

2N7002K3

List

List..... 1

Package outline..... 2

Features..... 2

Mechanical data..... 2

Maximum ratings 2

Electrical characteristics..... 3

Rating and characteristic curves..... 4~5

Pinning information..... 6

Marking..... 6

Suggested solder pad layout..... 6

Packing information..... 7

Reel packing..... 8

Suggested thermal profiles for soldering processes..... 8

2N7002K3

60V N-Channel Enhancement Mode MOSFET- ESD Protection

Features

- ESD protected 2kV HBM
- Low RDS(on)
- Surface mount package
- This is a Pb-free device
- Lead-free parts meet RoHS requirements
- Suffix "-H" indicates Halogen-free part, ex. 2N7002K3-H.

Applications

- Low side load switch
- Level shift circuits
- DC-DC converter
- Portable applications i.e. DSC, PDA, Cell phone, etc.

Mechanical data

- Epoxy:UL94-V0 rated flame retardant
- Case : Molded plastic, SOT-23
- Terminals : Solder plated, solderable per MIL-STD-750, Method 2026
- Mounting Position : Any
- Weight : Approximated 0.008 gram

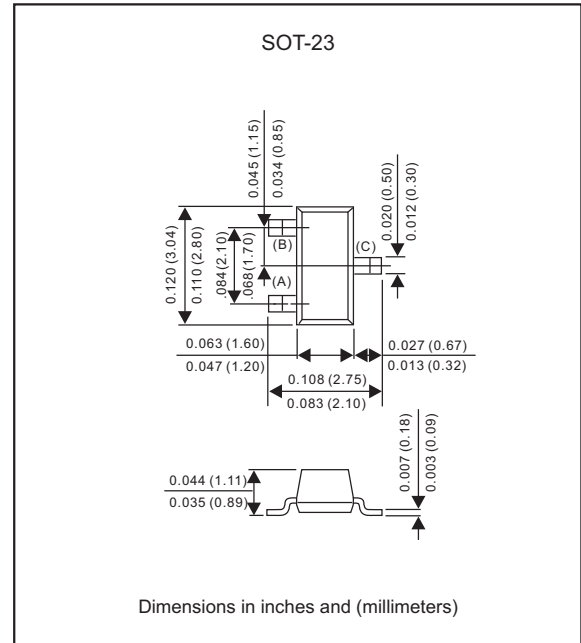
Maximum ratings (AT T_A=25°C unless otherwise noted)

| PARAMETER | Symbol | MIN. | TYP. | MAX. | UNIT |
|---|------------------|------|------|------|-------|
| Drain-source voltage | V _{DS} | | | 60 | V |
| Drain current | I _D | | | 320 | mA |
| Steady state T _A = 25°C | | | | 230 | |
| T _A = 85°C | | | | 380 | |
| t < 5 s T _A = 25°C | | | | 270 | |
| Pulsed drain current t _p = 10 μs | I _{DM} | | | 1.5 | A |
| Gate-source voltage | V _{GS} | | | ±20 | V |
| Power dissipation (note 1) | P _D | | | 320 | mW |
| Steady state | | | | 420 | |
| t < 5 s | | | | | |
| Source current (body diode) | I _S | | | 300 | mA |
| Lead temperature for soldering purposes (1/8" from case for 10 s) | T _L | | | 260 | °C |
| Gate-source ESD rating (HBM, Method) | E _{SD} | | | 2000 | V |
| Thermal resistance junction to ambient steady | R _{θJA} | | 417 | | °C /W |
| Thermal resistance junction to ambient t ≤ 5 s | | | 300 | | |
| Operation junction temperature range | T _J | -55 | | +150 | °C |
| Storage temperature range | T _{STG} | -55 | | +150 | °C |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [1 oz] including traces)

Package outline



2N7002K3

Electrical characteristics (At $T_A=25^\circ\text{C}$ unless otherwise noted)

| PARAMETER | CONDITIONS | Symbol | MIN. | TYP. | MAX. | UNIT |
|---|--|-------------------|------|------|-------------------|----------------------------|
| OFF CHARACTERISTICS | | | | | | |
| Drain-source breakdown voltage | $V_{GS} = 0V, I_D = 250\mu A$ | $V_{(BR)DSS}$ | 60 | | | V |
| Drain-to-source breakdown voltage temperature coefficient | | $V_{(BR)DSS}/T_J$ | | 71 | | $\text{mV}/^\circ\text{C}$ |
| Zero gate voltage drain current | $V_{DS} = 60V, V_{GS} = 0V, T_J = 25^\circ\text{C}$ $V_{DS} = 60V, V_{GS} = 0V, T_J = 125^\circ\text{C}$ $V_{DS} = 50V, V_{GS} = 0V, T_J = 25^\circ\text{C}$ | I_{DSS} | | | 1.0 500 100 | μA μA nA |
| Gate-body leakage current | $V_{GS} = \pm 20V, V_{DS} = 0V$ | I_{GSS} | | | ± 10 | μA |
| ON CHARACTERISTICS | | | | | | |
| Gate threshold voltage (note 2) | $V_{DS} = V_{GS}, I_D = 250\mu A$ | $V_{GS(th)}$ | 1.0 | | 2.5 | V |
| Negative threshold temperature coefficient | | $V_{GS(th)}/T_J$ | | 4.0 | | $\text{mV}/^\circ\text{C}$ |
| Drain-source on-resistance (note 2) | $V_{GS} = 10V, I_D = 500mA$ $V_{GS} = 5.0V, I_D = 50mA$ | $R_{DS(on)}$ | | | 2.3 2.7 | Ω |
| Forward transconductance (note 2) | $V_{DS} = 5.0V, I_D = 200mA$ | g_{FS} | 80 | | | msec |
| CHARGES AND CAPACITANCES | | | | | | |
| Input capacitance | $V_{DS} = 25V, V_{GS} = 0V, f = 1MHz$ | C_{iss} | | 34 | | pF |
| Output capacitance | | C_{oss} | | 3.0 | | |
| Reverse transfer capacitance | | C_{rss} | | 2.2 | | |
| Total gate charge | $V_{DS} = 10V, V_{GS} = 4.5V, I_D = 500mA$ | $Q_{g(TOT)}$ | | 0.71 | | nC |
| Threshold gate charge | | $Q_{g(TH)}$ | | 0.10 | | |
| Gate-source charge | | Q_{gs} | | 0.32 | | |
| Gate-drain charge | | Q_{gd} | | 0.16 | | |
| SWITCHING CHARACTERISTICS | | | | | | |
| Turn-on delay time (note 3) | $V_{DS} = 10V, V_{GEN} = 10V, I_D = 500mA$ | $t_{d(on)}$ | | 3.8 | | ns |
| Turn-on rise time (note 3) | | t_r | | 3.4 | | |
| Turn-off delay time (note 3) | | $t_{d(off)}$ | | 19 | | |
| Turn-off fall time (note 3) | | t_f | | 12 | | |
| DRAIN-SOURCE DIODE CHARACTERISTICS | | | | | | |
| Forward diode voltage | $I_S = 115mA, V_{GS} = 0V, T_J = 25^\circ\text{C}$ $I_S = 115mA, V_{GS} = 0V, T_J = 85^\circ\text{C}$ | V_{SD} | | | 1.4 0.7 | V |

Notes :

- Pulse Test: pulse width $\leq 300\mu s$, duty cycle $\leq 2\%$
- Switching characteristics are independent of operating junction temperatures

Rating and characteristic curves (2N7002K3)

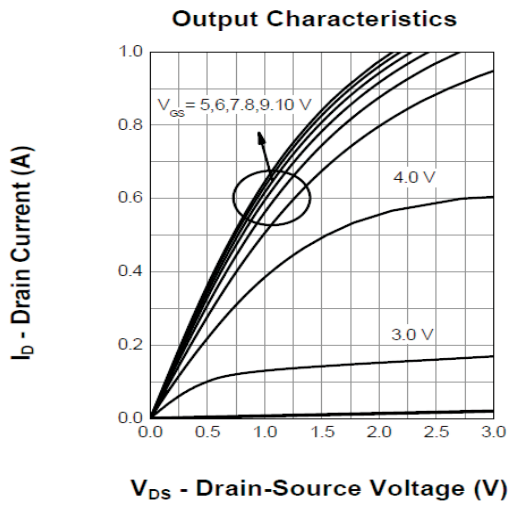


Fig. 1

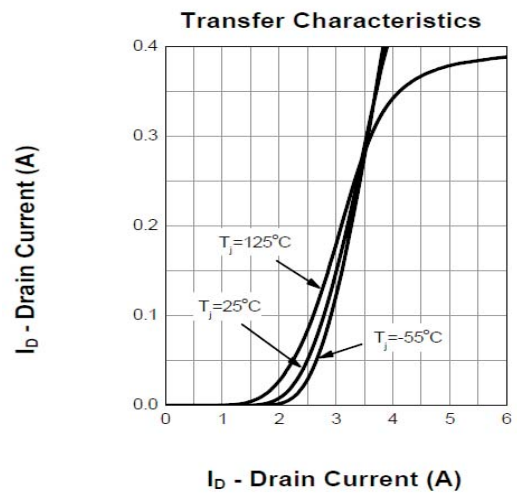


Fig. 2

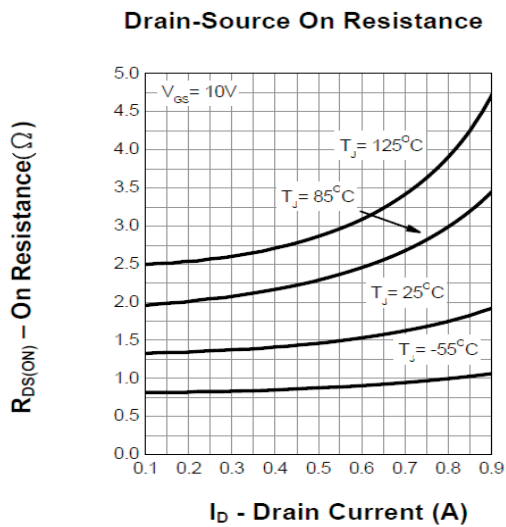


Fig. 3

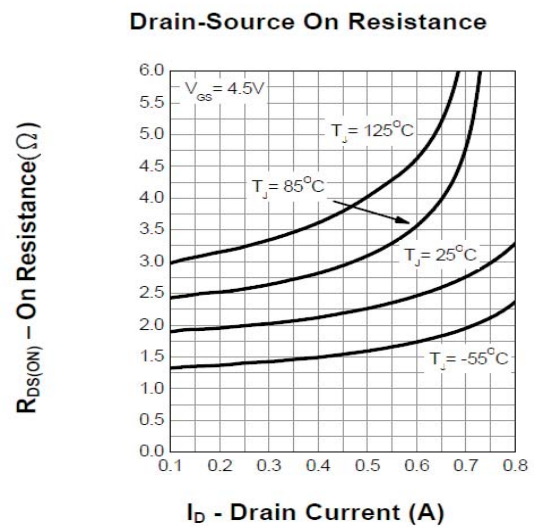


Fig. 4

Rating and characteristic curves (2N7002K3)

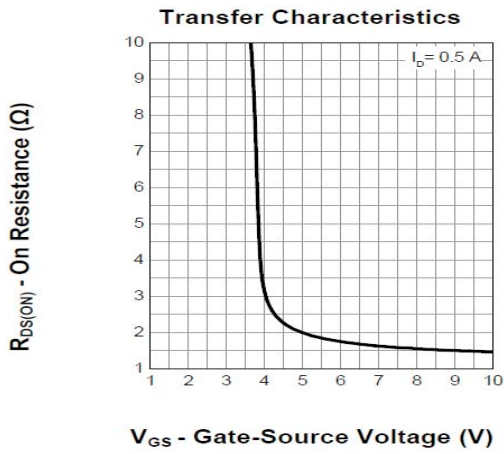


Fig. 5

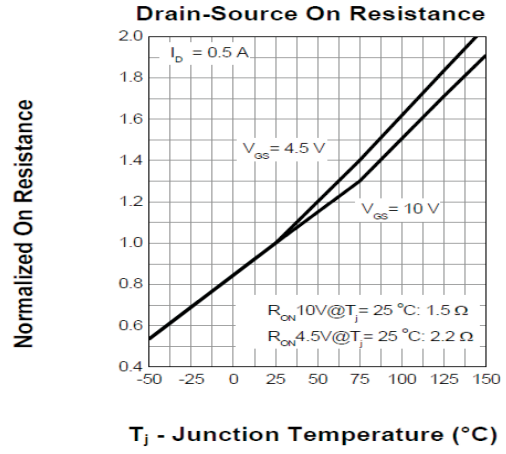


Fig. 6

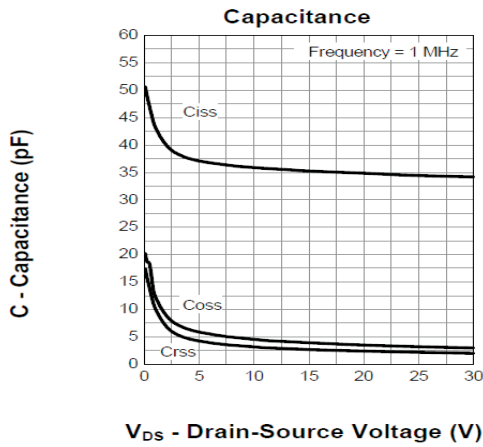


Fig. 7

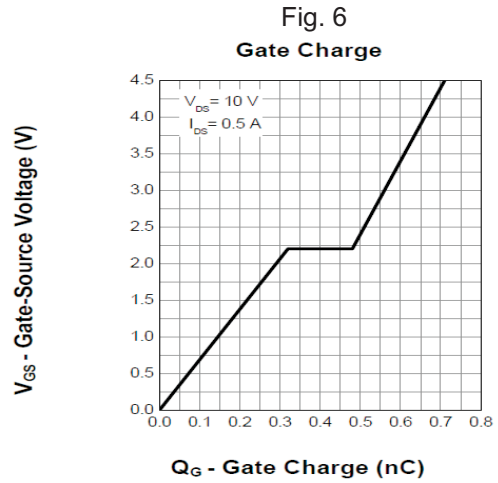


Fig. 8

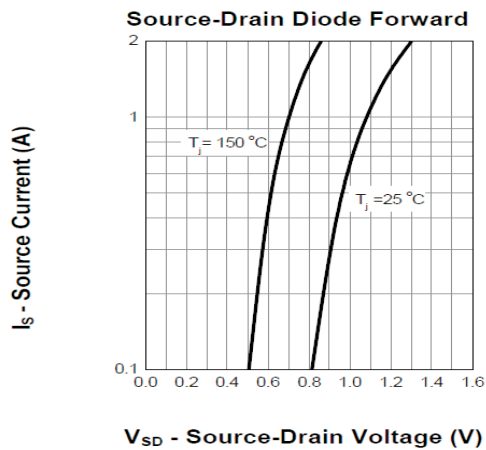
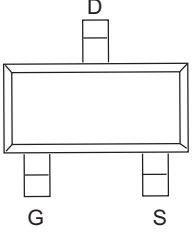
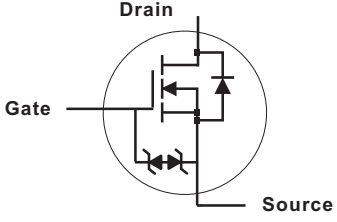


Fig. 9

2N7002K3

Pinning information

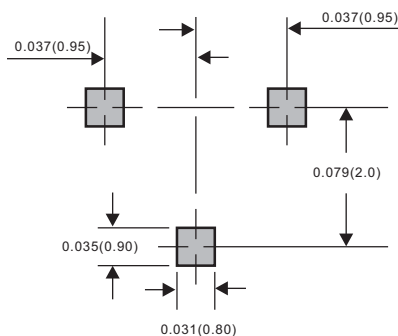
| Pin | Simplified outline | Symbol |
|--|---|---|
| PinD Drain PinG Gate PinS Source |  |  |

Marking

| Type number | Marking code |
|-------------|--------------|
| 2N7002K3 | RK |

Suggested solder pad layout

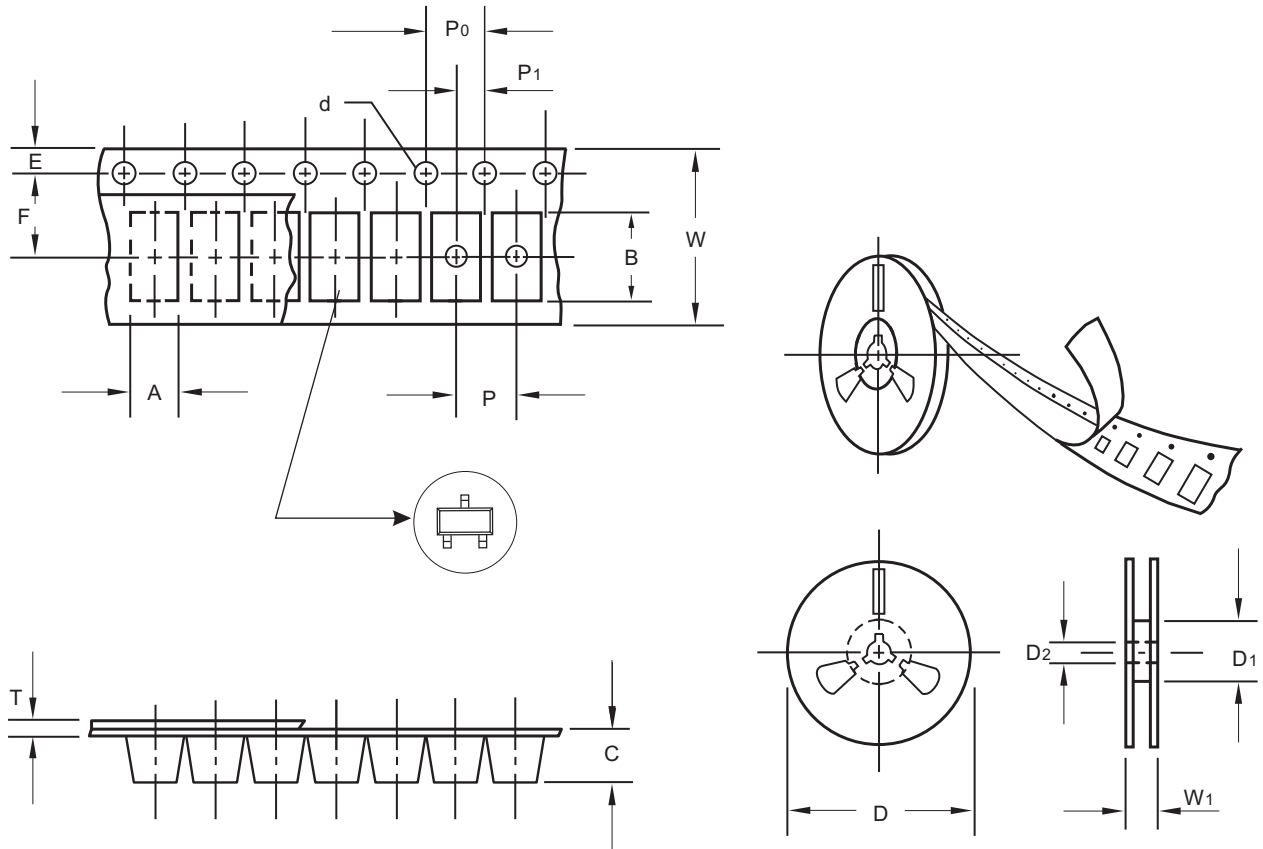
SOT-23



Dimensions in inches and (millimeters)

2N7002K3

Packing information



unit:mm

| Item | Symbol | Tolerance | SOT-23 |
|---------------------------|--------|-----------|--------|
| Carrier width | A | 0.1 | 3.15 |
| Carrier length | B | 0.1 | 2.77 |
| Carrier depth | C | 0.1 | 1.22 |
| Sprocket hole | d | 0.1 | 1.50 |
| 13" Reel outside diameter | D | 2.0 | - |
| 13" Reel inner diameter | D1 | min | - |
| 7" Reel outside diameter | D | 2.0 | 178.00 |
| 7" Reel inner diameter | D1 | min | 55.00 |
| Feed hole diameter | D2 | 0.5 | 13.00 |
| Sprocket hole position | E | 0.1 | 1.75 |
| Punch hole position | F | 0.1 | 3.50 |
| Punch hole pitch | P | 0.1 | 4.00 |
| Sprocket hole pitch | P0 | 0.1 | 4.00 |
| Embossment center | P1 | 0.1 | 2.00 |
| Overall tape thickness | T | 0.1 | 0.23 |
| Tape width | W | 0.3 | 8.00 |
| Reel width | W1 | 1.0 | 12.0 |

Note: Devices are packed in accordance with EIA standard RS-481-A and specifications listed above.

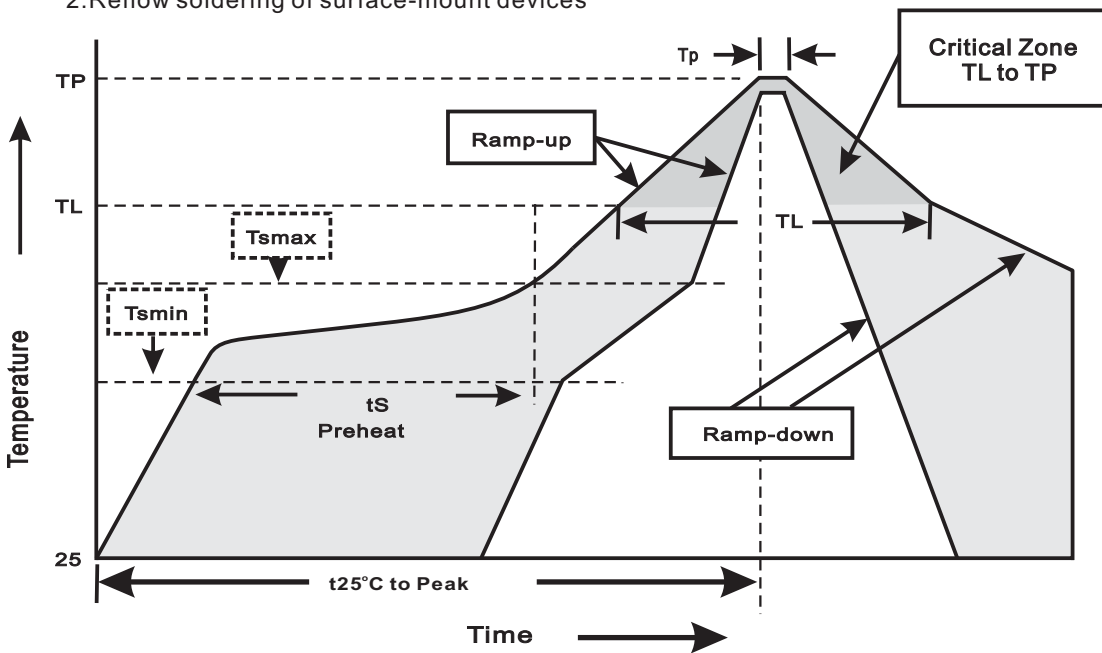
2N7002K3

Reel packing

| PACKAGE | REEL SIZE | REEL (pcs) | COMPONENT SPACING (m/m) | BOX (pcs) | INNER BOX (m/m) | REEL DIA, (m/m) | CARTON SIZE (m/m) | CARTON (pcs) | APPROX. GROSS WEIGHT (kg) |
|---------|-----------|------------|-------------------------|-----------|-----------------|-----------------|-------------------|--------------|---------------------------|
| SOT-23 | 7" | 3000 | 4.0 | 30,000 | 183*123*183 | 178 | 382*257*387 | 240,000 | 11.6 |

Suggested thermal profiles for soldering processes

- 1.Storage environment: Temperature=5°C~40°C Humidity=55%±25%
- 2.Reflow soldering of surface-mount devices



3.Reflow soldering

| Profile Feature | Soldering Condition |
|---|-----------------------------|
| Average ramp-up rate(T _L to T _P) | <3°C/sec |
| Preheat -Temperature Min(T _{min}) -Temperature Max(T _{max}) -Time(min to max)(t _s) | 150°C 200°C 60~120sec |
| T _{max} to T _L -Ramp-upRate | <3°C/sec |
| Time maintained above: -Temperature(T _L) -Time(t _L) | 217°C 60~260sec |
| Peak Temperature(T _P) | 255°C-0/+5°C |
| Time within 5°C of actual Peak Temperature(t _P) | 10~30sec |
| Ramp-down Rate | <6°C/sec |
| Time 25°C to Peak Temperature | <6minutes |