TOSHIBA Transistor Silicon NPN Epitaxial Planar Type (PCT process)

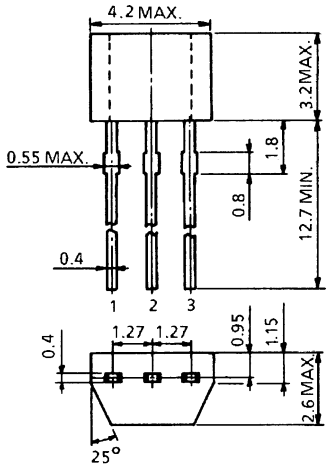
# 2SC2668

High Frequency Amplifier Applications

FM, RF, IF Amplifier Applications

- Small reverse transfer capacitance: $C_{re}$ = 0.70 pF (typ.)
- Low noise figure: NF = 2.5dB (typ.)

Unit: mm




| | |
|---|---|
| JEDEC | — |
| JEITA | — |
| TOSHIBA | 2-4E1A |

Weight: 0.13 g (typ.)

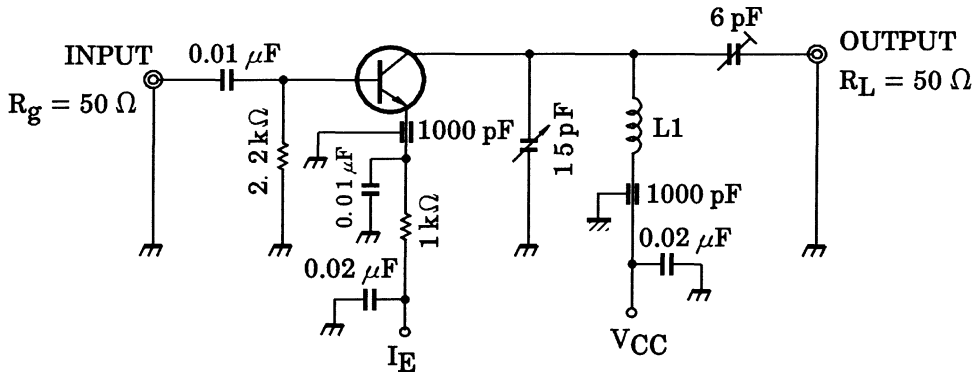
## Maximum Ratings (Ta = 25°C)

| Characteristics | Symbol | Rating | Unit |
|---|---|---|---|
| Collector-base voltage | $V_{CBO}$ | 40 | V |
| Collector-emitter voltage | $V_{CEO}$ | 30 | V |
| Emitter-base voltage | $V_{EBO}$ | 4 | V |
| Collector current | $I_C$ | 20 | mA |
| Emitter current | $I_B$ | 4 | mA |
| Collector power dissipation | $P_C$ | 100 | mW |
| Junction temperature range | $T_j$ | 125 | °C |
| Storage temperature range | $T_{stg}$ | −55~125 | °C |

## Electrical Characteristics (Ta = 25°C)

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Collector cut-off current | $I_{CBO}$ | $V_{CB}$ = 40 V, $I_E$ = 0 | — | — | 0.5 | μA |
| Emitter cut-off current | $I_{EBO}$ | $V_{EB}$ = 4 V, $I_C$ = 0 | — | — | 0.5 | μA |
| DC current gain | $h_{FE}$ (Note) | $V_{CE}$ = 6 V, $I_C$ = 1 mA | 40 | — | 200 | |
| Reverse transfer capacitance | $C_{re}$ | $V_{CE}$ = 6 V, f = 1 MHz | — | 0.70 | — | pF |
| Transition frequency | $f_T$ | $V_{CE}$ = 6 V, $I_C$ = 1 mA | — | 550 | — | MHz |
| Collector-base time constant | $C_c \cdot r_{bb'}$ | $V_{CE}$ = 6 V, $I_E$ = −1 mA, f = 30 MHz | — | — | 30 | ps |
| Noise figure | NF | $V_{CC}$ = 6 V, $I_E$ = −1 mA, f = 100 MHz, (Figure 1) | — | 2.5 | 5.0 | dB |
| Power gain | $G_{pe}$ | | — | 18 | — | dB |

Note: $h_{FE}$ classification R: 40~80 O: 70~140 Y: 100~200




$L_1$: 0.8 mmϕ silver plated copper wire, 4 turns. 10 mm ID, 8 mm length.

**Figure 1 NF, $G_{pe}$ Test Circuit**

## Y Parameter (typ.)

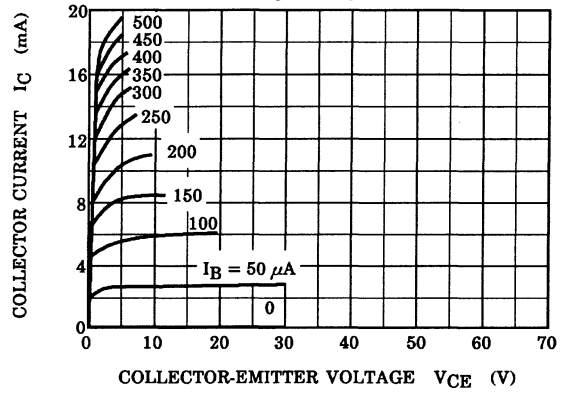
(1) Common emitter ($V_{CE}$ = 6 V, $I_E$ = −1 mA, f = 100 MHz)

| Characteristics | Symbol | Typ. | Unit |
|---|---|---|---|
| Input conductance | $g_{ie}$ | 2.9 | ms |
| Input capacitance | $C_{ie}$ | 10.2 | pF |
| Reverse transfer admittance | $\|Y_{re}\|$ | 0.33 | ms |
| Phase angle of reverse transfer admittance | $\theta_{re}$ | −90 | ° |
| Forward transfer admittance | $\|Y_{fe}\|$ | 40 | ms |
| Phase angle of forward transfer admittance | $\theta_{fe}$ | −20 | ° |
| Output conductance | $g_{oe}$ | 45 | μs |
| Output capacitance | $C_{oe}$ | 1.1 | pF |

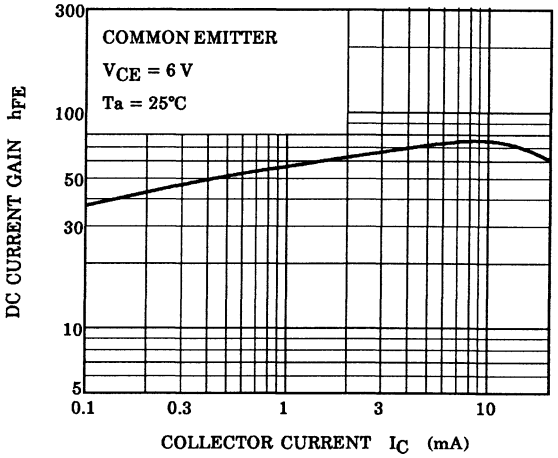
(2) Common base ($V_{CB}$ = 6 V, $I_E$ = −1 mA, f = 100 MHz)

| Characteristics | Symbol | Typ. | Unit |
|---|---|---|---|
| Input conductance | $g_{ib}$ | 34 | ms |
| Input capacitance | $C_{ib}$ | −10 | pF |
| Reverse transfer admittance | $\|Y_{rb}\|$ | 0.27 | ms |
| Phase angle of reverse transfer admittance | $\theta_{rb}$ | −105 | ° |
| Forward transfer admittance | $\|Y_{fb}\|$ | 34 | ms |
| Phase angle of forward transfer admittance | $\theta_{fb}$ | 165 | ° |
| Output conductance | $g_{ob}$ | 45 | μs |
| Output capacitance | $C_{ob}$ | 1.1 | pF |

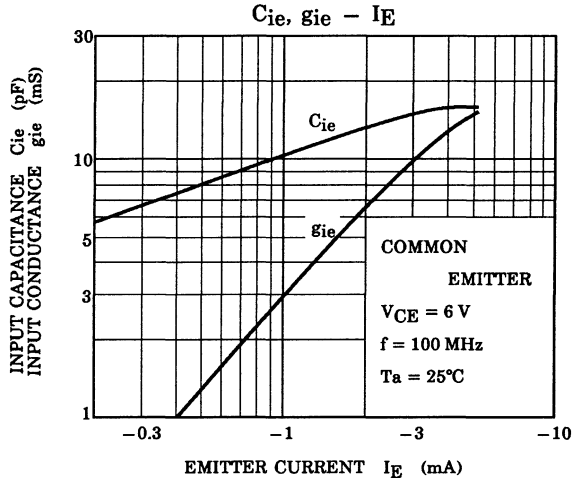
$I_C - V_{CE}$



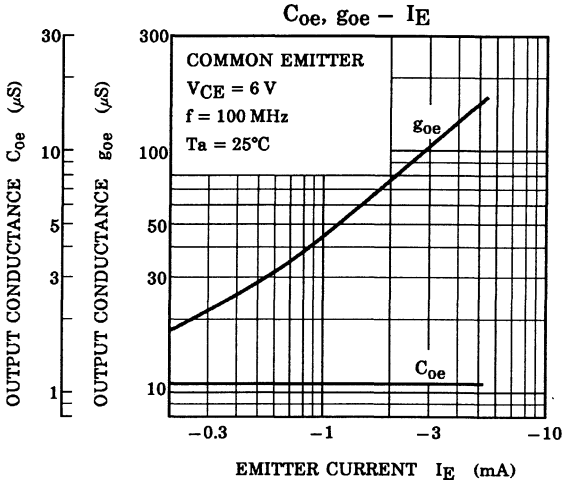

$h_{FE} - I_C$



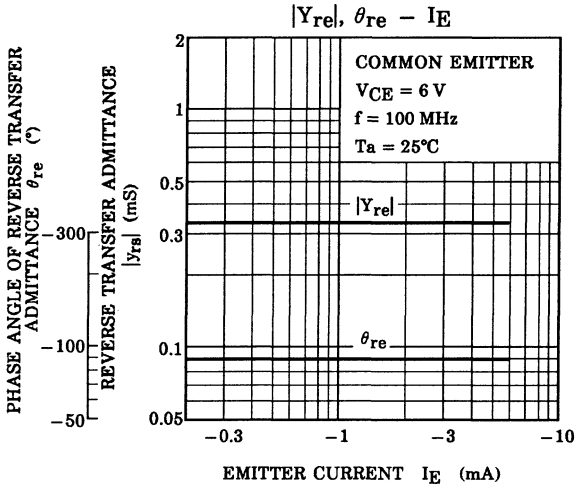

$C_{ie}$, $g_{ie} - I_E$

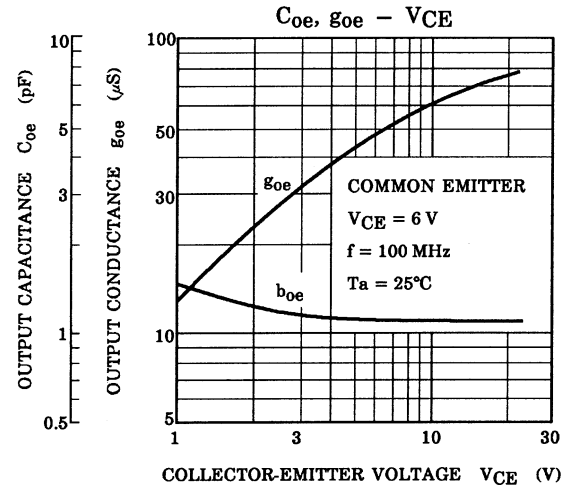


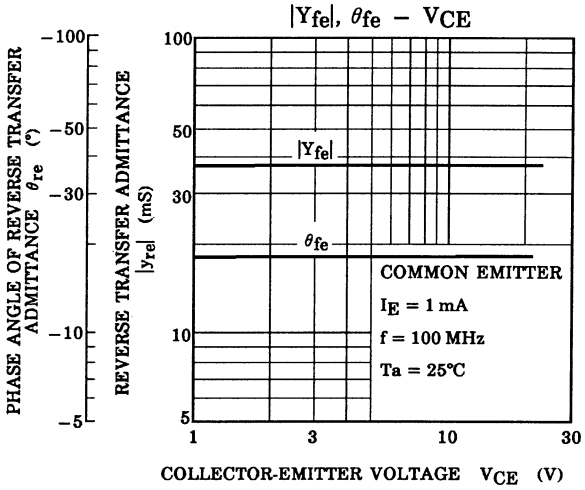

$C_{oe}$, $g_{oe} - I_E$

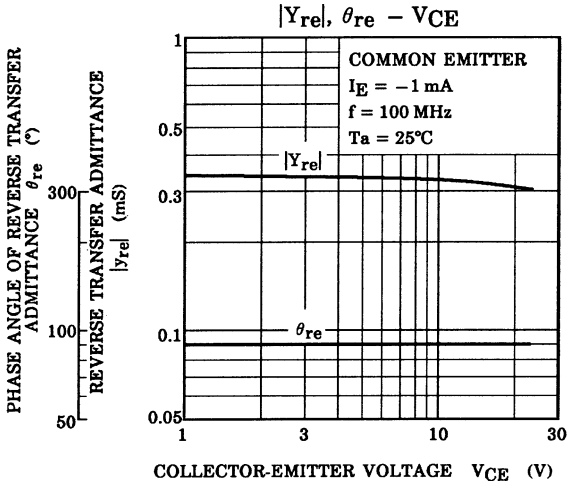


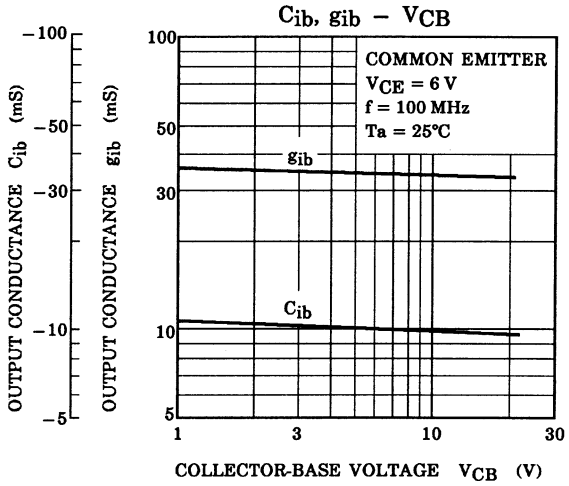

$|Y_{re}|$, $\theta_{re} - I_E$

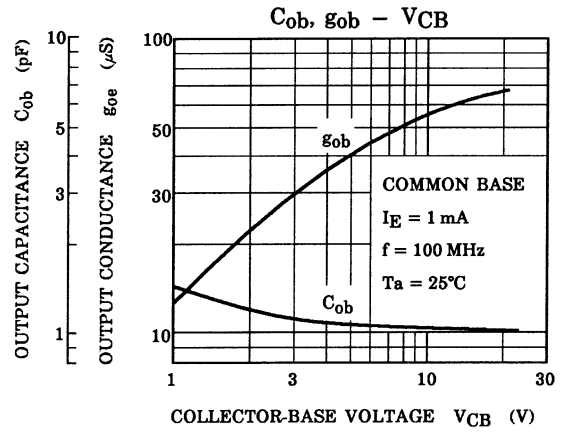


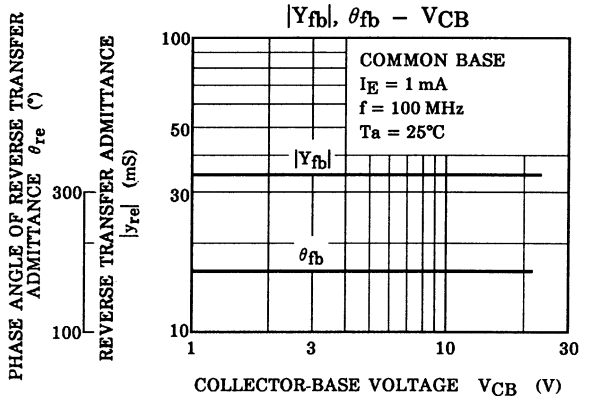

$C_{oe}$, $g_{oe}$ – $V_{CE}$
OUTPUT CAPACITANCE $C_{oe}$ (pF)
OUTPUT CONDUCTANCE $g_{oe}$ (μS)
$g_{oe}$
$b_{oe}$
COMMON EMITTER
$V_{CE}$ = 6 V
f = 100 MHz
Ta = 25°C
COLLECTOR-EMITTER VOLTAGE $V_{CE}$ (V)

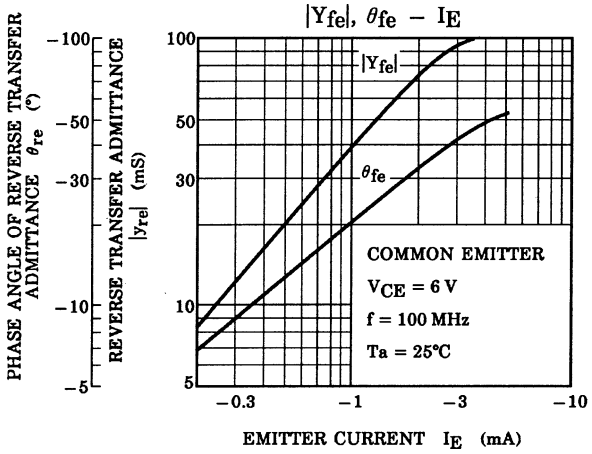

$|Y_{fe}|$, $\theta_{fe}$ – $V_{CE}$
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE $\theta_{re}$ (°)
REVERSE TRANSFER ADMITTANCE $|y_{re}|$ (mS)
$|Y_{fe}|$
$\theta_{fe}$
COMMON EMITTER
$I_E$ = 1 mA
f = 100 MHz
Ta = 25°C
COLLECTOR-EMITTER VOLTAGE $V_{CE}$ (V)

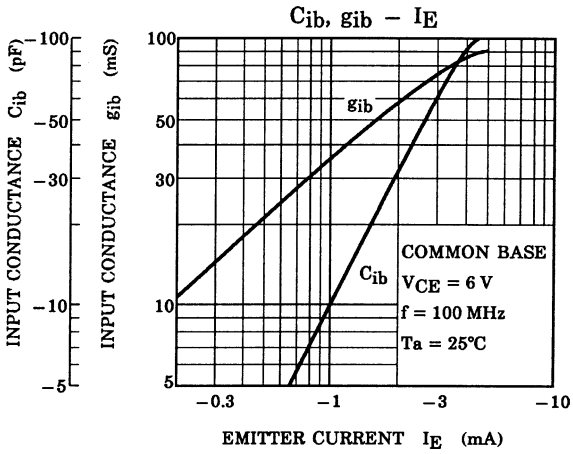

$|Y_{re}|$, $\theta_{re}$ – $V_{CE}$
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE $\theta_{re}$ (°)
REVERSE TRANSFER ADMITTANCE $|y_{re}|$ (mS)
COMMON EMITTER
$I_E$ = −1 mA
f = 100 MHz
Ta = 25°C
$|Y_{re}|$
$\theta_{re}$
COLLECTOR-EMITTER VOLTAGE $V_{CE}$ (V)

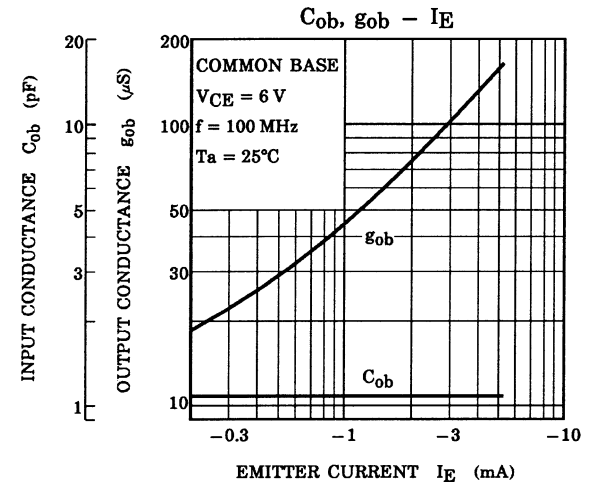

$C_{ib}$, $g_{ib}$ – $V_{CB}$
OUTPUT CONDUCTANCE $C_{ib}$ (mS)
OUTPUT CONDUCTANCE $g_{ib}$ (mS)
COMMON EMITTER
$V_{CE}$ = 6 V
f = 100 MHz
Ta = 25°C
$g_{ib}$
$C_{ib}$
COLLECTOR-BASE VOLTAGE $V_{CB}$ (V)

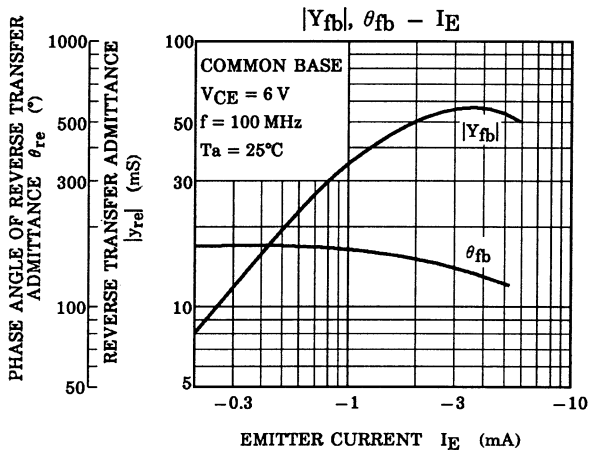

$C_{ob}$, $g_{ob}$ – $V_{CB}$
OUTPUT CAPACITANCE $C_{ob}$ (pF)
OUTPUT CONDUCTANCE $g_{oe}$ (μS)
$g_{ob}$
$C_{ob}$
COMMON BASE
$I_E$ = 1 mA
f = 100 MHz
Ta = 25°C
COLLECTOR-BASE VOLTAGE $V_{CB}$ (V)

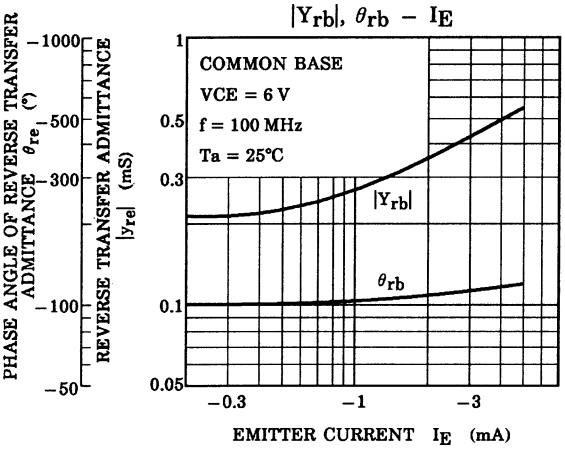

$|Y_{fb}|$, $\theta_{fb}$ – $V_{CB}$
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE $\theta_{re}$ (°)
REVERSE TRANSFER ADMITTANCE $|y_{re}|$ (mS)
COMMON BASE
$I_E$ = 1 mA
f = 100 MHz
Ta = 25°C
$|Y_{fb}|$
$\theta_{fb}$
COLLECTOR-BASE VOLTAGE $V_{CB}$ (V)

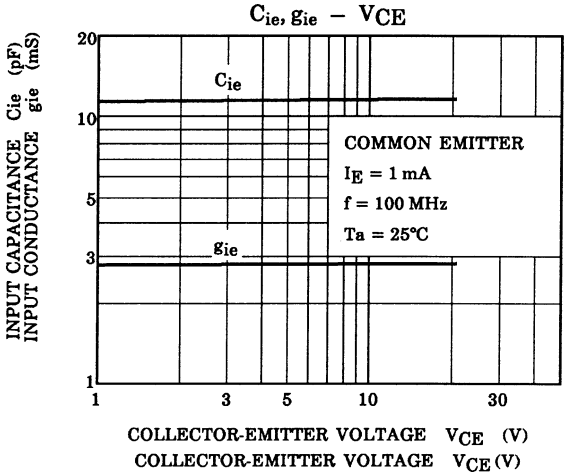

$|Y_{fe}|$, $\theta_{fe}$ – $I_E$
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE $\theta_{re}$ (°)
REVERSE TRANSFER ADMITTANCE $|y_{re}|$ (mS)
$|Y_{fe}|$
$\theta_{fe}$
COMMON EMITTER
$V_{CE}$ = 6 V
f = 100 MHz
Ta = 25°C
EMITTER CURRENT $I_E$ (mA)

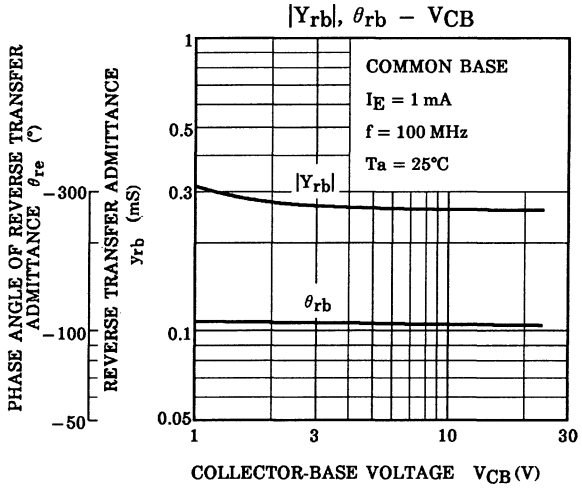

$C_{ib}$, $g_{ib}$ – $I_E$
INPUT CONDUCTANCE $C_{ib}$ (pF)
INPUT CONDUCTANCE $g_{ib}$ (mS)
$g_{ib}$
$C_{ib}$
COMMON BASE
$V_{CE}$ = 6 V
f = 100 MHz
Ta = 25°C
EMITTER CURRENT $I_E$ (mA)

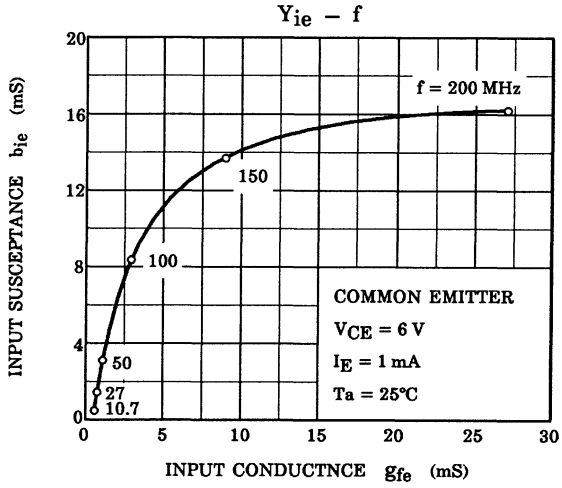

$C_{ob}$, $g_{ob}$ – $I_E$
INPUT CONDUCTANCE $C_{ob}$ (pF)
OUTPUT CONDUCTANCE $g_{ob}$ (μS)
COMMON BASE
$V_{CE}$ = 6 V
f = 100 MHz
Ta = 25°C
$g_{ob}$
$C_{ob}$
EMITTER CURRENT $I_E$ (mA)

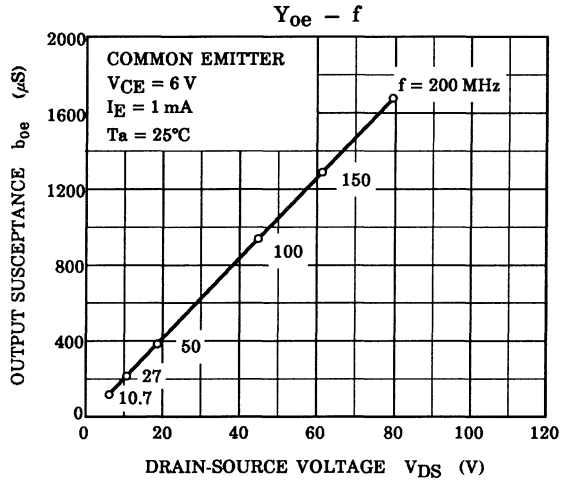

$|Y_{fb}|$, $\theta_{fb}$ – $I_E$
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE $\theta_{re}$ (°)
REVERSE TRANSFER ADMITTANCE $|y_{re}|$ (mS)
COMMON BASE
$V_{CE}$ = 6 V
f = 100 MHz
Ta = 25°C
$|Y_{fb}|$
$\theta_{fb}$
EMITTER CURRENT $I_E$ (mA)

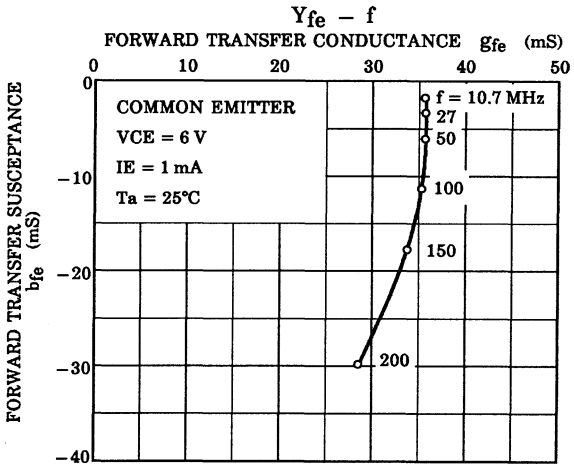

$|Y_{rb}|$, $\theta_{rb}$ – $I_E$
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE $\theta_{re}$ (°)
REVERSE TRANSFER ADMITTANCE $|y_{re}|$ (mS)
COMMON BASE
VCE = 6 V
f = 100 MHz
Ta = 25°C
$|Y_{rb}|$
$\theta_{rb}$
EMITTER CURRENT $I_E$ (mA)

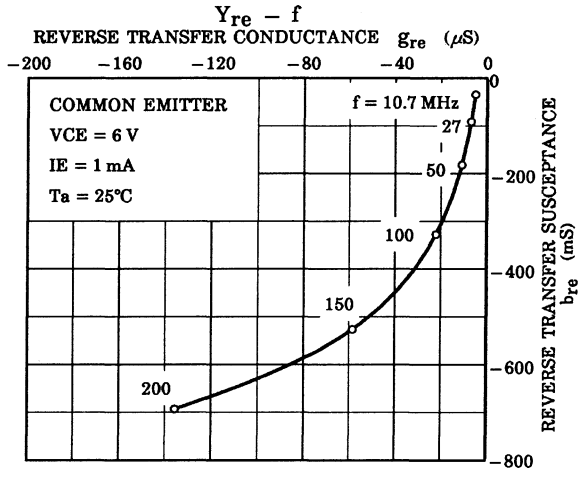

$C_{ie}$, $g_{ie}$ – $V_{CE}$
INPUT CAPACITANCE $C_{ie}$ (pF)
INPUT CONDUCTANCE $g_{ie}$ (mS)
$C_{ie}$
$g_{ie}$
COMMON EMITTER
$I_E$ = 1 mA
f = 100 MHz
Ta = 25°C
COLLECTOR-EMITTER VOLTAGE $V_{CE}$ (V)
COLLECTOR-EMITTER VOLTAGE $V_{CE}$ (V)

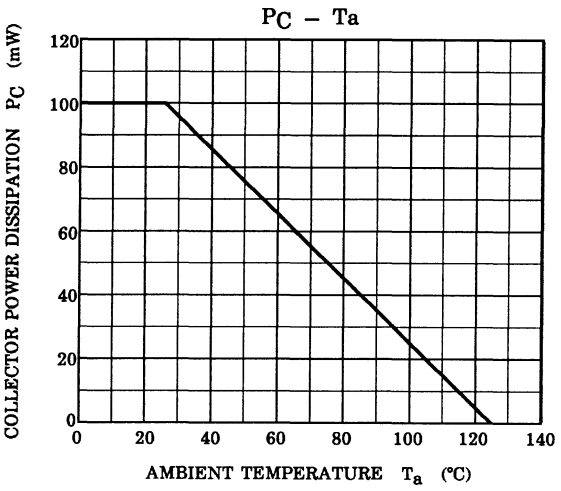

|Yrb|, θrb – VCB
COMMON BASE
IE = 1 mA
f = 100 MHz
Ta = 25°C
|Yrb|
θrb
PHASE ANGLE OF REVERSE TRANSFER ADMITTANCE θre (°)
REVERSE TRANSFER ADMITTANCE yrb (mS)
COLLECTOR-BASE VOLTAGE VCB (V)


Yie – f
f = 200 MHz
150
100
50
27
10.7
COMMON EMITTER
VCE = 6 V
IE = 1 mA
Ta = 25°C
INPUT SUSCEPTANCE bie (mS)
INPUT CONDUCTNCE gfe (mS)


Yoe – f
COMMON EMITTER
VCE = 6 V
IE = 1 mA
Ta = 25°C
f = 200 MHz
150
100
50
27
10.7
OUTPUT SUSCEPTANCE boe (μS)
DRAIN-SOURCE VOLTAGE VDS (V)


Yfe – f
FORWARD TRANSFER CONDUCTANCE gfe (mS)
COMMON EMITTER
VCE = 6 V
IE = 1 mA
Ta = 25°C
f = 10.7 MHz
27
50
100
150
200
FORWARD TRANSFER SUSCEPTANCE bfe (mS)


Yre – f
REVERSE TRANSFER CONDUCTANCE gre (μS)
COMMON EMITTER
VCE = 6 V
IE = 1 mA
Ta = 25°C
f = 10.7 MHz
27
50
100
150
200
REVERSE TRANSFER SUSCEPTANCE bre (mS)


PC – Ta
COLLECTOR POWER DISSIPATION PC (mW)
AMBIENT TEMPERATURE Ta (°C)

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