**2006**

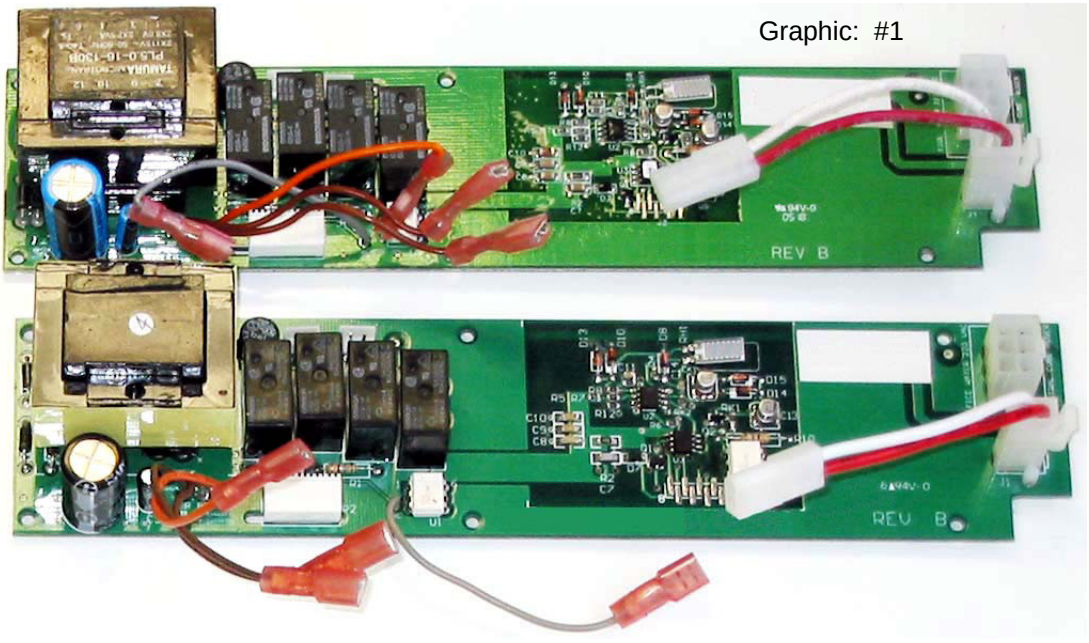
**Introduction:**

360° Test Labs has been retained to perform a formal competitive analysis of competing PCBAs/ Part Number: **Model 'X'**. For the client assembly, 360° Test Labs was supplied extensive documentation including BOMs, drawings, manufacturer specifications, and RoHS data. For the competitor assembly 360° Test Labs was supplied the BOM and then independently sourced missing requisite data from manufacturer documentation or distributor supplied documentation.

To make comparisons and draw supported conclusions, 360° Test Labs identified each component and the specifications associated with that component including, specified operating environments, ratings, and failure rates, etc. When the origin of manufacture was not determinable, analysis of materials physical and electrical characteristics was closely scrutinized.

**Findings:**

Graphic: #1



Note: Additional Information Found in Appendix for Red Shaded Items

| RefDes | Description | Value | Model 'X' | | | Model 'X'-2 | | | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | | | Manufacturer | Part Number | Specifications | Manufacturer | Part Number | Specifications | |
| PCB | PCB FR4, 1.5 OZ CU, .062" THICK | | MONKUNGCHINHO | :40575900 | | | | | Equivalent parts--no notable specification variances. |
| | SILICONE CONFORMAL COATING DOW CORNING 3-1753 | | | | | | | | Not used on clinet board. See conformal coating notes that follow this table. |
| P2 | CONNECTOR 10 PIN 1.25MM SPACING CABLE THRU BRD | | MOLEX | 52492-1020 | | MOLEX | 52492-1020 | | Same part. |
| D1 - 4, D6 | DIODE RECTIFIER 1 AMP 400PIV DO-41 | | PANJIT | 1N4004(TB) | 1 amp 400 PIV | | 1N4004 | | While this part is rated 400V, a bench test showed the Panjit breakdown was > 800 VDC. Part sample exceeds specs. |
| F1 | FUSE MSF 1 AMP 250V QUICK ACT | | Conquer | MSF 1A/250V | FUSE MEF 1A/250V | SCHURTER | 0034.6014 | | Equivalent parts. Identical overload ratings. The client Part has a wider temp rating, -55C to + 125C vs -40C to +85 C for the competing Part. See appendix for specification highlight. |
| K1 - 4 | Single Pole Relay, 5A N.O. 5VDC | | OMRON | G5Q-14 | | OMRON | G5S-1 | | The G5S-1 is rated 5 amps through the Normally Open Contacts, and 3 amps though the Normally Closed Contacts. The G5Q-14 is rated 10 amps though the Normally Open and 5 though the Normally Closed Contacts. All other specifications are identical. The clinet G5Q-14 is clearly a superior part. See appendix for specification highlight. |
| | | | | | | AROMAT | JQ1P-5V | | |
| | | | | | | Song Chuan | 892-ICC-S 5VDC | | |
| U1, U5 | TRIAC THRU-6 PIN DIP T-H | | Fairchild | MOC-3083M | | QT OPTOELECTRONICS | MOC3083-M | | Same part. QT Optoelectronics is a Vendor not a manufacturer. |
| P3, P4 | SHROUDED HEADER CONN 2 PIN 2.5MM PITCH WHITE | | Chyaoshiunn | JS-1151-02 | | JST | B2B-EH-A | | Equivalent parts--no notable specification variances. |
| P1 | CONNECTOR 6 PIN MINI-FIT | | TKP | JS-1151-06 | | MOLEX | 39-29-9066 | | Equivalent parts--no notable specification variances. |
| | | | | | | AMP | 794662-6 | | |
| C2 | CAPACITOR ELECTROLYTIC 2200UF 25V 5MM | 2200UF | YELLOWSTONE | GR2200M25W1321 | | PANASONIC | ECA-1EM222 | | Equivalent parts. Leakage Currents are rated differently. Panasonic 1 and 2 min values at 20C, Stone 3 min at 25C, but both are < 3u Amps after 3 min.See appendix for specification highlight. |
| | | | | | | ILLINOIS CAP | 228CKS025M | | |
| C3 | CAPACITOR ELECTROLYTIC 10UF 25V 2.5MM | 10uF | YELLOWSTONE | GR10M25W0511 | | PANASONIC | ECA-1EM100 | | Equivalent parts. Leakage Currents are rated differently Panasonic 1 and 2 min values at 20C, Stone 3 min at 25 C, but both are < 3u Amps after 3 min. The Stone part is rated to 105 C, while the Panasonic part is only rated 85C.See appendix for specification highlight. |
| SL | GRAY WIRE ASM (ICE CRADLE) T-H | | Yung Hua | | 1007#22 70m/m+FDFNYD1-187(5)+5192T-GREY | | | | No Information on the competing wire, client wire meets UL voltage and flame tests. |
| OR | ORANGE WIRE ASM (WATER CRADLE) T-H | | Yung Hua | | 1007#22 70m/m+FDFNYD1-187(5)+5191T-OR | | | | No Information on the competing wire, client wire meets UL voltage and flame tests. |
| BR | BROWN WIRE ASM (COMMON CRADLE) T-H | | Yung Hua | | 1007#22 70m/m+FDFNYD1-187(5)+5190T-BR | | | | No Information on the competing wire, client wire meets UL voltage and flame tests. |
| R1, R10 | RESISTOR CARBON FILM 560 OHM 5% 0.25W THRU-HOLE | 560 Ohm | Tzaiyuan | 560Ω | | SEI | CF1/45605% | | Equivalent parts--no notable specification variances. |
| | TRANSISTOR SINGLE NPN DIGITAL 15VDC 600MA SMT3 | | ROHM | DTC323TKT146 | | ROHM | DTC323TK T146 | | Same part. |
| | XSTR N CHAN MOSFET 60VDC 115MA SMT SOT-23 | | PANJIT | 2N7002 | | FAIRCHILD | 2N7002 | | The Panjit is a somewhat superior part. Panjit's part is rated for 350 milliwatts to Farichilds 200 milliwatts. Both parts are rated 60 VDC, but the Panjit is rated typcial 105 VDC. See appendix for specification highlight. |
| | | | | | | CENTERAL SEMICONDUCTOR | 2N7002 | | |
| | CAP CER 0.001UF 50VDC +/-10% X7R SMT 0805 | .001 uF | Compostar | 0805-0001-50-7r | 50V X7R +-10% | KEMET | C0805C102K5RACTU | | The Kemet part meets RoHS requirements, but does not mention compatablity with SAC solders. |
| | | | | | | BC COMPONENTS | 1206B102K500NT | | |
| | CAP CER 0.01UF 50VDC +/-10% X7R SMT 0805 | .01 uF | Compostar | 0805-001-50-7r | 50V X7R +-10% | PANASONIC | ECJ2VB1H103K | | See appendix for specification highlight. |
| | | | | | | AVX | 08055C103KAT2A | | |
| | CAPACITOR CERAMIC 0.01UF (10000PF) 50VDC +/-10% X7R SMT 1206 | .01 uF | Compostar | 1206-001-50-7r | 50V X7R +-10% | PANASONIC | ECU-V1H103KBM | | Equivalent parts--no notable specification variances. |
| | | | | | | KEMET | C1206C103K5RACTU | | |
| | | | | | | BC COMPONENTS | 1206B103K500NT | | |
| | CAP CER 0.1UF 50VDC +/-10% X7R SMT 1206 | .1 uF | Compostar | 1206-01-50-7r | 50V X7R +-10% | PANASONIC | ECJ3VB1H104K | | See appendix for specification highlight. |
| | | | | | | AVX | 12065C104KAT2A | | |
| D7 | DIODE SCHOTTKY RECTIFIER 20V 500MA SMT SOD123 | | ON | MBR0520LT1G | | FAIRCHILD | MBR0520L | | Equivalent parts--no notable specification variances. |
| | | | | | | ON-SEMI | MBR0520LT1 | | Same part. |
| R7, R8 | RES THICK FILM MARKED 1K 1% 1/8W OR 1/10W SMT 0805 | 1K | Tzaiyuan | 0805-1k-5 | | ROHM | MCR10EZHF1001 | | Equivalent parts. While the Rohm part supported Lead-Free soldering, the part itself did not claim RoHS compliance. |
| | CAPACITOR CERAMIC 10PF 50VDC +/-5% NPO SMT MULTILAYER CHIP 1206 COG, ALTERANATE AVX12061A100JATMA 100V KEMET | 10 pF | Compostar | 1206-0001-50-7r | 50V X7R +-10% | AVX | 12065A100DATIA, | | See appendix for specification highlight. |
| | | | | | | RFE | MA1206CG100K500R | | |
| C13, C14 | CAP ELECTROLYTIC 10UF 16VDC SMT 4 X 4.5MM | 10 uF | Nichicon | UZS1C100MCL1GB | 16v -40~85 UZS1C100MCL1GB | NICHICON | UZS1C100MCR1GB | | Same part. |
| | | | | | | TECATE | MXLP-016/M4X5TR13 | | |
| | | | | | | ILLINOIS CAP | 106SLP016M | | |
| R2 | RES THICK FILM MARKED 4.7K 5% 1/4W SMT 1206 | 4.7K | Tzaiyuan | 1206-47-5 | 1% | PANASONIC | ERJ-8GEYJ472V | | Equivalent parts. While the Rohm part supported Lead Free soldering, the part itself did not claim RoHS compliance. |
| | | | | | | ROHM | MCR18EZHJ472 | | |
| R12 | RES THICK FILM MARKED 7.32K 1% 1/8W SMT 0805 | 7.32K | Tzaiyuan | 0805-732-1 | 1% | PANASONIC | ERJ-6ENF7321V | | Equivalent parts. While the Rohm part supported Lead Free soldering, the part itself did not claim RoHS compliance. |
| | | | | | | ROHM | MCR10EZHF7321 | | |
| | RES THICK FILM MARKED 24.9K 1% 1/8W SMT 0805 | 24.9K | Tzaiyuan | 0805-129-1 | 1% | PANASONIC | ERJ-6ENF2492V | | Equivalent parts. While the Rohm part supported Lead Free soldering, the part itself did not claim RoHS compliance. |
| | | | | | | ROHM | MCR10EZHF2492 | | |
| R3 - R6 | RES THICK FILM MARKED 10K 1% 1/8W SMT 0805 | 10K | Tzaiyuan | 0805-10k-5 | 1% | PANASONIC | ERJ-6ENF1002V | | Equivalent parts. While the Rohm part supported Lead Free soldering, the part itself did not claim RoHS compliance. |
| | | | | | | ROHM | MCR10EZHF1002 | | |
| RH1 | SENSOR HUMIDITY RESITIVE +/-5% 0.1" PITCH T-H | | GE | EMD-4000 | +-5% | GENERAL EASTERN INSTRUMENTS | EMD-4000 | | Same part. |
| D8, D10, D13 - 15 | DIODE HIGH SPEED SWITCHING 100VDC 200MA T-H DO-35 | | Fairchild | 1N914 | | FAIRCHILD | 1N914 | | Same part. |
| | | | | | | VISHAY | 1N914 | | Equivalent parts--no notable specification variances. |
| U2 | IC DUAL WIDE LOW POWER OP AMP SMT SOIC-8 | | ON | LM358 | | NATIONAL | LM358AM | | The ON Simiconductor component has ESD clamps on the Op Amp Inputs. These can be very important in consumer appliances. The National Semi part does not mention ESD protection; thus, the ON Semi is a superior part. The ON LM358 is RoHS. |
| | | | | | | TEXAS INSTRUMENTS | LM358D | | |
| U3 | IC 8-BIT MICROCONTROLLER 1024 WORDS SOIC-8 (HSFRA.Hex) | | Microchip | PIC12F675 | | MICROCHIP | PIC12F675-I/SN | | Same Part |
| J1 | CONN 2 PIN MINI-FIT | | Chyaoshiunn | P120I-02(TKP) | | MOLEX | 39-29-9022 | | Equivalent parts--no notable specification variances. |
| T1 | TRANSFORMER 115/230VAC 60/50HZ 5VA 16V SERIES 8V PARALLEL CLASS B T-H | | Eng Electric Co. | 1P41-160031A-063 | 115/230VAC | TAMURA | PL5.0-16-130B MEC | | Equivalent parts. competing HiPot tested to 2500 V, client HiPot tested to 1800 V. |
| | Label #1 | | E-SHIN | 3918 | Warning Label | | | | Same part. |
| | Label #2 | | E-SHIN | 38904 | White Label | | | | Equivalent label. |

**Additional Comparative Details:**

The competitor board has a silicon based conformal coating over the Op-Amp area, the client board does not—an engineering review of the necessity of this coating should be made. On the positive side, the Op-Amp gain could be very sensitive to debris on the circuits—conformal coating would prevent this.

On the negative side, the Humidity Sensor on the competitor board has been conformally coated. **It is unlikely that the Humidity Sensor has been properly functioning on the competitor board**. The problem could be corrected by masking the Humidity Sensor during coating, or installing the sensor during a later step.

**360° Test Labs Independently Concludes and Certifies:**

The competing boards are functionally equivalent and of equivalent quality—excepting the issue noted above relating to conformal coating.

**Appendix -** Highlighted Competitor Related Specification Sheets



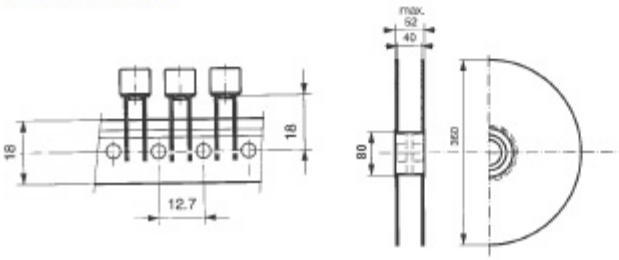
## Technical data and packaging
Types MSF 125
MSF 250
MST 250
MSTU 250
MXT 250

### Additional technical data

| | |
|---|---|
| Ambient temperature max. $T_a$ | MSF 125: – 25 °C to + 85 °C<br>MSF / MST / MSTU / MXT 250: – 40 °C to + 85 °C |
| Permissible continuous operating current at 23 °C | MSF 125: 0,7 · $I_n$ Shift of the rated current at ambient air temperatures > 23 °C see diagramm on page 204<br>MSF / MST / MSTU / MXT 250: 1 · $I_n$ |
| Resistance to vibration | Frequency 10 ÷ 2000 Hz, cross-over frequency 60 Hz<br>< 60 Hz constant amplitude of 1,5 mm (except MSF 125: 0,75 mm)<br>> 60 Hz constant acceleration of 100 m/s² (10 g)<br>according to IEC 60068-2-6, test Fc / |
| Resistance to shock | 490 m/s² (50 g), 11 ms according to IEC 60068-2-27 |
| Climate category | Types MSF 125, MXT 250 25/085/21; MSF 250, MST 250, MSTU 250 40/085/21 } according to IEC 60068-1 |
| Fuse-link temp. rise ≤ 75 K (UL/CSA) | Trackwidth for: I ≤ 4 A 2,5 mm<br>I > 5 A– 7 A 5,0 mm<br>I > 8 A–10 A 10 mm |
| Solderability | 235 °C / 2 sec. according to IEC 60068-2-20, test Ta |
| Soldering heat resistance | 260 °C / 10 sec. according to IEC 60068-2-20, test Tb |
| Materials Socket and cap | temperature resistant plastic, UL 94V-0 |
| Terminals | Copper tin-plated |

### Packaging
- Boxes of 100 pieces
- Taped and reeled 750 pieces
  MSF 125, 1000 pieces
- Ammopack 1000 pieces on request

### Tape and reel
according to IEC 60286-2



# Specifications

## ■ COIL RATINGS

| | | | | | | |
|---|---|---|---|---|---|---|
| Rated voltage | 5 VDC | 9 VDC | 12 VDC | 18 VDC | 24 VDC | 48 VDC |
| Rated current | 80 mA | 44.4 mA | 33.3 mA | 22.2 mA | 16.7 mA | 8.3 mA |
| Coil resistance | 62.5 Ω | 202.5 Ω | 360 Ω | 810 Ω | 1,440 Ω | 5,760 Ω |
| Must operate voltage | 75% max. of rated voltage | | | | | |
| Must release voltage | 5% min. of rated voltage | | | | | |
| Max. voltage | 150% of rated voltage at 23°C, 110% of rated voltage at 70°C | | | | | |
| Power consumption | Approx. 400 mW | | | | | |

**Note:** Rated current and coil resistance are measured at 23°C with a tolerance of ±10%.

## ■ CONTACT RATINGS

| Load | Resistive load | Inductive load |
|---|---|---|
| Rated load | 2 A (NO)/2 A (NC) at 277 VAC<br>3 A (NO)/3 A (NC) at 125 VAC<br>3 A (NO)/3 A (NC) at 30 VDC | 0.5 A at 250 VAC, cosφ=0.4<br>1 A at 250 VAC, cosφ=0.8<br>0.8 A at 250 VAC, cosφ=0.9 |
| Contact material | Ag | |
| Rated carry current | 5 A (NO)/3 A (NC) | |
| Max. switching voltage | 277 VAC, 30 VDC | |
| Max. switching current | 5 A (NO)/3 A (NC) | 1 A |
| Max. switching capacity | 625 VA, 150 W (NO)<br>375 VA, 90 W (NC) | 250 VA |
| Min. permissible load | 10 mA at 5 VDC | |

**Note:** P level: $\lambda 60 = 0.1 \times 10^{-6}$ operation (with an operating frequency of 120 operations/min.)

## ■ CHARACTERISTICS

| | |
|---|---|
| Contact resistance (See Note 2.) | 100 mΩ max. |
| Operate time (See Note 3.) | 10 ms max. |
| Release time (See Note 3.) | 5 ms max. |
| Insulation resistance (See Note 4.) | 1,000 MΩ min. |
| Dielectric strength | 4,000 VAC, 50/60 Hz for 1 min between coil and contacts<br>750 VAC, 50/60 Hz for 1 min between contacts of same polarity |
| Impulse withstand voltage | 8 kV (1.2 x 50 μs) |
| Vibration resistance | Destruction: 10 to 55 Hz, 1.5-mm double amplitude for 2 hours<br>Malfunction: 10 to 55 Hz, 1.5-mm double amplitude for 3 minutes |
| Shock resistance | Destruction: 1,000 m/s² (approx. 100G)<br>Malfunction: Energized: 100 m/s² (approximately 10G)<br>Non-energized: 50 m/s² (approximately 5G) |

(This table continues on the next page.)

# Radial Lead Type

Series: M Type : A

Japan
Malaysia
China
Taiwan

■ Features

Endurance:85°C 2000 h
Smaller than series SU

Standard

■ Specifications

| | | |
|---|---|---|
| Category Temp. Range | -40 to + 85°C | -25 to + 85°C |
| Rated W.V. Range | 6.3 to 100 V .DC | 160 to 450 V .DC |
| Nominal Cap. Range | 0.1 to 22000 µ F | 1.0 to 470 µ F |
| Capacitance Tolerance | ±20 % (120Hz/+20°C) | |
| DC Leakage Current | I ≤ 0.03 CV or 4(µ A) after 1 minutes<br>I ≤ 0.01 CV or 3(µ A) after 2 minutes<br>( Whichever, is greater) | I ≤ 0.06 CV + 10(µ A) after 2 minutes |
| Dissipation Factor | Please see the attached standard products list | |

Characteristics at Low Temperature

| W.V. (V) | 6.3 | 10 | 16 | 25 | 35 | 50 | 63 | 100 | 160 | 200 | 250 | 350 | 400 | 450 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Z(-25 °C)/ Z(+20 °C) | 5 | 4 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 5 | 6 | 6 |
| Z(-40 °C)/ Z(+20 °C) | 12 | 10 | 8 | 5 | 4 | 3 | 3 | 3 | - | - | - | - | - | - |

1. Add 0.5 per 1000 µF for products of 1000 µF or more at -25 °C
2. Add 1.0 per 1000 µF for products of 1000 µF or more at -40 °C
(Impedance ratio at 120 Hz)

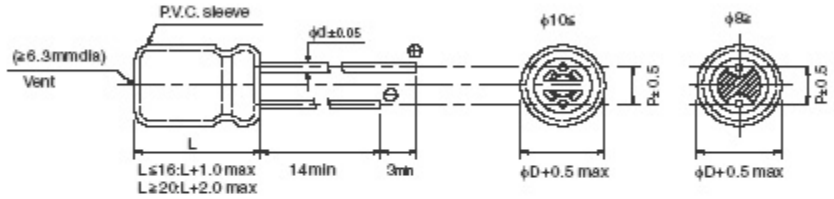
Endurance

After applying rated working voltage for 2000 hours at +85°C and then being stabilized at +20°C, capacitor shall meet the following limits.

| | |
|---|---|
| Capacitance change | ± 20% of initial measured value |
| D.F. | ≤ 150 % of initial specified value |
| DC leakage current | ≤ initial specified value |

Shelf Life: After storage for 1000 hours at +85±2 °C with no voltage applied and then being stabilized at +20 °C, capacitors shall meet the limits specified in "Endurance".(With voltage treatment)

■ Dimensions in mm (not to scale)




| Body Dia. ϕD | 5 | 6.3 | 8 | 10 | 12.5 | 16 | 18 |
|---|---|---|---|---|---|---|---|
| Lead Dia. ϕd | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | 0.8 | 0.8 |
| Lead space P | 2 | 2.5 | 3.5 | 5 | 5 | 7.5 | 7.5 |

FAIRCHILD
SEMICONDUCTOR™

November 1995

# 2N7000 / 2N7002 / NDS7002A
# N-Channel Enhancement Mode Field Effect Transistor

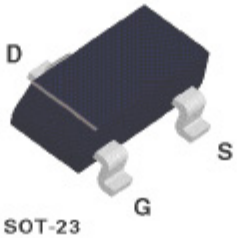
## General Description

These N-Channel enhancement mode field effect transistors are produced using Fairchild's proprietary, high cell density, DMOS technology. These products have been designed to minimize on-state resistance while provide rugged, reliable, and fast switching performance. They can be used in most applications requiring up to 400mA DC and can deliver pulsed currents up to 2A. These products are particularly suited for low voltage, low current applications such as small servo motor control, power MOSFET gate drivers, and other switching applications.

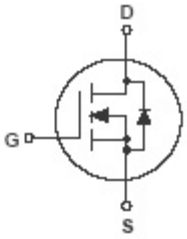
## Features

- High density cell design for low $R_{DS(ON)}$.
- Voltage controlled small signal switch.
- Rugged and reliable.
- High saturation current capability.


TO-92
2N7000




SOT-23
(TO-236AB)
2N7002/NDS7002A




## Absolute Maximum Ratings

$T_A$ = 25°C unless otherwise noted

| Symbol | Parameter | 2N7000 | 2N7002 | NDS7002A | Units |
|---|---|---|---|---|---|
| $V_{DSS}$ | Drain-Source Voltage | | 60 | | V |
| $V_{DGR}$ | Drain-Gate Voltage ($R_{GS} \leq 1$ MΩ) | | 60 | | V |
| $V_{GSS}$ | Gate-Source Voltage - Continuous | | ±20 | | V |
| | - Non Repetitive (tp < 50µs) | | ±40 | | |
| $I_D$ | Maximum Drain Current - Continuous | 200 | 115 | 280 | mA |
| | - Pulsed | 500 | 800 | 1500 | |
| $P_D$ | Maximum Power Dissipation | 400 | 200 | 300 | mW |
| | Derated above 25°C | 3.2 | 1.6 | 2.4 | mW/°C |
| $T_J, T_{STG}$ | Operating and Storage Temperature Range | -55 to 150 | | -65 to 150 | °C |
| $T_L$ | Maximum Lead Temperature for Soldering Purposes, 1/16" from Case for 10 Seconds | | 300 | | °C |
| **THERMAL CHARACTERISTICS** | | | | | |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | 312.5 | 625 | 417 | °C/W |



2N7000.SAM Rev. A1

## Electrical Characteristics $T_A$ = 25°C unless otherwise noted

| Symbol | Parameter | Conditions | Type | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 10 µA | All | 60 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 48 V, $V_{GS}$ = 0 V | 2N7000 | | | 1 | µA |
| | | $T_J$=125°C | | | | 1 | mA |
| | | $V_{DS}$ = 60 V, $V_{GS}$ = 0 V | 2N7002 NDS7002A | | | 1 | µA |
| | | $T_J$=125°C | | | | 0.5 | mA |
| $I_{GSSF}$ | Gate - Body Leakage, Forward | $V_{GS}$ = 15 V, $V_{DS}$ = 0 V | 2N7000 | | | 10 | nA |
| | | $V_{GS}$ = 20 V, $V_{DS}$ = 0 V | 2N7002 NDS7002A | | | 100 | nA |
| $I_{GSSR}$ | Gate - Body Leakage, Reverse | $V_{GS}$ = -15 V, $V_{DS}$ = 0 V | 2N7000 | | | -10 | nA |
| | | $V_{GS}$ = -20 V, $V_{DS}$ = 0 V | 2N7002 NDS7002A | | | -100 | nA |
| **ON CHARACTERISTICS** (Note 1) | | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 1 mA | 2N7000 | 0.8 | 2.1 | 3 | V |
| | | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 2N7002 NDS7002A | 1 | 2.1 | 2.5 | |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}$ = 10 V, $I_D$ = 500 mA | 2N7000 | | 1.2 | 5 | Ω |
| | | $T_J$ =125°C | | | 1.9 | 9 | |
| | | $V_{GS}$ = 4.5 V, $I_D$ = 75 mA | | | 1.8 | 5.3 | |
| | | $V_{GS}$ = 10 V, $I_D$ = 500 mA | 2N7002 | | 1.2 | 7.5 | |
| | | $T_J$ =100°C | | | 1.7 | 13.5 | |
| | | $V_{GS}$ = 5.0 V, $I_D$ = 50 mA | | | 1.7 | 7.5 | |
| | | $T_J$ =100C | | | 2.4 | 13.5 | |
| | | $V_{GS}$ = 10 V, $I_D$ = 500 mA | NDS7002A | | 1.2 | 2 | |
| | | $T_J$ =125°C | | | 2 | 3.5 | |
| | | $V_{GS}$ = 5.0 V, $I_D$ = 50 mA | | | 1.7 | 3 | |
| | | $T_J$ =125°C | | | 2.8 | 5 | |
| $V_{DS(ON)}$ | Drain-Source On-Voltage | $V_{GS}$ = 10 V, $I_D$ = 500 mA | 2N7000 | | 0.6 | 2.5 | V |
| | | $V_{GS}$ = 4.5 V, $I_D$ = 75 mA | | | 0.14 | 0.4 | |
| | | $V_{GS}$ = 10 V, $I_D$ = 500mA | 2N7002 | | 0.6 | 3.75 | |
| | | $V_{GS}$ = 5.0 V, $I_D$ = 50 mA | | | 0.09 | 1.5 | |
| | | $V_{GS}$ = 10 V, $I_D$ = 500mA | NDS7002A | | 0.6 | 1 | |
| | | $V_{GS}$ = 5.0 V, $I_D$ = 50 mA | | | 0.09 | 0.15 | |

2N7000.SAM Rev. A1

**Panasonic**
**Electronic Components**

**" NOT RECOMMENDED FOR NEW DESIGNS " NOTICE**

**SUBJECT:** ECJ-xxxxxxxxx Series Multi-l[illegible]ic Chip Capacitor Standard Capacitance Values in 0402, 0603, 0805, 12[illegible]zes

**BULLETIN #: ECN.PG33.05.26.04-1** **Date: May 26, 2004** supercedes

BULLETIN #: ECN.PG33.03.17.04-2 Dated: March 17, 2004 **Page 1 of 4**

**WHICH WAS PREVIOUSLY INCORRECTLY LISTED AS A DISCONTINUATION NOTICE**
**IS NOW CORRECTLY LISTED AS " NOT RECOMMENDED FOR NEW DESIGNS " NOTICE**

**EFFECTIVE DATE:** April 1, 2[illegible]

**REASON FOR CHANGE:** [illegible]ng the particular capacitance values into a smaller size package in line with industry trends and [illegible]ology capability. In some instances, because of low usage, some capacitance values will not b[illegible]able in the future. These P/Ns are those being considered.

**ENGINEERING CHANGE DETAILS:** See below for the particular part numbers.

**OTHER DETAILS:**

**Affected Part Numbers: [ P/Ns with or without 'dash' ' - ' are valid ]**

| Case Size | Nominal Capacitance | Old Part Number | New Part Number |
|---|---|---|---|
| 0402 | 1,500 pF | ECJ-0EF1H152x | No Replacement |
| 0402 | 3,300 pF | ECJ-0EF1H332x | No Replacement |
| 0402 | 6,800 pF | ECJ-0EF1H682x | No Replacement |
| 0402 | 1,500 pF | ECJ-0EF1E152x | No Replacement |
| 0402 | 3,300 pF | ECJ-0EF1E332x | No Replacement |
| 0402 | 6,800 pF | ECJ-0EF1E682x | No Replacement |
| 0402 | 15,000 pF | ECJ-0EF1E153x | No Replacement |
| 0402 | 15,000 pF | ECJ-0EF1C153x | No Replacement |
| 0402 | 33,000 pF | ECJ-0EF1C333x | No Replacement |
| 0402 | 68,000 pF | ECJ-0EF1C683x | No Replacement |
| 0603 | 0.12 µ F | ECJ-1VB1A124x | No Replacement |
| 0603 | 0.18 µ F | ECJ-1VB1A184x | No Replacement |
| 0603 | 0.27 µ F | ECJ-1VB0J274x | No Replacement |
| 0603 | 0.33 µ F | ECJ-1VB0J334x | No Replacement |
| 0603 | 0.39 µ F | ECJ-1VB0J394x | No Replacement |
| 0603 | 0.56 µ F | ECJ-1VB0J564x | No Replacement |
| 0603 | 0.82 µ F | ECJ-1VB0J824x | No Replacement |
| 0603 | 1, 000 pF | ECJ-1VF1H102x | No Replacement |
| 0603 | 1, 500 pF | ECJ-1VF1H152x | No Replacement |
| 0603 | 2,200 pF | ECJ-1VF1H222x | No Replacement |
| 0603 | 3,300 pF | ECJ-1VF1H332x | No Replacement |
| 0603 | 4,700 pF | ECJ-1VF1H472x | No Replacement |
| 0603 | 6,800 pF | ECJ-1VF1H682x | No Replacement |
| 0603 | 15,000 pF | ECJ-1VF1H153x | No Replacement |
| 0603 | 33,000 pF | ECJ-1VF1H333x | No Replacement |
| 0603 | 68,000 pF | ECJ-1VF1H683x | No Replacement |
| 0603 | 68,000 pF | ECJ-1VF1E683x | No Replacement |
| 0603 | 0.15 µ F | ECJ-1VF1C154x | No Replacement |
| 0603 | 0.33 µ F | ECJ-1VF1C334x | No Replacement |
| 0603 | 0.68 µ F | ECJ-1VF1A684x | No Replacement |

Panasonic Industrial Company, Product Management Division – Components Group
Two Panasonic Way, M/S: 7H-2, Secaucus, NJ 07094 USA

# CERAMIC CAPACITORS
## MA Series: Multilayer Surface Mount

### STANDARD VOLTAGES AND CAPACITANCE RANGES (pF)

| Temperature Coefficient | | | COG/NPO | X7R | X5R | Y5V |
|---|---|---|---|---|---|---|
| Size Code | Voltage | Code | (CG) | (XR) | (XR) | (YV) |
| 0402 | 6.3V | 060 | | | 100,000 - 1,000,000 | |
| | 10V | 100 | | 27,000 - 47,000 | 47,000 - 1,000,000 | |
| | 16V | 160 | | 5,600 - 22,000 | | 47,000 - 100,000 |
| | 25V | 250 | 0.5 - 470 | 3,900 - 4,700 | | 10,000 - 47,000 |
| | 50V | 500 | 0.5 - 220 | 120 - 3,300 | | 10,000 - 47,000 |
| 0603 | 6.3V | 060 | | | 1,000,000 - 2,200,000 | 2,200,000 |
| | 10V | 100 | | 120,000 - 220,000 | 330,000 - 680,00 | 470,000 - 1,000,000 |
| | 16V | 160 | | 33,000 - 100,000 | | 220,000 - 1,000,000 |
| | 25V | 250 | 1,000 - 2,200 | 27,000 - 100,000 | | 10,000 - 220,000 |
| | 50V | 500 | 0.5 - 2,200 | 120 - 100,000 | | 10,000 - 100,000 |
| | 100V | 101 | 0.5 - 680 | 120 - 10,000 | | |
| | 250V | 251 | 0.5 - 100 | | | |
| 0805 | 6.3V | 060 | | | 2,200,000 - 10,000,000 | 10,000,000 |
| | 10V | 100 | | 330,000 - 1,000,000 | 1,000,000 - 4,700,00 | 2,200,000 - 10,000,000 |
| | 16V | 160 | | 120,000 - 470,000 | 330,000 - 1,000,000 | 330,000 - 2,200,000 |
| | 25V | 250 | 5,600 - 15,000 | 100,000 - 330,000 | | 100,000 - 1,000,000 |
| | 50V | 500 | 0.5 - 4,700 | 120 - 100,000 | | 10,000 - 1,000,000 |
| | 100V | 101 | 0.5 - 2,700 | 120 - 22,000 | | |
| | 250V | 251 | 0.5 - 1,500 | 150 - 22,000 | | |
| | 500V | 501 | 0.5 - 470 | 150 - 5,600 | | |
| | 1000V | 102 | 0.5 - 270 | 150 - 2,700 | | |
| 1206 | 10V | 100 | | 1,000,000 | 3,300,000 - 10,000,000 | 2,200,000 - 22,000,000 |
| | 16V | 160 | | 330,333 - 1,000,000 | 2,200,000 - 4,700,000 | 2,200,000 - 4,700,000 |
| | 25V | 250 | 8,2000 - 47,000 | 120,000 - 1,000,000 | | 100,000 - 1,000,000 |
| | 50V | 500 | 0.5 - 4,700 | 220 - 470,000 | | 10,000 - 1,000,000 |
| | 100V | 101 | 0.5 - 2,700 | 220 - 100,000 | | |
| | 250V | 251 | 0.5 - 3,900 | 150 - 47,000 | | |
| | 500V | 501 | 0.5 - 2,200 | 150 - 22,000 | | |
| | 1000V | 102 | 0.5 - 1,500 | 150 - 3,3000 | | |
| | 2000V | 202 | 0.5 - 270 | 150 - 1,000 | | |
| 1210 | 6.3V | 060 | | | 22,000,000 - 47,000,000 | |
| | 10V | 100 | | | 22,000,000 | 22,000,000 - 47,000,000 |
| | 16V | 160 | | | 6,800,000 - 10,000,000 | 10,000,000 - 22,000,000 |
| | 25V | 250 | 12,000 - 22,000 | 220,000 - 4,700,000 | | 10,000,000 |
| | 50V | 500 | 5,600 - 15,000 | 120,000 - 1,000,000 | 2,200,000 - 3,300,000 | |
| | 100V | 101 | 1,000 - 10,000 | 47,000 - 220,000 | | |
| | 250V | 251 | 1,000 - 6,800 | 56,000 - 100,000 | | |
| | 500V | 501 | 1,000 - 3,300 | 150 - 22,000 | | |
| | 1000V | 102 | 0.5 - 2,200 | 150 - 3,900 | | |
| | 2000V | 202 | 0.5 - 560 | 150 - 1,800 | | |
| 1812 (also 1808 size for 250V - 3KV) | 6.3V | 060 | | | 47,000 - 100,000,000 | 100,000,000 |
| | 16V | 160 | | | 22,000 | 47,000,000 |
| | 25V | 250 | 47,000 - 100,000 | | | |
| | 50V | 500 | 4,700 - 33,000 | 220,000 - 3,300,000 | | |
| | 100V | 101 | 1,200 - 27,000 | 100,000 - 680,000 | | |
| | 250V | 251 | 1,000 - 12,000 | 150 - 470,000 | | |
| | 500V | 501 | 1,000 - 5,600 | 150 - 100,000 | | |
| | 1000V | 102 | 0.5 - 4,700 | 150 - 22,000 | | |
| | 2000V | 202 | 0.5 - 1,200 | 150 - 4,700 | | |
| | 3000V | 302 | 0.5 - 390 | 150 - 2,200 | | |

*Surface mount offerings continue to change, please contact RFE International, for values, sizes, and voltages not listed.

### PART NUMBER EXAMPLE

MA 1206 XR 104 K 500 R

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