# Electronic component
# 电子元器件

Valley Tang

# Component Family
# 元器件族系

- Electronic component电子元件
  - Passive component被动元件
  - Active component主动元件
  - Electromagnetic component电磁元件
  - Electromechanical component机电元件
  - Electro-optic component光电元件
  - Printed 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

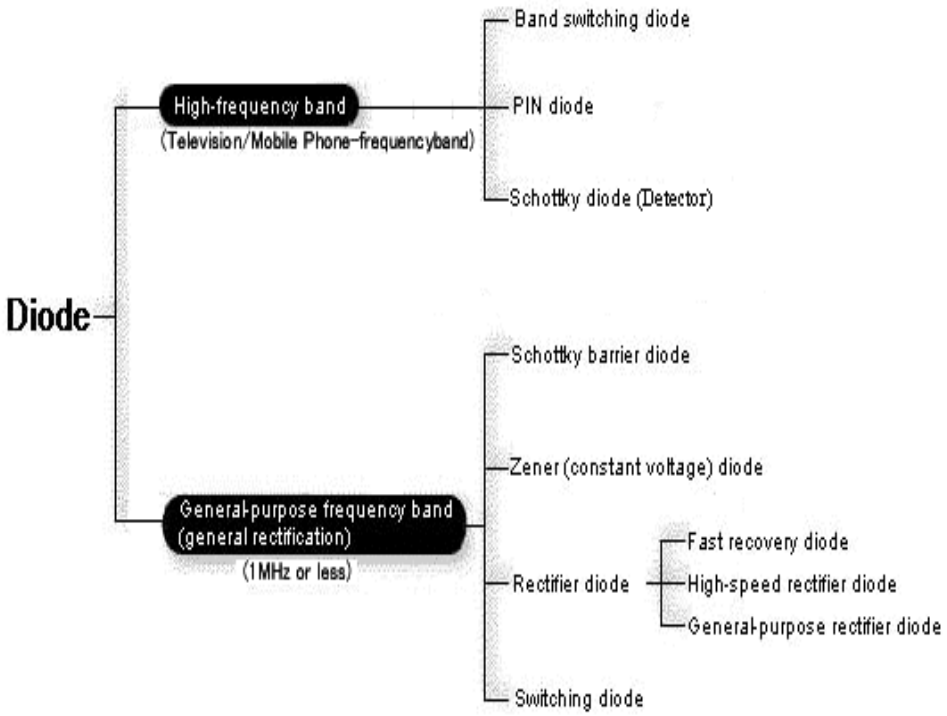
- Discrete semiconductor分立半导体
  - Diode二极管
  - Transistor晶体管
  - Thyristor晶闸管

# 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=<1MHz)



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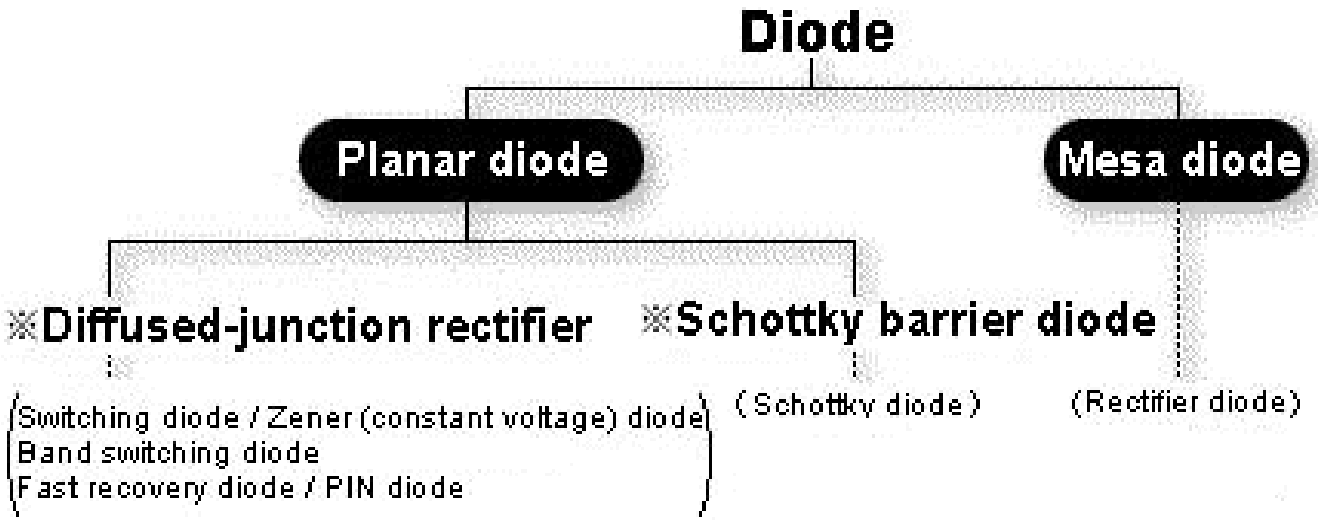
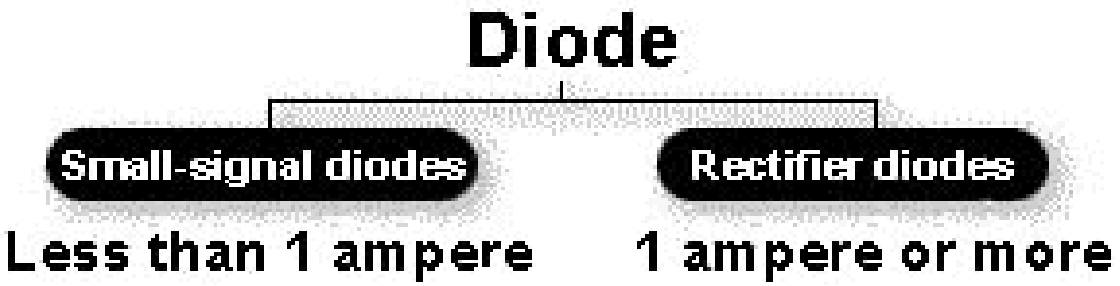
# Discrete semiconductor group分立半导体分类
# Diode二极管

- 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（=<1A）
  - Rectifier diode整流二极管（>1A）



# Discrete semiconductor group分立半导体分类
# Diode二极管

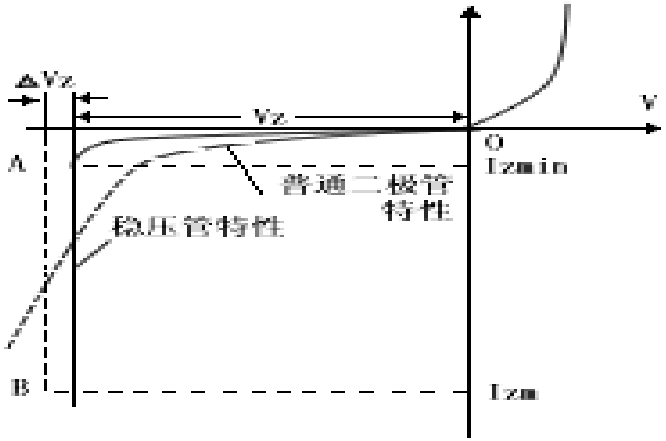
- Classification by integratability根据集成度可分为
  - Discrete type diode分立二极管
  - Diode arrays二极管阵列

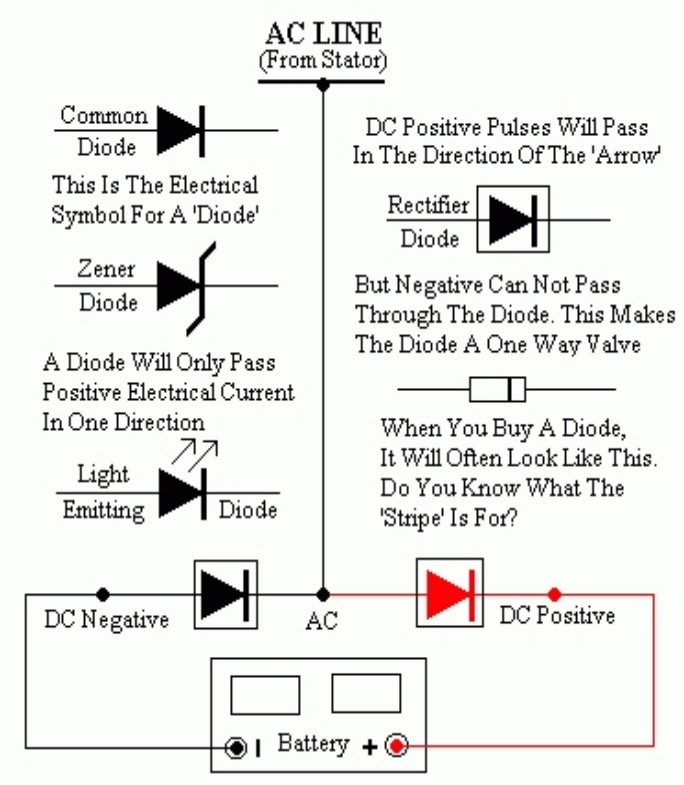
# Discrete semiconductor group分立半导体分类
# Diode二极管

- 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



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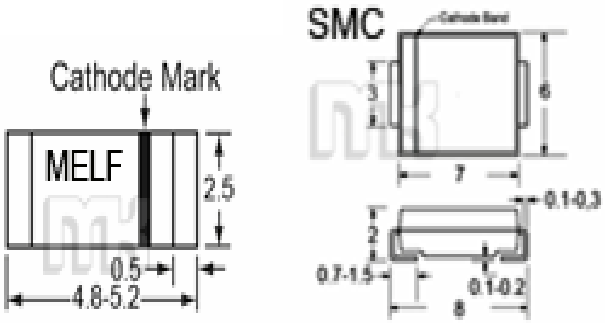
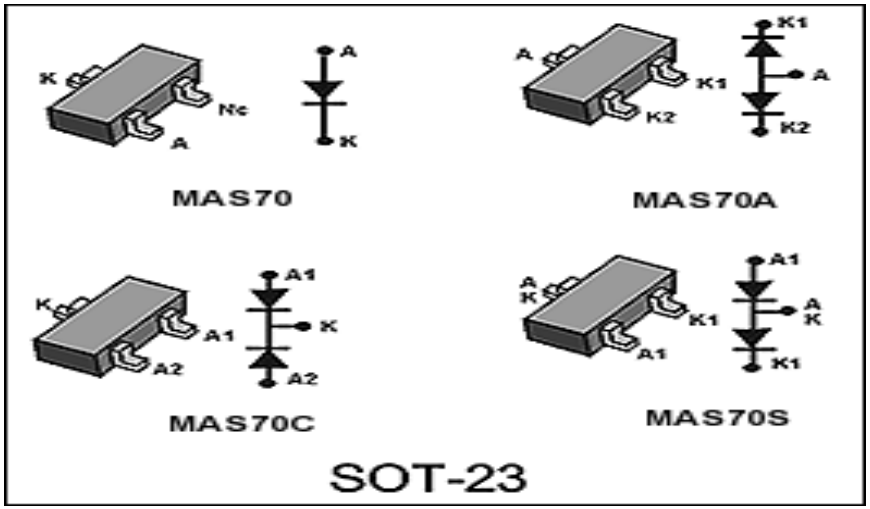
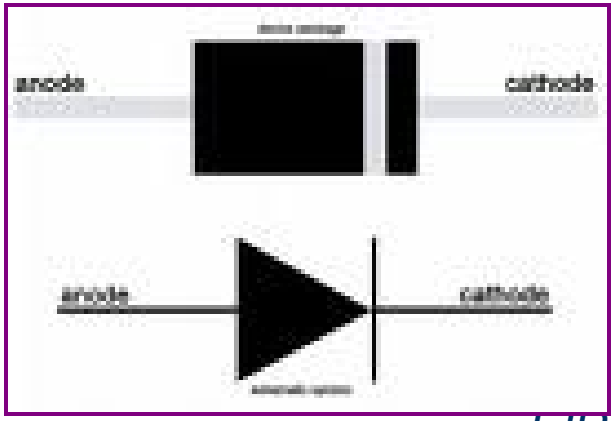
# Discrete semiconductor group分立半导体分类
# Diode二极管

- 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

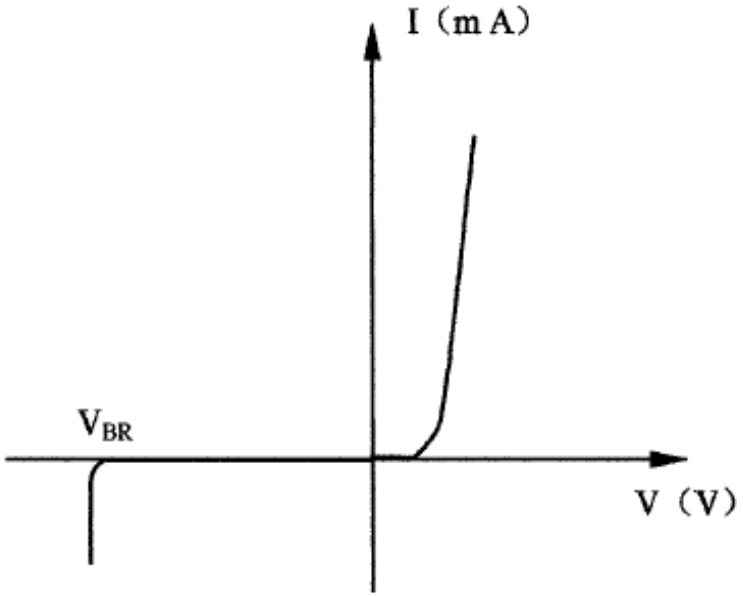


# Discrete semiconductor group分立半导体分类
# Diode二极管

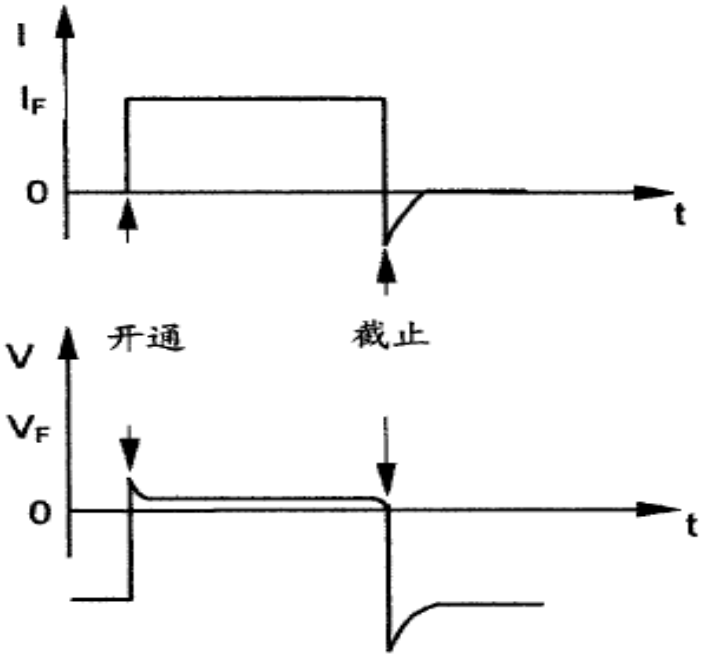
- Rectify diode整流二极管
  - Unilateral conductivity二极管的单向导电性




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

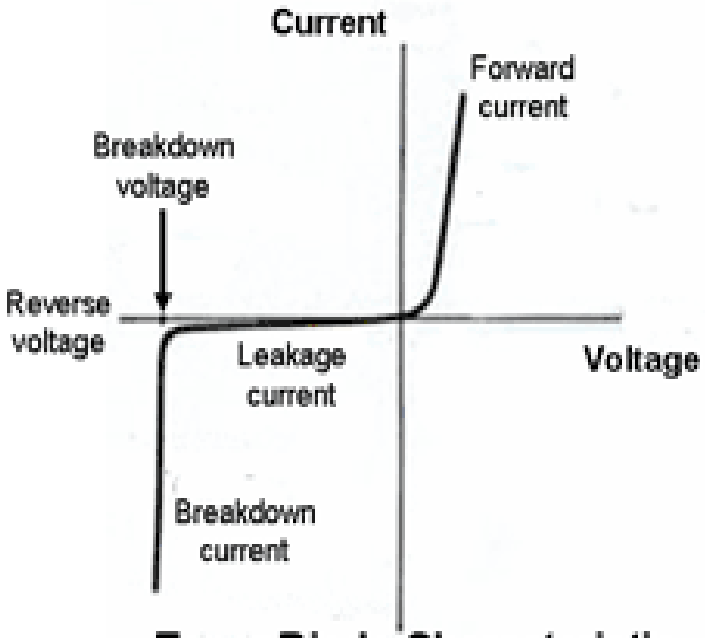
- Switch diode开关二极管
  - Switch characteristics二极管的开关特性




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



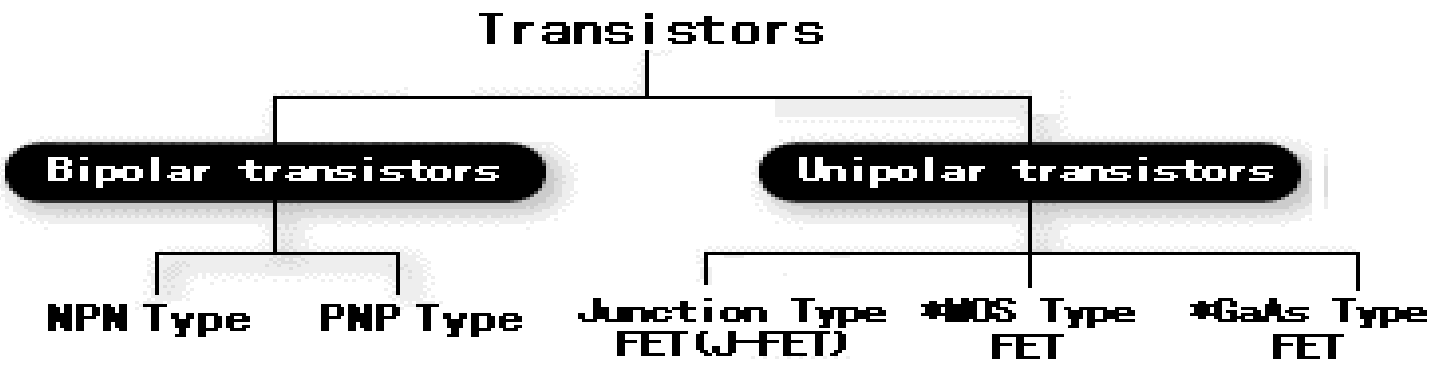
Zener Diode Characteristic

# 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

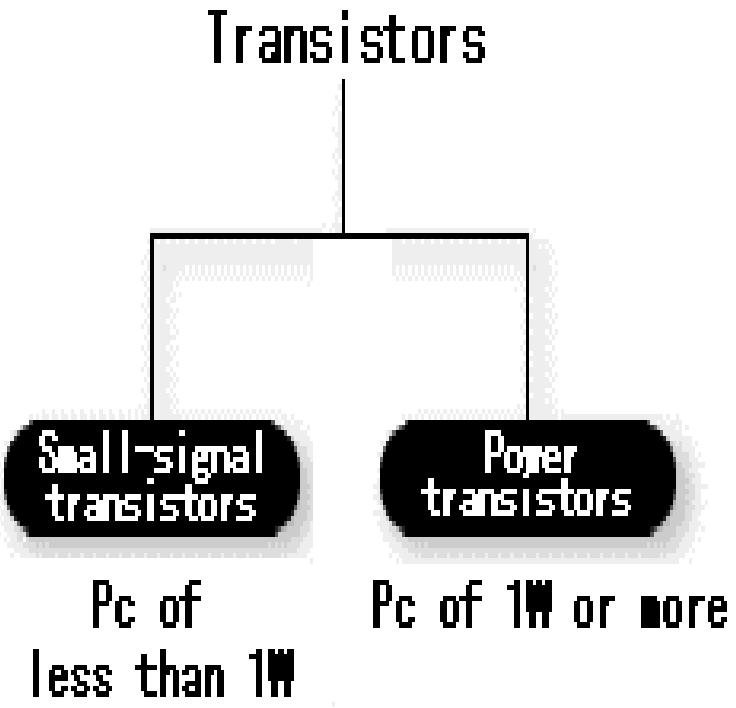
# Discrete semiconductor group分立半导体分类
# Transistor晶体管

- Classification by construction根椐构造可分为
  - 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）



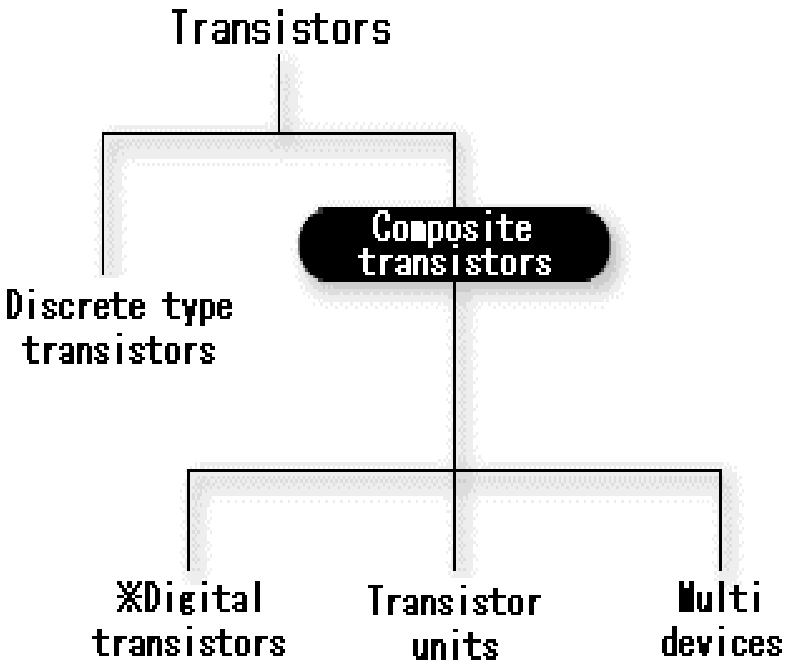
# Discrete semiconductor group分立半导体分类
# Transistor晶体管

- 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（>=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

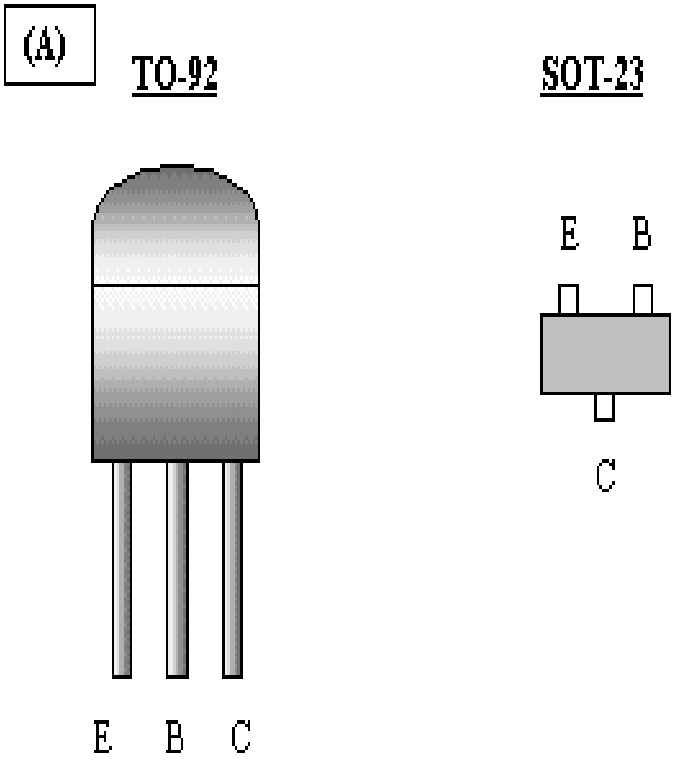
- Classification by shape根据组装工艺可分为
  - THT transistor通孔型晶体管
  - SMT transistor贴片型晶体管

# 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

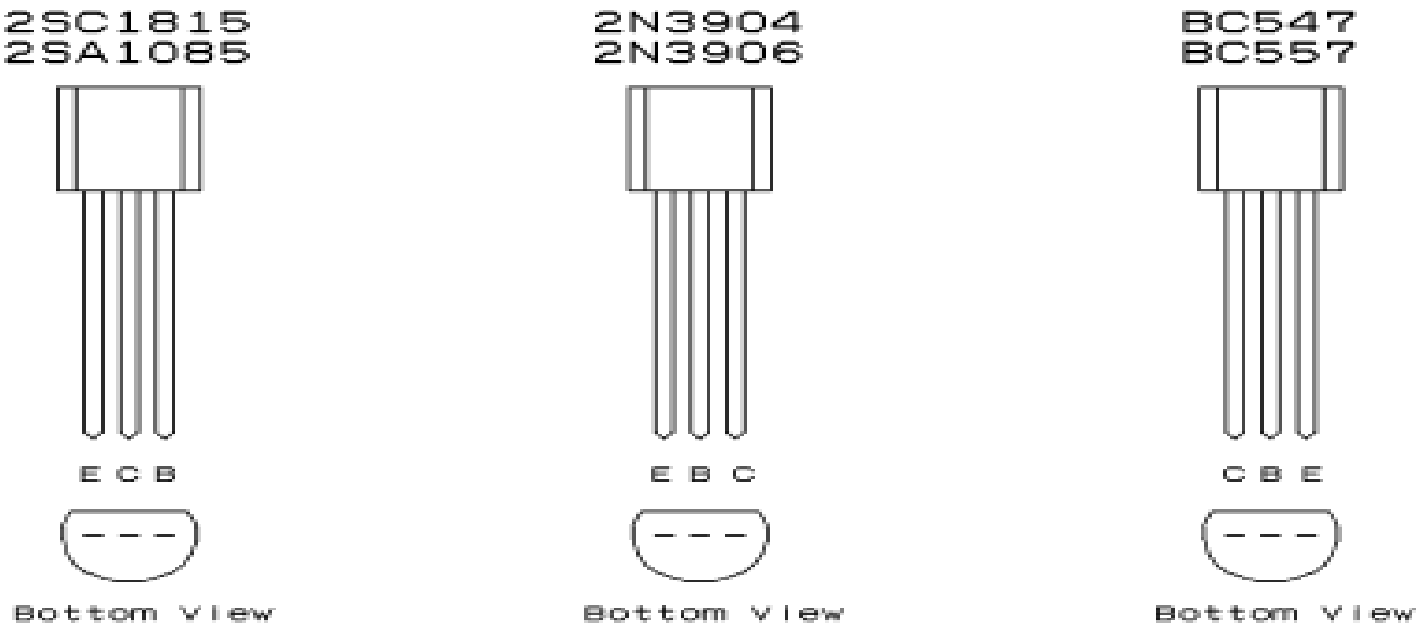
# Discrete semiconductor group分立半导体分类
# Transistor晶体管

- 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



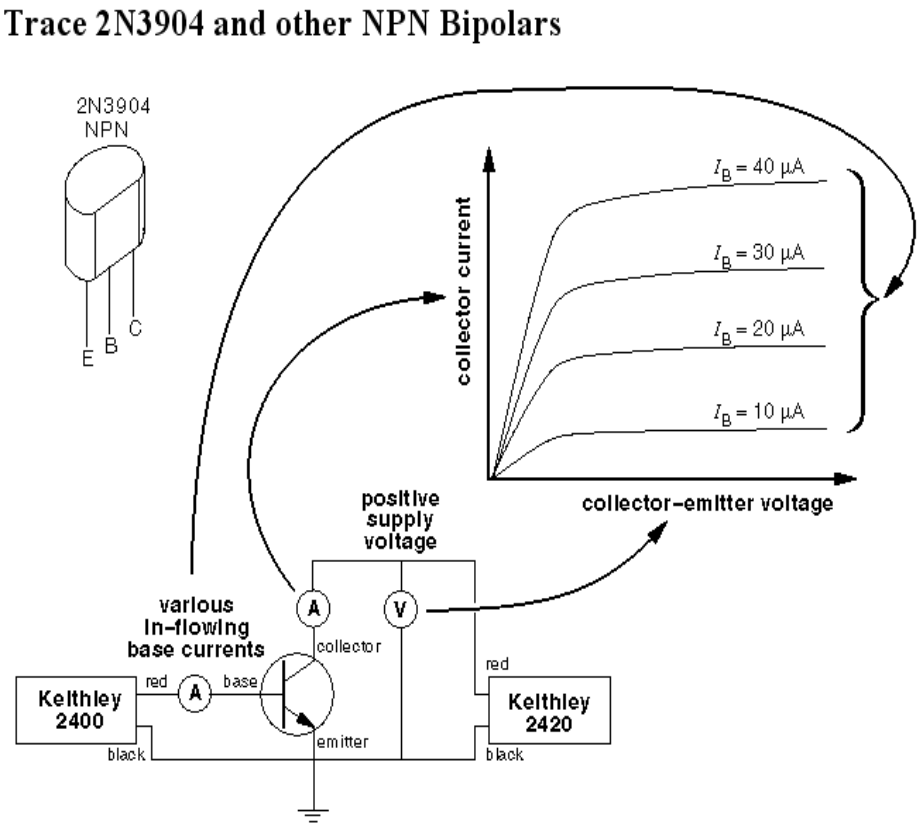
# Discrete semiconductor group分立半导体分类
# Transistor晶体管

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



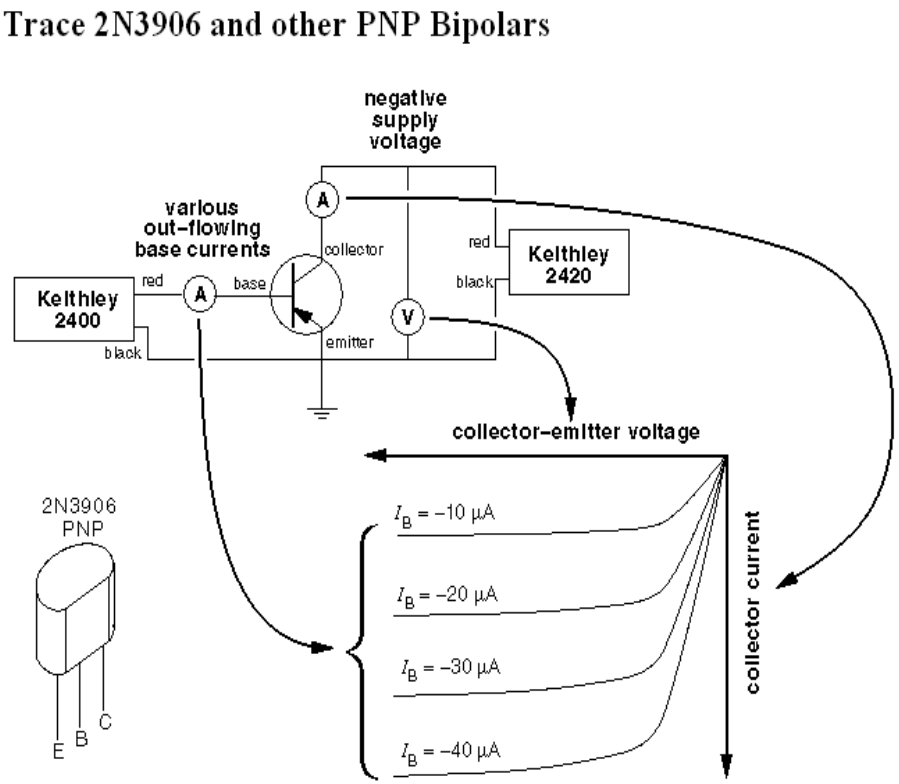
# Discrete semiconductor group分立半导体分类
# Transistor晶体管

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



# 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

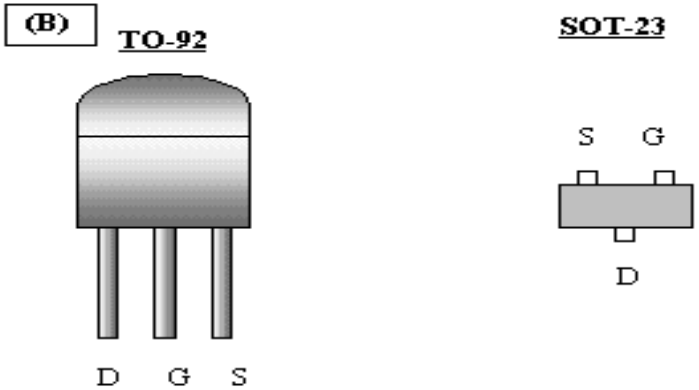


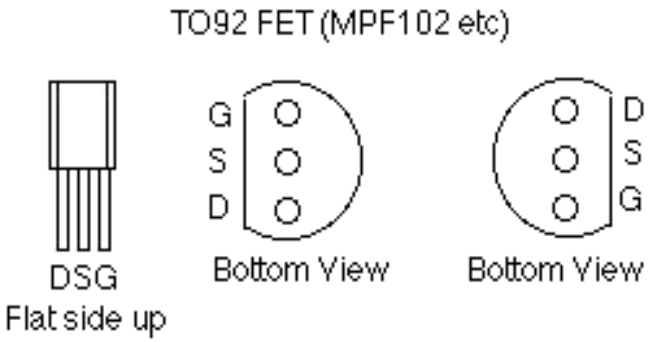
# Discrete semiconductor group分立半导体分类
# Transistor晶体管

- 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

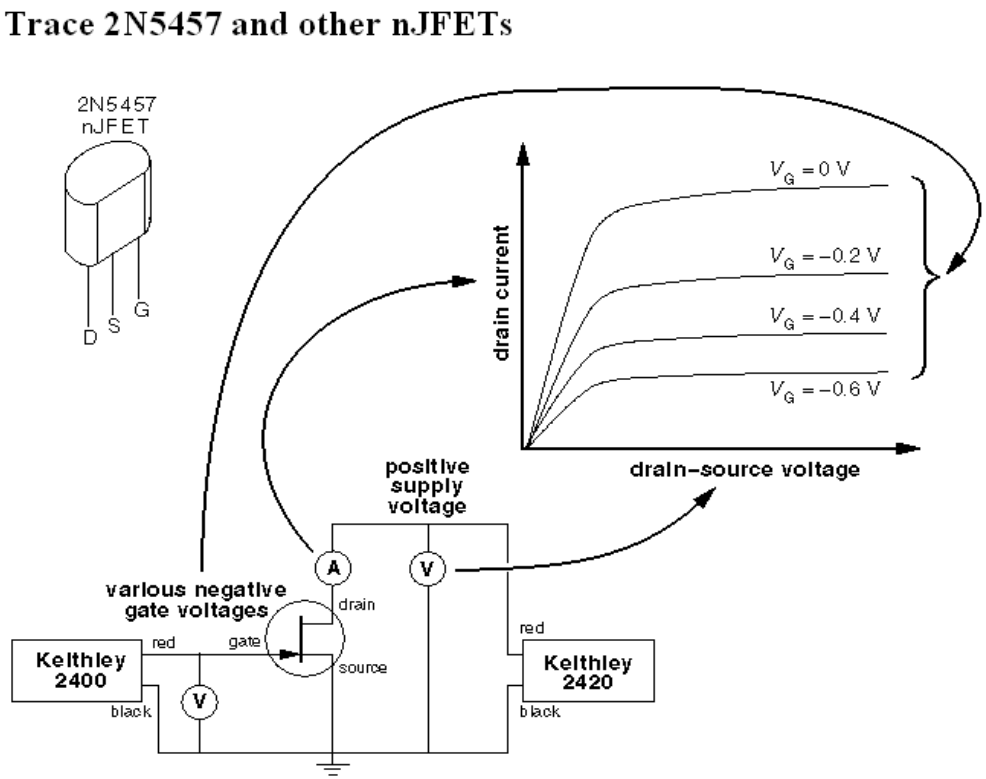
- FET pin-out场效应管的脚位
  - Various pin-out for various items不同的型号有不同的脚位



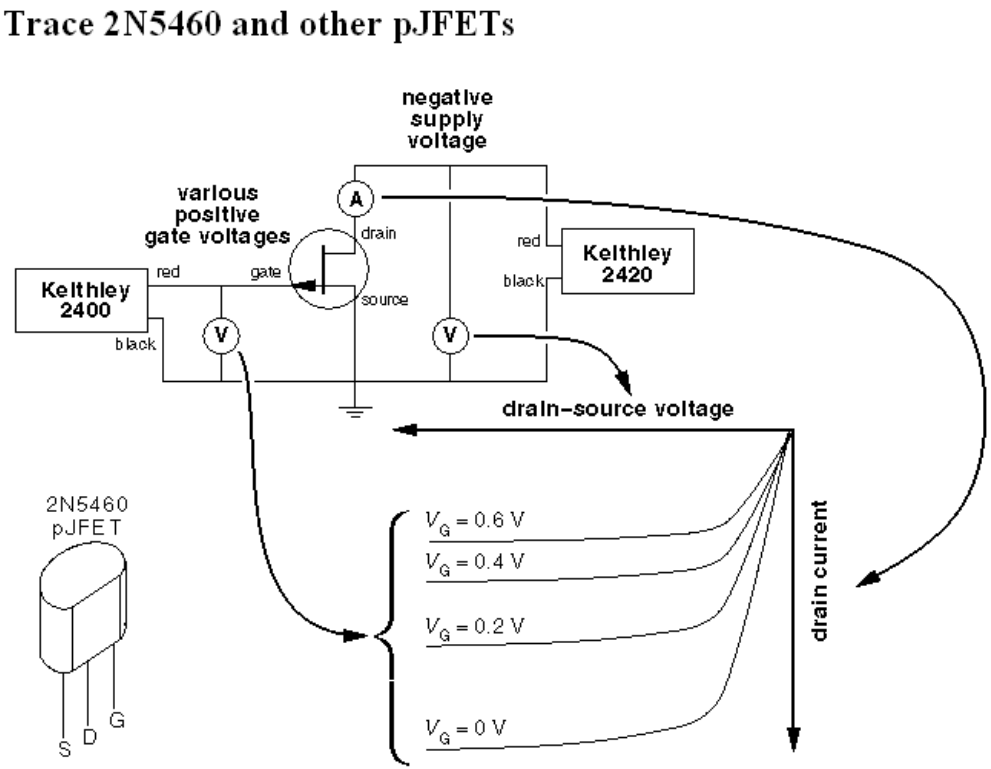
# Discrete semiconductor group分立半导体分类
# Transistor晶体管

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



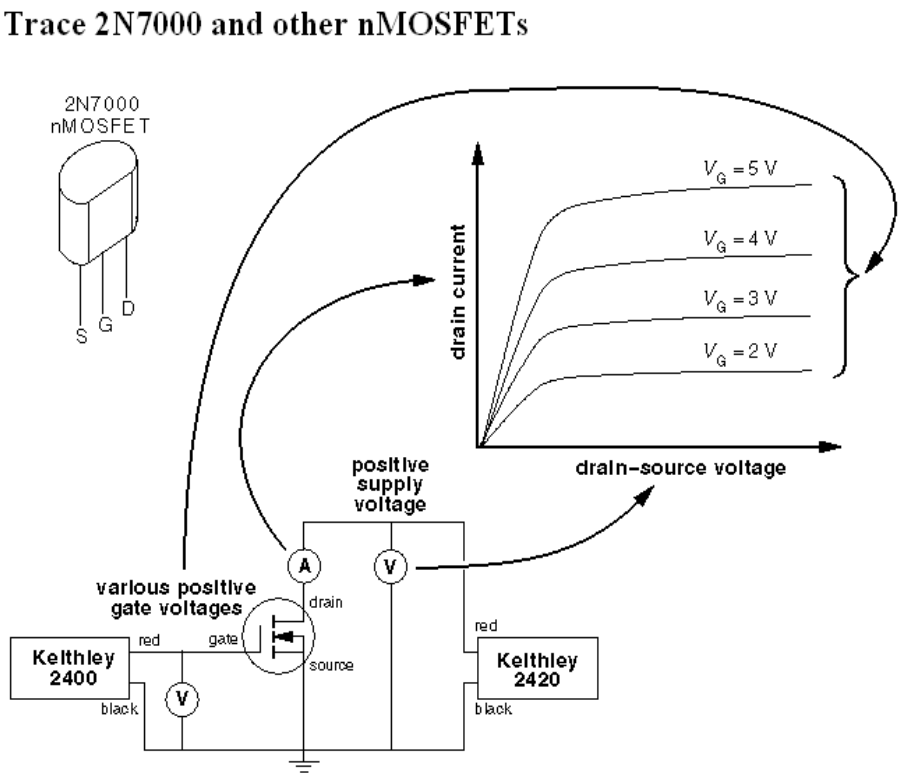
# Discrete semiconductor group分立半导体分类
# Transistor晶体管

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



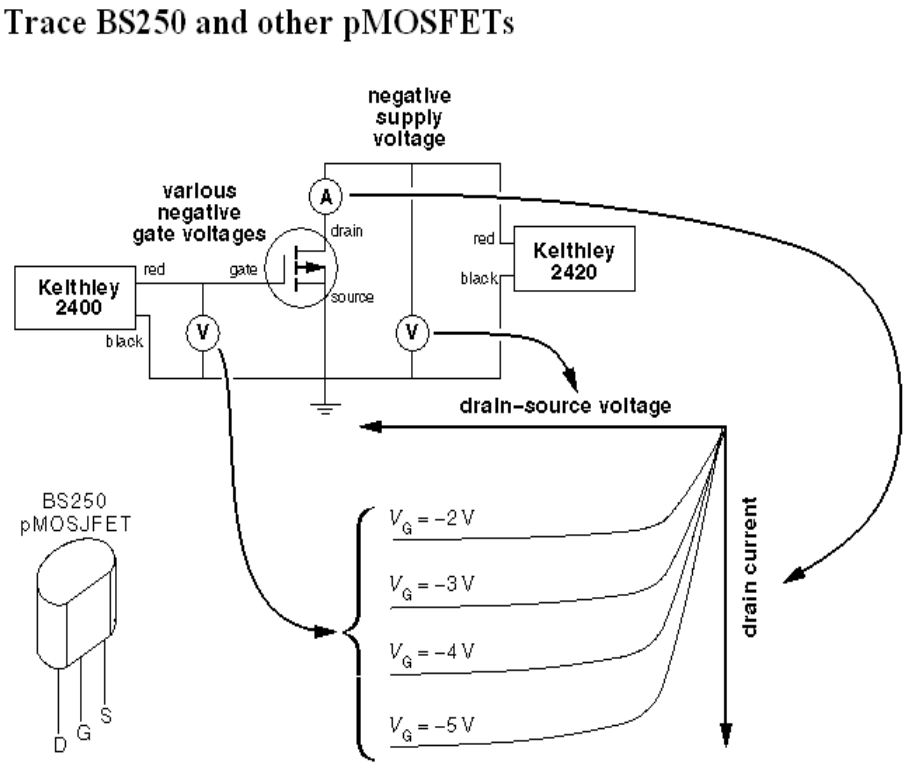
# Discrete semiconductor group分立半导体分类
# Transistor晶体管

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



# 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

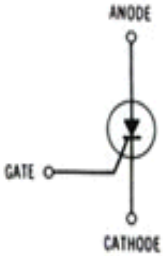


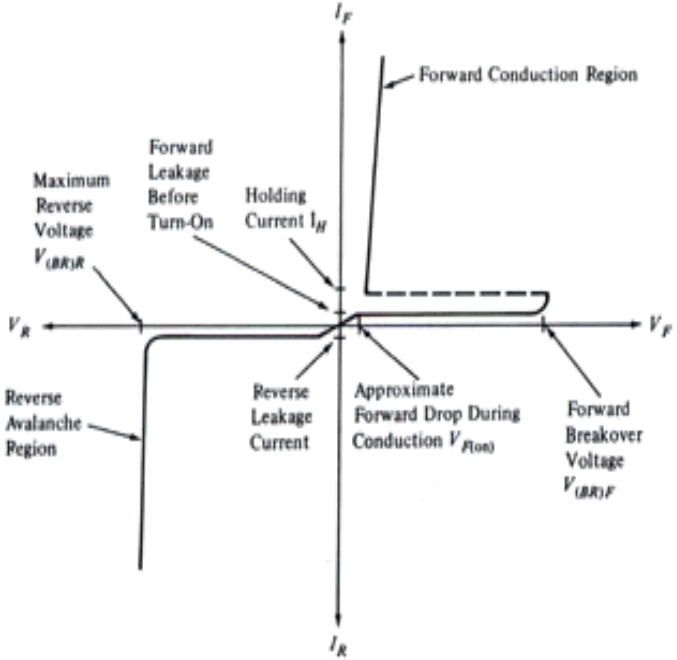
# Discrete semiconductor group分立半导体分类
# Thyritor晶闸管

- 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
# Thyritor晶闸管

- SCR单向可控硅

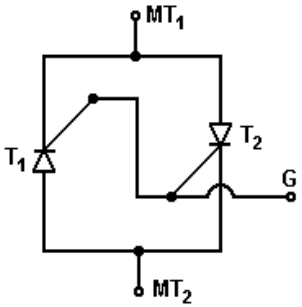


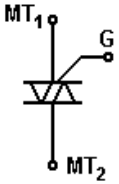

V–I characteristics of the SCR with gate open.

# Discrete semiconductor group分立半导体分类
# Thyritor晶闸管

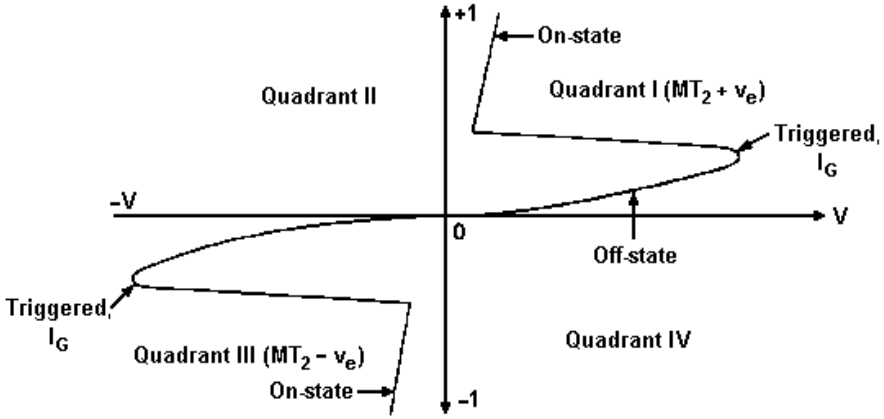
- BCR双向可控硅



(a) Equivalent of TRIAC



(b) TRIAC symbol



(c) v-i characteristics



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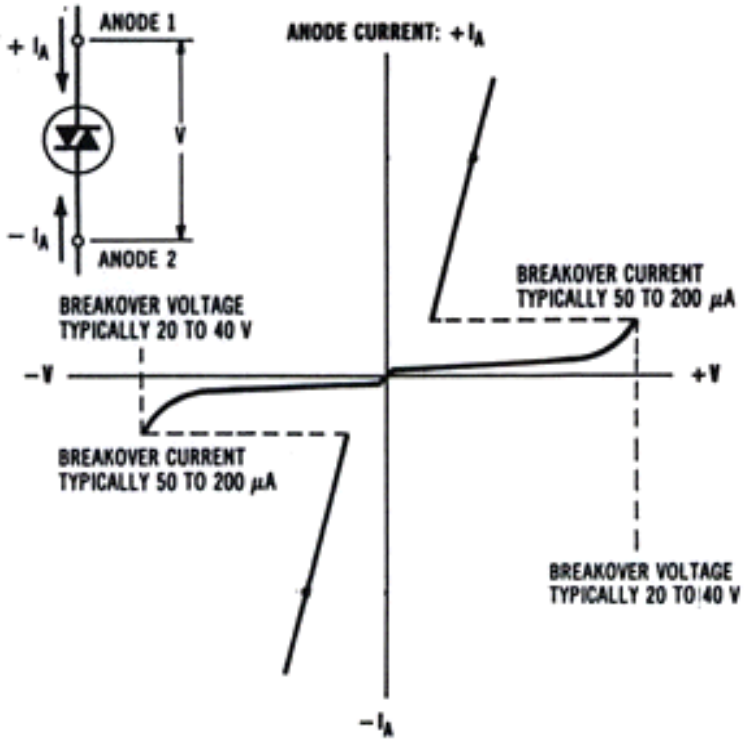
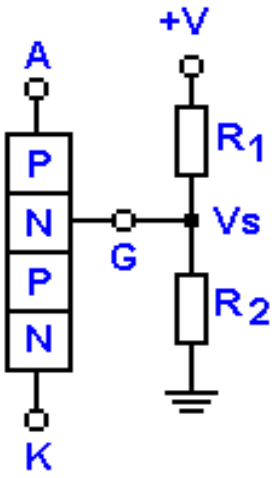
# Discrete semiconductor group分立半导体分类
# Thyritor晶闸管

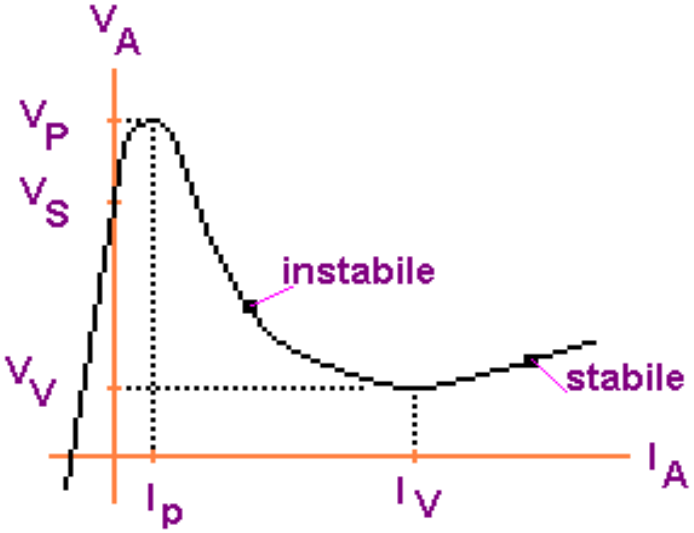
- DIAC双向触发二极管

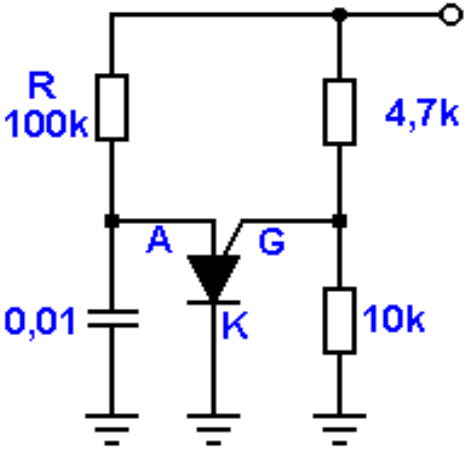


# Discrete semiconductor group分立半导体分类
# Thyritor晶闸管

- 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存贮器
  - 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/存贮器
  - 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

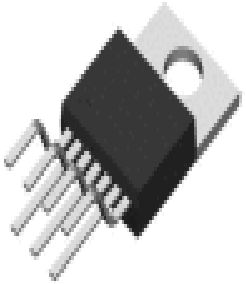
JESD30D

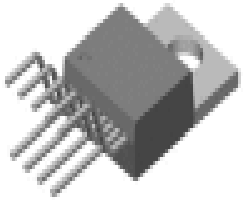
# IC group集成电路分类
# Single package单列封装

- 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

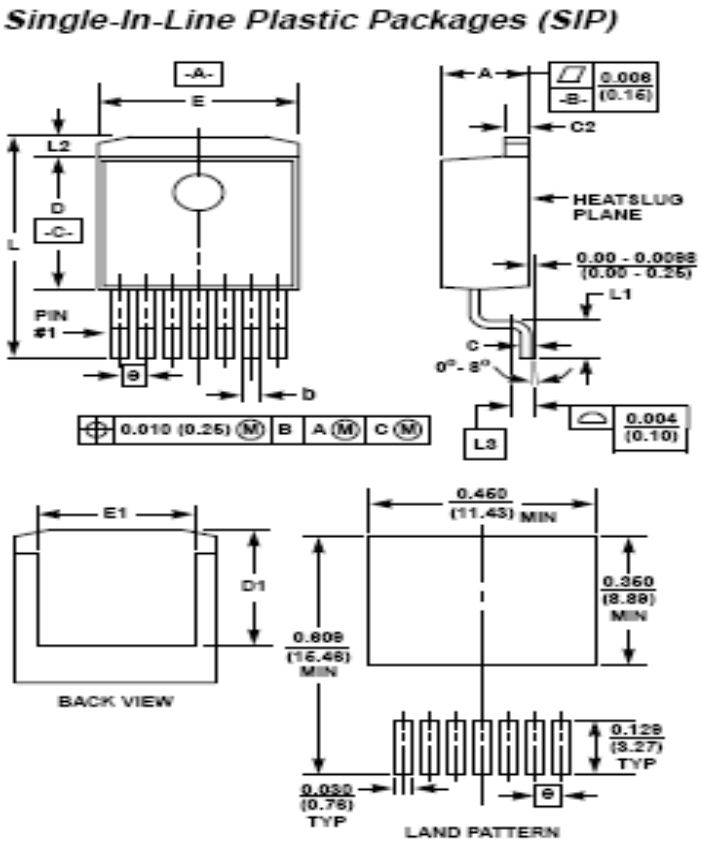



TO series

# IC group集成电路分类
# Single package单列封装

- SIP-SMT单列贴片封装




SIP



JR

# 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

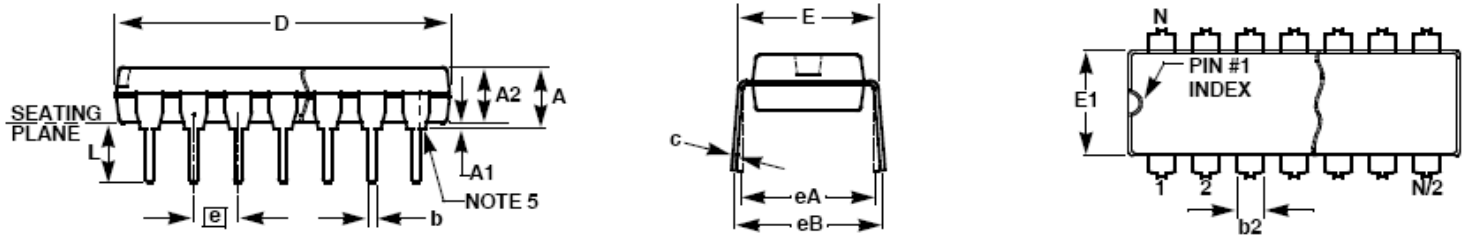
- Material封装材料
  - Plastic DIP/nonhermetic package PDIP非密封型
  - Ceramic DIP/hermetic package CDIP密封型
- Size & Pin#1 index尺寸和第一脚位标识
  - Popular body width is 300mils and 600mils通常的宽度是300毫英寸和600毫英寸

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

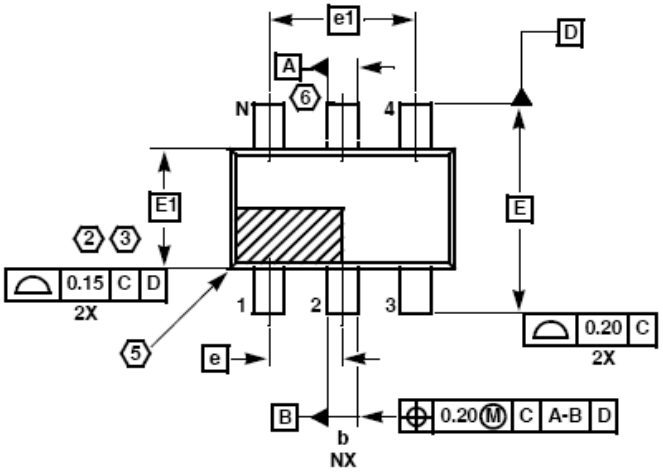
| Lead Count | Width | Length | Thickness | Pitch | Max. Height |
|---|---|---|---|---|---|
| 8 | 6.52 mm | 9.53 mm | 3.24 mm | 2.54 mm | 4.19 mm |
| 10 | 6.61 mm | 22.86 mm | 3.94 mm | 2.54 mm | 4.95 mm |
| 12/16 | 6.61 mm | 29.91 mm | 3.94 mm | 2.54 mm | 5.33 mm |
| 22 | 13.53 mm | 37.4 mm | 7.75 mm | 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



TJR

# IC group集成电路分类
# SOT-23/SC-70封装

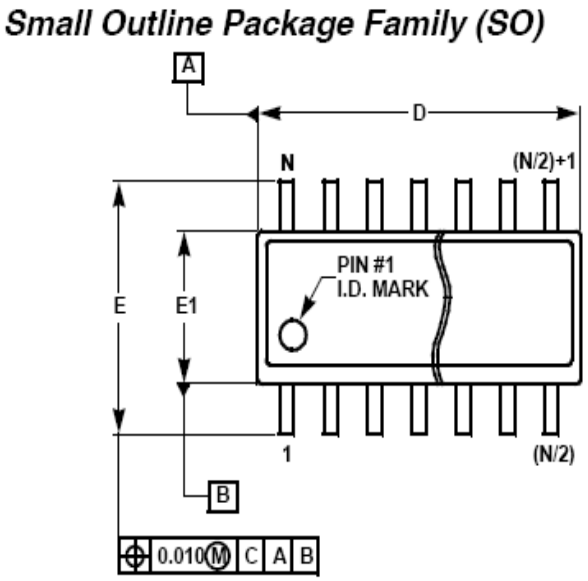
- Properties of some SOT-23 / SC-70 Package部分SOT-23/SC-70封装的属性

| 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




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

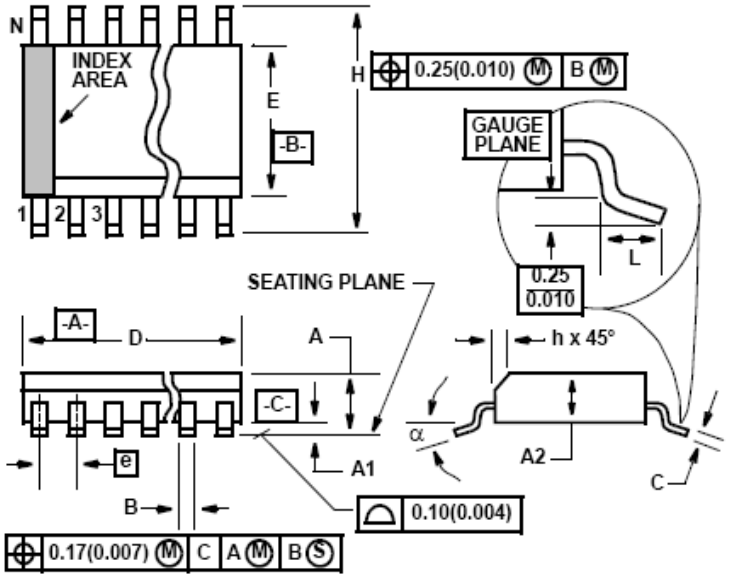
| Part Number | Number of Pins | Lead Style | Body Width | Qty Per Tube | Tape Width | Tape Pitch | Qty 13" Reel |
|---|---|---|---|---|---|---|---|
| SO20/26J | 20/26 | J-Lead | 7.6mm | 25 | 24mm | 12mm | 1,000 |
| SO28J | 28 | J-Lead | 7.6mm | 27 | 24mm | 12mm | 1,000 |
| SO32J | 32 | J-Lead | 7.6mm | 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

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




SSOP

SSOP_SIZE



TJR

# IC group集成电路分类
# SSOP封装

- Properties of some SSOP部分SSOP封装的属性

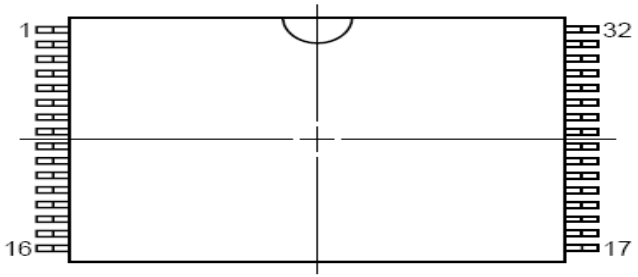
| Part Number | No. of Pins | Body Width | Pitch | Qty Per Tube | Tape Width | Tape Pitch | Qty 13" Reel |
|---|---|---|---|---|---|---|---|
| SSOP8 | 8 | 5.3mm | 0.65mm | 156 | 12mm | 8mm | 2,500 |
| SSOP14/16 | 14/16 | 5.3mm | 0.65mm | 100/80 | 16mm | 12mm | 1,000 |
| SSOP20/24 | 20/24 | 5.3mm | 0.65mm | 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

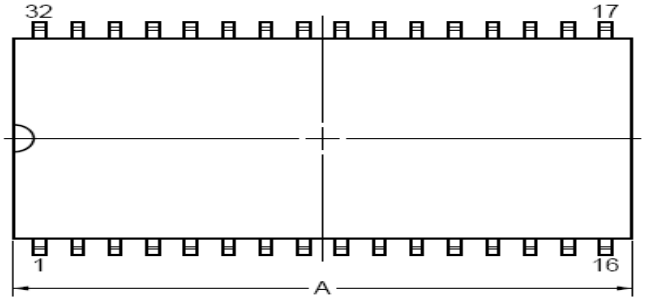
- TSOP
  - Nonhermetic package非密封型
  - 1.0mm thickness1.0毫米厚
  - Two types
    - TSOP I (leads from shorter edges)
    - TSOP II (leads from longer edges)

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

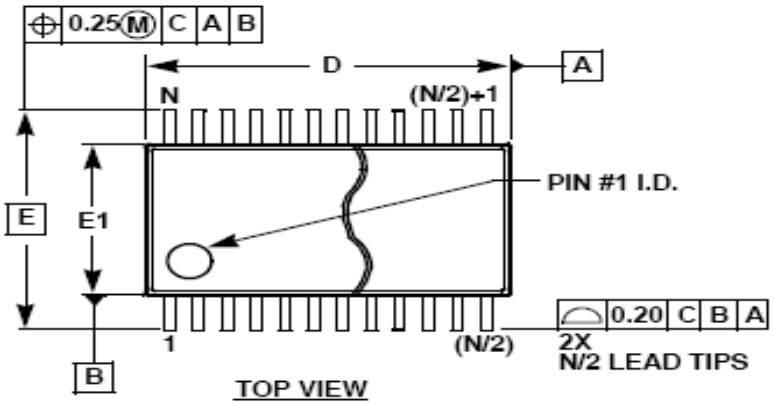
| Part Number | No. of Pins | Body Size | Lead Pitch | Qty Per Tray | Tape Width | Tape Pitch | Qty 13" Reel |
|---|---|---|---|---|---|---|---|
| TSOP20/24/26 | 20/24/26 | 7.6 x 17.14mm | 1.27mm | 176 | 24mm | 12mm | 1,000 |
| TSOP24/28 | 24/28 | 10.16 x 18.41mm | 1.27mm | 100 | 32mm | 16mm | 1,000 |
| 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



TJR

# 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 |

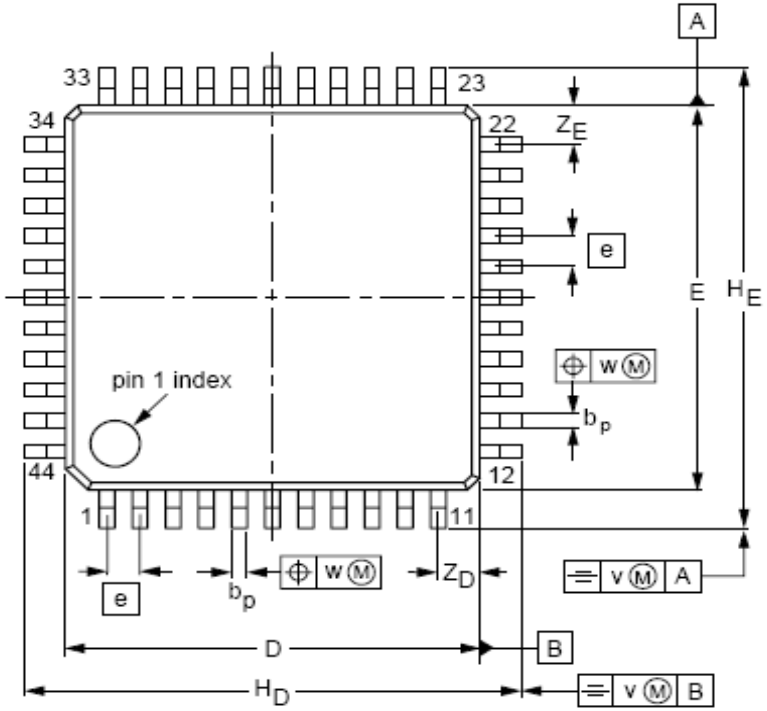
# IC group集成电路分类
# Quad package四列扁平封装

- 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




LQFP_SIZE

LQFP

# 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

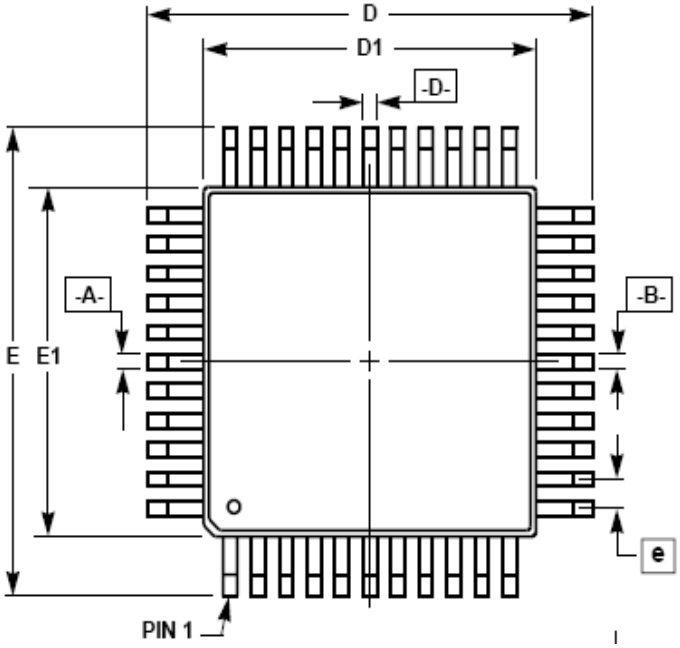
TQFP

- 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

TQFP_SIZE

TQFP

*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)

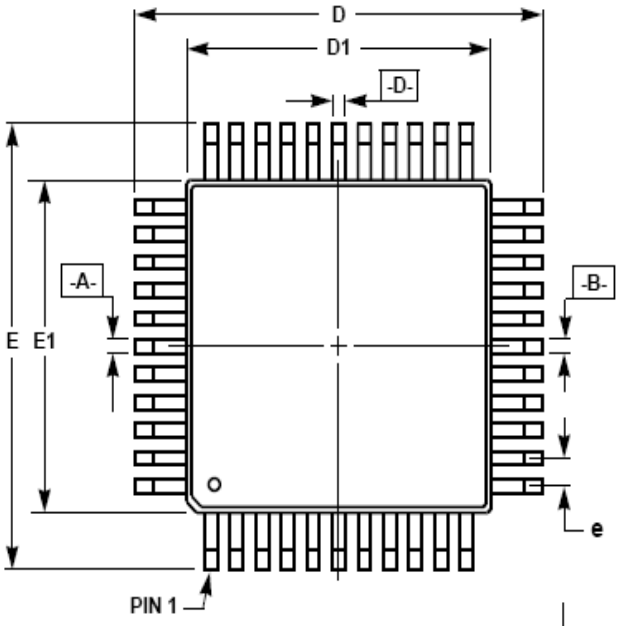
| Body Size | Body Tkns | Lead Form | Standoff | Foot Length | Tip To Tip | Lead Count | JEDEC | Tray Matrix | Units Per Tray |
|---|---|---|---|---|---|---|---|---|---|
| 5 x 5 | 1.00 | 1.00 | 0.10 | 0.60 | 7.0 | 32/40 | MS-026 | 12 x 30 | 360 |
| 7 x 7 | 1.00 | 1.00 | 0.10 | 0.60 | 9.0 | 32/48 | MS-026 | 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



TJR

# IC group集成电路分类
# MQFP封装

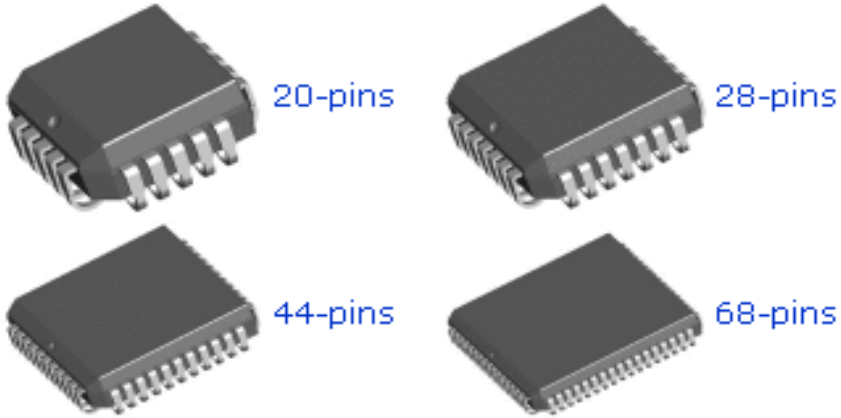
- Properties of some MQFP部分MQFP封装的属性

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

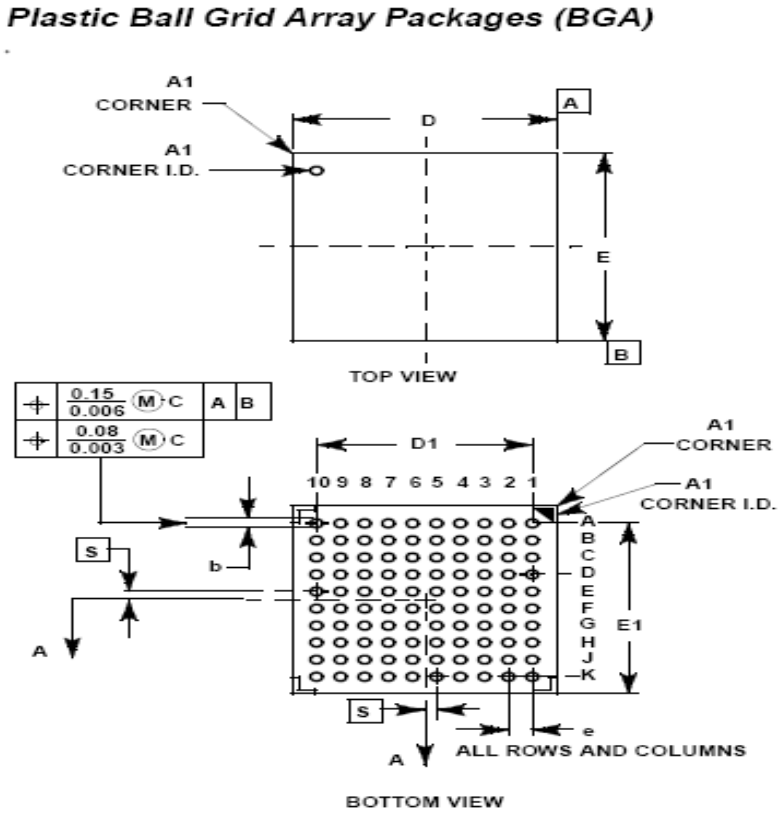
- PLCC
  - Nonhermetic package非密封型




PLCC

# IC group集成电路分类
# BGA封装

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



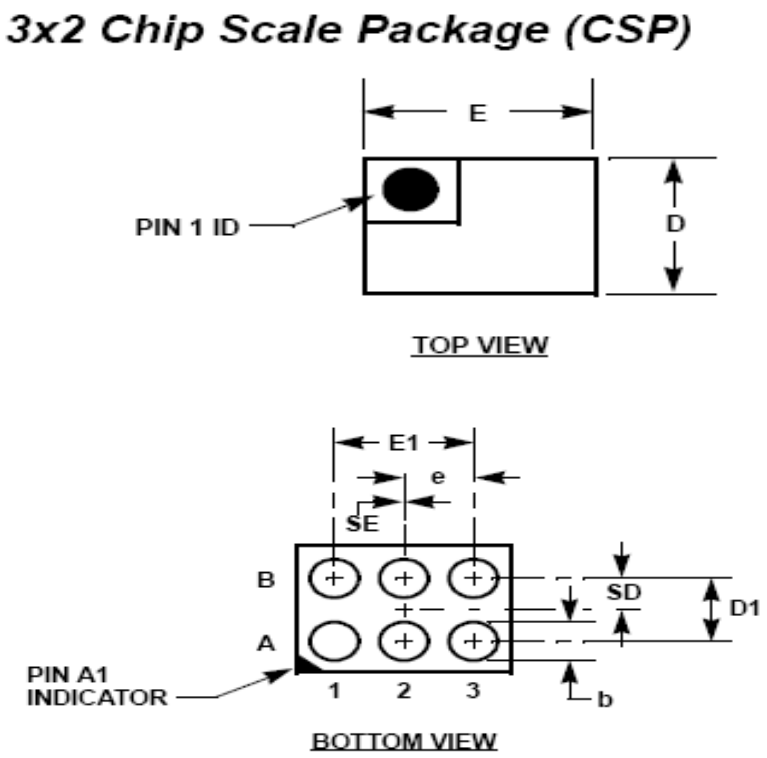

PBGA



TJR

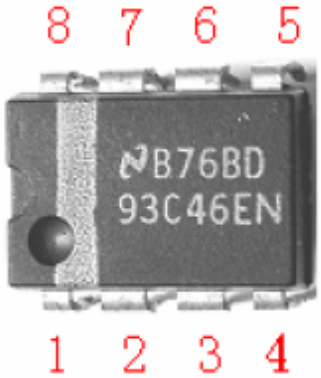
# IC group集成电路分类
# CSP封装

- 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



# 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

JEP130

# 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

- 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/存贮器
  - 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 series74/54系列IC
  - 4000 series4000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存贮器

- Memory存贮器
  - EPROM
  - EEPROM
  - FLASH
  - DRAM
  - SRAM

# IC group集成电路分类
# Memory存贮器

- 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频射IC

- RF频射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!