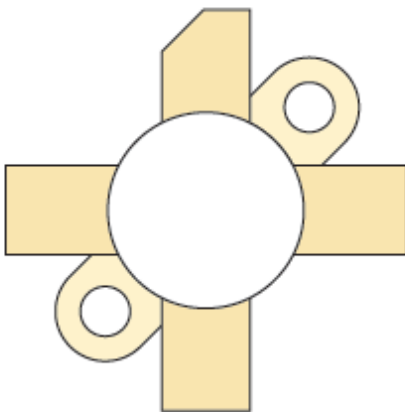

28 V, 150 W, 175 MHz RF Power MOSFET

Product Overview

The VRF141(MP) is a gold-metallized silicon n-channel RF power transistor designed for broadband commercial and military applications requiring high power and gain without compromising reliability, ruggedness, or inter-modulation distortion.



Features

- Improved ruggedness $V_{(BR)DSS} = 80\text{ V}$
- 150 W with 22 dB typical gain at 30 MHz, 28 V
- 150 W with 13 dB typical gain at 175 MHz, 28 V
- Excellent stability and low IMD
- Common source configuration
- Available in matched pairs (VRF141MP)
- 30:1 load VSWR capability at specified operating conditions
- Nitride passivated
- Refractory gold metallization
- High voltage replacement for MRF141
- RoHS compliant

1. Device Specifications

This section shows the specifications of the VRF141(MP) device.

1.1 Absolute Maximum Ratings

The following table shows the absolute maximum ratings of the VRF141(MP) device. $T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

Table 1-1. Absolute Maximum Ratings

Symbol	Parameter	Ratings	Unit
V_{DSS}	Drain source voltage	80	V
I_D	Continuous drain current at $T_C = 25\text{ }^{\circ}\text{C}$	20	A
V_{GS}	Gate-source voltage	± 40	V
P_D	Total power dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	300	W
T_{STG}	Storage temperature range	-65 to 150	$^{\circ}\text{C}$
T_J	Operating junction temperature	200	

1.2 Electrical Performance

The following table shows the static characteristics of the VRF141(MP) device. $T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

Table 1-2. Static Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$, $I_D = 100\text{ mA}$	80			V
$V_{DS(ON)}$	On-state drain voltage	$I_{D(ON)} = 10\text{ A}$, $V_{GS} = 10\text{ V}$		1.0	1.4	
I_{DSS}	Zero gate voltage drain current	$V_{DS} = 60\text{ V}$, $V_{GS} = 0\text{ V}$			1.0	mA
I_{GSS}	Gate-source leakage current	$V_{DS} = \pm 20\text{ V}$, $V_{GS} = 0\text{ V}$			1.0	μA
g_{fs}	Forward transconductance	$V_{DS} = 10\text{ V}$, $I_D = 5\text{ A}$	5.0			mhos
$V_{GS(th)}$	Gate-source threshold voltage	$V_{DS} = 10\text{ V}$, $I_D = 100\text{ mA}$	2.9	3.6	4.4	V

The following table shows the thermal characteristics of the VRF141(MP) device.

Table 1-3. Thermal Characteristics

Symbol	Characteristic	Min	Typ	Max	Unit
$R_{\theta JC}$	Junction-to-case thermal resistance			0.60	$^{\circ}\text{C/W}$

The following table shows the dynamic characteristics of the VRF141(MP) device. $T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

VRF141, VRF141MP

Device Specifications

Table 1-4. Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
C_{iss}	Input capacitance	$V_{GS} = 0\text{ V}$, $V_{DS} = 28\text{ V}$, $f = 1\text{ MHz}$		400		pF
C_{oss}	Output capacitance			375		
C_{rss}	Reverse transfer capacitance			50		

The following table shows the functional characteristics of the VRF141(MP) device. $T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

Table 1-5. Functional Characteristics

Parameter	Test Conditions	Min	Typ	Max	Unit
G _{PS}	f ₁ = 30 MHz, f ₂ = 30.001 MHz, V _{DD} = 28 V, I _{DQ} = 250 mA, P _{out} = 150 W _{PEP}	16	20		dB
G _{PS}	f ₁ = 175 MHz, V _{DD} = 28 V, I _{DQ} = 250 mA, P _{out} = 150 W		13		
η	f ₁ = 30 MHz, f ₂ = 30.001 MHz, V _{DD} = 28 V, I _{DQ} = 250 mA, P _{out} = 150 W _{PEP}	40	45		%
IMD _(d3)	f ₁ = 30 MHz, f ₂ = 30.001 MHz, V _{DD} = 28 V, I _{DQ} = 250 mA, P _{out} = 150 W _{PEP} ¹		−30	−28	dB
IMD _(d11)	f ₁ = 30 MHz, f ₂ = 30.001 MHz, V _{DD} = 28 V, I _{DQ} = 250 mA, P _{out} = 150 W _{PEP}		−60		
Ψ	f ₁ = 30 MHz, f ₂ = 30.001 MHz, V _{DD} = 28 V, I _{DQ} = 250 mA, P _{out} = 150 W _{PEP} 30:1 VSWR — all phase angles	No degradation in output power			

Note:

1. To MIL-STD-1311 Version A, test method 2204B, Two Tone, Reference Each Tone

The following table shows the class A characteristics of the VRF141(MP) device. $T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

Table 1-6. Class A Characteristics

Parameter	Test Conditions	Min	Typ	Max	Unit
G_{PS}	$f_1 = 30\text{ MHz}$, $f_2 = 30.001\text{ MHz}$, $V_{DD} = 28\text{ V}$, $I_{DQ} = 4.0\text{ A}$, $P_{out} = 50\text{ W}_{PEP}$		23		dB
$IMD_{(d3)}$			-50		
$IMD_{(d11)}$			-75		

1.3 Typical Performance Curves

This section shows the typical performance curves of the VRF141(MP) device.

Figure 1-1. Output Characteristics

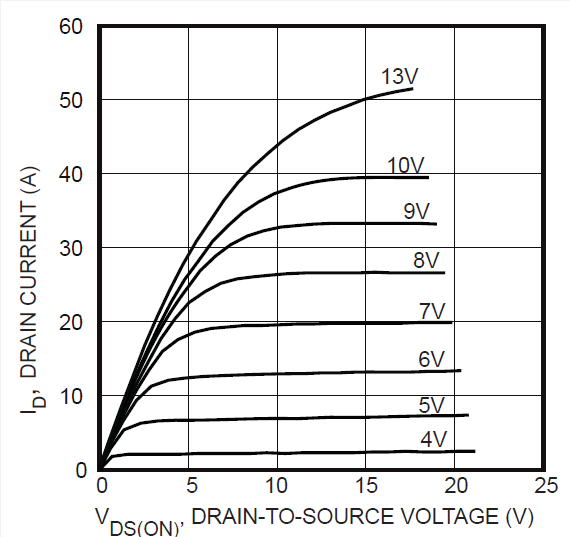


Figure 1-2. Transfer Characteristics

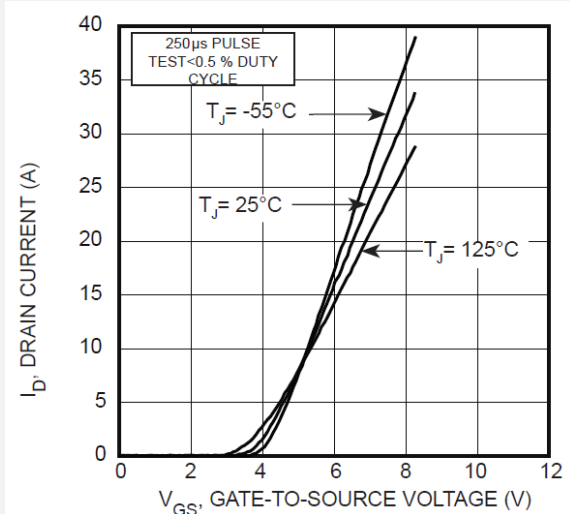


Figure 1-3. Capacitance vs. Drain-to-Source Voltage

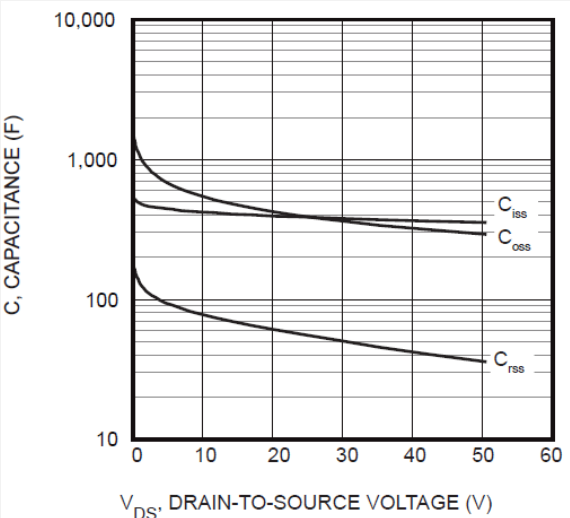


Figure 1-4. Forward Safe Operating Area

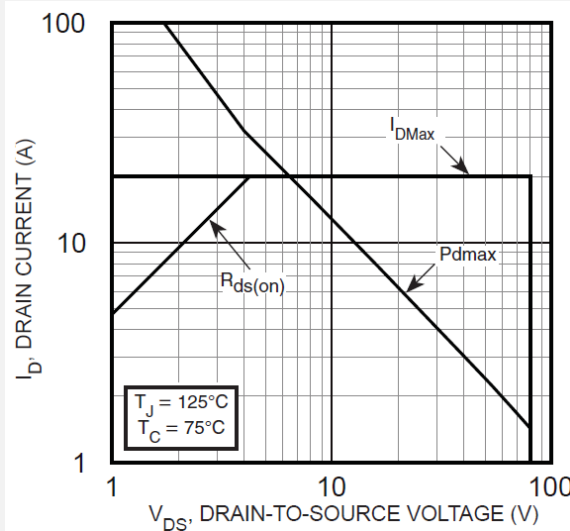


Figure 1-5. Maximum Effective Transient Thermal Impedance Junction-to-Case vs Pulse Duration

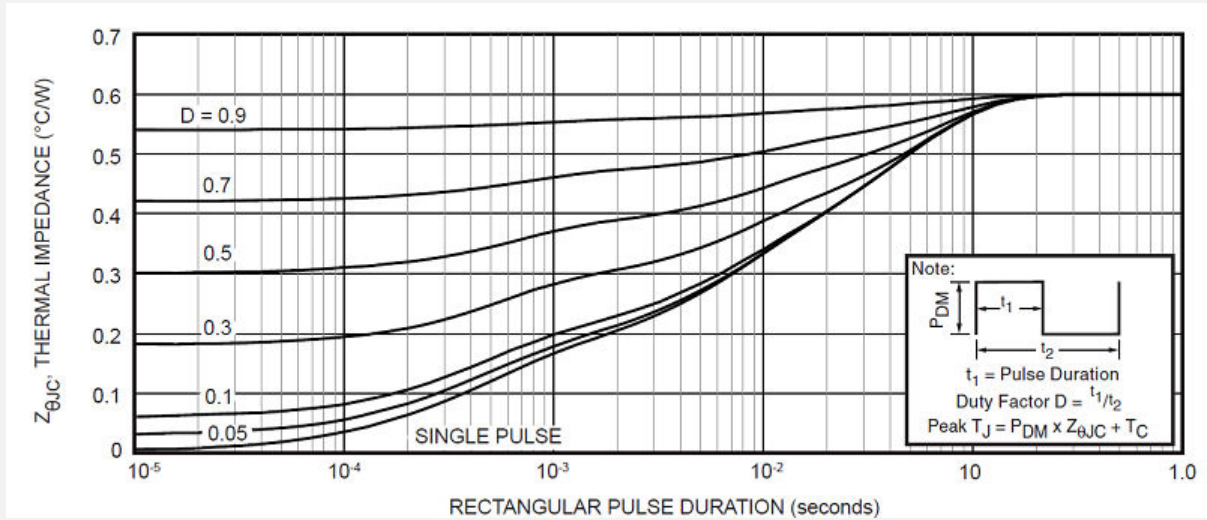


Figure 1-6. IMD vs. P_{OUT}

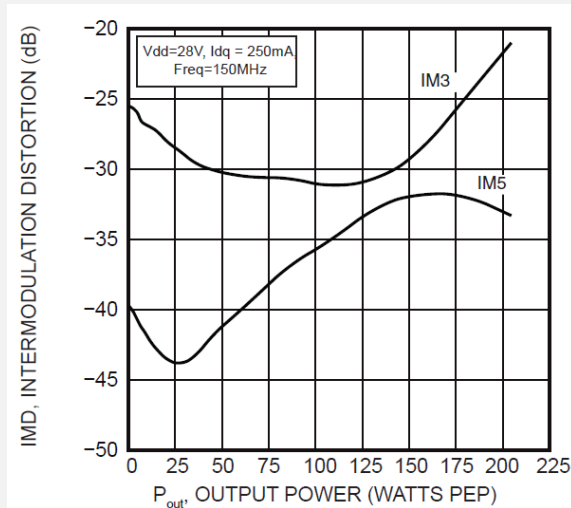


Figure 1-7. P_{IN} vs. P_{OUT}

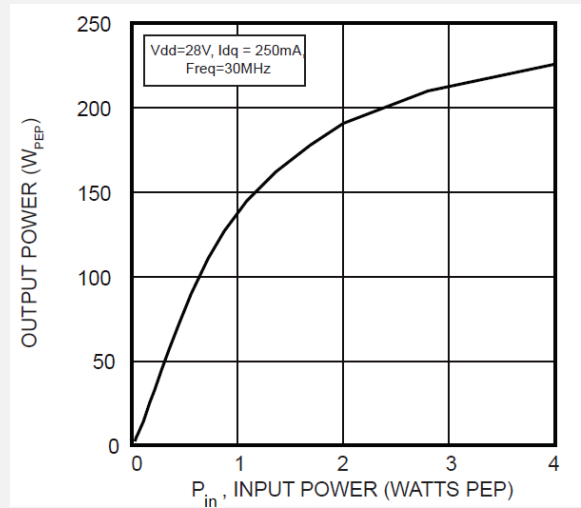
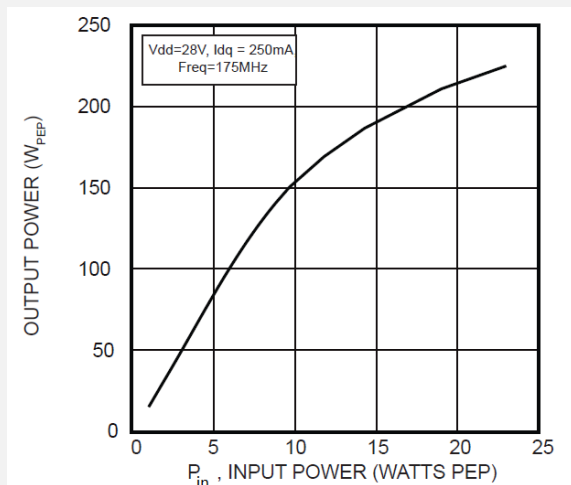


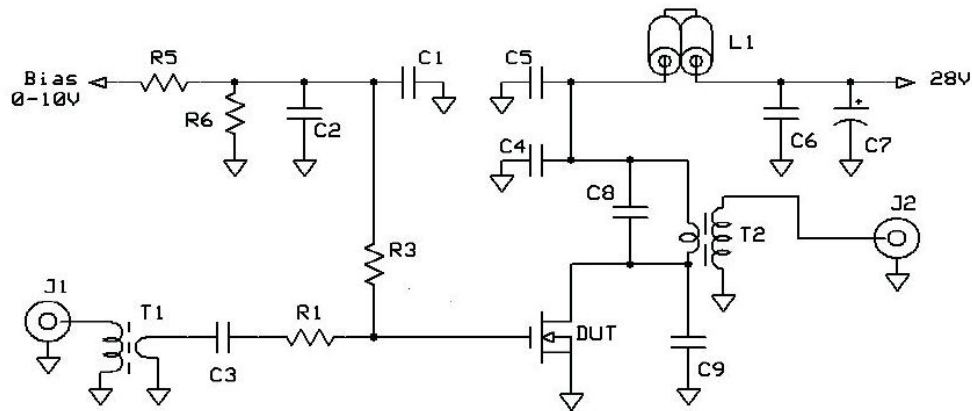
Figure 1-8. P_{IN} vs. P_{OUT}



2. Test Circuits

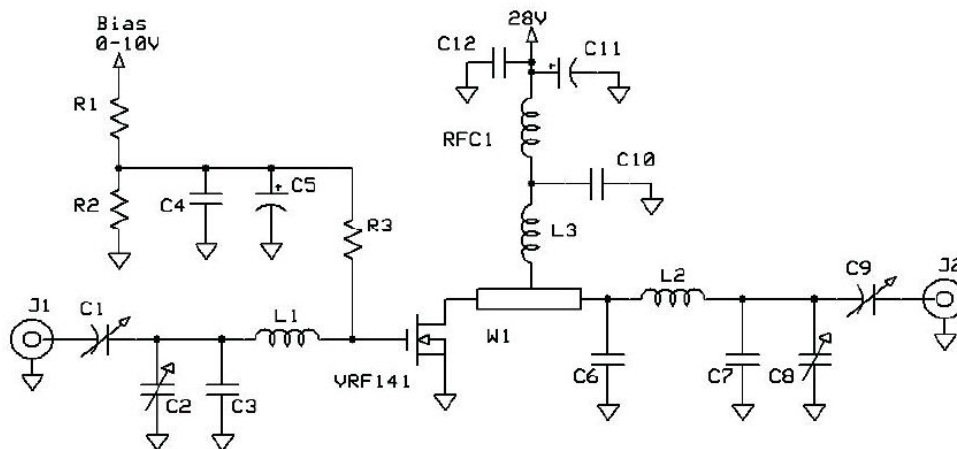
The following figures show the test circuits of the VRF141(MP) device.

Figure 2-1. 30 MHz Test Circuit



- | | |
|---|-------------------------------|
| C1 - 1uF 50V tantalum | C9 - 100 pF ATC 100B |
| C2-C6 - 0.1uF 100V SMT | L1 - two ferrite beads on #18 |
| C7 - 15uF 100V Elect | R1 - 1 ohm 1 W SMT |
| C8 - 820 pF ATC 100B | R3 - 200 ohm 1/2 Carbn |
| T1 - 16:1 bead/tube transformer | R4 - 470 ohm 1W |
| T2 = 1:25 broadband bead/tube transformer u=125 | R5 R6 - 2200 ohm 1/4W |

Figure 2-2. 175 MHz Test Circuit



- | | |
|-----------------------------|--|
| C1, 2, 8, 9 - ARCO 463 | L1 - 3/4" #18 ga into Hairpin |
| C3 C7 - 25 pF ATC 100B | W1 - printed line 0.23"W x 0.7" L |
| C4 C10 C12 - 0.1uF 100V SMT | L2 - 2t #16 ga .25" dia x .25" ~ 35nH |
| C5 - 1 uF 15WV tant | L3 - 2 turns #16 ga 5/16" ID tight. ~ 50nH |
| C6 - 270 pF ATC 100B | R1 R2 - 2.2k ohm 1/4W |
| C10 - .05 100V 1206 SMT | R3 - 150 ohm 1/4W |
| C11 - 15uF 100V Elect | RFC1 Fair-Rite 2961666631 (VK200-4B) |

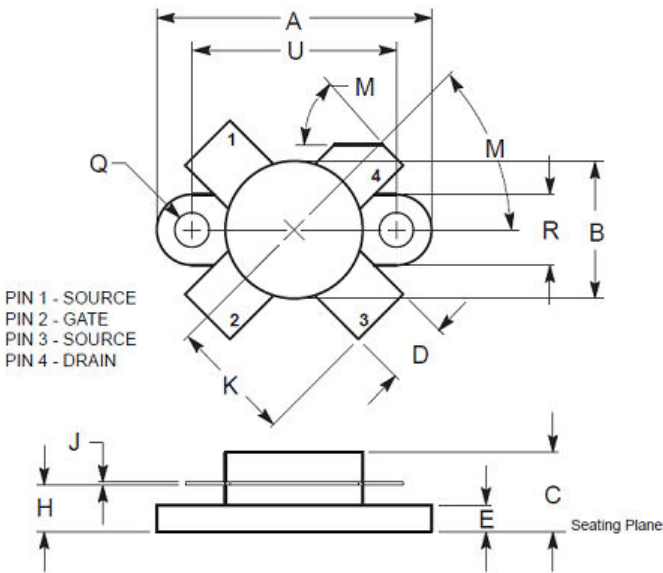
3. Package Specification

This section shows the package specification of the VRF141(MP) device.

3.1 Package Outline Drawing

The following figure illustrates the package outline of the VRF141(MP) device.

Figure 3-1. M174 Package Outline 0.5" SOE



DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.096	0.990	24.39	25.14
B	0.465	0.510	11.82	12.95
C	0.229	0.275	5.82	6.98
D	0.216	0.235	5.49	5.96
E	0.084	0.110	2.14	2.79
H	0.144	0.178	3.66	4.52
J	0.003	0.007	0.08	0.17
K	0.435		11.0	
M	45° NOM		45° NOM	
Q	0.115	0.130	2.93	3.30
R	0.246	0.255	6.25	6.47
U	0.720	0.730	18.29	18.54

4. Matched Pair Part Marking

Adding MP at the end of part number specifies a matched pair where $V_{GS(TH)}$ is matched between the two parts. V_{TH} values are marked on the devices per the following table.

Table 4-1. V_{TH} Range Codes

Code	V_{TH} Range	Code	V_{TH} Range
A	2.900–2.975	M	3.650–3.725
B	2.975–3.050	N	3.725–3.800
C	3.050–3.125	P	3.800–3.875
D	3.125–3.200	R	3.875–3.950
E	3.200–3.275	S	3.950–4.025
F	3.275–3.350	T	4.025–4.100
G	3.350–3.425	W	4.100–4.175
H	3.425–3.500	X	4.175–4.250
J	3.500–3.575	Y	4.250–4.325
K	3.575–3.650	Z	4.325–4.400

Note: V_{TH} values are based on Microchip measurements at datasheet conditions with an accuracy of 1.0%.

5. Revision History

Table 5-1. Revision History

Revision	Date	Description
A	12/2021	• Document migrated from Microsemi template to Microchip template; Assigned Microchip literature number DS-00004329A, which replaces the previous Microsemi literature number 050-4942. • Increased $V_{DS(on)}$ limit from 1.3V max. to 1.4V max.
Initial releases (Microsemi Revisions A through E)	09/2007 – 12/2020	Previous releases.

The Microchip Website

Microchip provides online support via our website at www.microchip.com/. This website is used to make files and information easily available to customers. Some of the content available includes:

- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip design partner program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

Product Change Notification Service

Microchip's product change notification service helps keep customers current on Microchip products. Subscribers will receive email notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, go to www.microchip.com/pcn and follow the registration instructions.

Customer Support

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Embedded Solutions Engineer (ESE)
- Technical Support

Customers should contact their distributor, representative or ESE for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in this document.

Technical support is available through the website at: www.microchip.com/support

Microchip Devices Code Protection Feature

Note the following details of the code protection feature on Microchip products:

- Microchip products meet the specifications contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is secure when used in the intended manner, within operating specifications, and under normal conditions.
- Microchip values and aggressively protects its intellectual property rights. Attempts to breach the code protection features of Microchip product is strictly prohibited and may violate the Digital Millennium Copyright Act.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is "unbreakable". Code protection is constantly evolving. Microchip is committed to continuously improving the code protection features of our products.

Legal Notice

This publication and the information herein may be used only with Microchip products, including to design, test, and integrate Microchip products with your application. Use of this information in any other manner violates these terms. Information regarding device applications 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. Contact your local Microchip sales office for additional support or, obtain additional support at www.microchip.com/en-us/support/design-help/client-support-services.

THIS INFORMATION IS PROVIDED BY MICROCHIP "AS IS". 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 ANY IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE, OR WARRANTIES RELATED TO ITS CONDITION, QUALITY, OR PERFORMANCE.

IN NO EVENT WILL MICROCHIP BE LIABLE FOR ANY INDIRECT, SPECIAL, PUNITIVE, INCIDENTAL, OR CONSEQUENTIAL LOSS, DAMAGE, COST, OR EXPENSE OF ANY KIND WHATSOEVER RELATED TO THE INFORMATION OR ITS USE, HOWEVER CAUSED, EVEN IF MICROCHIP HAS BEEN ADVISED OF THE POSSIBILITY OR THE DAMAGES ARE FORESEEABLE. TO THE FULLEST EXTENT ALLOWED BY LAW, MICROCHIP'S TOTAL LIABILITY ON ALL CLAIMS IN ANY WAY RELATED TO THE INFORMATION OR ITS USE WILL NOT EXCEED THE AMOUNT OF FEES, IF ANY, THAT YOU HAVE PAID DIRECTLY TO MICROCHIP FOR THE INFORMATION.

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 unless otherwise stated.

Trademarks

The Microchip name and logo, the Microchip logo, Adaptec, AnyRate, AVR, AVR logo, AVR Freaks, BesTime, BitCloud, CryptoMemory, CryptoRF, dsPIC, flexPWR, HELDO, IGLOO, JukeBlox, KeeLoq, Klear, LANCheck, LinkMD, maXStylus, maXTouch, MediaLB, megaAVR, Microsemi, Microsemi logo, MOST, MOST logo, MPLAB, OptoLyzer, PIC, picoPower, PICSTART, PIC32 logo, PolarFire, Prochip Designer, QTouch, SAM-BA, SenGenuity, SpyNIC, SST, SST Logo, SuperFlash, Symmetricom, SyncServer, Tachyon, TimeSource, tinyAVR, UNI/O, Vectron, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

AgileSwitch, APT, ClockWorks, The Embedded Control Solutions Company, EtherSynch, Flashtec, Hyper Speed Control, HyperLight Load, IntelliMOS, Libero, motorBench, mTouch, Powermite 3, Precision Edge, ProASIC, ProASIC Plus, ProASIC Plus logo, Quiet- Wire, SmartFusion, SyncWorld, Temux, TimeCesium, TimeHub, TimePictra, TimeProvider, TrueTime, WinPath, and ZL are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Adjacent Key Suppression, AKS, Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, Augmented Switching, BlueSky, BodyCom, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, Espresso T1S, EtherGREEN, GridTime, IdealBridge, In-Circuit Serial Programming, ICSP, INICnet, Intelligent Paralleling, Inter-Chip Connectivity, JitterBlocker, Knob-on-Display, maxCrypto, maxView, memBrain, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, NVM Express, NVMe, Omniscient Code Generation, PICDEM, PICDEM.net, PICKit, PICtail, PowerSmart, PureSilicon, QMatrix, REAL ICE, Ripple Blocker, RTAX, RTG4, SAM-ICE, Serial Quad I/O, simpleMAP, SimpliPHY, SmartBuffer, SmartHLS, SMART-I.S., storClad, SQL, SuperSwitcher, SuperSwitcher II, Switchtec, SynchroPHY, Total Endurance, TSHARC, USBCheck, VariSense, VectorBlox, VeriPHY, ViewSpan, WiperLock, XpressConnect, 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.

The Adaptec logo, Frequency on Demand, Silicon Storage Technology, Symmcom, and Trusted Time are registered trademarks of Microchip Technology Inc. in other countries.

GestIC is a registered trademark 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.

© 2021, Microchip Technology Incorporated and its subsidiaries. All Rights Reserved.

ISBN: 978-1-5224-9397-6

Quality Management System

For information regarding Microchip's Quality Management Systems, please visit www.microchip.com/quality.

Worldwide Sales and Service

AMERICAS	ASIA/PACIFIC	ASIA/PACIFIC	EUROPE
Corporate Office 2355 West Chandler Blvd. Chandler, AZ 85224-6199 Tel: 480-792-7200 Fax: 480-792-7277 Technical Support: www.microchip.com/support Web Address: www.microchip.com	Australia - Sydney Tel: 61-2-9868-6733 China - Beijing Tel: 86-10-8569-7000 China - Chengdu Tel: 86-28-8665-5511 China - Chongqing Tel: 86-23-8980-9588 China - Dongguan Tel: 86-769-8702-9880 China - Guangzhou Tel: 86-20-8755-8029 China - Hangzhou Tel: 86-571-8792-8115 China - Hong Kong SAR Tel: 852-2943-5100 China - Nanjing Tel: 86-25-8473-2460 China - Qingdao Tel: 86-532-8502-7355 China - Shanghai Tel: 86-21-3326-8000 China - Shenyang Tel: 86-24-2334-2829 China - Shenzhen Tel: 86-755-8864-2200 China - Suzhou Tel: 86-186-6233-1526 China - Wuhan Tel: 86-27-5980-5300 China - Xian Tel: 86-29-8833-7252 China - Xiamen Tel: 86-592-2388138 China - Zhuhai Tel: 86-756-3210040	India - Bangalore Tel: 91-80-3090-4444 India - New Delhi Tel: 91-11-4160-8631 India - Pune Tel: 91-20-4121-0141 Japan - Osaka Tel: 81-6-6152-7160 Japan - Tokyo Tel: 81-3-6880-3770 Korea - Daegu Tel: 82-53-744-4301 Korea - Seoul Tel: 82-2-554-7200 Malaysia - Kuala Lumpur Tel: 60-3-7651-7906 Malaysia - Penang Tel: 60-4-227-8870 Philippines - Manila Tel: 63-2-634-9065 Singapore Tel: 65-6334-8870 Taiwan - Hsin Chu Tel: 886-3-577-8366 Taiwan - Kaohsiung Tel: 886-7-213-7830 Taiwan - Taipei Tel: 886-2-2508-8600 Thailand - Bangkok Tel: 66-2-694-1351 Vietnam - Ho Chi Minh Tel: 84-28-5448-2100	Austria - Wels Tel: 43-7242-2244-39 Fax: 43-7242-2244-393 Denmark - Copenhagen Tel: 45-4485-5910 Fax: 45-4485-2829 Finland - Espoo Tel: 358-9-4520-820 France - Paris Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79 Germany - Garching Tel: 49-8931-9700 Germany - Haan Tel: 49-2129-3766400 Germany - Heilbronn Tel: 49-7131-72400 Germany - Karlsruhe Tel: 49-721-625370 Germany - Munich Tel: 49-89-627-144-0 Fax: 49-89-627-144-44 Germany - Rosenheim Tel: 49-8031-354-560 Israel - Ra'anana Tel: 972-9-744-7705 Italy - Milan Tel: 39-0331-742611 Fax: 39-0331-466781 Italy - Padova Tel: 39-049-7625286 Netherlands - Drunen Tel: 31-416-690399 Fax: 31-416-690340 Norway - Trondheim Tel: 47-72884388 Poland - Warsaw Tel: 48-22-3325737 Romania - Bucharest Tel: 40-21-407-87-50 Spain - Madrid Tel: 34-91-708-08-90 Fax: 34-91-708-08-91 Sweden - Gothenberg Tel: 46-31-704-60-40 Sweden - Stockholm Tel: 46-8-5090-4654 UK - Wokingham Tel: 44-118-921-5800 Fax: 44-118-921-5820