# AN9D, AN9E, AN9F Series

## Analog master slice IC series

### ■ Overview

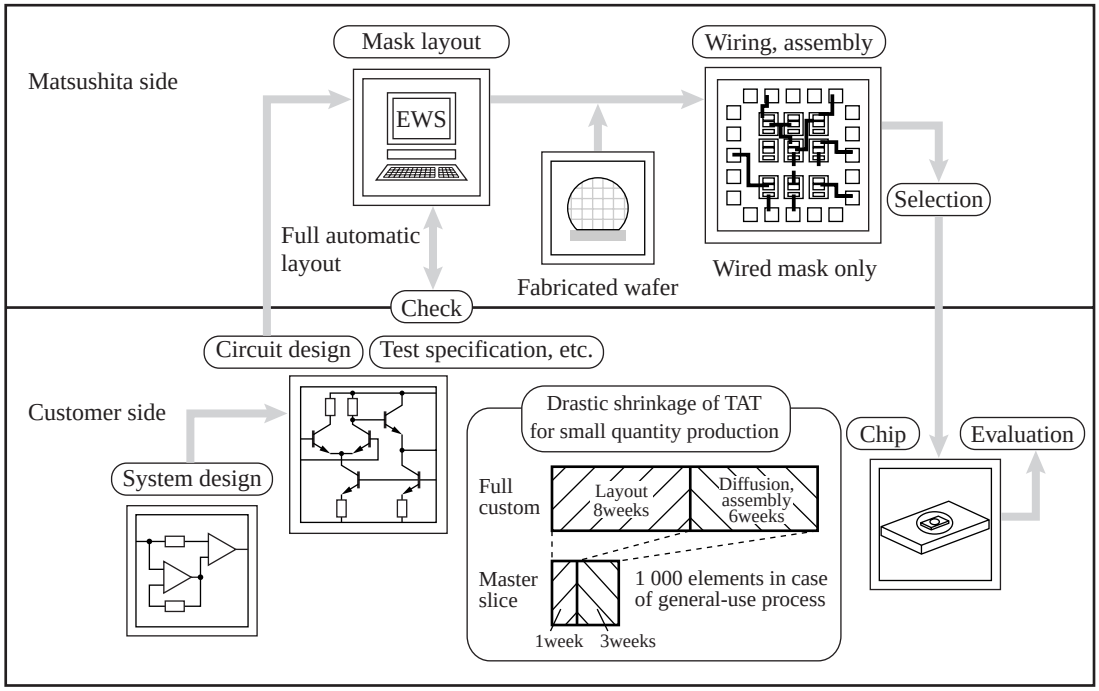
The AN9D, AN9E and AN9F series are master slice ICs of bipolar process, which enables you to integrate an analog circuit easily onto a single chip. A custom IC can be made by placing a wired pattern designed in line with the customer's analog circuit onto a master slice.

Starting from a wafer on which a most part of IC diffusion processes are already finished, you can shorten an IC pilot fabrication considerably. Further, placement of elements and inter-element wiring are done automatically by a computer, which results in short period of pattern designing and thereby developing a custom IC in a short period.

### ■ Features

- High design flexibility
  - Easy circuit constant design because of setting resistance or capacitance to an arbitrary value.
  - Free setting of contacts between a substrate and GND wiring prevents from operation error to be caused by floating of substrate potential.
  - Usable for multi power source because a resistor island potential can be set for each unit.
  - Builds in a lateral type PNP transistor of high reverse breakdown voltage between base and emitter, or a collector wall type NPN transistor of excellent saturation characteristics. (AN9DA00, AN9DB00, AN9DF00)
- Short development period
  - Due to a full automatic layout design, a sample is available in one month from a completion of a circuit diagram.
- Applicable to a small quantity production item
  - Possible to develop a custom IC for small quantity production due to a low development cost.

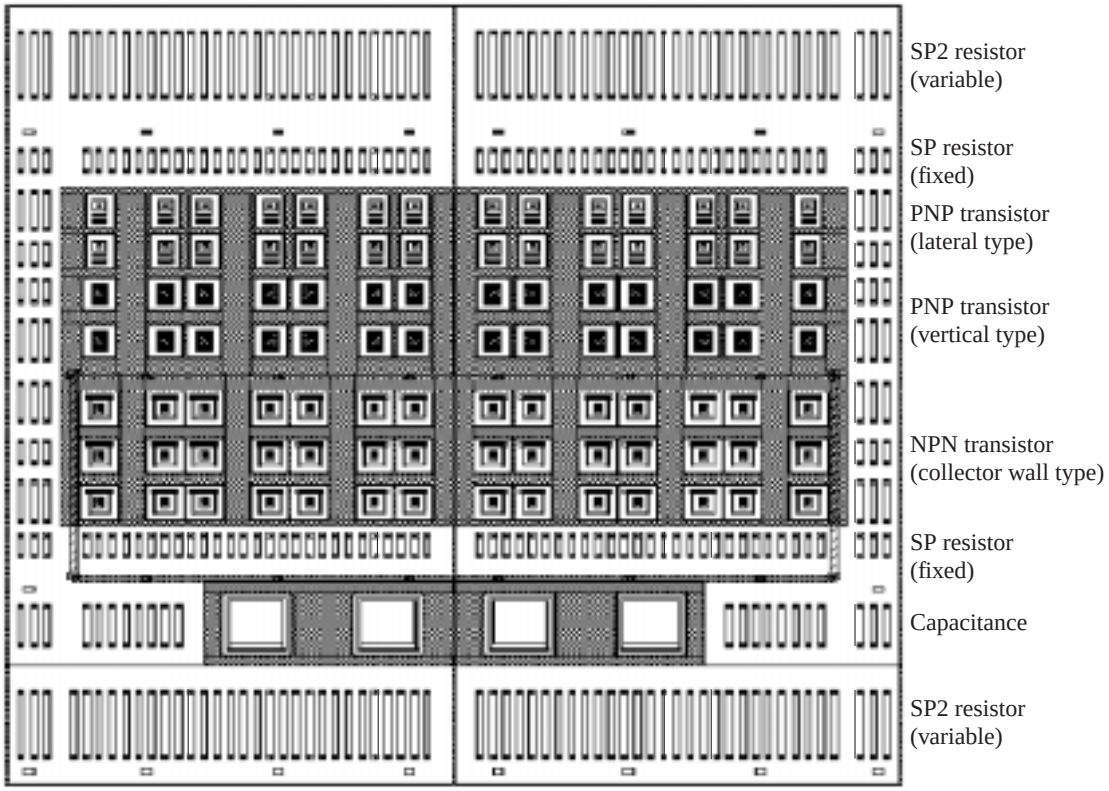
### ■ Development Flow



■ Product Mix

| Series name | Supply voltage | Element characteristics | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | NPN transistor | | | PNP transistor | | | |
| | | $f_{T(max)}$ | $BV_{CEO}$ | $h_{FE}$ | $f_{T(max)}$ | $BV_{CEO}$ | $h_{FE}$ | |
| AN9D series | to 12 V | 2.6 GHz | 14.4 V | 100 to 250 | 1.0 GHz | 14.4 V | 66 to 200 | For low power dissipation/ high speed operation IC |
| AN9E series | to 12 V | 3.5 GHz | 14.4 V | 80 to 250 | 1.5 GHz | 14.4 V | 50 to 130 | For Bi-CMOS IC |
| AN9F series | to 30 V | 300 MHz | 30 V | 80 to 250 | 9 MHz | 30 V | 80 to 350 | For high breakdown voltage IC |

■ Basic Block Configuration (AN9DA00, AN9DB00, AN9DF00)



- AN9D series ($V_{CC}$ = to 12 V, $f_{T(max)}$ = 2.6 GHz)
  - High speed low power dissipation process
  - Constant-variable resistor and capacitor elements built in
  - Large current transistor built in (AN9DA00, AN9DB00, AN9DF00)
  - Optimal for a control-system application due to built-in collector wall type NPN transistors and lateral PNP transistors (AN9DA00, AN9DB00, AN9DF00)
  - Optimal for signal processing application due to built-in high speed NPN transistors and vertical PNP transistors (AN9DC00, AN9DD00, AN9DE00)
  - IIL element built-in (AN9DF00)

| Product name | | | AN9DA00 | AN9DB00 | AN9DC00 | AN9DE00 | AN9DD00* | AN9DF00 | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| Pad count | | | 28 | 36 | 55 | 64 | 75 | 32 | |
| Total element count | | | 1 287 | 2 424 | 3 854 | 5 106 | 6 602 | 1 607 | |
| Transistor count | | | 306 | 600 | 920 | 1 288 | 1 610 | 306 | |
| | NPN | A11 | | | 320 | 448 | 560 | | Basic size |
| | | A21 | | | 160 | 224 | 280 | | Double size |
| | | A62P | 8 | 8 | | | | 8 | 62 times size |
| | | B11 | 126 | 252 | | | | 126 | Basic size (CW winding) |
| | PNP | LA1 | 84 | 168 | | | | 84 | Basic size (Lateral type) |
| | | LA4S | 4 | 4 | | | | 4 | 8 times size (Lateral type) |
| | | V11 | 84 | 168 | 320 | 448 | 560 | 84 | Basic size (Vertical type) |
| | | V21 | | | 120 | 168 | 210 | | Double size (Vertical type) |
| Gate countIIL | | | | | 320 | | | | |
| Resistor count | | | 969 | 1 800 | 2 854 | 3 706 | 4 852 | 969 | |
| | SP | 5 kΩ | 474 | 888 | 1 408 | 1 728 | 2 440 | 474 | |
| | | 10 kΩ | 198 | 336 | 480 | 640 | 800 | 198 | |
| | SP2 | 2.5 kΩ | 297 | 576 | 966 | 1 338 | 1 612 | 297 | Resistance variable |
| Capacitor count | | 5 pF | 12 | 24 | 80 | 112 | 140 | 12 | |

Note) *: Under development

- AN9E series ($V_{CC}$ = to 12 V, $f_{T(max)}$ = 3.5 GHz)
  - Bi-CMOS process adopted
  - Constant-variable resistor and capacitor elements built in
  - Gate array and standard cell built in
  - Zener zap elements built in

| Product name | | | AN9EA00* | AN9EB00* | Remarks |
|---|---|---|---|---|---|
| Pad count | | | 40 | 55 | |
| Total element count | | | 8 830 | 14 033 | |
| Transistor count | | | 900 | 1 402 | |
| | NPN | N21 | 420 | 588 | Double size |
| | | N54 | 20 | 34 | 40 times size |
| | | A42G | 20 | 96 | |
| | PNP | P21 | 420 | 588 | Double size (Vertical type) |
| | | V42G | 20 | 96 | |
| Resistor count | | | 5 016 | 7 138 | |
| | SP | 40 kΩ | 90 | 160 | |
| | | 10 kΩ | 1 440 | 2 016 | |
| | | 5 kΩ | 1 680 | 2 352 | |
| | PS | 5 kΩ | 1 086 | 1 602 | Resistance variable |
| | | 2 kΩ | 720 | 1 008 | Resistance variable |
| Capacitor count | | 5 pF | 60 | 84 | |
| Diode count | | | 30 | 42 | |
| | ZD1 | | 30 | 42 | Zener zap element |
| MOS count | | | 12 | 32 | |
| | N-MOS | | 6 | 16 | 60/2 |
| | P-MOS | | 6 | 16 | 30/2 |
| Gate array count | | | 2 800 | 5 400 | |
| | LOGIC | | 2 800 | 5 400 | Use rate 35% or less |
| Standard cell count | | | 12 | 19 | |
| | Analog SW | | 6 | 12 | |
| | Analog SW | | 4 | 4 | |
| | 8-bit DAC | | 1 | 1 | |
| | Oscillation circuit | | 1 | 2 | |

Note) ∗: Under development

- AN9F series ($V_{CC}$ = to 30 V, $f_{T(max)}$ = 300 MHz)
  - High voltage process adopted
  - Constant-variable resistor and capacitor elements built in
  - Built-in Zener diode for simplified reference voltage
  - Output-circuit-exclusive three blocks are built in
  - ZAP-adopted reference-voltage-exclusive one block is built in

| Product name | | | AN9FA00 | Remarks |
|---|---|---|---|---|
| Pad count | | | | 36 |
| Total element count | | | | 1 655 |
| Transistor count | | | | 308 |
| | NPN | N11X | 72 | Basic size |
| | | W11X | 72 | Basic size (surrounded with DN) |
| | | N100X | 8 | 100 times size |
| | PNP | YA1 | 144 | Basic size (Lateral type) |
| | | YX1DP | 12 | Emitter and collector are surrounded with DN |
| Resistor count | | | 1 308 | |
| | SP | 2 kΩ | 1 068 | Resistance variable |
| | | 5 kΩ | 48 | Resistance variable |
| | PW | 10 kΩ | 136 | |
| | | 50 kΩ | 56 | |
| Capacitor count | | 7.5 pF | 24 | Capacitance variable |
| Diode count | ZD | ZB2 | 15 | Bulk Zener diode |
| Special block | Output circuit | | 3 | 250 times size transistor built-in |
| Reference power supply circuit | | | 1 | 2.5 V reference power supply circuit |

## ■ Circuit Library

General-use basic circuits are available as libraries.

| Circuit name | Contents | Features | Remarks |
|---|---|---|---|
| Op-amp.1 | General-use<br>Single power supply operational amp. | Wide output D-range: 0.2 V to $V_{CC}$ − 0.5 V<br>Low power consumption: $I_{CC}$ = 0.5 mA | AN9D series |
| Op-amp.2 | High speed<br>Highly stable operational amp. | High speed: Cutoff frequency = 20 MHz<br>: Slew rate = 100 V/µs | AN9D series |
| Op-amp.3 | General-use<br>Single power supply operational amp. | Low power consumption: $I_{CC}$ = 0.15 mA | AN9D series |
| Op-amp.4 | General-use<br>Single power supply operational amp. | High gain: Voltage gain = 107 dB<br>High stability: Phase margin = 43° | AN9D series |
| Comp1 | Low power consumption<br>Single power supply comparator | Low power consumption: $I_{CC}$ = 0.1 mA<br>High speed: $t_r$ / $t_f$ = 0.15 µs/0.3 µs | AN9D series |
| Comp2 | Single power supply<br>High speed comparator | High speed: $t_d$ = 0.015 µs | AN9D series |
| Reg1 | General-use<br>Stabilized power supply | High temp. stability: 150 ppm/degree or less<br>Wide output voltage range: 1.3 V to $V_{CC}$ − 0.5 V | AN9D series |

■ Package Table

| Series name | | AN9DX00 series | | | | | | AN9EX00 series | | AN9FX00 |
|---|---|---|---|---|---|---|---|---|---|---|
| Master name | | AN9DA00 | AN9DB00 | AN9DC00 | AN9DD00 | AN9DE00 | AN9DF00 | AN9EA00 | AN9EB00 | AN9FA00 |
| Package | Pin count | | | | | | | | | |
| DIL | 16 | ● | | | | | | | | |
| | 18 | | | | | | | | | |
| | 20 | | | | | | | | | |
| | 22 | ● | ● | | | | ● | | | |
| | 24 | ● | | | | | | | | |
| | 28 | | ● | ● | | | | | | ● |
| SDIL | 20 | ● | | | | | ● | | | |
| | 22 | ● | | | | | ● | | | |
| | 24 | ● | ● | | | | ● | | | |
| | 28 | | ● | ● | | ● | | ● | ● | ● |
| | 30 | | ● | ● | | | | | | ● |
| | 42 | | ● | ● | | | | | | ● |
| | 52 | | | ● | | ● | | | ● | ● |
| SO | 18 | | | | | | | | | |
| | 20 | ● | ● | | | | ● | | | |
| | 22 | | | | | | | | | |
| | 24 | ● | | | | | ● | | | |
| | 28 | ● | ● | ● | | ● | ● | ● | ● | ● |
| | 36 | ● | ● | | | | ● | | | ● |
| QPF | 32 | | | | | | | ● | | ● |
| | 44 | | | | | | | | ● | |
| | 48 | | | | | | ● | | ● | ● |
| | 64 | | | ● | ● | ● | ● | | ● | ● |
| | 80 | | | | | | | | ● | ● |
| QFN | 24 | ● | | | | | | | | |
| | 44 | ● | ● | ● | | | ● | ● | ● | ● |