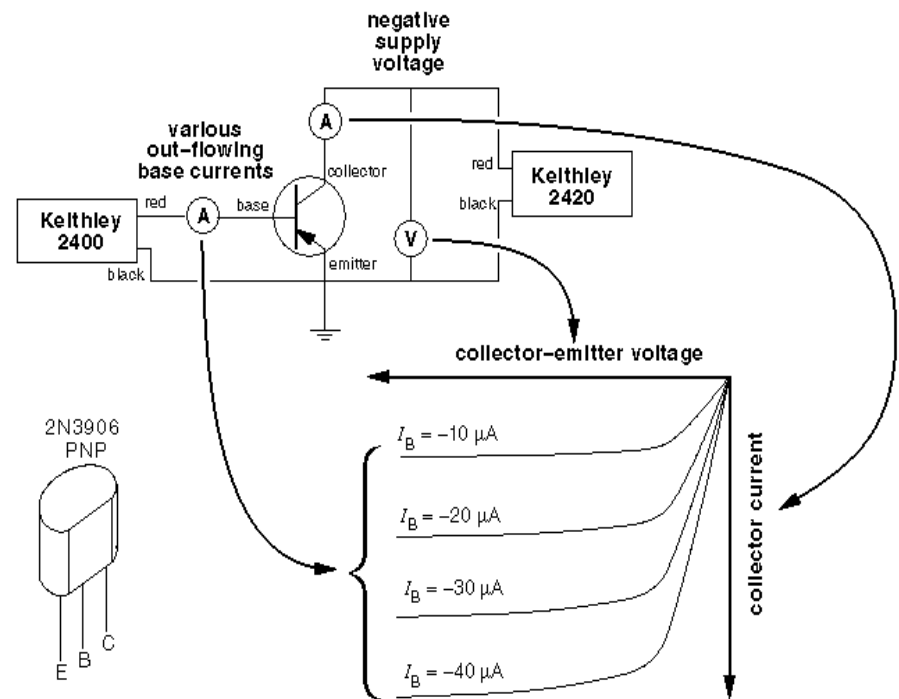


Discrete semiconductor group 分立半导体分类

Transistor 晶体管

- NPN Transistor I-V characteristic NPN 型三极管伏安特性

Trace 2N3906 and other PNP Bipolars



Discrete semiconductor group 分立半导体分类

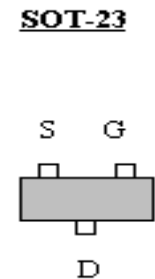
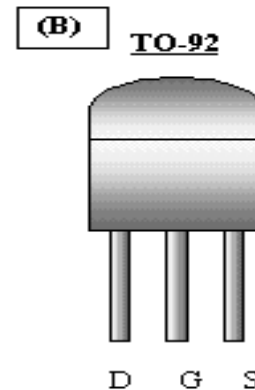
Transistor 晶体管

- Unipolar transistor/Field effect transistor 单极性晶体管（即FET场效应管）
 - N channel JFET N通道J型场效应管
 - P channel JFET P通道J型场效应管
 - N channel MOSFET N通道MOS型场效应管
 - P channel MOSFET P通道MOS型场效应管

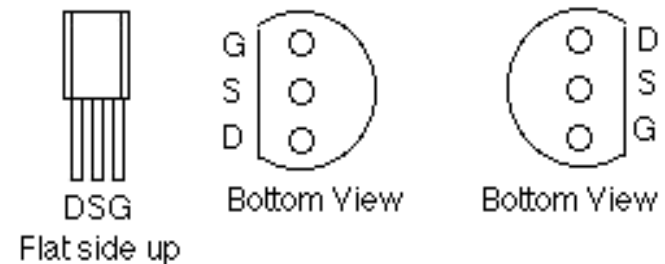
Discrete semiconductor group 分立半导体分类

Transistor 晶体管

- FET pin-out 场效应管的脚位
 - Various pin-out for various items 不同的型号有不同的脚位



TO92 FET (MPF102 etc)

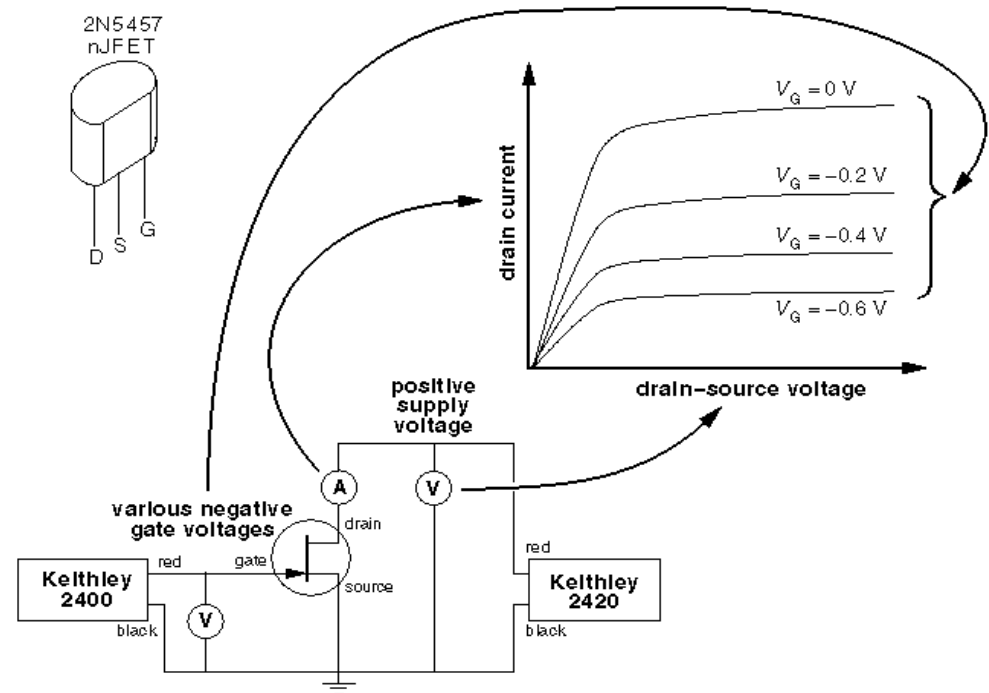


Discrete semiconductor group 分立半导体分类

Transistor 晶体管

- N channel JFET characteristic curve N通道J型场效应管特性曲线

Trace 2N5457 and other nJFETs

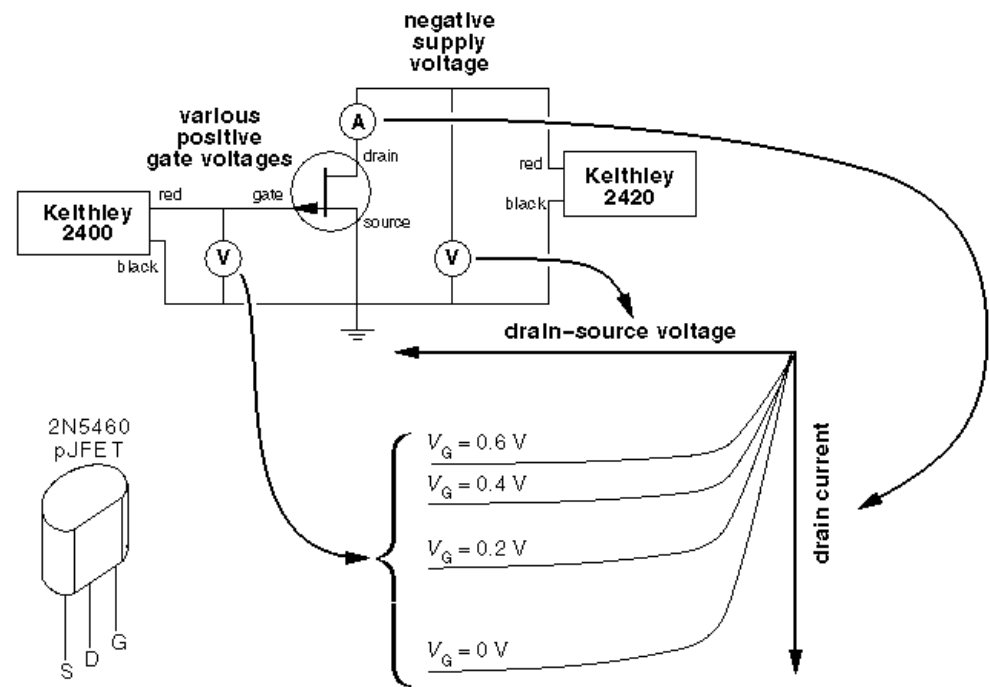


Discrete semiconductor group 分立半导体分类

Transistor 晶体管

- P channel JFET characteristic curve P通道J型场效应管特性曲线

Trace 2N5460 and other pJFETs

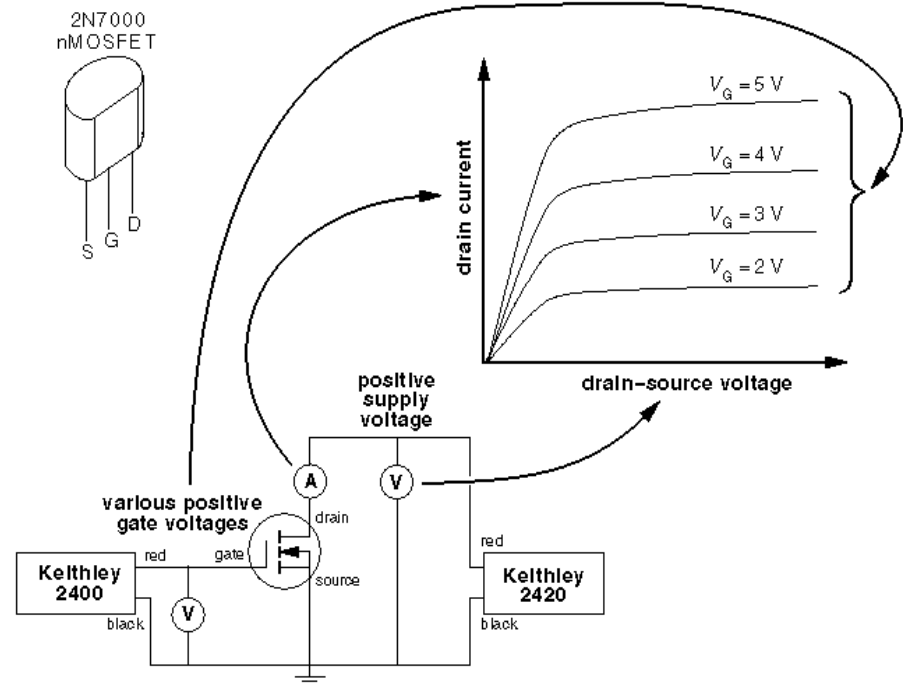


Discrete semiconductor group 分立半导体分类

Transistor 晶体管

- N channel MOSFET characteristic curve
N通道MOS型场效应管特性曲线

Trace 2N7000 and other nMOSFETs

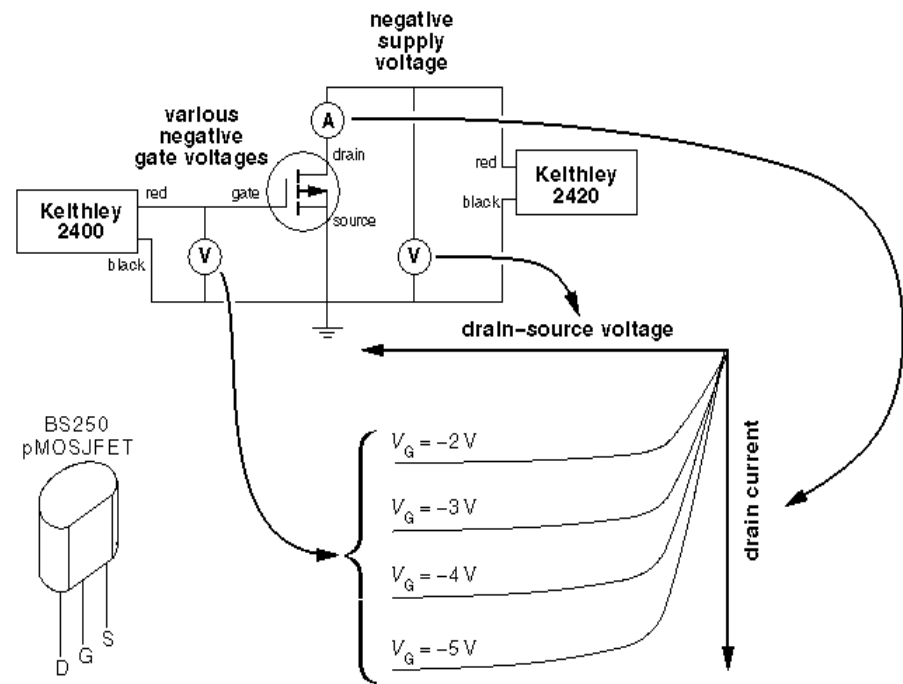


Discrete semiconductor group 分立半导体分类

Transistor 晶体管

- P channel MOSFET characteristic curve
P通道MOS型场效应管特性曲线

Trace BS250 and other pMOSFETs



Discrete semiconductor group 分立半导体分类

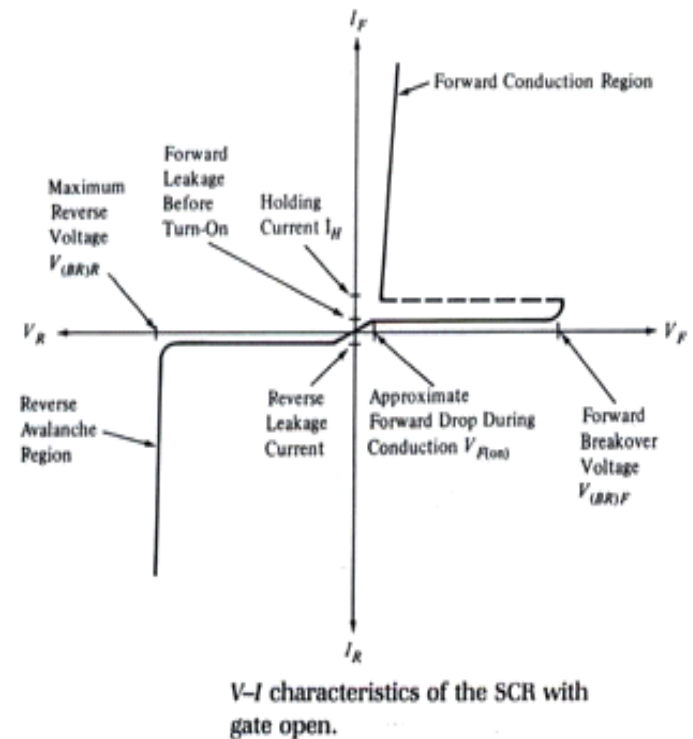
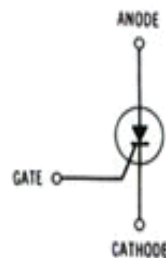
Thyristor 晶闸管

- Thyristor 晶闸管
 - SCR/Silicon controlled rectifier 单向可控硅
 - TRIAC/BCR 双向可控硅
 - DIAC 双向触发二极管
 - PUT 可编程单结晶体管

Discrete semiconductor group 分立半导体分类

Thyristor 晶闸管

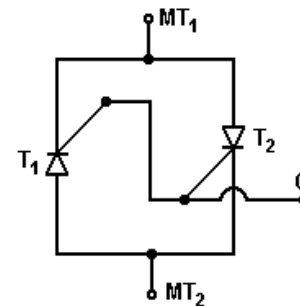
- SCR 单向可控硅



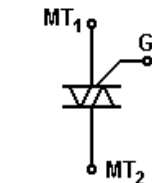
Discrete semiconductor group 分立半导体分类

Thyristor 晶闸管

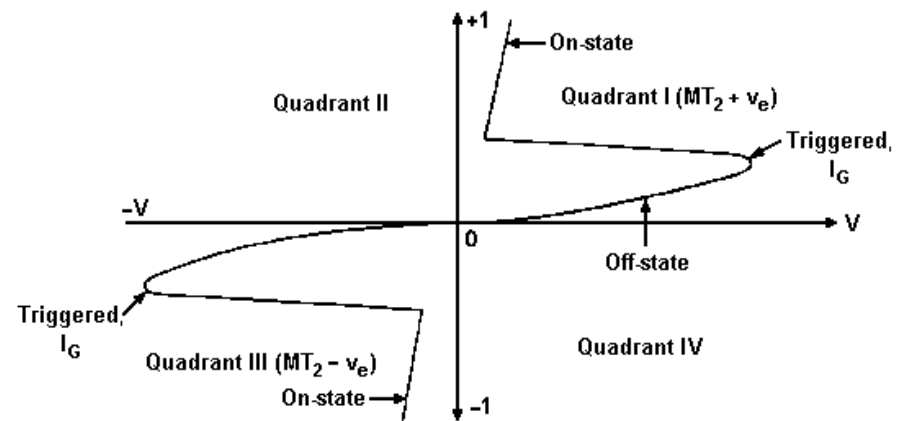
- BCR双向可控硅



(a) Equivalent of TRIAC



(b) TRIAC symbol

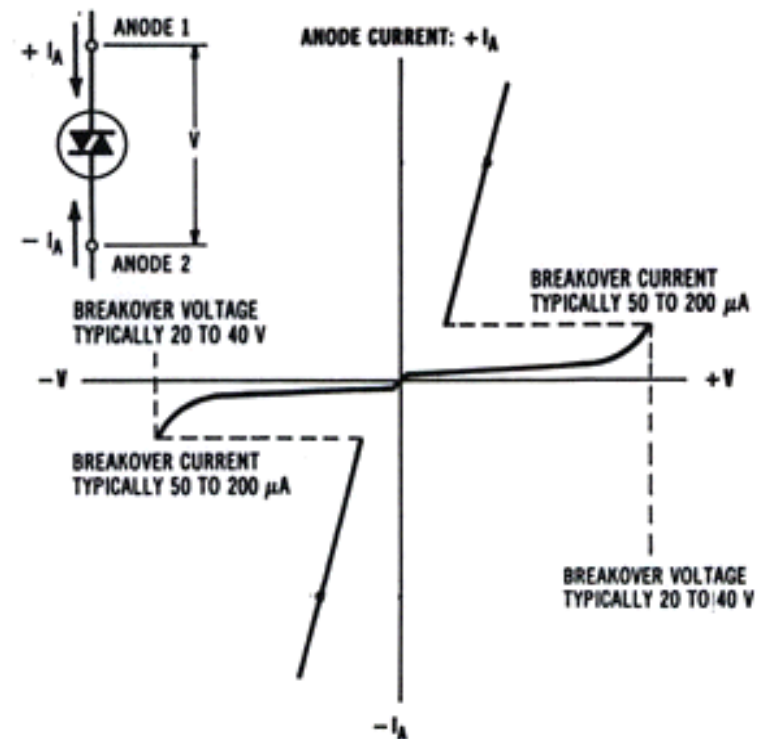


(c) v - i characteristics

Discrete semiconductor group 分立半导体分类

Thyristor 晶闸管

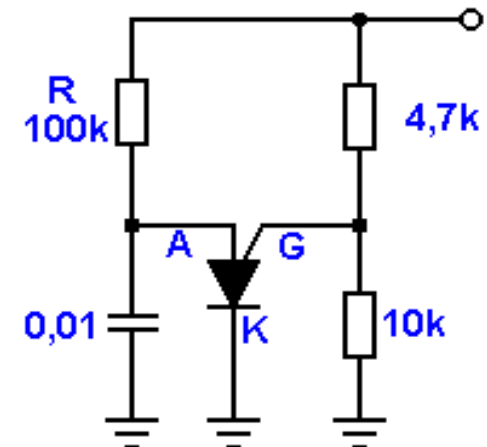
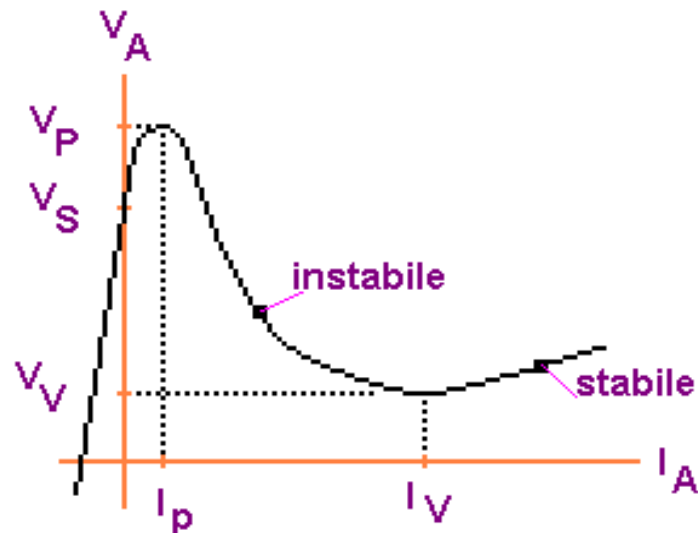
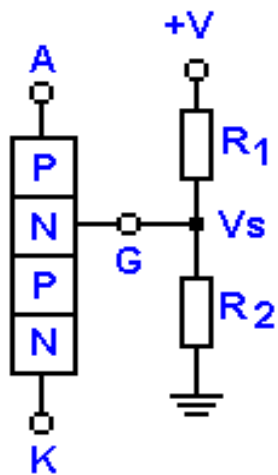
- DIAC 双向触发二极管



Discrete semiconductor group 分立半导体分类

Thyritor 晶闸管

- PUT 可编程单结晶体管



IC group 集成电路分类

- IC 集成电路

Classification by package 根据封装形式可分为

- Single package
- Dual package
- Quad package
- BGA package
- CSP/chip scale package

Classification by construction 根据制造工艺可分为

- Analog & mixed signal 模拟与混合信号 IC
- Digital logic 数字逻辑 IC

IC group 集成电路分类

- Analog & mixed Signal 模拟与混合信号IC
 - ADC/DAC 模数/数模转换IC
 - Audio & Modem 音频/调制IC
 - Controller 控制IC
 - OP amp 运算放大器
 - Opto-coupler 光耦
 - Power converter 电源变换IC
 - Switch analog 模拟开关IC
 - Video interface 视频接口IC
 - Voltage reference 电压参考IC
 - Voltage regulator 电压调整IC
 - RF 射频IC

IC group 集成电路分类

- Digital logic 数字逻辑IC
 - Standard logic 标准逻辑IC
 - Programmable logic 可编程逻辑IC
 - Memory 存储器
 - Processor 处理器
 - Specialized IC 专用IC
 - LAN/WAN/Interface 局域网/广域网/接口IC
 - Bus 总线IC

IC group 集成电路分类

- Classification by function 根据用途可分为
 - General purpose linear 通用线性IC
 - Power management/电源管理IC
 - Thermal management/热管理IC
 - Clock management/时钟管理IC
 - Standard logic/标准逻辑IC
 - Other logic/其它逻辑IC
 - Memory/存储器
 - Process/处理器
 - Optoelectronics 光电IC
 - RF 射频IC

IC group 集成电路分类

IC package 集成电路封装形式

- IC package 集成电路封装形式
 - Single package 单列封装
 - Dual package 双列封装
 - Quad package 四列扁平封装
 - BGA package 球栅列阵封装
 - CSP/chip scale package 晶片级封装

JESD30 is attached 半导体芯片封装标准



JESD30D

IC group 集成电路分类

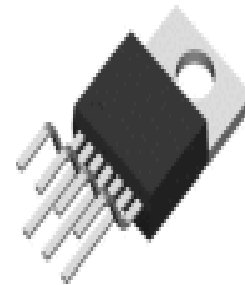
Single package 单列封装

- Single package 单列封装
 - SIP-THT 单列通孔封装
 - SIP-SMT 单列贴片封装

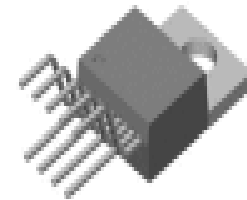
IC group 集成电路分类

Single package 单列封装

- SIP-THT 单列通孔封装
 - TO-XXX



7-pins



9-pins



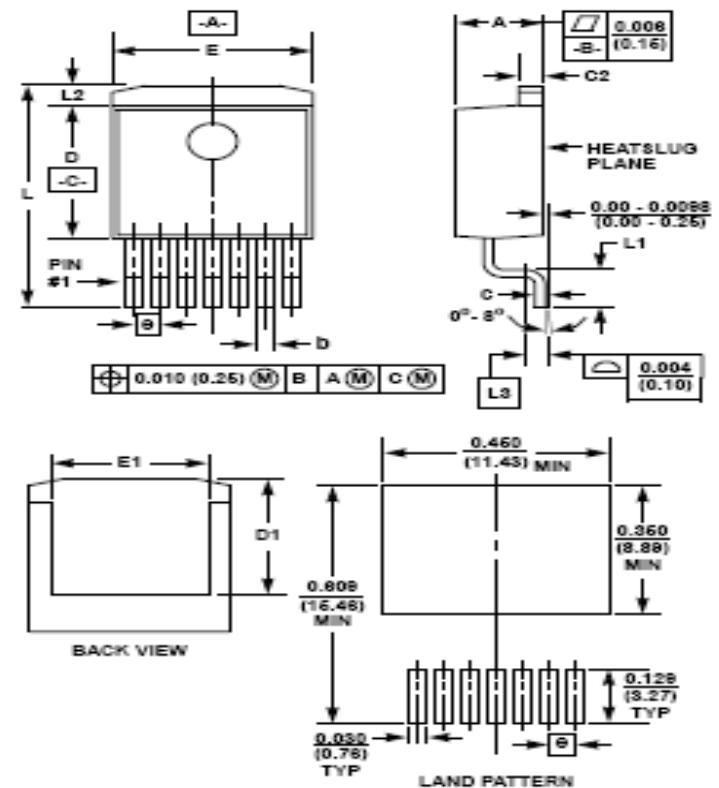
TO series

IC group 集成电路分类

Single package 单列封装

- SIP-SMT 单列贴片封装

Single-In-Line Plastic Packages (SIP)



SIP

IC group 集成电路分类

Dual package 双列封装

- Dual package 双列封装
 - DIP/Dual Inline Package 双列直插封装
 - SOT-23/Standard Outline Transistor
 - SC-70/Single Chip
 - SOIC/Small Outline IC
 - SSOP/Shrink Small Outline Package
 - TSOP/Thin Small Outline Package
 - TSSOP/Thin Shrink Small Outline Package

IC group 集成电路分类

DIP封装

DIP封装

- Material封装材料
 - Plastic DIP/nonhermetic package PDIP非密封型
 - Ceramic DIP/hermetic package CDIP密封型
- Size & Pin#1 index尺寸和第一脚位标识
 - Popular body width is 300mils and 600mils通常的宽度是300毫英寸和600毫英寸



PDIP_SIZE

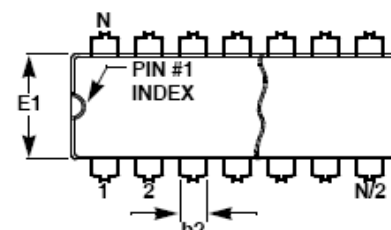
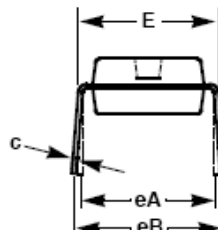
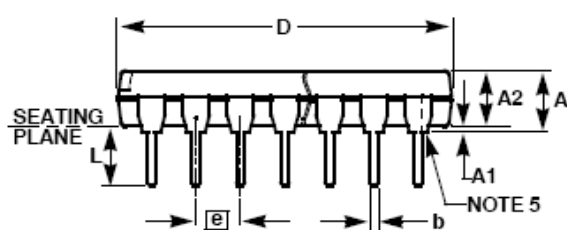


CDIP



PDIP

Plastic Dual-In-Line Packages (PDIP)



IC group 集成电路分类

DIP封装

- Properties of Some Examples of PDIP部分PDIP封装的属性

Lead Count	Width	Length	Thickness	Pitch	Max. Height
8	6.52 mm	9.53 mm	3.24 mm	2.54 mm	4.19 mm
10	6.61 mm	22.86 mm	3.94 mm	2.54 mm	4.95 mm
12/16	6.61 mm	29.91 mm	3.94 mm	2.54 mm	5.33 mm
22	13.53 mm	37.4 mm	7.75 mm	2.54 mm	8.89 mm
24	13.71 mm	31.75 mm	4.57 mm	2.54 mm	5.08 mm
28	13.525 mm	37.4 mm	4.07 mm	2.54 mm	6.35 mm

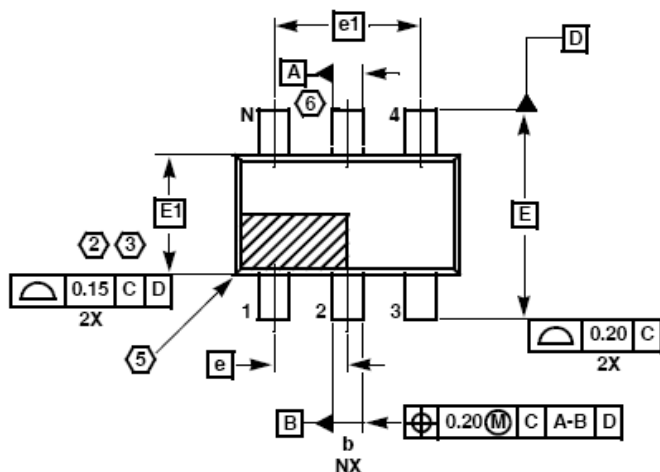
IC group 集成电路分类

SOT-23/SC-70封装

SOT-23/SC-70封装

- Material材料
 - Nonhermetic package 非密封型
- Size & Pin#1 indicator 尺寸和第一脚位标识

SOT-23 Package Family



SOT-23



SOT_SIZE

IC group 集成电路分类

SOT-23/SC-70封装

- Properties of some SOT-23 / SC-70 Package 部分 SOT-23/SC-70封装的属性

Part #	No. of Pins	Body Length	Body Width	Body Thickness	Lead Pitch
5-L SOT-23	5	115 mils	63 mils	40 mils	37.5 mils
6-L SOT-23	6	115 mils	63 mils	40 mils	37.5 mils
5-L SC70	5	79 mils	49 mils	35 mils	25.5 mils
5-L SC70	5	83 mils	49 mils	35 mils	25.5 mils

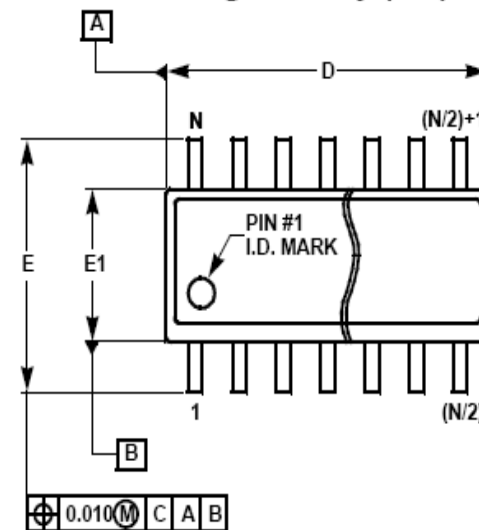
IC group 集成电路分类

SOIC封装

SOIC封装

- Material 材料
 - Nonhermetic package 非密封型
- Type
 - Gull wing leads 欧翼型/SOIC
 - J-type leads J型/SOJ
- Size & Pin#1 indicator 尺寸和第一脚位标识
 - SOIC 不同的宽度
 - SOIC narrow (150mils) 常用的
 - SOIC wide (300mils) 常用的

Small Outline Package Family (SO)



SOIC family



SOIC

TJR

IC group 集成电路分类

SOIC封装

- Properties of some SOIC 部分SOIC封装的属性

Part #	No. of Pins	Lead Style	Body Width	Qty Per Tube	Tape Width	Tape Pitch	Qty 13" Reel
SO8G	8	Gull	3.8mm	99	12mm	8mm	2,500
SO14G	14	Gull	3.8mm	50	16mm	8mm	2,500
SO16G	16	Gull	3.8mm	50	16mm	8mm	2,500
SO16G	16	Gull	7.6mm	46	16mm	12mm	1,000
SO20G	20	Gull	7.6mm	38	24mm	12mm	1,000
SO28G	28	Gull	7.6mm	25	24mm	12mm	1,000
SO44G	44	Gull	13.3mm	17	24mm	45mm	750

IC group 集成电路分类

SOIC封装

- Properties of some SOJ部分SOJ封装的属性

Part Number	Number of Pins	Lead Style	Body Width	Qty Per Tube	Tape Width	Tape Pitch	Qty 13" Reel
SO20/26J	20/26	J-Lead	7.6mm	25	24mm	12mm	1,000
SO28J	28	J-Lead	7.6mm	27	24mm	12mm	1,000
SO32J	32	J-Lead	7.6mm	25	24mm	12mm	1,000
SO40J	40	J-Lead	10.0mm	15	44mm	16mm	500
SO42J	42	J-Lead	10.0mm	15	44mm	16mm	500

IC group 集成电路分类

SSOP封装

SSOP

- Material材料
 - Nonhermetic package 非密封型
- Size & Pin#1 indicator 尺寸和第一脚位标识

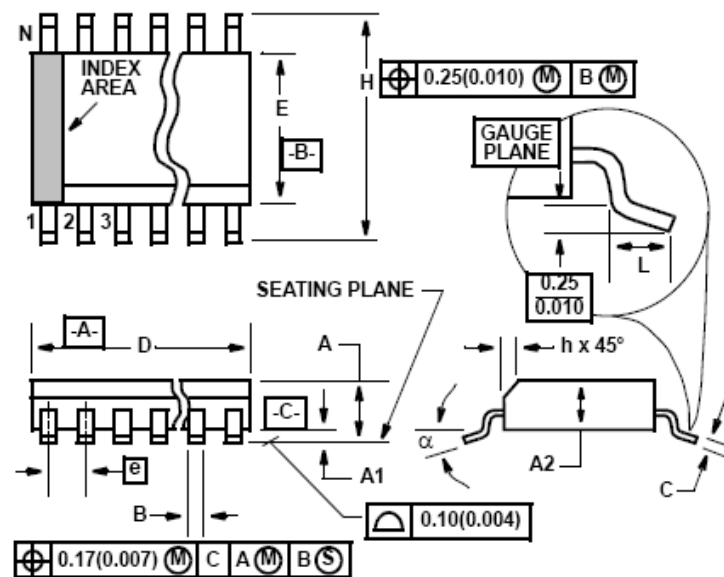


SSOP



SSOP_SIZE

Shrink Small Outline Plastic Packages (SSOP)
Quarter Size Outline Plastic Packages (QSOP)



IC group 集成电路分类

SSOP封装

- Properties of some SSOP 部分SSOP封装的属性

Part Number	No. of Pins	Body Width	Pitch	Qty Per Tube	Tape Width	Tape Pitch	Qty 13" Reel
SSOP8	8	5.3mm	0.65mm	156	12mm	8mm	2,500
SSOP14/16	14/16	5.3mm	0.65mm	100/80	16mm	12mm	1,000
SSOP20/24	20/24	5.3mm	0.65mm	66/62	16mm	12mm	1,000
SSOP28	28	5.3mm	0.65mm	47	16mm	12mm	1,000
SSOP48	48	7.6mm	1.27mm	30	32mm	12/16mm	1,000
SSOP56	56	7.6mm	1.27mm	26	32mm	12/16mm	500
SSOP64	64	10.2mm	0.8mm	—	44mm	16/24mm	500

IC group 集成电路分类

TSOP封装

- TSOP

- Nonhermetic package 非密封型
- 1.0mm thickness 1.0毫米厚
- Two types
 - TSOP I (leads from shorter edges)
 - TSOP II (leads from longer edges)



TSOP-I

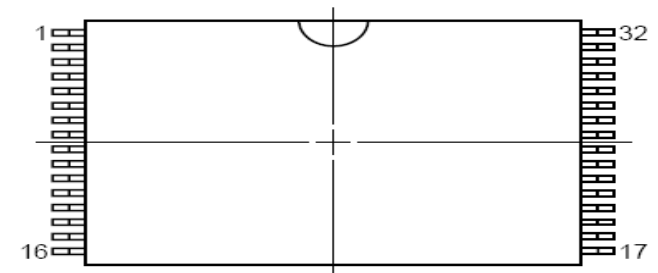


TSOP-I_SIZE

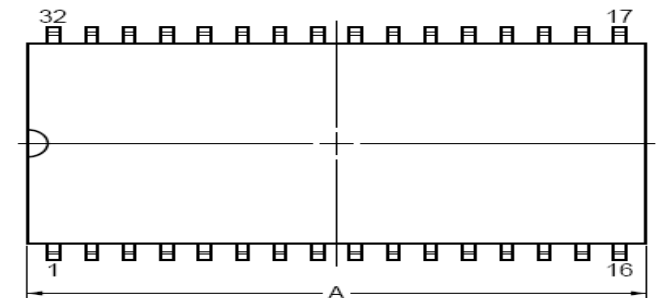


TSOP-II_SIZE

32-PIN PLASTIC TSOP (I) (8x13.4)



32-PIN PLASTIC TSOP (II) (10.16mm(400))



TJR

IC group 集成电路分类

TSOP封装

- Properties of some TSOP-I type 部分TSOP-I封装的特性

Part Number	No. of Pins	Body Size	Lead Pitch	Qty Per Tray	Tape Width	Tape Pitch	Qty 13" Reel
TSOP20/24	20/24	6 x 14.4mm	0.5mm	240	24mm	12mm	1,000
TSOP28	28	8.1 x 11.8mm	0.55mm	234	24mm	12mm	1,000
TSOP28/32	28/32	8 x 18.4mm	0.5mm	156	32mm	12/16mm	1,000
TSOP40	40	10 x 18.4mm	0.5mm	120	32mm	16mm	1,000
TSOP48	48	12 x 18.4mm	0.5mm	96	32mm	16mm	1,000

IC group 集成电路分类

TSOP封装

- Properties of some TSOP-II type 部分TSOP-II封装的特性

Part Number	No. of Pins	Body Size	Lead Pitch	Qty Per Tray	Tape Width	Tape Pitch	Qty 13" Reel
TSOP20/24/26	20/24/26	7.6 x 17.14mm	1.27mm	176	24mm	12mm	1,000
TSOP24/28	24/28	10.16 x 18.41mm	1.27mm	100	32mm	16mm	1,000
TSOP32	32	10.16 x 20.95mm	1.27mm	117	32mm	16mm	1,000
TSOP40/44	40/44	10.16 x 18.42mm	0.8mm	135	32mm	16mm	1,000
TSOP50	50	10.16 x 20.95mm	0.8mm	117	32mm	16mm	1,000
TSOP54	54	12.7 x 22.22mm	0.8mm	84	44mm	20mm	1,000
TSOP66	66	10.16 x 22.22mm	0.65mm		44mm	20mm	1,000

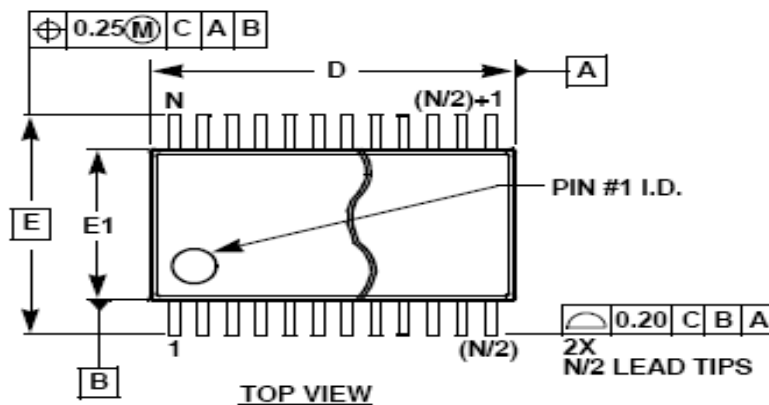
IC group 集成电路分类

TSSOP封装

TSSOP

- Material材料
 - Nonhermetic package 非密封型
- Size & Pin#1 indicator 尺寸和第一脚位标识

Thin Shrink Small Outline Package Family



TSSOP



TSSOP_SIZE

IC group 集成电路分类

TSSOP 封装

- Properties of some TSSOP 部分TSSOP封装的属性

Part Number	No. of Pins	Body Width	Pitch	Tape Width	Tape Pitch	Qty Per Tube	Qty Per Reel
TSSOP8/10	8/10	3.0mm	0.65mm	12mm	8mm	98	2,500
TSSOP14	14	4.4mm	0.65mm	12/16mm	8mm	96	1,000/2,500
TSSOP28	28	4.4mm	0.65mm	16mm	8/12mm	50	1,000
TSSOP28/32	28/32	6.1mm	0.65mm	24mm	12mm	50/44	1,000
TSSOP38	38	6.1mm	0.65mm	24mm	12mm	39	1,000
TSSOP48/56	48/56	6.1mm	0.5mm	24mm	12mm	39/35	1,000
TSSOP56	56	4.4mm	0.4mm	24mm	12mm	42	1,000
TSSOP64	64	6.1mm	0.5mm	N/A	N/A	28	N/A
TSSOP80	80	6.1mm	0.4mm	N/A	N/A	28	N/A

IC group 集成电路分类

Quad package 四列扁平封装

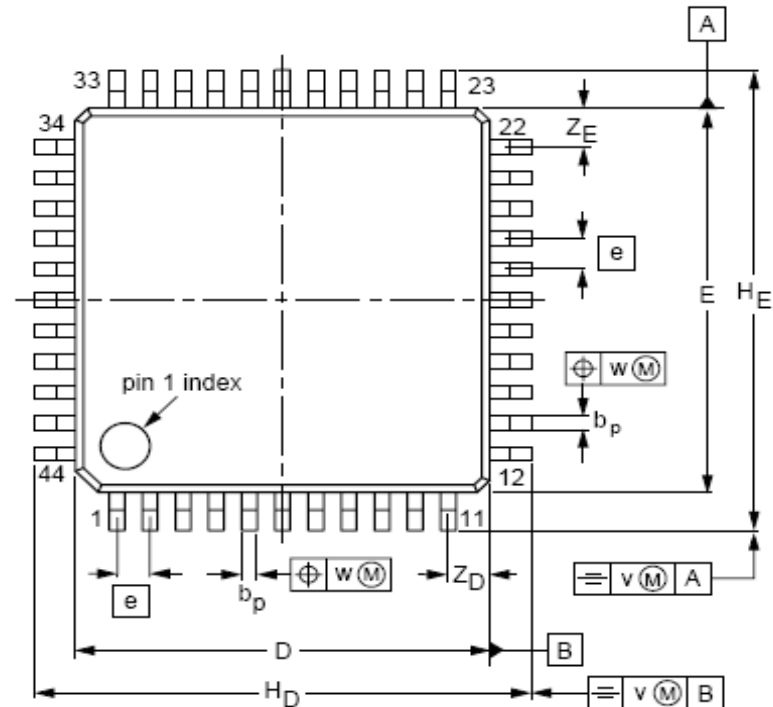
- Quad package
 - LQFP/Low-profile Quad Flat Pack
 - TQFP/Thin Quad Flat Pack
 - MQFP/Metric Quad Flat Pack
 - PLCC/Plastic Leaded Chip Carrier Package

IC group 集成电路分类

LQFP封装

LQFP

- Material材料
 - Nonhermetic package 非密封型
- Size & Pin#1 indicator 尺寸和第一脚位标识
 - 1.4mm thickness 厚度 1.4毫米



IC group 集成电路分类

LQFP 封装

- Properties of some LQFP 部分LQFP封装的属性

LQFP Nominal Package Dimensions (units in mm)

Body Size	Body Tkns	Lead Form	Standoff	Foot Length	Tip To Tip	Lead Count	JEDEC	Tray Matrix	Units Per Tray
7 x 7	1.40	1.00	0.10	0.60	9.0	32/48/64	MS-026	10 x 25	250
10 x 10	1.40	1.00	0.10	0.60	12.0	44/52/64/80	MS-026	8 x 20	160
14 x 14	1.40	1.00	0.10	0.60	16.0	44/64/80/100/120/128	MS-026	6 x 15	90
14 x 20	1.40	1.00	0.10	0.60	16.0 x 22.0	100/128	MS-026	6 x 12	72
20 x 20	1.40	1.00	0.10	0.60	22.0	128/144/176	MS-026	5 x 12	60
24 x 24	1.40	1.00	0.10	0.60	26.0	160/176/216	MS-026	4 x 10	40
28 x 28	1.40	1.00	0.10	0.60	30.0	160/208/256	MS-026	4 x 9	36

IC group 集成电路分类

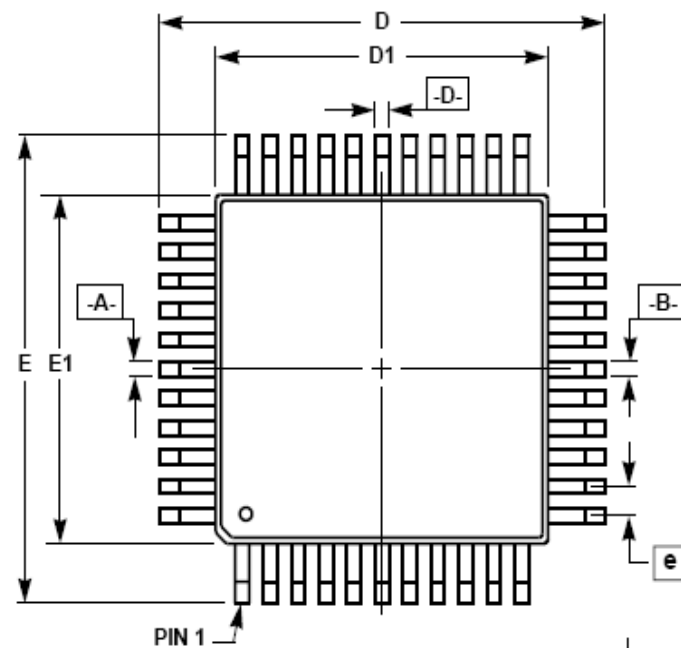
TQFP 封装

TQFP

- Material 材料
 - Nonhermetic package 非密封型
- Size & Pin#1 indicator 尺寸和第一脚位标识
 - 1.0mm thickness 厚度 1.0毫米



Thin Plastic Quad Flatpack Packages (TQFP)



IC group 集成电路分类

TQFP 封装

- Properties of some TQFP 部分TQFP封装的属性

TQFP NOMINAL PACKAGE DIMENSIONS (mm)

Body Size	Body Tkns	Lead Form	Standoff	Foot Length	Tip To Tip	Lead Count	JEDEC	Tray Matrix	Units Per Tray
5 x 5	1.00	1.00	0.10	0.60	7.0	32/40	MS-026	12 x 30	360
7 x 7	1.00	1.00	0.10	0.60	9.0	32/48	MS-026	10 x 25	250
10 x 10	1.00	1.00	0.10	0.60	12.0	44/52/64	MS-026	8 x 20	160
12 x 12	1.00	1.00	0.10	0.60	14.0	80	MS-026	7 x 17	119
14 x 14	1.00	1.00	0.10	0.60	16.0	44/64/80/100/120/128	MS-026	6 x 15	90
20 x 20	1.00	1.00	0.10	0.60	22.0	144/176	MS-026	5 x 12	60

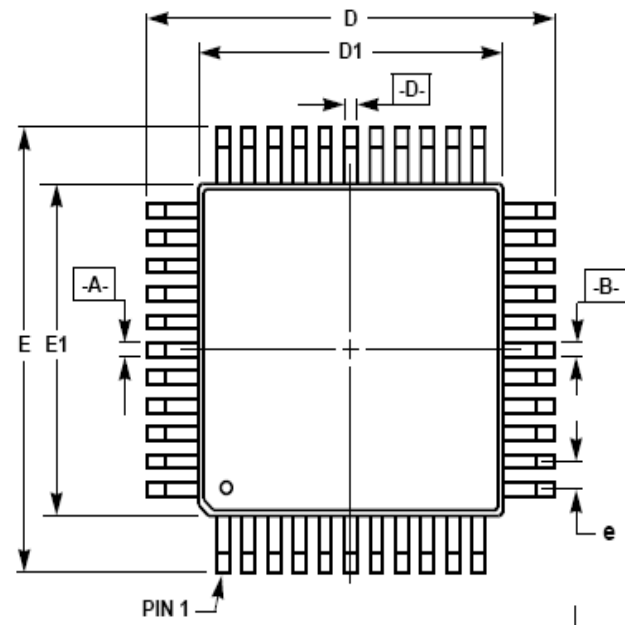
IC group 集成电路分类

MQFP封装

MQFP

- Material材料
 - Nonhermetic package 非密封型
- Size & Pin#1 indicator 尺寸和第一脚位标识
 - 2.0mm, 2.7mm, 3.5mm thickness 厚度2.0毫米、2.7毫米、3.5毫米

Metric Plastic Quad Flatpack Packages (MQFP)



MQFP



MQFP_SIZE

IC group 集成电路分类

MQFP 封装

- Properties of some MQFP 部分MQFP封装的属性

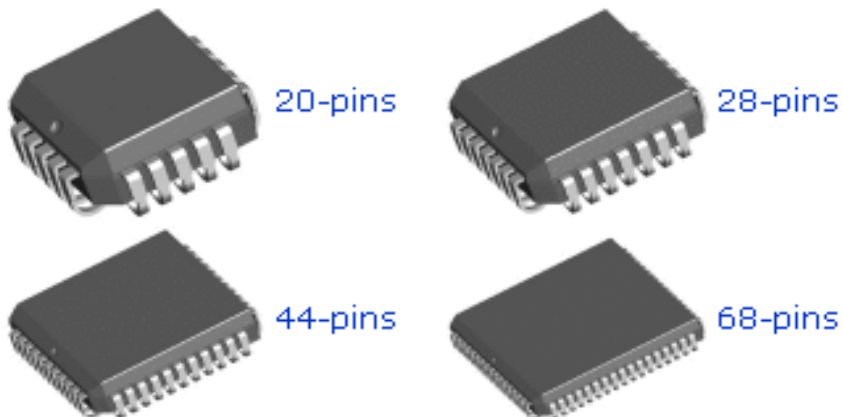
MQFP NOMINAL PACKAGE DIMENSIONS (mm)

Body Size	Body Tkns	Lead Form	Standoff	Tip To Tip	Lead Count	JEDEC	Tray Matrix	Units Per Tray
10 x 10	2.00	1.60	0.15	13.2	44/52/64	MS-022	6 x 16	96
10 x 10	2.00	1.95	0.15	13.9	44/52/64	MO-112	6 x 16	96
14 x 14	2.00	1.60	0.15	17.2	52/64/80/100	MS-022	6 x 14	84
14 x 14	2.67	1.60	0.15	17.2	52/64/80/100	MS-022	6 x 14	84
14 x 14	2.67	1.95	0.15	17.9	52/64/80/100	MO-112	6 x 14	84
14 x 20	2.71	1.60	0.33	17.2 x 23.2	64/80/100/128	MS-022	6 x 11	66
14 x 20	2.71	1.95	0.23	17.9 x 23.9	64/80/100/128	MO-112	6 x 11	66
28 x 28	3.37	1.30	0.13	30.6	208/256	MS-029	3 x 8	24
28 x 28	3.37	1.30	0.33	30.6	120/128/144/160/208	MS-029	3 x 8	24
28 x 28	3.37	1.60	0.33	31.2	120/128/144/160/208	MS-022	3 x 8	24
32 x 32	3.40	1.30	0.38	34.6	240	MS-029	3 x 8	24
32 x 32	3.40	1.30	0.32	34.6	240	MS-029	3 x 8	24
40 x 40	3.80	1.30	0.43	42.6	304	MS-029	2 x 6	12

IC group 集成电路分类

PLCC封装

- PLCC
 - Nonhermetic package 非密封型

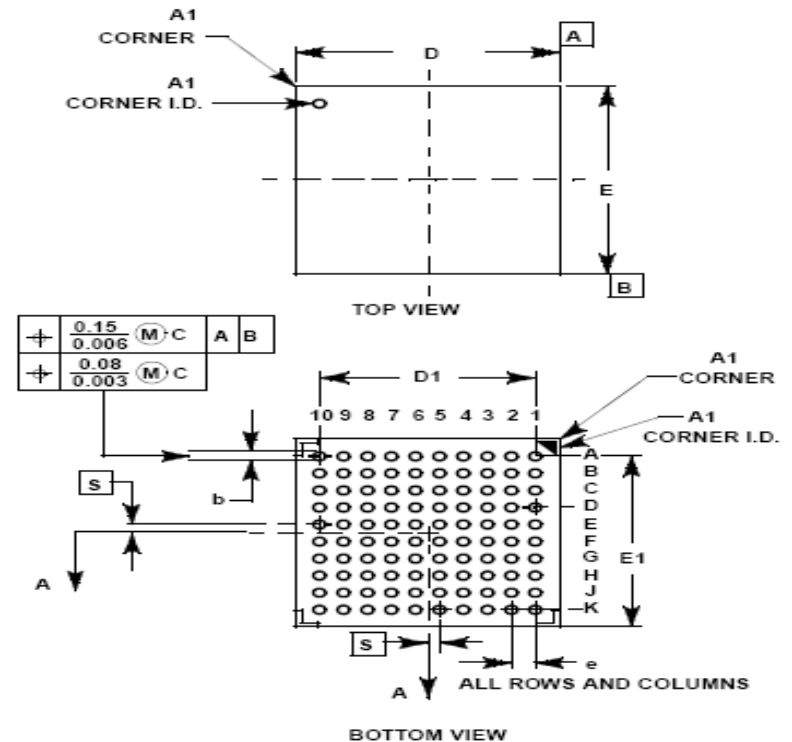
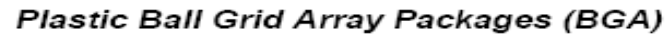


IC group 集成电路分类

BGA 封装

- PBGA Package

- Nonhermetic package 非密封型
- IPC/JEDEC J-STD-013



PBGA

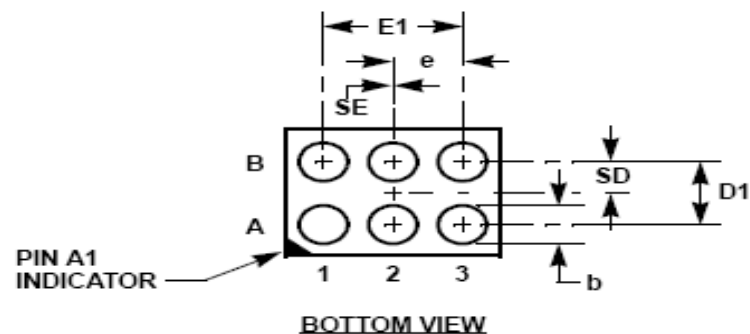
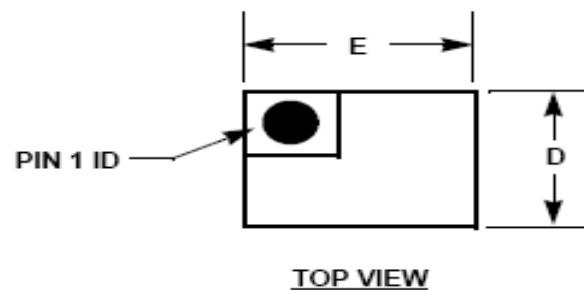
IC group 集成电路分类

CSP封装

- CSP封装

- Package is no more than 1.2X of die封装尺寸不大于晶片的1.2倍
- IPC/JEDEC J-STD-012
- Also stand for chip size package有时也表示晶片尺寸封装

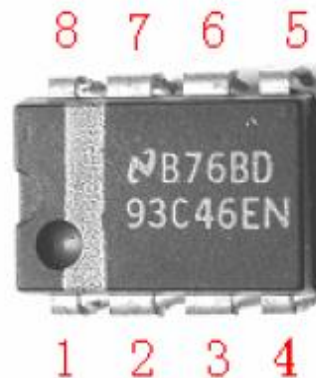
3x2 Chip Scale Package (CSP)



IC group 集成电路分类

PIN#1 indicator 第一脚识别符

- IC orientation 集成电路方向识别
 - A reference mark, chamfer, notch, tab, flat, or similar feature that identifies the number-one terminal position. 一个参考的记号，斜面，槽口，横杠，或类似的标识去识别第一脚。



IC group 集成电路分类

IC packing 集成电路包装

- IC packing 集成电路包装
 - Reel tape 卷带
 - Tubes 管装
 - Trays 托盘

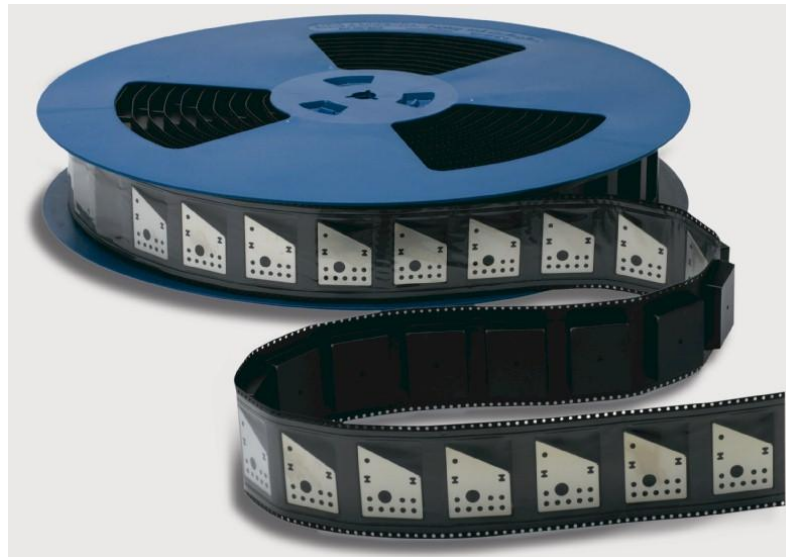
JEP130 is attached



IC group 集成电路分类

IC packing 集成电路包装

- Reel & Tape



IC group 集成电路分类

IC packing 集成电路包装

- Tray



IC group 集成电路分类

IC packing 集成电路包装

- Tube



IC group 集成电路分类

非密封性IC湿敏等级

- MSL
 - MSL1 NA
 - MSL2 1年
 - MSL2a 4周
 - MSL3 168小时
 - MSL4 72小时
 - MSL5 48小时
 - MSL5a 24小时
 - MSL6 使用前必须烘烤，并且在规定的时间内使用
- *参考IPC/JEDEC标准
J-STD-020 & J-STD-033

IC group 集成电路分类

- Classification by function 根据用途可分为
 - General purpose linear 通用线性IC
 - Power management/电源管理IC
 - Thermal management/热管理IC
 - Clock management/时钟管理IC
 - Standard logic/标准逻辑IC
 - Other logic/其它逻辑IC
 - Memory/存储器
 - Process/处理器
 - Optoelectronics 光电IC
 - RF 射频IC

IC group 集成电路分类

General purpose linear 通用线性IC

- General purpose linear 通用线性IC
 - Operational amplifier 运算放大器
 - Comparator 比较器
 - Driver 驱动IC
 - Interface 接口IC
 - Analog switch 模拟开关IC

IC group 集成电路分类

Power management 电源管理IC

- Power management 电源管理IC
 - Regulator 调整器
 - LDO 低压差调整器
 - DC/DC Converter 电压变换IC
 - Voltage reference 电压参考IC
 - Voltage supervisor 电压监视IC
 - PWM 调制IC
 - Battery management 电池管理IC

IC group 集成电路分类

Thermal management 热管理IC

- Thermal management 热管理IC
 - Thermal sensor 热感应器

IC group 集成电路分类

Clock management 时钟管理IC

- Clock management 时钟管理IC
 - Clock 时钟IC
 - RTC 实时时钟IC
 - PLL 锁相环IC
 - Oscillator IC 振荡IC

IC group 集成电路分类

Standard logic 标准逻辑 IC

- Standard logic 标准逻辑 IC
 - 74/54 series 74/54 系列 IC
 - 4000 series 4000 系列 IC

IC group 集成电路分类

Other logic 其它逻辑IC

- Other logic 其它逻辑IC
 - PLD 可编程逻辑IC

IC group 集成电路分类

Memory 存储器

- Memory 存储器
- RAM
 - DRAM
 - SRAM
- ROM
 - EPROM
 - EEPROM
 - FLASH

Memory 存储元件

- Memory存储元件
 - RAM
 - ROM

Memory - RAM

存储元件 – 随机存取存储器

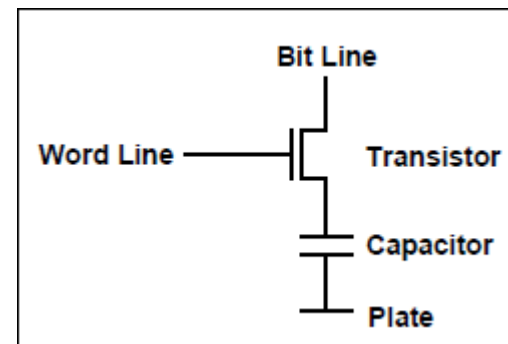
- RAM

- 根据断电后原保存信息能否丢失分为
 - 易失性Volatile RAM
 - DRAM
 - SRAM
 - 非易失性Non-Volatile RAM
 - NVRAM
 - BRAM
 - FRAM

Memory - RAM

存储元件 – 随机存取存储器

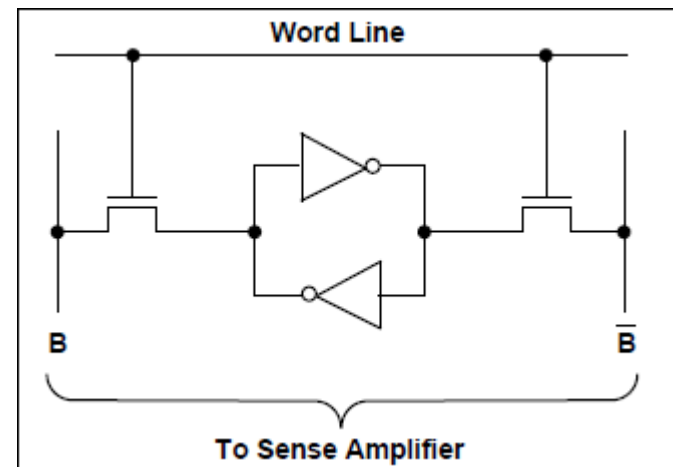
- 动态随机存取存储器DRAM
- DRAM的构成
- DRAM单元是由一个晶体管(Transistor)和一个电容器(Capacitor)构成。



Memory - RAM

存储元件—随机存取存储器

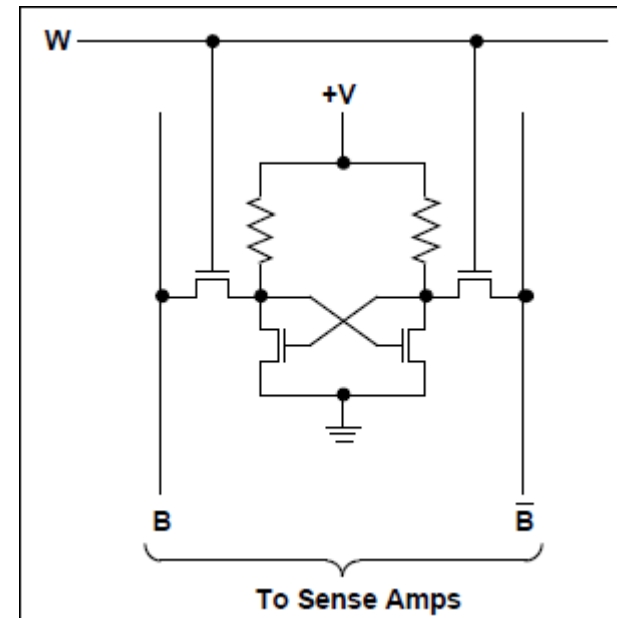
- 静态随机存取存储器SRAM
- SRAM构成
- SRAM构成有几种形式，一个单元是由一个双稳态触发器和二个晶体管构成。
 - 4T cell
 - 6T cell
 - TFT cell



Memory - RAM

存储元件 - 随机存取存储器

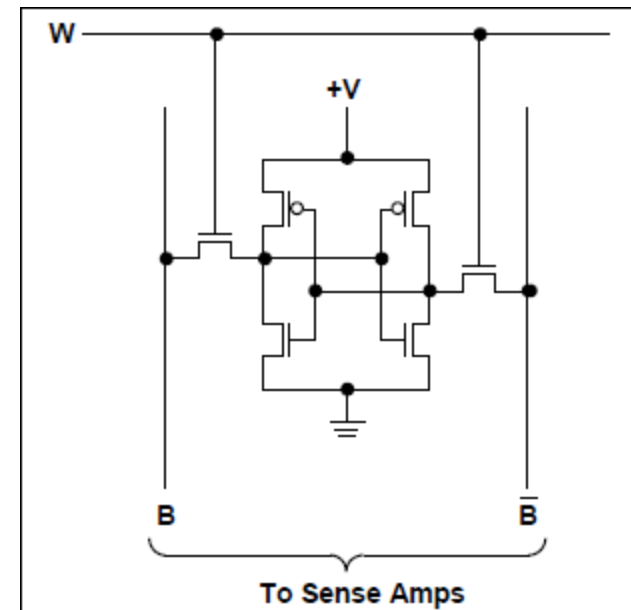
- 4T 单元
- 一个单元是由四个NMOS晶体管和二个电阻构成。



Memory - RAM

存储元件 – 随机存取存储器

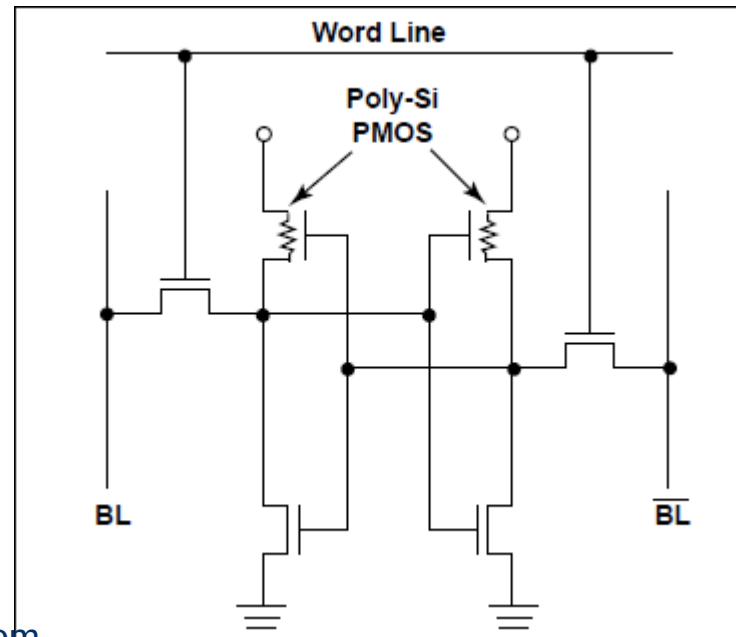
- 6T 单元
- 一个单元是由4个NMOS和2个PMOS构成。



Memory - RAM

存储元件 - 随机存取存储器

- TFT 单元
- 一个单元是由四个NMOS晶体管和二个TFT构成。



Memory - RAM

存储元件 – 随机存取存储器

- DRAM与SRAM比较
- DRAM单元是由一个晶体管和一个电容构成，单位体积的容量较高，所以成本低。但速度慢。
- SRAM单元是由六个晶体管构成，成本相对较高，速度快。

Memory - RAM

存储元件 – 随机存取存储器

- SRAM和DRAM用途
- SRAM一般介于CPU和DRAM间的作为缓存区
- DRAM一般常作为主内存区。

Memory - RAM

存储元件 – 随机存取存储器

- 非易失性随机存取存储器NVRAM
- SRAM+EEPROM
- Battery-backed SRAM
- Ferroelectric DRAM

Memory - ROM

存储元件 – 只读存储器

- ROM
- ROM主要有以下几种
 - PROM (Programmable ROM)
 - EPROM (Erasable Programmable ROM)
 - EEPROM (Electrically Erasable and programmable ROM)
 - FLASH

Memory - ROM

存储元件 – 只读存储器

- PROM
 - Mask PROM
 - PROM
- MROM单元是由一个晶体管构成，程序是晶圆厂在制程中制成。

Memory - ROM

存储元件 – 只读存储器

- PROM

- PROM单元是由一个晶体管构成，程序是客户自己烧录。
- 它是由周文俊在1956年发明。

Memory - ROM

存储元件 – 只读存储器

- EPROM
 - UV EPROM
 - OTP EPROM
 - Electrically EPROM
- UV EPROM
 - 单元是由一个晶体管构成，
 - 但删除程序需要外部的紫外线经由器件顶部的透明窗口处理。
 - 它是由Dov Frohman在1971年发明。

Memory - ROM

存储元件 – 只读存储器

- OTP (One Time Programmable) EPROM
 - OTP单元是由一个晶体管构成。
 - 它是一种一次性可编程存储芯片。
 - 相对于UV EPROM有成本上的优势。

Memory - ROM

存贮元件 – 只读存贮器

- EEPROM

- EEPROM单元是由一个，一个半，或二个晶体管构成。
- 它是一种可以通过电子方式多次擦写的半导体存贮芯片。
- 它是由George Perlegos在1983年发明。

Memory - ROM

存储元件 – 只读存储器

- EEPROM类型
- 串行式(serial)
 - Microwire 接口（3线）：型号以 93 开始系列。例：93C46
 - I2CTM接口（2线）：型号以 24 开始系列。例：24LC02
 - SPI接口（3线）：型号以 25 开始系列。例：25LC08
 - UNI/OTM接口（1线）：由 Microchip 公司，型号以 11 开始系列。
 - 1-Wire®接口（1线）：由 Dallas / Maxim 公司。
- 并行式(parallel)
 - 型号以28开始系列。

Memory - ROM

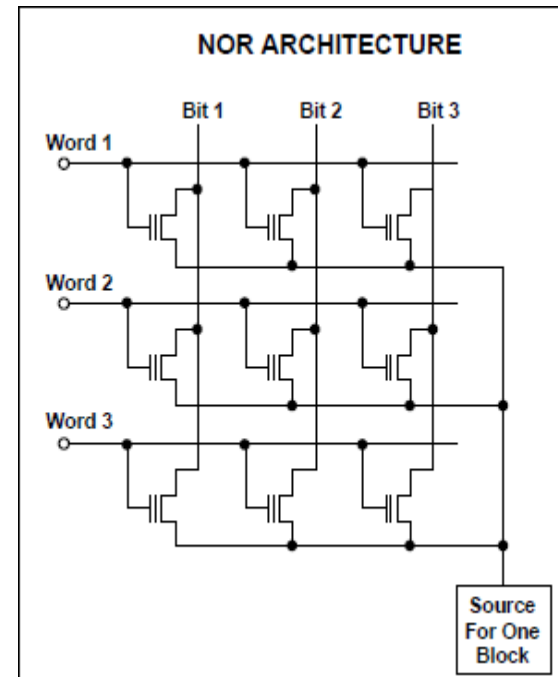
存储元件 – 只读存储器

- Flash Memory
- Flash分
 - NOR Cell
 - NAND Cell
 - DINOR Cell
 - AND Cell
- 它是由Dr. Masuoka在1984年发明。
- 型号以29或49开始系列。

Memory - ROM

存储元件—只读存储器

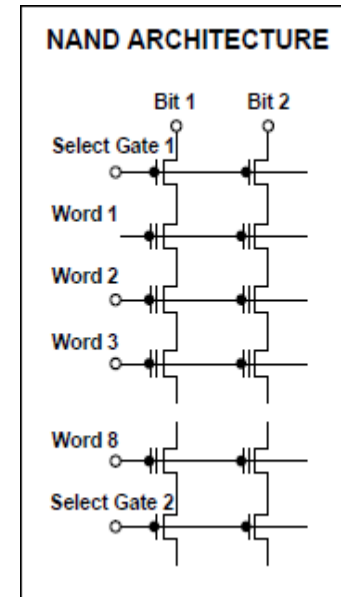
- NOR Flash



Memory - ROM

存储元件—只读存储器

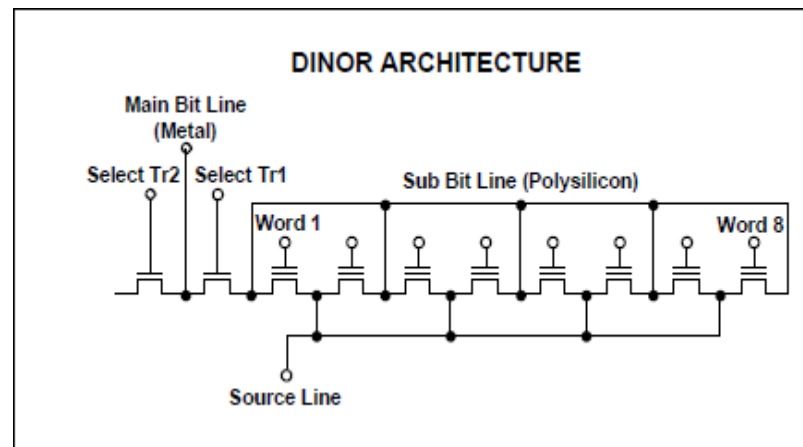
- NAND Flash



Circuit Protection Component

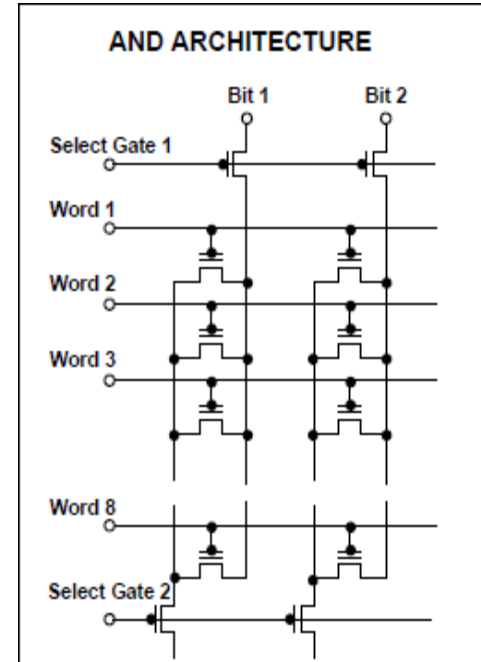
电路保护元件

- DINOR Flash



存贮元件-只读存贮器

- AND Flash



Memory - ROM

存储元件 – 只读存储器

- EPROM, EEPROM, & FLASH的区别
 - EPROM只能一次性写入或用UV擦除重写
 - EEPROM可以反复电擦写，并且通常以较小单位（位元）擦除或写入
 - FLASH也可以反复电擦写，但通常以较大的区块擦除或写入。

Memory 存储元件

- 主要品牌制造商
- EUR/US
 - ATMEL, INFINEON, MICRON, MAXWELL, SST, GSI, SPANSION, MICROCHIP, SANDISK, CYPRESS, EON, ST, NUMONYX, RAMTRON, QIMONDA, EIPIDA, AVED
- APAC
 - SAMSUNG, HYNIX, WINBOND, ESMT, ISSI, GIANTEC, MACRONIX, CHIPLUS, A-LINK, NEXTRON, ICSI, PNY, ACCUTEK

IC group 集成电路分类

Memory 存储器

- Various memory comparison

Type	Volatile?	Writeable?	Erase Size	Max Erase Cycles	Cost (per Byte)	Speed
SRAM	Yes	Yes	Byte	Unlimited	Expensive	Fast
DRAM	Yes	Yes	Byte	Unlimited	Moderate	Moderate
Masked ROM	No	No	n/a	n/a	Inexpensive	Fast
PROM	No	Once, with a device programmer	n/a	n/a	Moderate	Fast
EPROM	No	Yes, with a device programmer	Entire Chip	Limited (consult datasheet)	Moderate	Fast
EEPROM	No	Yes	Byte	Limited (consult datasheet)	Expensive	Fast to read, slow to erase/write
Flash	No	Yes	Sector	Limited (consult datasheet)	Moderate	Fast to read, slow to erase/write
NVRAM	No	Yes	Byte	Unlimited	Expensive (SRAM + battery)	Fast

IC group 集成电路分类

Process 处理器

- Process 处理器
 - MCU 单片机
 - OTP
 - MASK
 - MTP
 - CPU
 - DSP

IC group 集成电路分类

Optoelectronics 光电IC

- Optoelectronics 光电IC
 - Optocoupler 光耦IC

IC group 集成电路分类

RF 射频IC

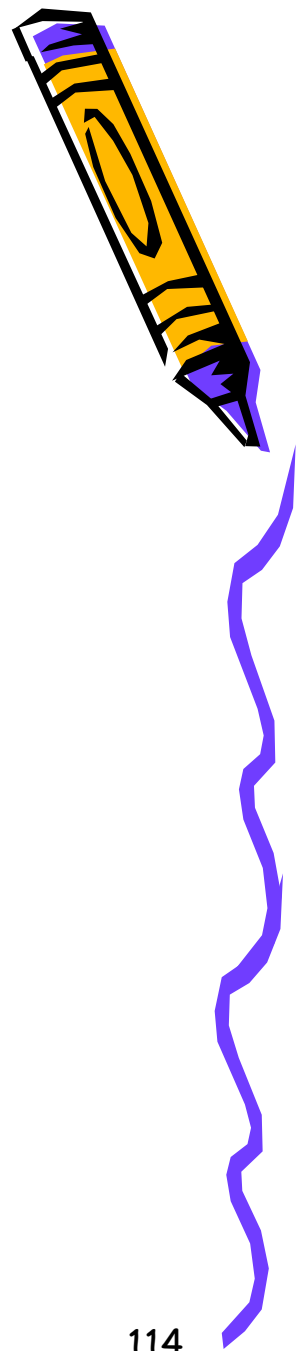
- RF 射频IC

IC group 集成电路分类

- Hybrid IC 混合集成电路

Active oscillator group 有源振荡器分类

- Active oscillator 有源振荡器
 - XO
 - VCXO
 - TCXO



Questions & Answer?

Any question is welcome!

