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**How To**

**Use Digital Multimeter**

**How to choose a**

**multimeter for**

**electronics use THE**

**BEST Multimeter**

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multimeter How to  
clean your Fluke  
meter | Work safety:  
Proper tool cleaning  
and disinfection~~



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Multimeter What is a  
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Fluke Pro Tips Fluke  
179 Digital Multimeter  
How to Use The Data

Logging Feature on  
The Fluke 289 Digital  
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Fluke  
8020A digital  
multimeter (1979)

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**Multimeter Fluke 70**

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Click on the main image for a larger view and to see image descriptions. The Fluke 77 series IV digital multimeter has the features needed to repair most electrical and electronic problems. This meter is simple to use and has significant improvements over

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Fluke's original 70 Series with more measurement functions, conformance to the latest safety standards, and a much larger display that's easier to view.

## **Fluke 70 Series | TTid**

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application 3/15

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by guest is proposed in order to estimate the maximum allowed switching frequency based on the thermal design of the SiC devices. Using these results, hard- and soft-switching converters are

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## **Data Sheet Multimeter Fluke 70 Datasheet Application ...**

The Fluke 179 True-

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True-rms Multimeter has the features needed to find most electrical and HVAC problems. Simple to use with significant improvements over the original Fluke 70 Series.

- Wide 1000 V measurement range
- True-rms for precise measurement of non-linear signals
- Capacitance,



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resistance, continuity  
and frequency ...

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Each Fluke 20, 70,  
80, 170 and 180  
Series DMM will be  
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lifetime. As used  
herein, "lifetime" is

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defined as seven years after Fluke discontinues manufacturing the product, but the warranty period shall be at least ten years from the date of purchase. This warranty does not cover fuses, disposable batteries, damage from neglect, misuse,

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contamination,  
alteration, accident or  
abnormal conditions  
of operation or  
handling, including  
failures ...

## **80 Series III**

The Fluke 77 IV  
digital multimeter has  
the features needed  
to repair most  
electrical and  
electronic problems.

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This meter is simple to use and has significant improvements over Fluke's original 70 Series with more measurement functions, conformance to the latest safety standards, and a much larger display that's easier to view. It measures: Wide 1000

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V measurement  
range.

**Fluke 77 IV Digital  
Multimeter | Fluke**  
?70% RH at 30 °C to  
40 °C: Altitude:  
Operating: 2000 m:  
Storage: 12,000 m:  
Temperature  
coefficient: 0.1 X  
(specified accuracy)  
/°C (<18 °C or >28  
°C) Fuse protection

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for current inputs: 440  
mA, 1000 V Fast  
Fuse, Fluke specified  
part only. 11A, 1000V  
Fast Fuse, Fluke  
specified part only.  
Size (H x W x L) 183  
x 91 x 49.5 mm:  
Weight: 455 g: IP  
rating: IP 40: Safety

**Fluke 15B+ Digital  
Multimeter | Fluke  
Fluke 289 True-RMS**

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Logging Multimeter  
helps you find little  
problems before they  
become big ones. The  
Fluke 289 is the next  
generation high  
performance industrial  
logging multimeter.  
This Fluke Connect-  
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designed to solve  
complex problems in  
electronics, plant  
automation, power

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electro-mechanical  
equipment.

## **Fluke 289 True-RMS Industrial Data Logging Multimeter | Fluke**

Compact true-rms  
meter for field service  
technicians. The  
Fluke 115 field  
technician's digital  
multimeter measures



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True-rms voltage and current with plus resistance, continuity, frequency, and capacitance to meet the needs of a wide variety of field service technicians.

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Sheet 13 pages.

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3 Fluke Corporation  
Fluke 170 Series True-  
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Multimeters 1 All AC  
voltage and AC

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current ranges are specified from 5 % of range to 100 % of range. 2 Crest factor of 3 at full scale up to 500 V, decreasing linearly to crest factor 1.5 at 1000 V.

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Introducing the  
rugged new Fluke 70

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Series III Digital Multimeters. Rough handling and high voltage are tough on a meter. But the new Fluke 70 Series III DMMs take it all in stride. They're built tough inside and out. With overvoltage protection to guard against spikes up to 6 kV, and safety ratings to prove it.

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**Fluke 70-3 Industrial  
Multimeter |  
TEquipment**

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Multimeters Data  
Sheets on  
GlobalSpec. Industrial  
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Fluke-289/IMSK:  
Fluke has combined  
its advanced data  
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with Trendcapture  
with the i400 AC  
Current Clamp.

## **Fluke Digital Multimeters Data Sheets |**

### **Engineering360**

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Industrial Multimeter.  
The Fluke 87V TRMS  
Multimeter provides  
the resolution and  
accuracy to efficiently

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troubleshoot motor drives, plant automation, power distribution, and electromechanical equipment even in loud, high energy, and high altitude locations. This digital multimeter takes the guesswork out of drive system ...

**Fluke Multimeter |  
Fluke 87V MAX**

*Page 32/84*



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**TRMS Digital  
Multimeter ...**

Fluke 177 TRMS  
Digital Multimeter with  
display backlight  
delivers the right  
features for electrical  
maintenance experts  
Independently tested  
for safe use in CAT IV  
600 V/CAT III 1000 V  
environments. The  
Fluke 177 TRMS  
digital multimeter

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includes all the features you need to troubleshoot and repair many problems in electrical and electronic systems.

**Fluke 177 TRMS  
Multimeter | Digital  
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3 Fluke Corporation  
Fluke 170 Series True-  
rms Digital  
Multimeters 1 All AC

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voltage and AC current ranges are specified from 5 % of range to 100 % of range. 2 Crest factor of ? 3 at full scale up to 500 V, decreasing linearly to crest factor ? 1.5 at 1000 V.

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TECHNICAL DATA  
Fluke 370 FC Series  
True-rms Wireless  
AC/DC Clamp Meters  
... • Connect your  
meter to your  
smartphone using  
Fluke Connect ... 1.8  
m (70.8 in) Safety IEC  
61010-1, Pollution  
Degree 2 IEC  
61010-2-032: CAT III

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1000 V / CAT IV 600  
V  
Fluke 70  
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## Application

Increasing demand for efficiency and power density pushes Si-based devices to some of their inherent material limits, including those related to temperature operation, switching

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frequency, and blocking voltage. Recently, SiC-based power devices are promising candidates for high-power and high-frequency switching applications. Today, SiC MOSFETs are commercially available from several manufacturers.

Although technology

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affiliated with SiC MOSFETs is improving rapidly, many challenges remain, and some of them are investigated in this work. The research work in this dissertation is divided into the three following parts. Firstly, the static and switching characteristics of the



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state-of-the-art 1.2 kV planar and double-trench SiC MOSFETs from two different manufacturers are evaluated. The effects of different biasing voltages, DC link voltages, and temperatures are analysed. The characterisation results show that the devices exhibit

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superior switching performances under different operating conditions. Moreover, several aspects of using the SiC MOSFET's body diode in a DC/DC converter are investigated, comparing the body-diodes of planar and double-trench devices. Reverse

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recovery is evaluated in switching tests considering the case temperature, switching rate, forward current, and applied voltage. Based on the measurement results, the junction temperature is estimated to guarantee safe operation. A simple

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electro-thermal model is proposed in order to estimate the maximum allowed switching frequency based on the thermal design of the SiC devices. Using these results, hard- and soft-switching converters are designed, and devices are characterised as being in continuous

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operation at a very high switching frequency of 1 MHz. Thereafter, the SiC MOSFETs are operated in a continuous mode in a 10 kW / 100-250 kHz buck converter, comparing synchronous rectification, the use of the body diode, and the use of an external

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Schottky diode.

Further, the parallel operation of the planar devices is considered. Thus, the paralleling of SiC MOSFETs is investigated before comparing the devices in continuous converter operation. In this regard, the impact of the most common mismatch

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parameters on the static and dynamic current sharing of the transistors is evaluated, showing that paralleling of SiC MOSFETs is feasible. Subsequently, an analytical model of SiC MOSFETs for switching loss optimisation is proposed. The analytical model

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exhibits relatively close agreement with measurement results under different test conditions. The proposed model tracks the oscillation effectively during both turn-on and –off transitions. This has been achieved by considering the influence of the most crucial parasitic



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elements in both power and gate loops. In the second part, a comprehensive short-circuit ruggedness evaluation focusing on different failure modes of the planar and double-trench SiC devices is presented. The effects of different biasing voltages, DC link voltages, and

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gate resistances are evaluated.

Additionally, the temperature-dependence of the short-circuit capability is evaluated, and the associated failure modes are analysed. Subsequently, the design and test of two different methods for overcurrent protection are proposed. The

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desaturation  
technique is applied  
to the SiC MOSFETs  
and compared to a  
second method that  
depends on the stray  
inductance of the  
devices. Finally, the  
benefits of using SiC  
devices in continuous  
high-frequency, high-  
power DC/DC  
converters is  
experimentally

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evaluated. In this regard, a design optimisation of a high-frequency transformer is introduced, and the impact of different core materials, conductor designs, and winding arrangements are evaluated. A ZVZCS Phase-Shift Full-Bridge unidirectional DC/DC converter is

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proposed, using only the parasitic leakage inductance of the transformer.

Experimental results for a 10 kW, (100-250) kHz prototype indicate an efficiency of up to 98.1% for the whole converter.

Furthermore, an optimized control method is proposed to

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minimise the circulation current in the isolated bidirectional dual active bridge DC/DC converter, based on a modified dual-phase-shift control method. This control method is also experimentally compared with traditional single-phase shift control, yielding a significant

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improvement in efficiency. The experimental results confirm the theoretical analysis and show that the proposed control can enhance the overall converter efficiency and expand the ZVZCS range. Die steigende Nachfrage nach Effizienz und Leistungsdichte bringt Si-basierte

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Leistungsbauteile an einige inhärente Materialgrenzen, die unter anderem mit der Temperaturbelastung, der Schaltfrequenz und der Blockierspannung in Zusammenhang stehen. In jüngster Zeit sind SiC-basierte Leistungsbauelemente vielversprechende Kandidaten für



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Hochleistungs- und Hochfrequenzanwendungen. Aktuell sind SiC-MOSFETs von mehreren Herstellern im Handel erhältlich. Obwohl sich die Technologie der SiC-MOSFETs rasch verbessert, werden viele Herausforderungen bestehen bleiben. Einige dieser

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Herausforderungen werden in dieser Arbeit untersucht. Die Untersuchungen in dieser Dissertation gliedern sich in die drei folgenden Teile: Im ersten Teil erfolgt, die statische und die transiente Charakterisierung der aktuellen 1,2 kV Planarund Doubletrench SiC-

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## MOSFETs

verschiedener Hersteller. Die Auswirkungen unterschiedlicher Gatespannungen, Zwischenkreisspannungen und Temperaturen werden analysiert. Die Ergebnisse der Charakterisierung zeigen, dass die Bauteile überlegene Schalteleistungen unter

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verschiedenen  
Betriebsbedingungen  
aufweisen. Darüber  
hinaus wird der  
Einsatz der internen  
SiC-Bodydioden in  
einem DC/DC-  
Wandler untersucht,  
wobei die  
Unterschiede  
zwischen Planar- und  
Doppeltrench-  
Bauteilen aufgezeigt  
werden. Das Reverse-

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Recovery-Verhalten  
wird unter  
Berücksichtigung der  
Gehäusetemperatur,  
der  
Schaltgeschwindigkeit  
, des Durchlassstroms  
und der angelegten  
Spannung bewertet.  
Anhand der  
Messergebnisse wird  
die Sperrschichttemp  
eratur geschätzt,  
damit ein sicherer

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Betrieb gewährleistet ist. Ein einfaches elektrothermisches Modell wird vorgestellt, um die maximal zulässige Schaltfrequenz auf der Grundlage des thermischen Designs der SiC-Bauteile abzuschätzen. Anhand dieser Ergebnisse werden hart- und

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weichschaltende  
Umrichter konzipiert  
und die Bauteile  
werden im  
Dauerbetrieb mit einer  
sehr hohen  
Schaltfrequenz von 1  
MHz untersucht.  
Danach werden die  
SiC-MOSFETs im  
Dauerbetrieb in einem  
10 kW / 100-250 kHz-  
Tiefsetzsteller  
betrieben. Dabei wird

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die Synchrongleichrichtung, die Verwendung der internen Diode und die Verwendung einer externen Schottky-Diode verglichen. Außerdem wird die Parallelisierung von SiC-MOSFETs untersucht, bevor die Parallelschaltung der verschiedenen Bauelemente ebenso



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im kontinuierlichen  
Konverterbetrieb  
verglichen wird. Es  
wird der Einfluss der  
häufigsten  
Parametervariationen  
auf die statische und  
dynamische  
Stromaufteilung der  
Transistoren  
analysiert, was zeigt,  
dass eine  
Parallelisierung von  
SiC-MOSFETs

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möglich ist.

Anschließend wird ein analytisches Modell der SiC-MOSFETs zur Schaltverlustoptimierung vorgeschlagen. Das analytische Modell zeigt eine relativ enge Übereinstimmung mit den Messergebnissen unter verschiedenen Testbedingungen. Das vorgeschlagene

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Modell bildet die Schwingungen sowohl beim Ein- als auch beim Ausschalten effektiv nach. Dies wurde durch die Berücksichtigung der wichtigsten parasitären Elemente in Strom- und Gatekreisen erreicht. Im zweiten Teil wird eine umfassende

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Bewertung der Kurzschlussfestigkeit mit Fokus auf verschiedene Ausfallmodi der planaren und double-trench SiC-Bauelemente vorgestellt. Die Auswirkungen unterschiedlicher Gatespannungen, Zwischenkreisspannungen und Gate-

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Widerstände werden  
ausgewertet.

Zusätzlich wird die  
temperaturabhängige  
Kurzschlussfähigkeit  
ausgewertet und die  
zugehörigen  
Fehlerfälle werden  
analysiert.

Anschließend wird die  
Auslegung und  
Prüfung von zwei  
verschiedenen  
Verfahren zum

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Überstromschutz  
evaluiert. Die „Desatu-  
ration“-Technik wird  
auf SiC-MOSFETs  
angewendet und mit  
einer zweiten  
Methode verglichen,  
welche die parasitäre  
Induktivität der  
Bauelemente nutzt.  
Schließlich wird der  
Nutzen des Einsatzes  
von SiC-Bauteilen in  
kontinuierlichen Hochf

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Multi-Meter  
Fluke 70  
Datasheet  
Application

requenz-Hochleistung

s-DC/DC-Wandlern

experimentell

untersucht. In diesem

Zusammenhang wird

eine

Designoptimierung

eines Hochfrequenztr

ansformators

vorgestellt und der

Einfluss

verschiedener

Kernmaterialien,

Leiterausführungen

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und Wicklungsanordnungen wird bewertet. Es wird ein unidirektionaler ZVZCS Vollbrücken-DC/DC-Wandler vorgestellt, der nur die parasitäre Streuinduktivität des Transformators verwendet.

Experimentelle Ergebnisse für einen 10 kW, (100-250) kHz



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Prototyp zeigen  
einen Wirkungsgrad  
von bis zu 98,1% für  
den gesamten  
Umrichter.

Abschließend wird ein  
optimiertes  
Regelverfahren  
verwendet, welches  
auf einem  
modifizierten Dual-Ph  
ase-Shift-  
Regelverfahren  
basiert, um den

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Kreisstrom im  
isolierten  
bidirektionalen Dual-Aktiv-Brücken-DC/DC-Wandler zu  
minimieren. Diese  
Regelmethode wird  
experimentell mit der  
herkömmlichen Single-Phase-Shift-Regelung  
verglichen. Hierbei  
zeigt sich eine  
deutliche  
Effizienzsteigerung

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durch die neue  
Regelmethode. Die  
experimentellen  
Ergebnisse bestätigen  
die theoretische  
Analyse und zeigen,  
dass die  
vorgeschlagene  
Regelung den  
Gesamtwirkungsgrad  
des Umrichters  
erhöhen und den  
ZVZCS-Bereich  
erweitern kann.

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Electronics in Textiles and Clothing: Design, Products and Applications covers the fundamentals of electronics and their applications in textiles and clothing product development. The book emphasizes the interface between

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electronics and textile materials, detailing diverse methods and techniques used in industrial practice. It explores ways to integrate textile materials with electronics for communicating/signal transferring applications. It also discusses wearable electronic products for

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Industrial applications based on functional properties and end users in sectors such as defense, medicine, health monitoring, and security. The book details the application of wearable electronics and outlines the textile fibres used for wearable electronics. It includes coverage

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of different yarn types and fabric production techniques and modifications needed on conventional machines for developing fabrics using specialty yarns. The coverage includes problems faced during the production processes and their solutions. Novel sensors,



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specialty yarns, Body Sensor Networks (BSN), and the development of flexible solar tents used for power generation round out the coverage. The book then concludes with discussions of the development of fabric-integrated wearable electronic products for use in

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Mobihealth care systems, smart cloth for ambulatory remote monitoring, electronic jerkin, heating gloves, and pneumatic gloves. Based mainly on the authors' projects and field work, the book takes a practical approach to the issues involved in designing electronic circuits and their

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possibilities for signals, giving you an understanding of problems that can occur when executing the work. It also describes the future scope of e-textiles using conductive materials for medical, healthcare textile product development, and safety aspects.

The text provides

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guidelines for the development of wearable textiles, giving a new meaning to the term human-machine symbiosis in the context of pervasive/invisible computing.

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