

LM3045/LM3046/LM3086 Transistor Arrays

General Description

The LM3045, LM3046 and LM3086 each consist of five general purpose silicon NPN transistors on a common monolithic substrate. Two of the transistors are internally connected to form a differentially-connected pair. The transistors are well suited to a wide variety of applications in low power system in the DC through VHF range. They may be used as discrete transistors in conventional circuits however, in addition, they provide the very significant inherent integrated circuit advantages of close electrical and thermal matching. The LM3045 is supplied in a 14-lead cavity dual-in-line package rated for operation over the full military temperature range. The LM3045 but are supplied in a 14-lead molded dual-in-line package for applications requiring only a limited temperature range.

Features

- Two matched pairs of transistors

 V_{BE} matched ±5 mV

 Input offset current 2 µA max at I_C = 1 mA
- Five general purpose monolithic transistors
- Operation from DC to 120 MHz
- Wide operating current range
- Low noise figure

3.2 dB typ at 1 kHz

■ Full military

temperature range (LM3045)

-55°C to +125°C

Applications

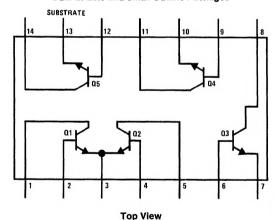
 General use in all types of signal processing systems operating anywhere in the frequency range from DC to VHF

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- Custom designed differential amplifiers
- Temperature compensated amplifiers

Schematic and Connection Diagram

Dual-In-Line and Small Outline Packages



Order Number LM3045J, LM3046M, LM3086M, LM3046N or LM3086N See NS Package Number J14A, M14A or N14A

5-210

Absolute Maximum Ratings (TA = 25°C)

If Military/Aerospace specified devices are required, contact the National Semiconductor Sales Office/Distributors for availability and specifications.

| availability and specifications. | LM3045 | | LM3046/ | | |
|---|-----------------|---------|------------|---------|-------|
| | Each | Total | Each | Total | Units |
| | Transistor | Package | Transistor | Package | |
| Power Dissipation: | | | | | |
| $T_A = 25^{\circ}C$ | 300 | 750 | 300 | 750 | mW |
| $T_A = 25^{\circ}C \text{ to } 55^{\circ}C$ | | | 300 | 750 | mW |
| T _A > 55°C | | | Derate a | mW/°C | |
| $T_A = 25^{\circ}C \text{ to } 75^{\circ}C$ | 300 | 750 | | | mW |
| T _A > 75°C | Derate | e at 8 | | | mW/°C |
| Collector to Emitter Voltage, V _{CEO} | 15 | | 15 | | V |
| Collector to Base Voltage, V _{CBO} | 20 | | 20 | | V |
| Collector to Substrate Voltage, V _{CIO} (Note 1) | 20 | | 20 | | V |
| Emitter to Base Voltage, V _{EBO} | 5 | | 5 | | V |
| Collector Current, I _C | 50 | | 50 | | mA |
| Operating Temperature Range | -55°C to +125°C | | -40°C to | | |
| Storage Temperature Range | -65°C to +150°C | | ~65°C to | | |
| Soldering Information | | | | | |
| Dual-In-Line Package Soldering (10 Sec.) | 260°C | | 260°C | | |
| Small Outline Package | | | | | |
| Vapor Phase (60 Seconds) | | | 215°C | | |
| Infrared (15 Seconds) | | | 220°C | | |

See AN-450 "Surface Mounting Methods and Their Effect on Product Reliability" for other methods of soldering surface mount devices

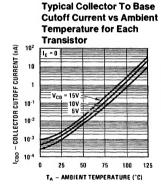
Electrical Characteristics (T_A = 25°C unless otherwise specified)

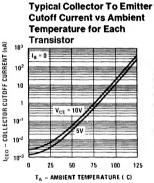
| | | Limits | | | Limits | | | Units |
|--|--|----------------|-------|-----|--------|-------|-----|-------|
| Parameter | Conditions | LM3045, LM3046 | | | LM3086 | | | |
| | | Min | Тур | Max | Min | Тур | Max | |
| Collector to Base Breakdown Voltage (V(BR)CBO) | $I_C = 10 \mu\text{A}, I_E = 0$ | 20 | 60 | | 20 | 60 | | V |
| Collector to Emitter Breakdown Voltage (V(BR)CEO) | $I_C = 1 \text{ mA, } I_B = 0$ | 15 | 24 | | 15 | 24 | | V |
| Collector to Substrate Breakdown Voltage (V _{(BR)CIO}) | $I_{C} = 10 \mu\text{A}, I_{CI} = 0$ | 20 | 60 | | 20 | 60 | | ٧ |
| Emitter to Base Breakdown Voltage (V(BR)EBO) | I_{E} 10 μ A, I_{C} = 0 | 5 | 7 | | 5 | 7 | | V |
| Collector Cutoff Current (I _{CBO}) | $V_{CB} = 10V, I_{E} = 0$ | | 0.002 | 40 | | 0.002 | 100 | nA |
| Collector Cutoff Current (I _{CEO}) | $V_{CE} = 10V, I_{B} = 0$ | | | 0.5 | | | 5 | μΑ |
| Static Forward Current Transfer | $V_{CE} = 3V$ $\begin{cases} I_{C} = 10 \text{ mA} \\ I_{C} = 1 \text{ mA} \\ I_{C} = 10 \mu\text{A} \end{cases}$ | | 100 | | | 100 | | |
| Ratio (Static Beta) (hFE) | $\left\{ I_{C}=1 \text{ mA} \right\}$ | 40 | 100 | | 40 | 100 | | |
| | $l_{\rm C} = 10 \mu{\rm A}$ | | 54 | | | 54 | | |
| Input Offset Current for Matched Pair Q ₁ and Q ₂ I _{O1} - I _{IO2} | $V_{CE} = 3V$, $I_{C} = 1$ mA | | 0.3 | 2 | | | | μΑ |
| Base to Emitter Voltage (V _{BE}) | $V_{CE} = 3V$ $\{I_{E} = 1 \text{ mA} \}$ $I_{E} = 10 \text{ mA}$ | | 0.715 | | | 0.715 | | v |
| | $l_{E} = 10 \text{mA}$ | | 0.800 | | | 0.800 | | |
| Magnitude of Input Offset Voltage for Differential Pair V _{BE1} - V _{BE2} | $V_{CE} = 3V$, $I_{C} = 1$ mA | | 0.45 | 5 | | | | mV |
| Magnitude of Input Offset Voltage for Isolated Transistors $ V_{BE3} - V_{BE4} $, $ V_{BE4} - V_{BE5} $, $ V_{BE5} - V_{BE3} $ | $V_{CE} = 3V$, $I_{C} = 1$ mA | | 0.45 | 5 | | | | m∨ |
| Temperature Coefficient of Base to Emitter Voltage $\left(\frac{\Delta V_{BE}}{\Delta T}\right)$ | $V_{CE} = 3V$, $I_{C} = 1 \text{ mA}$ | | -1.9 | | | -1.9 | | mV/°C |
| Collector to Emitter Saturation Voltage (VCE(SAT)) | $I_B = 1 \text{ mA}, I_C = 10 \text{ mA}$ | | 0.23 | | | 0.23 | | V |
| Temperature Coefficient of Input Offset Voltage $\left(\frac{\Delta V_{10}}{\Delta T} \right)$ | $V_{CE} = 3V$, $I_{C} = 1$ mA | | 1.1 | | | | | μV/°C |

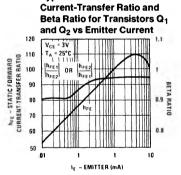
Note 1: The collector of each transistor of the LM3045, LM3046, and LM3086 is isolated from the substrate by an integral diode. The substrate (terminal 13) must be connected to the most negative point in the external circuit to maintain isolation between transistors and to provide for normal transistor action.

| Parameter | Conditions | Min | Тур | Max | Units |
|---|---|------|----------------------------------|-----|-------|
| Low Frequency Noise Figure (NF) | $f = 1 \text{ kHz}, V_{CE} = 3V,$ $I_{C} = 100 \mu\text{A}, R_{S} = 1 \text{ k}\Omega$ | | 3.25 | | dB |
| LOW FREQUENCY, SMALL SIGNAL EQUIVALEN | IT CIRCUIT CHARACTERIS | TICS | | | |
| Forward Current Transfer Ratio (hfe) | $ f = 1 \text{ kHz}, V_{CE} = 3V, $ $I_{C} = 1 \text{ mA} $ | | 110 (LM3045, LM3046) (LM3086) | | |
| Short Circuit Input Impednace (hie) | | | 3.5 | | kΩ |
| Open Circuit Output Impedance (hoe) | | | 15.6 | | μmho |
| Open Circuit Reverse Voltage Transfer Ratio (hre) | | | 1.8 x 10 ⁻⁴ | | |
| ADMITTANCE CHARACTERISTICS | | | | | |
| Forward Transfer Admittance (Yfe) | $f = 1 \text{ MHz}, V_{CE} = 3V,$ | | 31 — j 1.5 | | |
| Input Admittance (Yie) | I _C = 1 mA | | 0.3+J0.04 | | |
| Output Admittance (Yoe) | | | 0.001 + j 0.03 | | |
| Reverse Transfer Admittance (Yre) | | | See Curve | | |
| Gain Bandwidth Product (f _T) | $V_{CE} = 3V, I_{C} = 3 \text{ mA}$ | 300 | 550 | | |
| Emitter to Base Capacitance (CEB) | $V_{EB} = 3V$, $I_{E} = 0$ | | 0.6 | | pF |
| Collector to Base Capacitance (C _{CB}) | $V_{CB} = 3V, I_{C} = 0$ | | 0.58 | | pF |
| Collector to Substrate Capacitance (C _{Cl}) | $V_{CS} = 3V, I_{C} = 0$ | | 2.8 | } | pF |

Typical Performance Characteristics

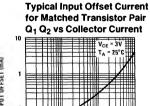


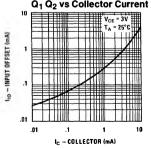




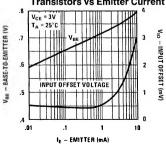
Typical Static Forward

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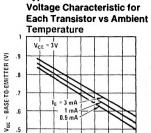
Typical Static Base To Emitter Voltage Characteristic and Input Offset Voltage for Differential Pair and Paired Isolated **Transistors vs Emitter Current**



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Typical Performance Characteristics (Continued)

INPUT OFFSET (mV)

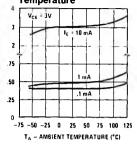


TA - AMBIENT TEMPERATURE (°C)

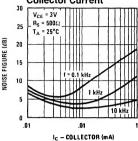
-75 -50 -25 0 25 50 75 100 125

Typical Base To Emitter

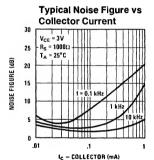




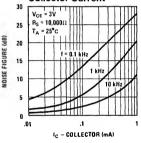
Typical Noise Figure vs **Collector Current**



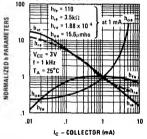
TI /H/7950-4



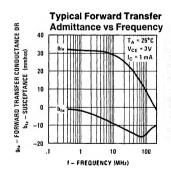
Typical Noise Figure vs Collector Current



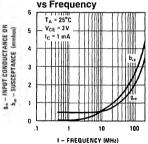
Typical Normalized Forward Current Transfer Ratio, Short Circuit Input Impedance, Open Circuit Output Impedance, and Open Circuit Reverse Voltage Transfer Ratio vs **Collector Current**



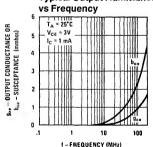
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Typical Input Admittance vs Frequency

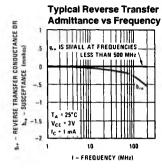


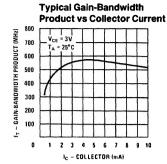
Typical Output Admittance vs Frequency



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Typical Performance Characteristics (Continued)





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