More information on the Engineer's Toolbox, including product datasheet links, can be found at www.vishay.com/ref/et3.

For inquiries, please contact your local sales representative.
Key components for MEDICAL EQUIPMENT

THE VISHAY ADVANTAGE
High and Stable Accuracy
Small Size
Low Profile
Non-Magnetic
Tight Tolerance
Ultra-Stable
Low TCR
Screening Options
and more....

X-Ray / Computed Tomography (CT)
Cardiac Pacing
External Defibrillators
Patient Monitoring
Glucose Meters
MRI / MRT
### X-Ray / Computed Tomography (CT)

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<th><strong>MOSFETs</strong></th>
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<tr>
<td>High-Voltage Ceramic Capacitor Multiplier Sets with Leads, Class 2 Ceramic</td>
<td>Power Resistor for Mounting onto a Heatsink, Thick Film Technology</td>
<td>Dual N-Channel 40 V (D-S) MOSFET</td>
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<tr>
<td>RHK</td>
<td>LPS</td>
<td>Si4286DY</td>
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<tr>
<td>• Fully customizable: can be designed according to the customer’s requirements</td>
<td>• High power, 57 mm x 57 mm, up to 1100 W at 25 °C on heatsink, low weight of 83 g</td>
<td>• TrenchFET® Gen III technology, maximum $R_{DSS}$, 32.5 mΩ</td>
</tr>
<tr>
<td>• High output voltage, compact design, up to 14 stages available</td>
<td>• Non-inductive down to 1 µH, high pulse capability up to 1000 J for short pulse</td>
<td>• Popular SO-8 packaging</td>
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<td>High-Voltage Ultrafast Avalanche SMD Rectifiers</td>
<td>High-Voltage Ceramic DC Disc Capacitors, 10 kV$<em>{DC}$ and 15 kV$</em>{DC}$</td>
<td>Metal Oxide Resistors, Special Purpose, High Voltage</td>
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<tr>
<td>BYG23T</td>
<td>615R</td>
<td>RNX</td>
</tr>
<tr>
<td>• Ultrafast reverse recovery time</td>
<td>• Very high voltage ratings, low dissipation and excellent voltage stability</td>
<td>• High voltage (up to 8 kV) with rated power up to 5 W</td>
</tr>
<tr>
<td>• Ideal for automated placement</td>
<td>• 20 kV rated voltage available on request, high degree of customization possible</td>
<td>• Wide value range (100 Ω to 2 GΩ)</td>
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<tr>
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<td>E Series 650 V Power MOSFET</td>
<td>Metal Oxide Resistors, Special Purpose, High Voltage</td>
<td>Wide Range of Case Sizes, Voltage Ratings, and Capacitance Values</td>
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<tr>
<td>SiHG24N65E</td>
<td>ROX</td>
<td>VJ Non-Magnetic Series</td>
</tr>
<tr>
<td>• High-performance E Series, high-voltage technology, maximum $R_{DSS}$ 145 mΩ</td>
<td>• High voltage (up to 45 kV)</td>
<td>• Non-magnetic available with copper or epoxy bondable terminations</td>
</tr>
<tr>
<td>• Popular TO-247 packaging, maximum continuous current of 24 A</td>
<td>• Wide value range (100 Ω to 3 GΩ)</td>
<td>• Safety screened for magnetic properties</td>
</tr>
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<tr>
<th><strong>RESISTORS</strong></th>
<th><strong>CERAMIC CAPACITORS</strong></th>
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</tr>
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<tr>
<td>Thick Film Chip Resistors, High Voltage</td>
<td>Body Sizes: 0402 to 3838, Excellent Power Handling Capabilities</td>
<td>Capacitors for Power Electronics (PEC) – Cylindrical</td>
</tr>
<tr>
<td>CRMV / CRHV</td>
<td>MLCC RF Capacitors</td>
<td>GLI</td>
</tr>
<tr>
<td>• High-voltage capability (up to 3 kV), with outstanding stability (&lt; 0.5 %)</td>
<td>• Non-magnetic available with copper or epoxy bondable terminations</td>
<td>• Low losses at high frequencies</td>
</tr>
<tr>
<td>• Can be customized to meet specific customer needs</td>
<td>• Lead-bearing terminations available for high-reliability applications</td>
<td>• High current rating</td>
</tr>
</tbody>
</table>

**View datasheets for these products**  
www.vishay.com/ref/et3me1a
## Cardiac Pacing

### MOSFETs
- **Dual N-Channel 20 V (D-S) MOSFET**
  - **SMMB912DK**
  - High-grade TrenchFET® technology, maximum $R_{DS(on)}$ 216 mΩ, hi-rel medical
  - 1.6 mm x 1.6 mm PowerPAK® SC-75 packaging

### RESISTORS
- **High-Stability Thin Film Flat Chip Resistors**
  - **TNPW0402...e3**
  - Excellent overall stability, endurance < 0.05 %, TCR down to 10 ppm/K
  - AEC-Q200 qualified, sulfur resistant, halogen-free

### DIODES
- **Small-Signal Switching Diode**
  - **IMBD4148-VGS08**
  - AEC-Q101 qualified
  - Fast switching diode in SOT-23 case, especially suited for automatic insertion

### RESISTORS INDUCTORS CERAMIC CAPACITORS
- **Thin Film, Top-Contact Miniature Resistor**
  - **MSFM**
  - 0.015 in x 0.015 in ultra-small form factor with value range from 2.5 Ω to 400 KΩ
  - Self-passivating tantalum nitride film well suited for high-moisture environments

### INDUCTORS
- **Custom Magnetics**
  - Ultra-compact transformers and inductors for high-reliability implantable devices
  - Custom designs for high reliability and efficient operation to extend battery life

### NON-LINEAR RESISTORS INDUCTORS TANTALUM CAPACITORS
- **NTC Thermistors, Naked Chips**
  - **NTCC100E4**
  - High stability over long time
  - Wire-bondable NTC die version available

### CERAMIC CAPACITORS
- **Frequency Range from 400 MHz to 5 GHz**
  - **Ceramic Chip Antenna**
  - Frequency range from 400 MHz to 5 GHz
  - Wide operating temperature range: -40 °C to +85 °C

### ICs
- **High-Voltage, Single- and Dual-Supply SPDT Analog Switch with Enable Pin**
  - **DG469**
  - 3.6 Ω low and flat switch on-resistance in MSOP8 and SO8 packages
  - Integrated VL and fast switching with guaranteed break before make

### MLCC HF-Rel
- Multiple screening options (group A, group C, voltage conditioning) available
- Customized certification available on request to meet your quality requirements

### MLCC RF Capacitors
- Non-magnetic available with copper or epoxy bondable terminations
- Lead-bearing terminations available for high-reliability applications

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View datasheets for these products [www.vishay.com/ref/et3me1b](http://www.vishay.com/ref/et3me1b)
## External Defibrillators

### RESISTORS
**Metal Oxide Resistors, Special Purpose, High Voltage**

**ROX**
- High voltage (up to 45 kV)
- Wide value range (100 Ω to 3 GΩ)

### INDUCTORS
**Custom Magnetics**
- Ultra-compact transformers and inductors for high-reliability devices
- Custom designs for high reliability and efficient operation to extend battery life

### ENERGY STORAGE CAPACITORS
**Hybrid Storage Capacitors**
196 HVC ENYCAP™
- Power back-up for memory controllers, industrial PCs, real-time clocks
- Storage device for energy harvesting, emergency light, and micro power supplies

### CERAMIC CAPACITORS
**MIL-PRF-55681-Qualified Facility, Reliability Testing Done on Maintenance Basis**
**MLCC Hi-Rel Capacitors**
- Multiple screening options (group A, group C, voltage conditioning) available
- Customized certification available on request to meet your quality requirements

### RESISTORS
**Thin Film Mini-MELF Resistors**
**SMM0204...e3**
- Excellent stability in different environmental conditions

### INDUCTORS
**Low-Profile, High-Current IHLP® Inductors**
**IHLP-2525**
- Compact, high-current power inductor for DC/DC conversion and filter applications
- High-frequency energy storage up to 5 MHz

### CERAMIC CAPACITORS
**MIL-PRF-55681-Qualified Facility, Reliability Testing Done on Maintenance Basis**
**MLCC Hi-Rel Capacitors**
- Multiple screening options (group A, group C, voltage conditioning) available
- Customized certification available on request to meet your quality requirements

### NON-LINEAR RESISTORS
**NTC Thermistors, SMD 0603, Chip**
**NTHS0603**
- Standard series
- Glass protected

### TANTALUM CAPACITORS
**Solid Tantalum Chip Capacitors**
**298D MICROtan®, 298W Extended Range MICROtan 298D**
- High capacitance in small case sizes including 0603 and 0402 footprint
- Perfect for space constrained designs

### MOSFETs
**E Series 650 V N-Channel Power MOSFET**
**SiHG47N65E**
- Low figure-of-merit (FOM) $R_{on} \times Q_g$

### ICs
**Dual 2 A, 1.2 V, Slew Rate Controlled Load Switch**
**SiP32413**
- Low and flat $R_{on}$ over the full operation voltage range of 1.2 V to 5.5 V
- Features 150 µs turn-on rise time, switch-off reverse blocking, and output discharge

### DIODES
**2-Line Bus-Port ESD Protection, Flow-Through Design**
**VBUS052CD-FAH**
- Compact LLP1713-7L package
- Low load capacitance $C_o = 0.8 \text{ pF}$

### ICS
**Low-Voltage, Low $R_{on}$ Quad SPST Analog Switch**
**DG2041, DG2042, DG2043**
- Low on resistance of 1 Ω
- 1 pC charge injection with fast switching

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View datasheets for these products [www.vishay.com/ref/et3me1c](http://www.vishay.com/ref/et3me1c)
Patient Monitoring

High-Quality Displays Offer Excellent Human-to-Machine Interface Solutions

- LCD, Color TFT, OLED
  - Standard and custom display / modules for flight control and monitoring
  - High brightness options for LCD, OLED, and color TFT

High-Stability Thin Film Flat Chip Resistors

- TNPW0402...e3
  - Excellent overall stability, endurance < 0.05 %, TCR down to 10 ppm/K
  - AEC-Q200 qualified, sulfur resistant, halogen-free

Low-Voltage, Low R<sub>ON</sub> Dual SPST Analog Switch

- DG2037
  - Low R<sub>ON</sub> of 3 Ω in cost effective SOT-23-8 and MSOP-8 packages
  - Low power consumption ideal for portable devices and handheld instrumentation

High-Precision Wraparound, Thin Film Chip Resistors

- P (Sizes 0302 to 2512)
  - Low TCR down to 5 ppm/°C (-55 °C; +155 °C), tight tolerance down to 0.01 %
  - Sulfur resistant, failure rate E7 level, from 10 Ω up to 200 MΩ

Dual N-Channel 20 V (D-S) MOSFET

- SIA906EDJ
  - High-performance TrenchFET® technology, maximum R<sub>DS(on)</sub> 46 mΩ
  - 2 mm x 2 mm PowerPAK® SC-70 packaging

Metal Film Resistors, High Precision, High Stability

- PTF
  - Tolerances to ± 0.01 %
  - TCR down to 5 ppm/°C, in temperature range of -20 °C to +85 °C

Low-Noise, Low R<sub>ON</sub> Dual SPST Analog Switch

- DG2037
  - Low R<sub>ON</sub> of 3 Ω in cost effective SOT-23-8 and MSOP-8 packages
  - Low power consumption ideal for portable devices and handheld instrumentation

Dual N-Channel 20 V (D-S) MOSFET

- SIA906EDJ
  - High-performance TrenchFET® technology, maximum R<sub>DS(on)</sub> 46 mΩ
  - 2 mm x 2 mm PowerPAK® SC-70 packaging

Metal Film Resistors, High Precision, High Stability

- PTF
  - Tolerances to ± 0.01 %
  - TCR down to 5 ppm/°C, in temperature range of -20 °C to +85 °C

ICs

- microBUCK® SiC403 6 A, 28 V Integrated Buck Regulator with Programmable LDO
  - SiC403A
    - Offers a scalable design with 10 A and 15 A parts in the same footprint
    - Soft-start, UVP / OVP, OCP, selectable power-saving mode, LDO, PGOOD, OTP

- MIL-PRF-55681-Qualified Facility, Reliability Testing Done on Maintenance Basis

- MLCC Hi-Rel Capacitors
  - Multiple screening options (group A, group C, voltage conditioning) available
  - Customized certification available on request to meet your quality requirements

- 2-Line Bus-Port ESD Protection, Flow-Through Design

- VBUS052CD-FAH
  - Compact LLP1713-7L package
  - Low load capacitance C<sub>l</sub> = 0.8 pF

View datasheets for these products www.vishay.com/ref/et3me1d
### Glucose Meters

- **RESISTORS**
  - High-Stability Thin Film Flat Chip Resistors
    - TNPW0402...e3
    - Excellent overall stability, endurance < 0.05 %, TCR down to 10 ppm/K
    - AEC-Q200 qualified, sulfur resistant, halogen-free
  - MOSFETs
    - N-Channel 20 V (D-S) MOSFET
      - Si1012CR
      - Classic TrenchFET® technology, maximum $R_{DS(ON)}$ 396 mΩ
      - Popular SC-75A packaging
  - DIODES
    - Small-Signal Schottky Diode
      - BAT54-02V-V-G-08
      - Space-saving SOD-523 package
      - This diode features very low turn-on voltage and fast switching

- **RECTIFIERS**
  - Surface-Mount Schottky Barrier Rectifiers
    - MSS1P3U-M3/89A
    - Very low profile – typical height of 0.65 mm ideal for automated placement
    - Low forward voltage drop, low power losses
  - RESISTORS
    - High-Precision Wraparound, Thin Film Chip Resistors
      - P (Sizes 0302 to 2512)
      - Low TCR down to 5 ppm/°C (-55 °C; +155 °C), tight tolerance down to 0.01 %
      - Sulfur resistant, failure rate E7 level, from 10 Ω up to 200 MΩ
  - DISPLAYS
    - High-Quality Displays Offer Excellent Human-to-Machine Interface Solutions
      - LCD, Color TFT, OLED
      - Standard and custom display / modules for flight control and monitoring
      - High brightness options for LCD, OLED, and color TFT

- **OPTOELECTRONICS**
  - High-Sensitivity PIN Photodiode in Leadless Low-Profile Package
    - VEMD5010X01
    - 0.8 mm height SMD photodiode featuring a chip with a 7.5 mm² sensitive area
    - Daylight blocking filter matched with IR emitters operating at wavelength 870 nm or 950 nm
  - INDUCTORS
    - Low-Profile, High-Current IHLP® Inductors
      - IHLP-1212AB-11
      - Very low-profile, high-current power inductor for DC/DC converters and filters
      - High-frequency energy storage up to 5 MHz
  - NON-LINEAR RESISTORS
    - NTC Thermistors, SMD 0603, Chip
      - NTHS0603
      - Standard series
      - Glass protected

- **ICs**
  - 1.0 A Slew Rate Controlled Load Switch with Reverse Blocking in SC70-6, and TDFN4
    - Sip32431DR3-T1GE3
    - 40 pA low quiescent current, 1.5 V to 5.5 V wide operation voltage range
    - Features true reverse current blocking and output discharge
  - NON-LINEAR RESISTORS
    - NTC Thermistors, Radial Leaded, Accuracy Line
      - NTCE203E3103SB0
      - Thermal cycling resistant
      - Suitable for potting
  - CERAMIC CAPACITORS
    - Body Sizes: 0402 to 3838, Excellent Power Handling Capabilities
      - MLCC RF Capacitors
      - Non-magnetic available with copper or epoxy bondable terminations
      - Lead-bearing terminations available for high-reliability applications

**View datasheets for these products** [www.vishay.com/ref/et3me1e](http://www.vishay.com/ref/et3me1e)
## MRI / MRT

### MOSFETs
- **P-Channel 60 V**
  - Power MOSFET
  - **IRFR9024**
  - Rugged planar technology, maximum $R_{DS(on)} = 280 \, \text{mΩ}$
  - Popular DPAK packaging

- **P-Channel 30 V**
  - (D-S) MOSFET
  - **Si4435DDY**
  - Classic TrenchFET® technology, maximum $R_{DS(on)} = 24 \, \text{mΩ}$
  - Popular SO-8 packaging

### RESISTORS
- **Lead (Pb)-Bearing High-Stability Thin Film Chip Resistors**
  - **TNPW1206**
  - Excellent overall stability, endurance $< 0.05 \, \%$, resistance range from 10 Ω to 2 MΩ
  - Pb content $> 6 \, \%$, TCR down to 10 ppm/K, and tolerance down to 0.1 %

- **Power Resistor for Mounting onto a Heatsink, Thick Film Technology**
  - **LPS**
  - High power, 57 mm x 57 mm, up to 1100 W at 25 °C on heatsink, low weight of 83 g
  - Non-inductive down to 1 µH, high pulse capability up to 1000 J for short pulse

- **Wirewound Resistors, Non-Magnetic, Non-Inductive, Axial Lead**
  - **MRA Non-Magnetic**
  - Not susceptible to high magnetic field strengths, power ratings to 12 W
  - High energy pulse capability, all welded construction, non-inductive winding

### OPTOELECTRONICS
- **Dual-Channel, 5 MBd High-Speed Optocoupler in DIP-8 Package**
  - **SFH6732**
  - Schmitt-Trigger stage detector for improved noise immunity
  - Faraday shield provides common-mode transient immunity of 500 V/µs at $V_{CM} = 300 \, \text{V}$

### MODULES
- **“Full Bridge” IGBT MTP (Ultrafast NPT IGBT), 20 A**
  - **20MT120UFAPbF**
  - Speed: 8 kHz to 60 kHz
  - 10 µs short circuit capability

### DIODES
- **Standard Recovery Diodes (Hockey PUK Version), 650 A**
  - **SD300C04**
  - High voltage ratings up to 3200 V
  - Case style DO-200AA

### RESISTORS
- **Compact Non-Magnetic Precision Thin Film Chip Resistor**
  - **PNM Non-Magnetic**
  - Multiple case sizes from 0402 to 2512, with wide resistance range from 10 Ω to 3 MΩ
  - TCR down to 25 ppm/°C and tolerance as low as 0.1 % available

### CERAMIC CAPACITORS
- **Wide Range of Case Sizes, Voltage Ratings, and Capacitance Values**
  - **VJ Non-Magnetic Series**
  - Non-magnetic available with copper or epoxy bondable terminations
  - Safety screened for magnetic properties

- **Body Sizes: 0402 to 3838, Excellent Power Handling Capabilities**
  - **MLCC RF Capacitors**
  - Non-magnetic available with copper or epoxy bondable terminations
  - Lead-bearing terminations available for high-reliability applications

- **Solid Tantalum Surface-Mount Chip Capacitors, TANTAMOUNT®, Molded Case, Hi-Rel COTS**
  - **T83**
  - Weibull grading and surge current test options, standard and low-ESR option
  - Medical Instrumentation, high-reliability applications

View datasheets for these products [www.vishay.com/ref/et3me1f](http://www.vishay.com/ref/et3me1f)