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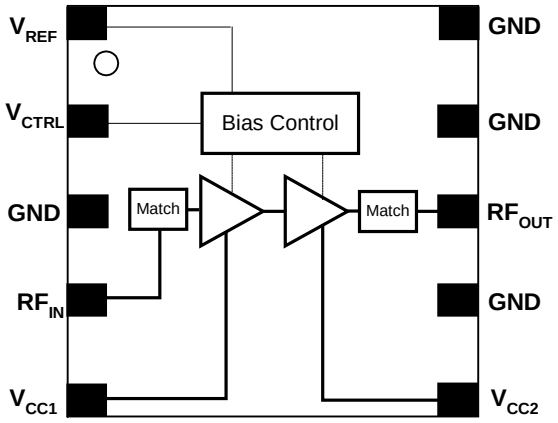
TriQuint SEMICONDUCTOR

WIRELESS COMMUNICATIONS DIVISION



TQM7138

DATA SHEET

3V HBT SiGe CDMA 4x4mm POWER AMPLIFIER MODULE

Features

- *Analog continuous bias capability with excellen linearity over 1.9 to 3.0VDC and temperature stability over –30C to 85C*
- *Excellent PAE*
- *Small 10 pin 4x4mm module*
- *1xRTT Compatible*
- *Industry compatible digital quiescent current state control*
- *Analog continuous bias capability*
- *CMOS compatible logic input*
- *Excellent Rx band noise performance*
- *Internally matched input and output*
- *Full ESD Protection*
- *Low leakage current*

Applications

- *Cellular Band CDMA IS-95/98 based mobile phones.*
- *Single-Mode, Dual Mode, and Tri Mode CDMA/AMPS phones*

Product Description:

The TQM7138 is a 3V, 2 stage SiGe HBT Power Amplifier Module designed for use in mobile phones. Its extremely small 4x4mm package makes it ideal for today's extremely small data enabled phones. Its RF performance meets the requirements for products designed to IS-95/98 standards. The TQM7138 provides the capability to be operated in one, two, or continuous quiescent current modes. In digital quiescent current mode operation, the TQM7138 is controlled from the base-band processor using a CMOS compatible I_{CQ} voltage control voltage. Overall current consumption of the device is minimized by selecting the lowest I_{CQ} state available for each power output level. RF input and output matching is included within the module; therefore, minimal external circuitry is required.

The TQM7138 gives excellent RF performance with low current consumption resulting in longer talk times in portable applications. The small 4mm square surface mount package is ideal for new generation small and light phones.

Electrical Specifications:

Parameter	Min	Typ	Max	Units
Frequency	824		849	MHz
CDMA mode Pout[1]		28		dBm
CDMA Mode Efficiency[1]		35		%
AMPS Mode Output Power[2]		31.5		dBm
AMPS Mode Efficiency[2]		51		%

Note 1: Test Conditions CDMA Mode: V_{CC1}=3.4VDC, V_{CC2}=3.4VDC, V_{REF} =3.00VDC, V_{CTRL}=0.0VDC, Tc=25°C, Pout = 28.0dBm

Note 2: Test Conditions AMPS Mode: V_{CC1}=3.4VDC, V_{CC2}=3.4VDC, V_{REF}=3.00VDC, V_{CTRL}=0.0VDC, Tc=25°C, Pout=31.5dBm

For additional information and latest specifications, see our website: ***www.triquint.com***

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Absolute Maximum Ratings

Symbol	Parameter	Absolute Maximum Value	Units
V_{CC1}, V_{CC2}	Power Supply Voltage, no RF Applied	-0.5 to 6.0	VDC
	RF Applied	-0.5 to 5.0	
V_{REF}, V_{CTRL}	Bias reference voltages (V_{REF}) and bias control voltage (V_{CTRL}).	-0.5 to 5.0	VDC
P_{DISS}	Power Dissipation	2.5	W
T_C	Case Temperature, Survival	-40 to +100	°C
T_{STG}	Storage Temperature	-40 to +150	°C
RF_{IN}	DC Grounded RF input, 50ohm RF impedance	0 to 0V	VDC
RF_{OUT}	DC Blocked RF output, 50 ohm RF impedance	-20V to 20V	VDC

Note: The part may not survive all maximums applied simultaneously.

CDMA Mode Electrical Characteristics[1,2,3]

Parameter	Conditions	Min.	Typ/Nom	Max.	Units
RF Frequency		824		849	MHz
Pout, I_{CQ}-hi	V_{CTRL} = low		28		dBm
Large Signal Gain, I_{CQ}-hi	Pout = 28dBm, V_{CTRL}= low		30		dB
Large Signal Gain, I_{CQ}-low	Pout = 16dBm, V_{CTRL} = high		28		dB
Gain Variation vs. Temp.	-30 to 85 °C, Pout=28dBm		+0.7/-1.6		dB
Quiescent Current, I_{CQ}-hi	V_{CTRL}= low		120		mA
Quiescent Current, I_{CQ}-low	V_{CTRL} = low		69		mA
Icc	Pout = 28dBm, V_{CTRL} = low		525		mA
Power Added Efficiency	Pout = 28dBm, V_{CTRL} = low		35		%
Adjacent Channel Power (ACP)	Pout = 28dBm, V_{CTRL} = low, IS-95 Standard		-49		dBc
Adjacent Channel Power (ACP-1xRTT)	Pout-=27.5dBm, V_{CTRL} = low, IS-98 Standard, 4.5 dB Peak to Average Ratio, CCDF=1%		-49		dBc
Alternate Channel Power (ALT)	Pout = 28dBm, V_{CTRL} = low, IS-95 Standard		-57		dBc
Alternate Channel Power (ALT-1xRTT)	Pout-=27.5dBm, V_{CTRL} = low, IS-98 Standard, 4.5 dB Peak to Average Ratio, CCDF=1%		-57		dBc
Output Power Low -Power Icq state	ACPR = -51dBc, V_{CTRL} = high, IS-95 Standard		16		dBm

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CDMA Mode Electrical Characteristics[1,2,3] (cont'd)

Noise Power in Rx band	Pout=28dBm, V_{CTRL} = low, IS-95 Standard		-138		dBm/Hz
Input VSWR	Both I_{CQ}-hi & I_{CQ}-low		2:1		
Second Harmonic	Pout=+28dBm, V_{CTRL} = low, IS-95 Standard		-38		dBc
Third Harmonic	Pout=+28dBm, V_{CTRL} = low, IS-95 Standard		-48		dBc
Recommended Supply Voltage		3.2	3.4	4.2	VDC
Reference Voltage		2.9	3.00	3.1	VDC
V_{REF} Current, I_{CQ}-hi	Hi-Power Mode, V_{CTRL} = high		7		mA
V_{REF} Current, I_{CQ}-low	Low-Power Mode, V_{CTRL} = low		4		mA
Leakage Current	V_{CTRL} = low, V_{REF}=0VDC		10		µA
Logic Current (V_{CTRL})				100	µA
Logic Voltage (V_{CTRL})	High	1.7	2.0		VDC
	Low	0	0.25	0.5	VDC
Recommended Operating Temperature		-30		+85C	
Ruggedness	No Damage, Pout=+28dBm, V_{CTRL} = low, IS-95 Standard			10:1	
Stability	No Oscillations, Pout=+28dBm, V_{CTRL} = low, IS-95 Standard			10:1	

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Note 1: *Test Conditions: V_{CC1}=3.4VDC, V_{CC2}=3.4VDC, V_{REF}=3.00VDC, V_{CTRL}=0.0VDC, RF=836 MHz, T_C = 25°C unless otherwise specified.*

Note 2*: Min./Max. limits are at +25°C case temperature unless otherwise specified.*

Note 3*: TriQuint Test Board.*

AMPS Mode Electrical Characteristics[1,2,3]

Parameter	Conditions	Min.	Typ/Nom	Max.	Units
RF Frequency		824		849	MHz
Pout, Saturated			31.5		dBm
Large Signal Gain	Pout = 31.5 dBm		28		dB
Power Added Efficiency	Pout = 31.5 dBm		51		%
Receive Band Noise Power	BW=30KHz, f=Tx+45MHz		-137		dBm/Hz
Input VSWR	All Operating Pout and Vcc		2:1		
2nd Harmonic	Pout = 31.5 dBm		-34		dBc
3rd Harmonic	Pout = 31.5 dBm		-49		dBc
Icc	Pout = 31.5 dBm		812		mA

Note 1: *Test Conditions: V_{CC1}=3.4VDC, V_{CC2}=3.4VDC, V_{REF}=3.00, V_{CTRL}=0.0VDC, RF=836MHz, T_C = 25°C unless otherwise specified.*

Note 2: *Min./Max. limits are at +25°C case temperature unless otherwise specified.*

Note 3: *TriQuint Test Board.*

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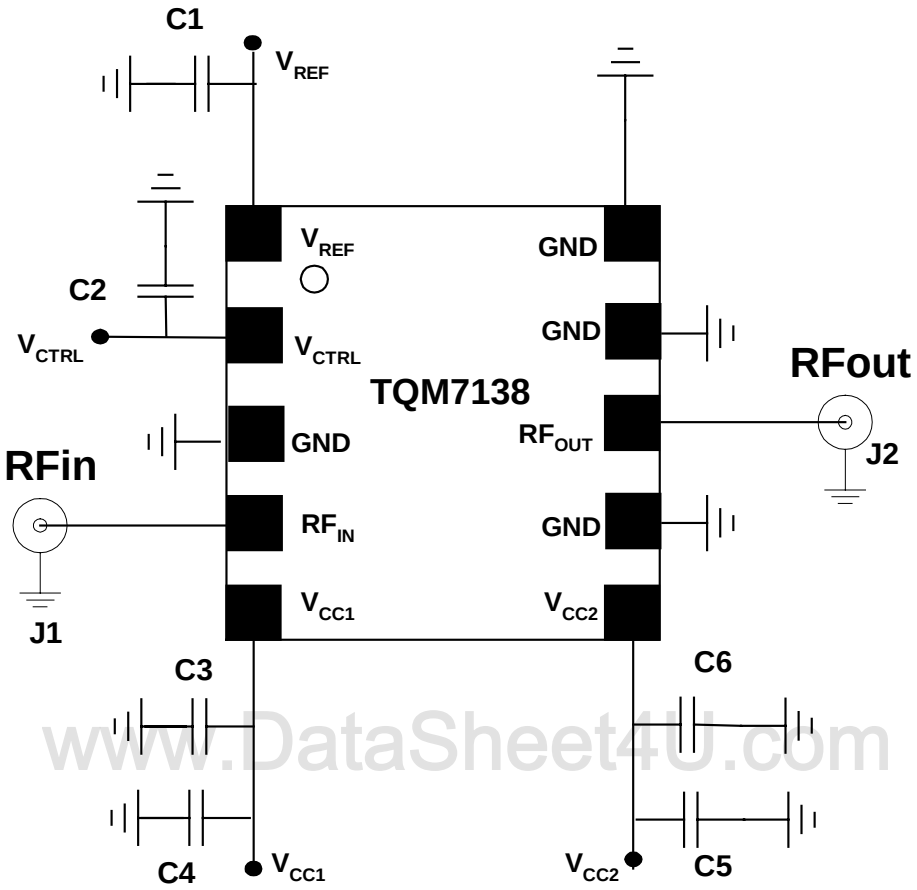
Application/Test Circuit:



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US Cellular Band, 824 – 849 MHz

Bill of Material for TQM7138 Power Amplifier Module Application/Test Circuit*

Component	Reference Designator	Part Number	Value, Cellular Band	Size
Power Amplifier Module		TQM7138		8pin/6mm square
RF Connector	J1, J2			
Capacitor	C1, C2, C3, C6		0.1µF	0402
Capacitor	C4, C5		10µF	1210

*May vary due to printed circuit board layout and material

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Product Description:

The TQM7138 is a two stage SiGe HBT power amplifier module in a cascade configuration intended for use in CDMA Cellular band handsets.

Operation

The operation modes of the TQM7138 are determined based on the setting of V_{CNTRL} and V_{REF}. The truth table below defines the operating mode. Also, if the TQM7138 will be used in continuous bias mode V_{CNTRL} must be connected on the circuit board to ground.

Operating Mode	V_{CNTRL1}	V_{REF}
High Power	Low	>2.7VDC
Low-Power	High	>2.7VDC
Continuous Bias	Low	~1.9 to 3.0VDC
Off	Low	0VDC

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Application

The applications circuit for the TQM7138 is very simple since most of the critical components are included inside the module. There are several important considerations when using the module in a phone design.

First of all, it is important that the source impedance of the V_{CC} power supply be very low. This is because the high current demand during the modulation peaks of the CDMA waveform can introduce voltage ripple at the symbol rate that will introduce additional inter-modulation distortion or Adjacent Channel Power distortion at the output of the power amplifier. If the power amplifier has a quiescent current of 100 mA and a peak current demand in excess of 1 amp, it is possible to see 900 mA change in the current required from V_{CC} as the modulated signal moves from one extreme to the other. If the power supply source impedance were 1 ohm, the resulting voltage ripple would be 0.9 volts which would cause the amplifier to fail it ACP requirements. Generally, the power supply source impedance should be kept as low as possible, preferably below 0.1 ohms total. Most battery technologies used in cellular telephones will support a low source impedance, but it may be necessary to supplement this in some designs with an low ESR capacitor. Ceramic or tantalum capacitors of approximately 10 micro-farads work well for this requirement.

The application circuit includes 0.1 µF capacitors at each of the PA control lines and V_{CC} lines to ensure proper RF bypassing. Depending on the phone board layout and circuit bypassing in other areas of the phone, some of these components may not be necessary. There are a number of VCO signals and IF signals used in a given phone design, so it is important to protect the PA module from interfering signals and to limit any interference coming from the PA itself. Care should be taken when removing any of the RF bypassing components.

One final area of concern is with excessive bypassing. If too large a value of bypassing capacitor is used on any of the control lines, it could reduce the frequency response of that control line to the point where a specification failure could occur. Please be sure that the logic lines and regulated supply lines driving the power amplifier control lines are adequate to supply peak current requirements of the bypassing capacitors chosen on the control lines.

One Bias State Operation

The TQM7138 can be operated using one bias state. If this mode is selected, V_{CNTRL} should be connected to ground.

Continuous Bias-State Operation

The TQM7138 can be operated in continuous bias mode in which the V_{REF} voltage is varied from ~1.9V to 3.0V to set the PAM quiescent current as appropriate for the desired output power level. In this mode, V_{CNTRL} should be connected to ground on the phone board. Specific application circuit information for this mode is available upon request.

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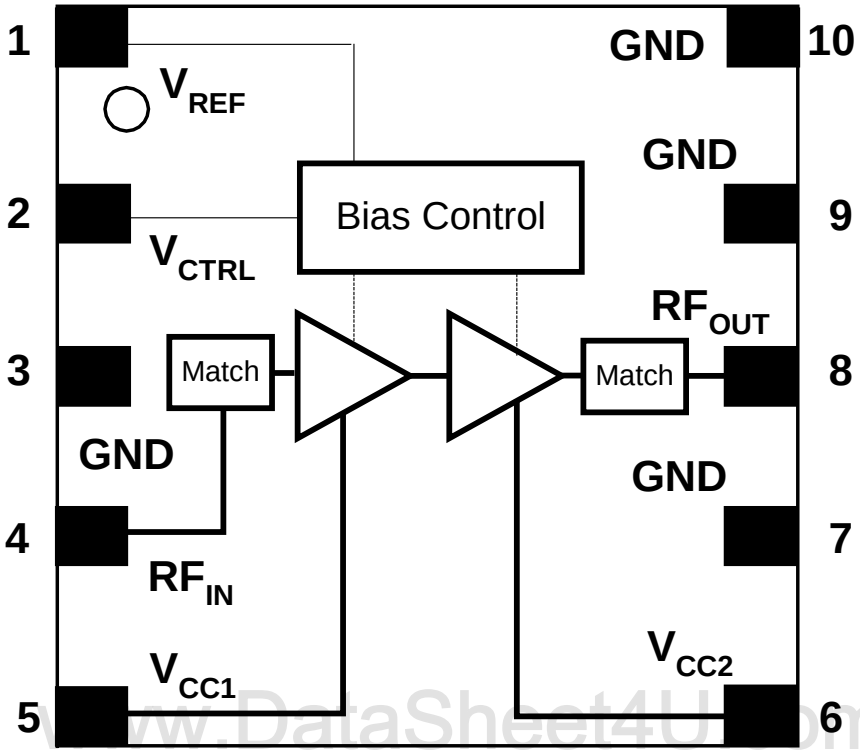
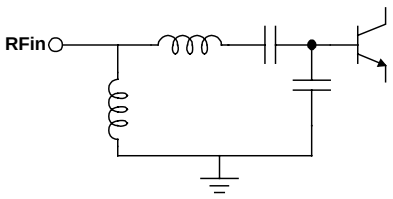
Package Pinout:



Pin Descriptions:

Pin Name	Pin #	Description and Usage (Equivalent Circuit)
GND	Paddle	Device Ground and Heat Sink. Needs good thermal path to remove heat.
V_{REF}	1	Regulated supply for setting bias. Vref is set to 0VDC to power-off the TQM7138
V_{CTRL}	2	CMOS compatible logic level to set bias level
RF_{IN}	4	RF input. The RF circuit is DC ground. 50 Ohm RF impedance. 
V_{CC1}	5	Collector supply for input stage.
V_{CC2}	6	Collector supply for output stage.
RF_{OUT}	8	RF output. The RF circuit is DC blocked internally. 50 ohm RF impedance.
GND	3, 7, 9, 10	Ground

TriQuint recommends use of several via holes to the backside ground under the Paddle.

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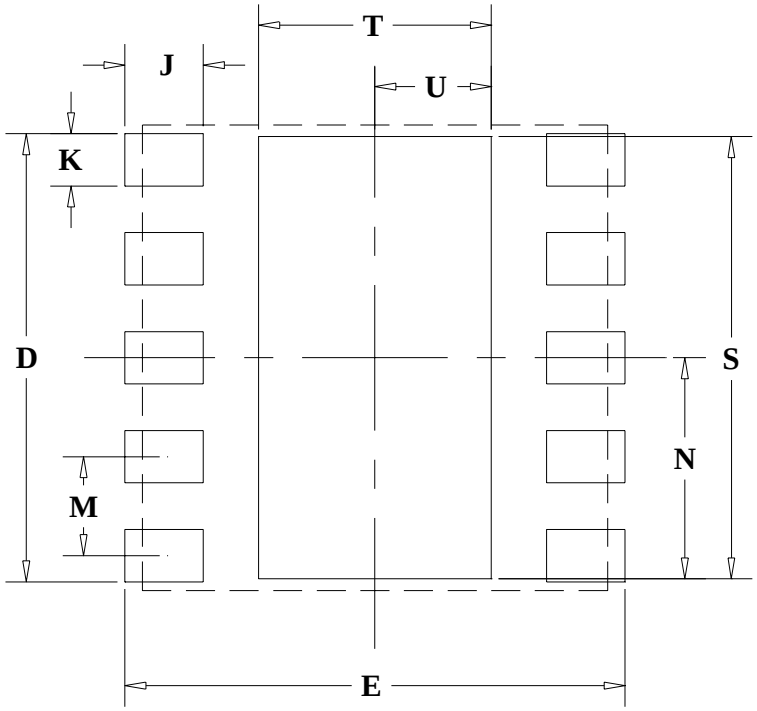
Recommended PC board layout to Accept 10 Pin Module Package:



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DIMENSION	MM
D	3.85
E	4.30
J	0.68
K	0.45
M	0.85
N	1.90
S	3.80
T	2.00
U	1.00

Notes:
1 Only ground signal traces are allowed directly under the package
2 Primary dimensions are in millimeters alternate dimensions are in inches.

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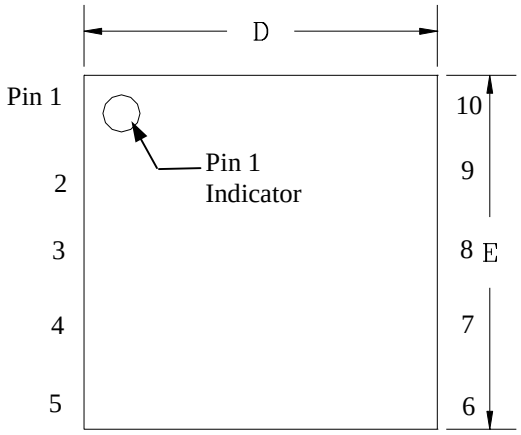
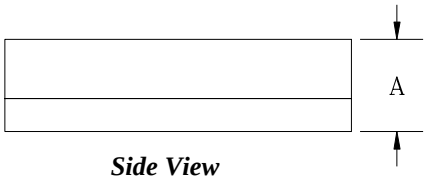
Package Type: 10 Pin Plastic Module Package



Top View



Side View

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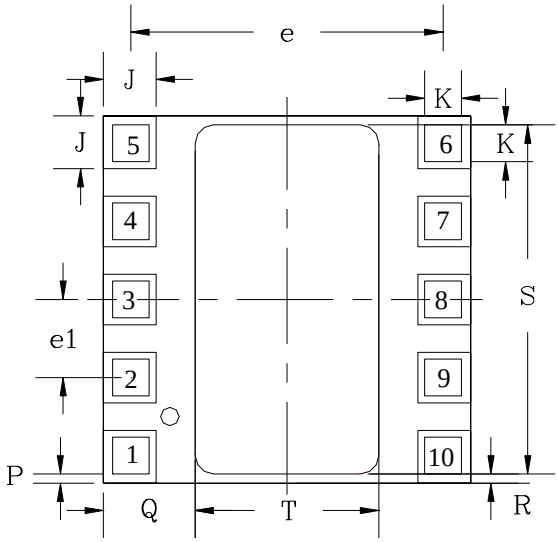

Bottom View

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Package Type: 10 Pin Plastic Module Package (cont'd)

DESIGNATION	DESCRIPTION	DIMENSION
A	OVERALL HEIGHT	1.06 +/-0.09 mm
D	PACKAGE LENGTH	4.0 +/-0.1 mm
E	PACKAGE WIDTH	4.0 +/-0.1 mm
J	SOLDER MASK OPENING LENGTH AND WIDTH	0.575 +/-0.075 mm
K	METAL PAD LENGTH AND WIDTH	0.40 +/-0.05 mm
P	DISTANCE BETWEEN METAL PAD AND PACKAGE EDGE	0.10 +/-0.025 mm
T	GND SOLDER MASK OPENING WIDTH	2.00 +/-0.05 mm
S	GND SOLDER MASK OPENING LENGTH	3.80 +/-0.05 mm
R	DISTANCE BETWEEN GND SOLDER MASK OPENING AND PACKAGE EDGE	0.10 +/-0.1 mm
Q	DISTANCE BETWEEN GND SOLDER MASK OPENING AND PACKAGE EDGE	1.00 +/-0.1 mm
e	TERMINAL PITCH FOR TERMINAL 1-10, 2-9, 3-8, 4-7 AND 5-6	3.400 mm
e1	TERMINAL PITCH FOR TERMINAL 1-2-3-4-5 AND 6-7-8-9-10	0.850 mm

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Notes:

1. GND SOLDER MASK OPENING IS NOT CENTERED ON THE PACKAGE

Additional Information

For latest specifications, additional product information, worldwide sales and distribution locations, and information about TriQuint:

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Email: info_wireless@tqs.com **Fax: (503) 615-8902**

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