# DN1509

## N-Channel, Depletion-Mode, Vertical DMOS FET

### Features

- High-input impedance
- Low-input capacitance
- Fast switching speeds
- Low on-resistance
- Free from secondary breakdown
- Low input and output leakages

### Applications

- Normally-on switches
- Battery operated systems
- Converters
- Linear amplifiers
- Constant current sources
- Telecom

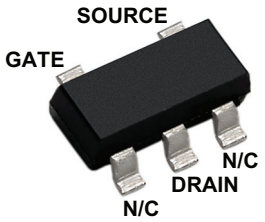
### Description

This low threshold, depletion-mode, normally-on, transistor utilizes an advanced vertical Diffusion Metal Oxide Semiconductor (DMOS) structure and a well proven silicon-gate manufacturing process. This combination produces a device with the power-handling capabilities of bipolar transistors, plus the high-input impedance and positive-temperature coefficient inherent in Metal-Oxide Semiconductor (MOS) devices. Characteristic of all MOS structures, this device is free from thermal runaway and thermally-induced secondary breakdown.

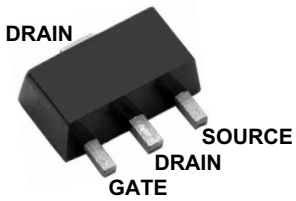
Vertical DMOS Field-Effect Transistors (FETs) are ideally suited to a wide range of switching and amplifying applications where a very low threshold voltage, high breakdown voltage, high input impedance, low input capacitance, and fast switching speeds are desired.

© 2015 Microchip Technology Inc.

## Package Type




5-lead SOT-23




TO-243AA (SOT-89)

See Table 2-1 for pin information


© 2015 Microchip Technology Inc.

## 1.0 ELECTRICAL CHARACTERISTICS

### ABSOLUTE MAXIMUM RATINGS†

Drain-to-source voltage ..... $BV_{DSX}$
Drain-to-gate voltage ..... $BV_{DGX}$
Gate-to-source voltage ..... ±20V
Operating and storage temperature ..... -55°C to +150°C

**† Notice:** Stresses above those listed under “Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

### 1.1 Electrical Specifications

**TABLE 1-1: DC AND AC CHARACTERISTICS**

| **Electrical Specifications:** Unless otherwise specified, for all specifications $T_A = T_J$ = +25°C | | | | | | |
|---|---|---|---|---|---|---|
| **Symbol** | **Parameter** | **Min** | **Typ** | **Max** | **Units** | **Conditions** |
| **DC Parameters** (**Note 1**, unless otherwise stated) | | | | | | |
| $BV_{DSX}$ | Drain-to-source breakdown voltage | 90 | – | – | V | $V_{GS}$ = -5V, $I_D$ = 1.0µA |
| $V_{GS(OFF)}$ | Gate-to-source off voltage | -1.8 | – | -3.5 | V | $I_D$ = 10µA |
| $\Delta V_{GS(OFF)}$ | $V_{GS(OFF)}$ change with temperature | – | – | -4.5 | mV/°C | $V_{DS}$ = 15V, $I_D$= 10µA (**Note 2**) |
| $I_{GSS}$ | Gate body leakage | – | – | 100 | nA | $V_{GS}$ = ±20V, $V_{DS}$ = 0V |
| $I_{D(OFF)}$ | Drain-to-source leakage current | – | – | 1.0 | µA | $V_{DS}$ = $BV_{DSX}$, $V_{GS}$ = -5.0V |
| | | – | – | 1.0 | mA | $V_{DS}$ = 0.8 $BV_{DSX}$, $V_{GS}$ = -5.0V, $T_A$= 125°C (**Note 2**) |
| $I_{DSS}$ | Saturated drain-to-source current | 300 | 540 | – | mA | $V_{GS}$ = 0V, $V_{DS}$ = 25V |
| $R_{DS(ON)}$ | Static drain-to-source on-state resistance | – | 3.2 | 6.0 | Ω | $V_{GS}$ = 0V, $I_D$= 200mA |
| $\Delta R_{DS(ON)}$ | Change in $R_{DS(ON)}$ with temperature | – | – | 1.1 | %/°C | $V_{GS}$ = 0V, $I_D$= 200mA (**Note 2**) |
| **AC Parameters** (**Note 2**) | | | | | | |
| $G_{FS}$ | Forward transconductance | 200 | – | – | mmho | $V_{DS}$ = 10V, $I_D$= 200mA |
| $C_{ISS}$ | Input capacitance | | 70 | 150 | pF | $V_{GS}$ = -10V, $V_{DS}$ = 25V, f = 1MHz |
| $C_{OSS}$ | Common source output capacitance | – | 20 | 40 | | |
| $C_{RSS}$ | Reverse transfer capacitance | – | 6.0 | 15 | | |
| $t_{d(ON)}$ | Turn-on delay time | – | 12 | 30 | ns | $V_{DD}$ = 25V, $I_D$ = 100mA, $R_{GEN}$ = 25Ω |
| $t_r$ | Rise time | – | 16 | 45 | | |
| $t_{d(OFF)}$ | Turn-off delay time | – | 15 | 45 | | |
| $t_f$ | Fall time | – | 25 | 60 | | |
| **Diode Parameters** | | | | | | |
| $V_{SD}$ | Diode forward voltage drop | – | – | 1.8 | V | $V_{GS}$ = -5.0V, $I_{SD}$= 500mA (**Note 1**) |
| $t_{rr}$ | Reverse recovery time | – | 400 | – | ns | $V_{GS}$ = -5.0V, $I_{SD}$= 500mA (**Note 2**) |

**Note 1:** All DC parameters are 100% tested at 25°C unless otherwise stated. Pulse test: 300 µs pulse, 2% duty cycle.

**2:** Specification is obtained by characterization and is not 100% tested.

© 2015 Microchip Technology Inc.

**TABLE 1-2: TYPICAL THERMAL RESISTANCE**

| Package | $\theta_{ja}$ |
|---|---|
| 5-lead SOT-23 | 253°C/W |
| TO-243AA (SOT-89) | 78°C/W[1] |

1. Mounted on FR4 board, 25mm x 25mm x 1.57 mm

**TABLE 1-3: THERMAL CHARACTERISTICS**

| Package | $I_D$[1] continuous (mA) | $I_D$ pulsed (mA) | Power Dissipation @$T_A$ = 2.5°C (W) | $I_{DR}$[1] (mA) | $I_{DRM}$ (mA) |
|---|---|---|---|---|---|
| 5-lead SOT-23 | 200 | 500 | 0.49 | 200 | 500 |
| TO-243AA (SOT-89) | 360 | 500 | 1.6[2] | 360 | 500 |

1. $I_D$ continuous is limited by max rated $T_J$
2. Mounted on FR4 board, 25mm x 25mm x 1.57 mm

## 2.0 PIN DESCRIPTION

The locations of the pins are listed in Package Type.

**TABLE 2-1: PIN DESCRIPTION**

| Pin # SOT-23 | Pin # TO-243AA | Function |
|---|---|---|
| 5 | 1 | GATE |
| 2 | 2 | DRAIN |
| 4 | 3 | SOURCE |
| 1,3 | | NC |


© 2015 Microchip Technology Inc.

## 3.0 APPLICATION INFORMATION

Figure 3-1 shows the switching waveform and test circuit for DN1509.

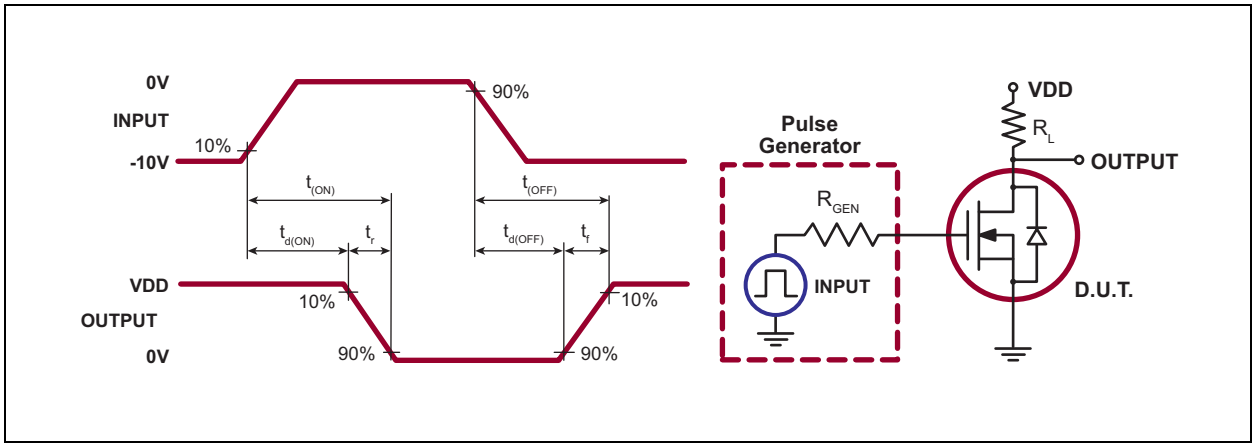



***FIGURE 3-1:*** *Switching Waveforms and Test Circuit*

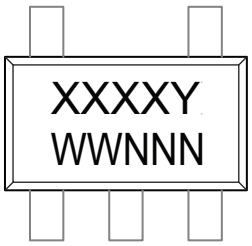
### Product Summary

| $BV_{DSX}/BV_{DGX}$ (V) | $R_{DS(ON)}$ (max) (Ω) | $I_{DSS}$ (min) (mA) |
|---|---|---|
| 90 | 6.0 | 300 |

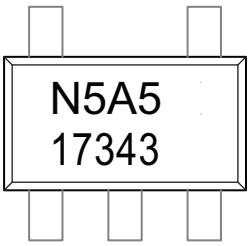
## 4.0 PACKAGING INFORMATION

### 4.1 Package Marking Information

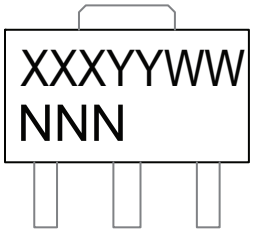
5-lead SOT-23 *



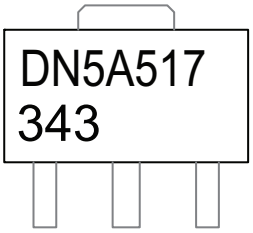

Example




3-lead TO-243AA * (SOT-89)




Example

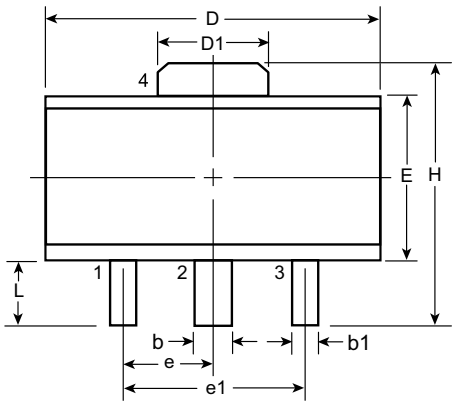



| | | |
|---|---|---|
| **Legend:** | XX...X | Product Code or Customer-specific information |
| | Y | Year code (last digit of calendar year) |
| | YY | Year code (last 2 digits of calendar year) |
| | WW | Week code (week of January 1 is week ‘01’) |
| | NNN | Alphanumeric traceability code |
| | (e3) | Pb-free JEDEC® designator for Matte Tin (Sn) |
| | * | This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package. |

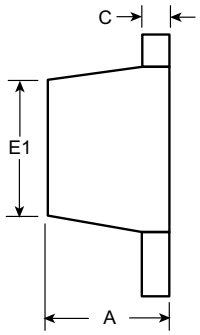
**Note**: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for product code or customer-specific information. Package may or not include the corporate logo.


© 2015 Microchip Technology Inc.

## 3-Lead TO-243AA (SOT-89) Package Outline (N8)




**Top View**




**Side View**

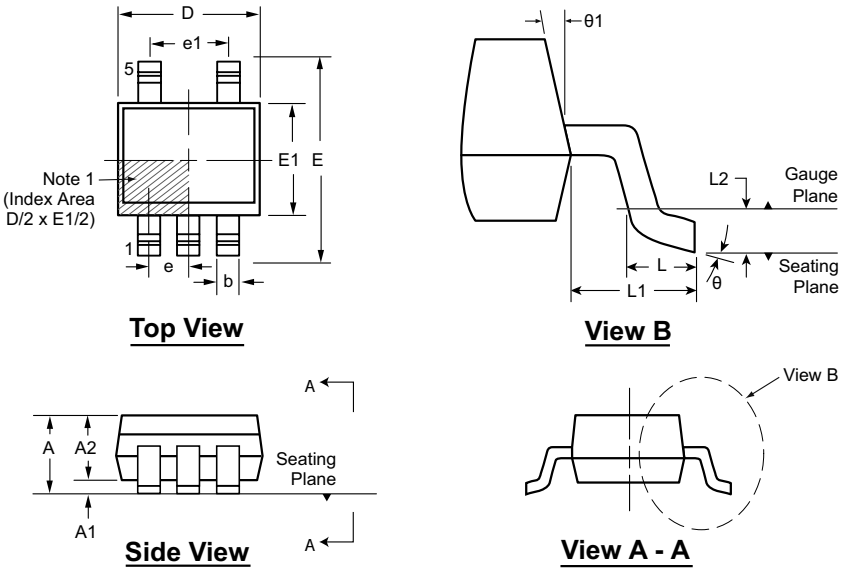
Note: For the most current package drawings, see the Microchip Packaging Specification at www.microchip.com/packaging.

| Symbol | | A | b | b1 | C | D | D1 | E | E1 | e | e1 | H | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dimensions (mm) | MIN | 1.40 | 0.44 | 0.36 | 0.35 | 4.40 | 1.62 | 2.29 | 2.00† | 1.50 BSC | 3.00 BSC | 3.94 | 0.73† |
| | NOM | - | - | - | - | - | - | - | - | | | - | - |
| | MAX | 1.60 | 0.56 | 0.48 | 0.44 | 4.60 | 1.83 | 2.60 | 2.29 | | | 4.25 | 1.20 |

*JEDEC Registration TO-243, Variation AA, Issue C, July 1986.*
*† This dimension differs from the JEDEC drawing*
***Drawings not to scale.***

## 5-Lead SOT-23 Package Outline (K1)

***2.90x1.60mm body, 1.45mm height (max), 0.95mm pitch***




Note: For the most current package drawings, see the Microchip Packaging Specification at www.microchip.com/packaging.

***Note:***

1. *A Pin 1 identifier must be located in the index area indicated. The Pin 1 identifier can be: a molded mark/identifier; an embedded metal marker; or a printed indicator.*

| Symbol | | A | A1 | A2 | b | D | E | E1 | e | e1 | L | L1 | L2 | θ | θ1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dimension (mm) | MIN | 0.90* | 0.00 | 0.90 | 0.30 | 2.75* | 2.60* | 1.45* | 0.95 BSC | 1.90 BSC | 0.30 | 0.60 REF | 0.25 BSC | 0° | 5° |
| | NOM | - | - | 1.15 | - | 2.90 | 2.80 | 1.60 | | | 0.45 | | | 4° | 10° |
| | MAX | 1.45 | 0.15 | 1.30 | 0.50 | 3.05* | 3.00* | 1.75* | | | 0.60 | | | 8° | 15° |

*JEDEC Registration MO-178, Variation AA, Issue C, Feb. 2000.*
** This dimension is not specified in the JEDEC drawing.*
***Drawings not to scale.***


© 2015 Microchip Technology Inc.

# APPENDIX A: REVISION HISTORY

## Revision A (June 2015)

- Update file to new format

## Revision B (August 2015)

- Minor fix to Table 1-1

## PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

| PART NO. | XX | - | X | - | X |
|---|---|---|---|---|---|
| Device | Package Options | | Environmental | | Media Type |

| | | |
|---|---|---|
| Device: | DN1509 = | N-Channel, Depletion-Mode, vertical DMOS FET |
| Package: | K1 = | SOT-23, 5-lead |
| | N8 = | TO-243AA (SOT-89), 3-lead |
| Environmental | G = | Lead (Pb)-free/ROHS-compliant package |
| Media Type: | (blank) = | 3000/Reel for K1 packages |
| | = | 2000/Reel for N8 packages |

**Examples:**

a) DN1509K1-G — SOT-23 package, 3000/reel

b) DN1509N8-G — TO-243AA package, 2000/reel


© 2015 Microchip Technology Inc.

**Note the following details of the code protection feature on Microchip devices:**

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION, INCLUDING BUT NOT LIMITED TO ITS CONDITION, QUALITY, PERFORMANCE, MERCHANTABILITY OR FITNESS FOR PURPOSE**.** Microchip disclaims all liability arising from this information and its use. Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights.

**Trademarks**

The Microchip name and logo, the Microchip logo, dsPIC, FlashFlex, flexPWR, JukeBlox, KEELOQ, KEELOQ logo, Kleer, LANCheck, MediaLB, MOST, MOST logo, MPLAB, OptoLyzer, PIC, PICSTART, PIC$^{32}$ logo, RightTouch, SpyNIC, SST, SST Logo, SuperFlash and UNI/O are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

The Embedded Control Solutions Company and mTouch are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Analog-for-the-Digital Age, BodyCom, chipKIT, chipKIT logo, CodeGuard, dsPICDEM, dsPICDEM.net, ECAN, In-Circuit Serial Programming, ICSP, Inter-Chip Connectivity, KleerNet, KleerNet logo, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICtail, RightTouch logo, REAL ICE, SQI, Serial Quad I/O, Total Endurance, TSHARC, USBCheck, VariSense, ViewSpan, WiperLock, Wireless DNA, and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

Silicon Storage Technology is a registered trademark of Microchip Technology Inc. in other countries.

GestIC is a registered trademarks of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

© 2015, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

ISBN: 978-1-63277-700-3

**QUALITY MANAGEMENT SYSTEM**
**CERTIFIED BY DNV**
**═ ISO/TS 16949 ═**

*Microchip received ISO/TS-16949:2009 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC® MCUs and dsPIC® DSCs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.*

# Worldwide Sales and Service

## AMERICAS

**Corporate Office**
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
http://www.microchip.com/support
Web Address:
www.microchip.com

**Atlanta**
Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

**Austin, TX**
Tel: 512-257-3370

**Boston**
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

**Chicago**
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

**Cleveland**
Independence, OH
Tel: 216-447-0464
Fax: 216-447-0643

**Dallas**
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

**Detroit**
Novi, MI
Tel: 248-848-4000

**Houston, TX**
Tel: 281-894-5983

**Indianapolis**
Noblesville, IN
Tel: 317-773-8323
Fax: 317-773-5453

**Los Angeles**
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608

**New York, NY**
Tel: 631-435-6000

**San Jose, CA**
Tel: 408-735-9110

**Canada - Toronto**
Tel: 905-673-0699
Fax: 905-673-6509

## ASIA/PACIFIC

**Asia Pacific Office**
Suites 3707-14, 37th Floor
Tower 6, The Gateway
Harbour City, Kowloon

**Hong Kong**
Tel: 852-2943-5100
Fax: 852-2401-3431

**Australia - Sydney**
Tel: 61-2-9868-6733
Fax: 61-2-9868-6755

**China - Beijing**
Tel: 86-10-8569-7000
Fax: 86-10-8528-2104

**China - Chengdu**
Tel: 86-28-8665-5511
Fax: 86-28-8665-7889

**China - Chongqing**
Tel: 86-23-8980-9588
Fax: 86-23-8980-9500

**China - Dongguan**
Tel: 86-769-8702-9880

**China - Hangzhou**
Tel: 86-571-8792-8115
Fax: 86-571-8792-8116

**China - Hong Kong SAR**
Tel: 852-2943-5100
Fax: 852-2401-3431

**China - Nanjing**
Tel: 86-25-8473-2460
Fax: 86-25-8473-2470

**China - Qingdao**
Tel: 86-532-8502-7355
Fax: 86-532-8502-7205

**China - Shanghai**
Tel: 86-21-5407-5533
Fax: 86-21-5407-5066

**China - Shenyang**
Tel: 86-24-2334-2829
Fax: 86-24-2334-2393

**China - Shenzhen**
Tel: 86-755-8864-2200
Fax: 86-755-8203-1760

**China - Wuhan**
Tel: 86-27-5980-5300
Fax: 86-27-5980-5118

**China - Xian**
Tel: 86-29-8833-7252
Fax: 86-29-8833-7256

## ASIA/PACIFIC

**China - Xiamen**
Tel: 86-592-2388138
Fax: 86-592-2388130

**China - Zhuhai**
Tel: 86-756-3210040
Fax: 86-756-3210049

**India - Bangalore**
Tel: 91-80-3090-4444
Fax: 91-80-3090-4123

**India - New Delhi**
Tel: 91-11-4160-8631
Fax: 91-11-4160-8632

**India - Pune**
Tel: 91-20-3019-1500

**Japan - Osaka**
Tel: 81-6-6152-7160
Fax: 81-6-6152-9310

**Japan - Tokyo**
Tel: 81-3-6880- 3770
Fax: 81-3-6880-3771

**Korea - Daegu**
Tel: 82-53-744-4301
Fax: 82-53-744-4302

**Korea - Seoul**
Tel: 82-2-554-7200
Fax: 82-2-558-5932 or
82-2-558-5934

**Malaysia - Kuala Lumpur**
Tel: 60-3-6201-9857
Fax: 60-3-6201-9859

**Malaysia - Penang**
Tel: 60-4-227-8870
Fax: 60-4-227-4068

**Philippines - Manila**
Tel: 63-2-634-9065
Fax: 63-2-634-9069

**Singapore**
Tel: 65-6334-8870
Fax: 65-6334-8850

**Taiwan - Hsin Chu**
Tel: 886-3-5778-366
Fax: 886-3-5770-955

**Taiwan - Kaohsiung**
Tel: 886-7-213-7828

**Taiwan - Taipei**
Tel: 886-2-2508-8600
Fax: 886-2-2508-0102

**Thailand - Bangkok**
Tel: 66-2-694-1351
Fax: 66-2-694-1350

## EUROPE

**Austria - Wels**
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

**Denmark - Copenhagen**
Tel: 45-4450-2828
Fax: 45-4485-2829

**France - Paris**
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

**Germany - Dusseldorf**
Tel: 49-2129-3766400

**Germany - Karlsruhe**
Tel: 49-721-625370

**Germany - Munich**
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

**Italy - Milan**
Tel: 39-0331-742611
Fax: 39-0331-466781

**Italy - Venice**
Tel: 39-049-7625286

**Netherlands - Drunen**
Tel: 31-416-690399
Fax: 31-416-690340

**Poland - Warsaw**
Tel: 48-22-3325737

**Spain - Madrid**
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

**Sweden - Stockholm**
Tel: 46-8-5090-4654

**UK - Wokingham**
Tel: 44-118-921-5800
Fax: 44-118-921-5820

07/14/15


© 2015 Microchip Technology Inc.

ENTEGRECİ

Bu belge www.entegreci.com üzerinden sunulmaktadır.

# Elektronik komponent tedarikinde Entegreci

Entegreci, Eskişehir merkezli, Türkiye geneline satış yapan bir elektronik komponent mağazasıdır. Entegreler (IC), mikrodenetleyiciler, transistörler, diyotlar, pasif elemanlar, konnektörler, modüller ve geliştirme kartları tek adetten seri üretim adetlerine kadar satılır. Ürün sayfalarında güncel stok durumunu, fiyatı ve datasheet bağlantısını bulabilirsiniz.

### Parça koduyla arama

Üretici parça numarasını yazın; stok ve fiyatı hemen görün.

**www.entegreci.com**

### Ürün kategorileri

Entegreden kapasitöre tüm elektronik komponent kategorileri.

**Kategorilere göz atın**

### Üreticiler

Aradığınız üreticinin ürünlerini tek sayfada inceleyin.

**Üreticileri görün**

### Toplu alım ve teklif

Listede olmayan ya da yüksek adetli parçalar için teklif isteyin.

**Teklif isteyin**

**www.entegreci.com** | **destek@entegreci.com** | **0850 305 90 34**

Entegreci is an online electronic components store based in Türkiye. Search by manufacturer part number to see stock, prices and datasheets for integrated circuits, microcontrollers, transistors, passive components and connectors, or request a quote for parts that are not listed.

Bu sayfa Entegreci tarafından eklenmiştir. Belgenin önceki sayfaları asıl yayıncısına aittir ve içeriği değiştirilmemiştir; en güncel sürüm için belgenin yayıncısına başvurun.