



STW5NB90

N - CHANNEL 900V - 2.3Ω - 5.6A - TO-247 PowerMESH™ MOSFET

| TYPE | V _{DSS} | R _{DS(on)} | I _D |
|----------|------------------|---------------------|----------------|
| STW5NB90 | 900 V | < 2.5 Ω | 5.6 A |

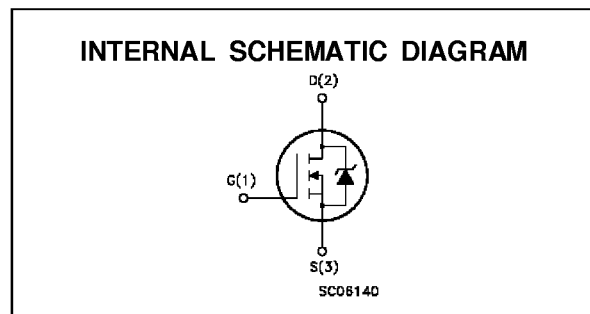
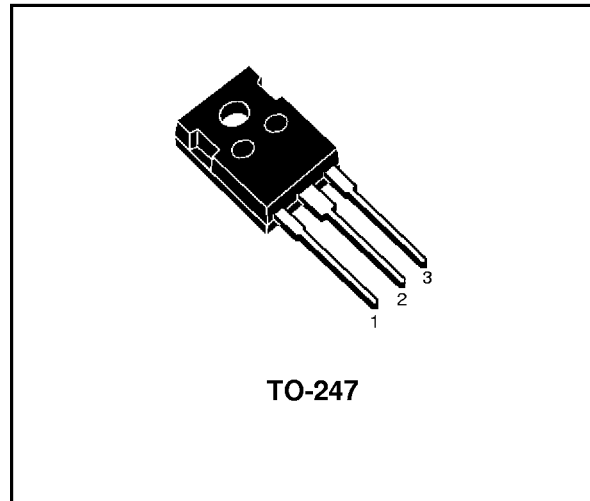
- TYPICAL R_{DS(on)} = 2.3 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- VERY LOW INTRINSIC CAPACITANCES
- GATE CHARGE MINIMIZED

DESCRIPTION

Using the latest high voltage MESH OVERLAY™ process, STMicroelectronics has designed an advanced family of power MOSFETs with outstanding performances. The new patent pending strip layout coupled with the Company's proprietary edge termination structure, gives the lowest R_{DS(on)} per area, exceptional avalanche and dv/dt capabilities and unrivalled gate charge and switching characteristics.

APPLICATIONS

- SWITCH MODE POWER SUPPLIES (SMPS)
- DC-AC CONVERTERS FOR WELDING EQUIPMENT AND UNINTERRUPTIBLE POWER SUPPLIES AND MOTOR DRIVE
- HIGH CURRENT, HIGH SPEED SWITCHING



ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|---------------------|---|------------|------|
| V _{DS} | Drain-source Voltage (V _{GS} = 0) | 900 | V |
| V _{DGR} | Drain- gate Voltage (R _{GS} = 20 kΩ) | 900 | V |
| V _{GS} | Gate-source Voltage | ± 30 | V |
| I _D | Drain Current (continuous) at T _c = 25 °C | 5.6 | A |
| I _D | Drain Current (continuous) at T _c = 100 °C | 3.3 | A |
| I _{DM} (•) | Drain Current (pulsed) | 22.4 | A |
| P _{tot} | Total Dissipation at T _c = 25 °C | 160 | W |
| | Derating Factor | 1.28 | W/°C |
| dv/dt(1) | Peak Diode Recovery voltage slope | 4 | V/ns |
| T _{stg} | Storage Temperature | -65 to 150 | °C |
| T _j | Max. Operating Junction Temperature | 150 | °C |

(•) Pulse width limited by safe operating area

(1) I_{SD} ≤ 5A, di/dt ≤ 200 A/μs, V_{DD} ≤ V_{(BR)DSS}, T_J ≤ T_{JMAX}

STW5NB90

THERMAL DATA

| | | | | |
|----------------|--|-----|------|---------------|
| $R_{thj-case}$ | Thermal Resistance Junction-case | Max | 0.78 | $^{\circ}C/W$ |
| $R_{thj-amb}$ | Thermal Resistance Junction-ambient | Max | 30 | $^{\circ}C/W$ |
| $R_{thc-sink}$ | Thermal Resistance Case-sink | Typ | 0.1 | $^{\circ}C/W$ |
| T_l | Maximum Lead Temperature For Soldering Purpose | | 300 | $^{\circ}C$ |

AVALANCHE CHARACTERISTICS

| Symbol | Parameter | Max Value | Unit |
|----------|--|-----------|------|
| I_{AR} | Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T_j max) | 5.6 | A |
| E_{AS} | Single Pulse Avalanche Energy (starting $T_j = 25^{\circ}C$, $I_D = I_{AR}$, $V_{DD} = 50 V$) | 284 | mJ |

ELECTRICAL CHARACTERISTICS ($T_{case} = 25^{\circ}C$ unless otherwise specified)

OFF

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------------|--|---|------|------|-----------|--------------------|
| $V_{(BR)DSS}$ | Drain-source Breakdown Voltage | $I_D = 250 \mu A$ $V_{GS} = 0$ | 900 | | | V |
| I_{DSS} | Zero Gate Voltage Drain Current ($V_{GS} = 0$) | $V_{DS} = \text{Max Rating}$ $V_{DS} = \text{Max Rating}$ $T_c = 125^{\circ}C$ | | | 1 50 | μA μA |
| I_{GSS} | Gate-body Leakage Current ($V_{DS} = 0$) | $V_{GS} = \pm 30 V$ | | | ± 100 | nA |

ON (*)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|-----------------------------------|--|------|------|------|----------|
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS} = V_{GS}$ $I_D = 250 \mu A$ | 3 | 4 | 5 | V |
| $R_{DS(on)}$ | Static Drain-source On Resistance | $V_{GS} = 10V$ $I_D = 2.5 A$ | | 2.3 | 2.5 | Ω |
| $I_{D(on)}$ | On State Drain Current | $V_{DS} > I_{D(on)} \times R_{DS(on)max}$ $V_{GS} = 10 V$ | 5.6 | | | A |

DYNAMIC

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|------------------------------|---|------|------|------|------|
| $g_{fs} (*)$ | Forward Transconductance | $V_{DS} > I_{D(on)} \times R_{DS(on)max}$ $I_D = 2.5 A$ | 2.5 | 4.1 | | S |
| C_{iss} | Input Capacitance | $V_{DS} = 25 V$ $f = 1 MHz$ $V_{GS} = 0$ | | 1250 | | pF |
| C_{oss} | Output Capacitance | | | 128 | | pF |
| C_{rss} | Reverse Transfer Capacitance | | | 13 | | pF |

ELECTRICAL CHARACTERISTICS (continued)

SWITCHING ON

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------|--------------------|--|------|------|------|------|
| $t_{d(on)}$ | Turn-on Time | $V_{DD} = 450\text{ V}$ $I_D = 2.5\text{ A}$ | | 18 | | ns |
| t_r | Rise Time | $R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$ (see test circuit, figure 3) | | 9 | | ns |
| Q_g | Total Gate Charge | $V_{DD} = 720\text{ V}$ $I_D = 5\text{ A}$ $V_{GS} = 10\text{ V}$ | | 33 | 47 | nC |
| Q_{gs} | Gate-Source Charge | $R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$ | | 10 | | nC |
| Q_{gd} | Gate-Drain Charge | | | 13 | | nC |

SWITCHING OFF

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------------|-----------------------|--|------|------|------|------|
| $t_{r(Voff)}$ | Off-voltage Rise Time | $V_{DD} = 720\text{ V}$ $I_D = 5\text{ A}$ | | 13 | | ns |
| t_f | Fall Time | $R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$ | | 10 | | ns |
| t_c | Cross-over Time | (see test circuit, figure 5) | | 17 | | ns |

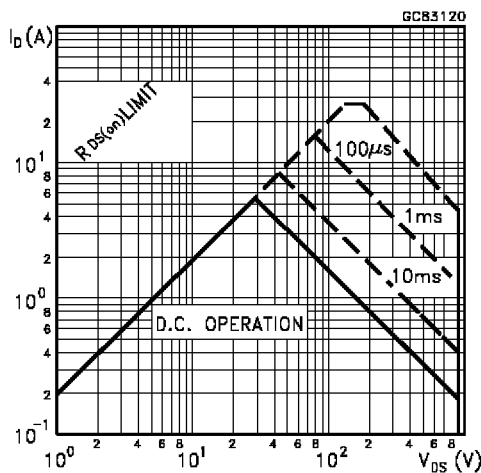
SOURCE DRAIN DIODE

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------------|-------------------------------|---|------|------|------|---------------|
| I_{SD} | Source-drain Current | | | | 5.6 | A |
| $I_{SDM}(\bullet)$ | Source-drain Current (pulsed) | | | | 22.4 | A |
| $V_{SD}(\ast)$ | Forward On Voltage | $I_{SD} = 5\text{ A}$ $V_{GS} = 0$ | | | 1.6 | V |
| t_{rr} | Reverse Recovery Time | $I_{SD} = 5\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$ $T_j = 150\text{ }^\circ\text{C}$ (see test circuit, figure 5) | | 700 | | ns |
| Q_{rr} | Reverse Recovery Charge | | | 5.4 | | μC |
| I_{RRM} | Reverse Recovery Current | | | 15.5 | | A |

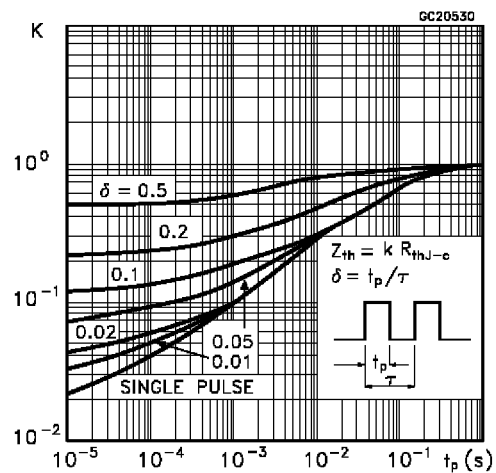
(*) Pulsed: Pulse duration = 300 μs , duty cycle 1.5%

(•) Pulse width limited by safe operating area

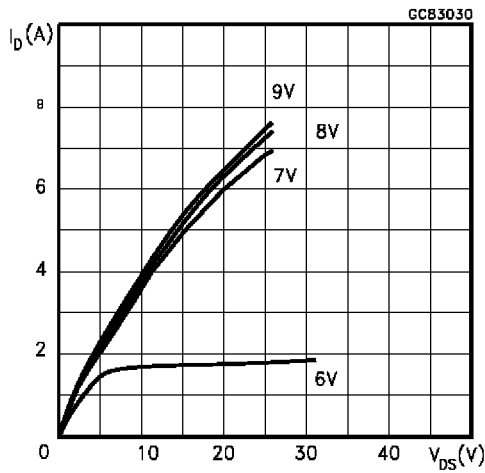
Safe Operating Area



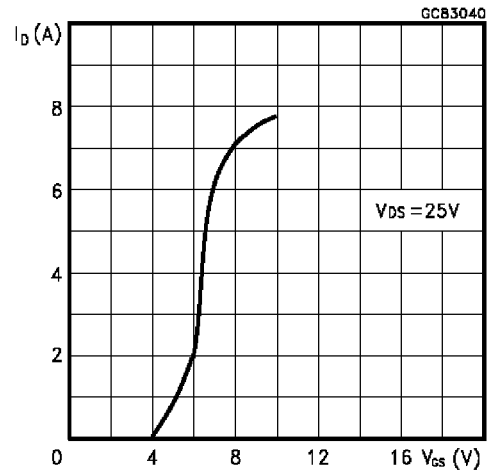
Thermal Impedance



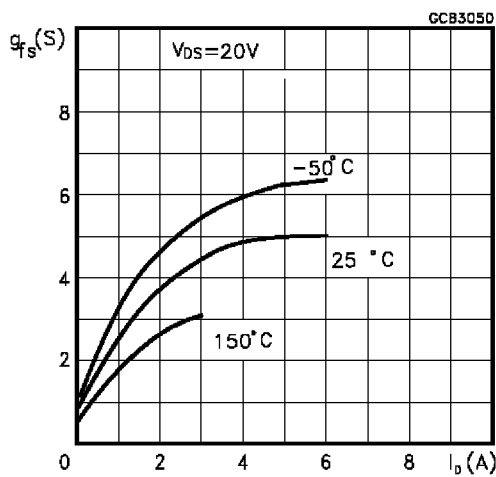
Output Characteristics



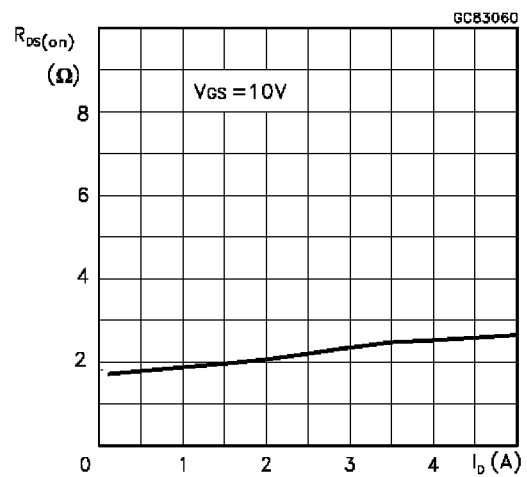
Transfer Characteristics



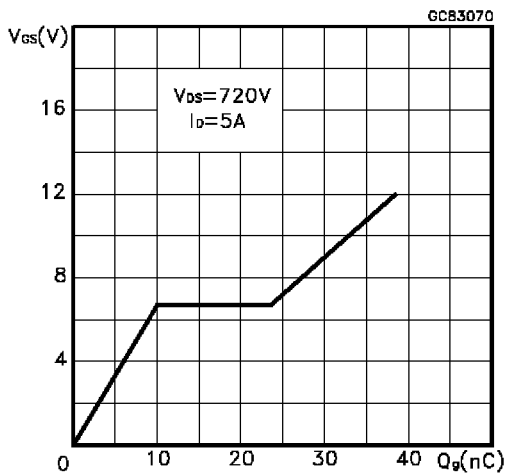
Transconductance



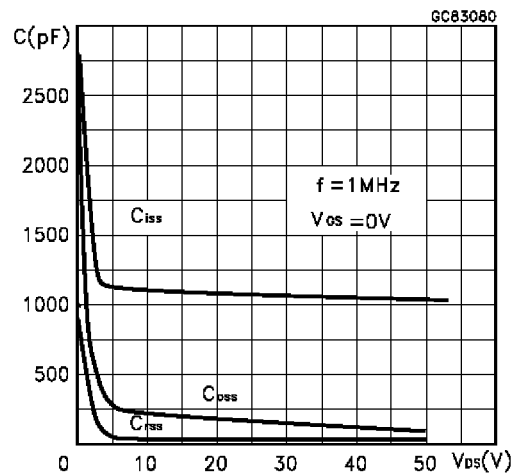
Static Drain-source On Resistance



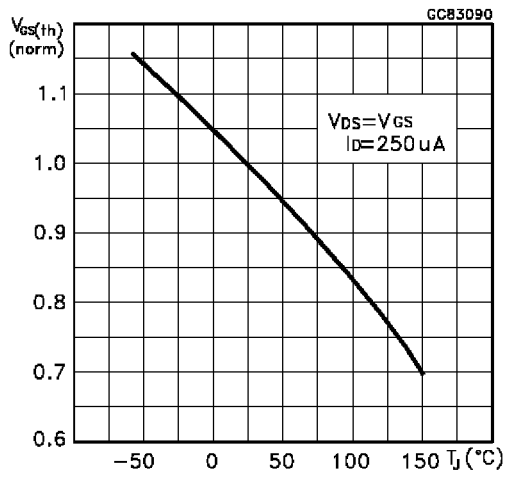
Gate Charge vs Gate-source Voltage



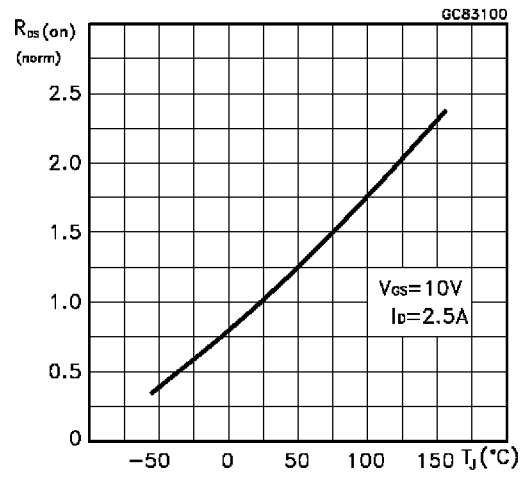
Capacitance Variations



Normalized Gate Threshold Voltage vs Temperature



Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics

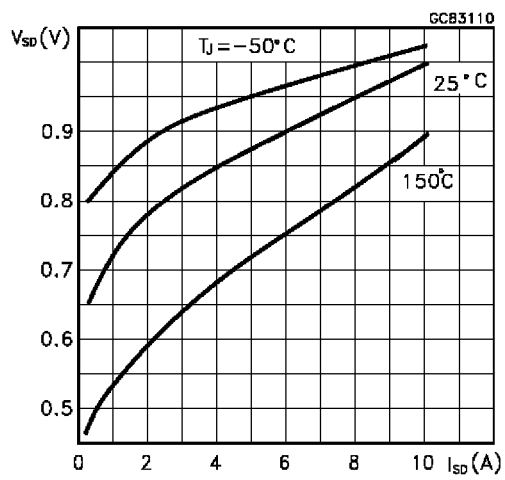


Fig. 1: Unclamped Inductive Load Test Circuit

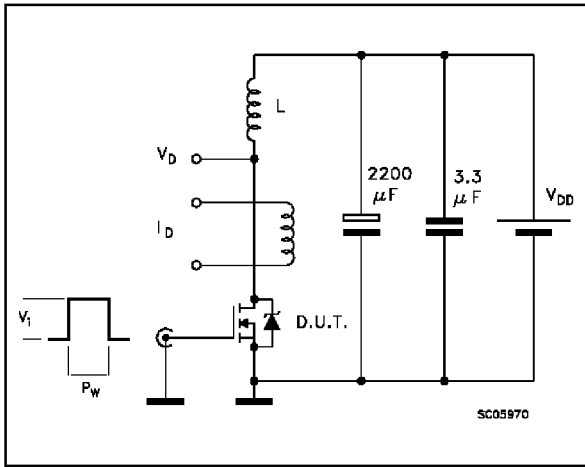


Fig. 2: Unclamped Inductive Waveform

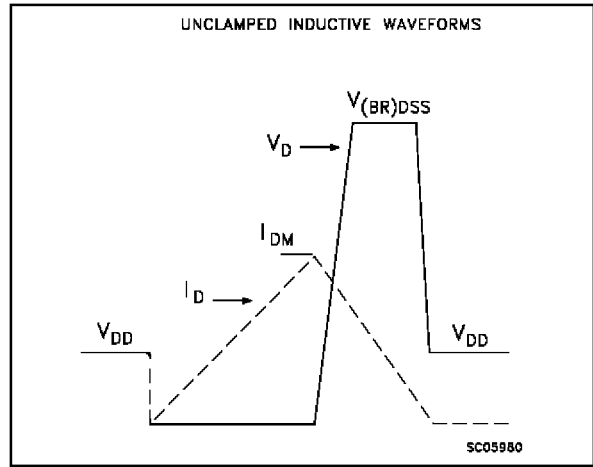


Fig. 3: Switching Times Test Circuits For Resistive Load

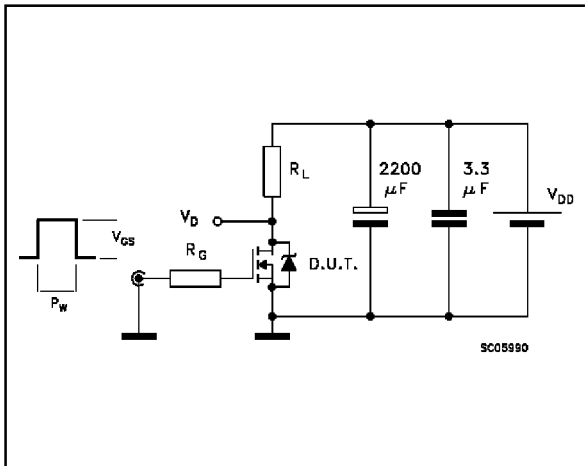


Fig. 4: Gate Charge test Circuit

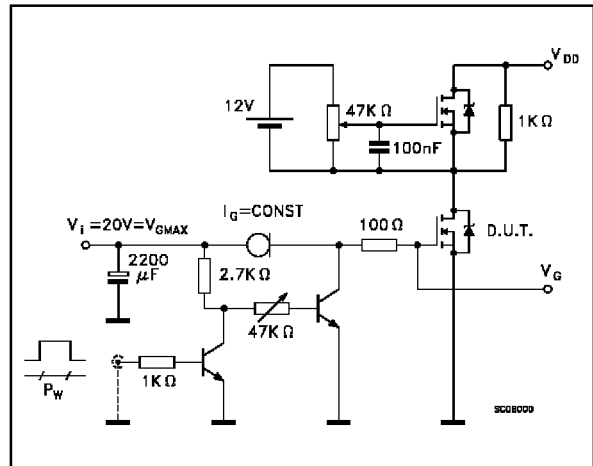
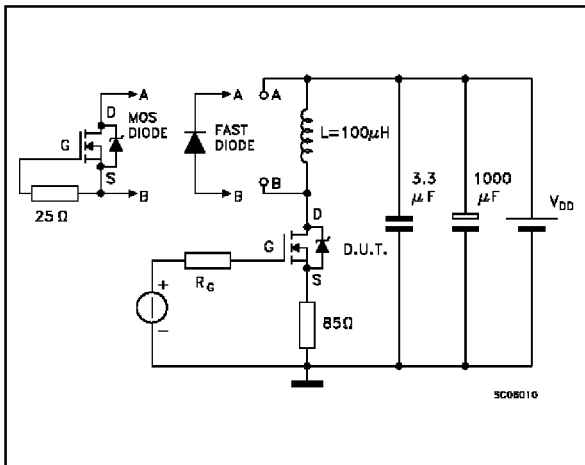


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



TO-247 MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.7 | | 5.3 | 0.185 | | 0.209 |
| D | 2.2 | | 2.6 | 0.087 | | 0.102 |
| E | 0.4 | | 0.8 | 0.016 | | 0.031 |
| F | 1 | | 1.4 | 0.039 | | 0.055 |
| F3 | 2 | | 2.4 | 0.079 | | 0.094 |
| F4 | 3 | | 3.4 | 0.118 | | 0.134 |
| G | | 10.9 | | | 0.429 | |
| H | 15.3 | | 15.9 | 0.602 | | 0.626 |
| L | 19.7 | | 20.3 | 0.776 | | 0.779 |
| L3 | 14.2 | | 14.8 | 0.559 | 0.413 | 0.582 |
| L4 | | 34.6 | | | 1.362 | |
| L5 | | 5.5 | | | 0.217 | |
| M | 2 | | 3 | 0.079 | | 0.118 |
| Dia | 3.55 | | 3.65 | 0.140 | | 0.144 |

