

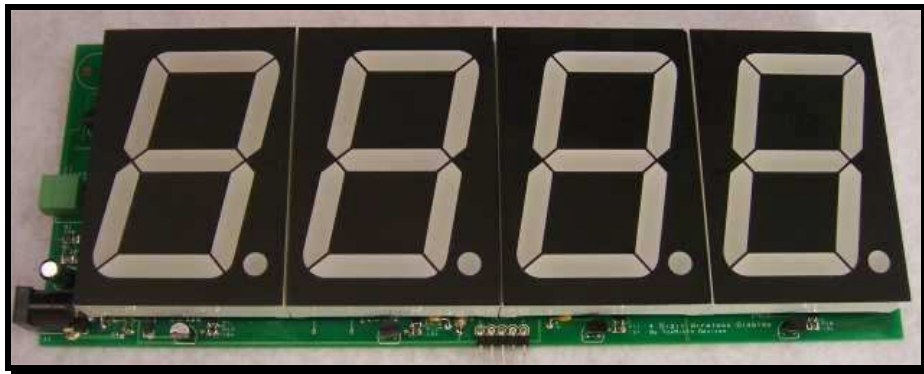


TUXMICRO DEVICES
WWW.TUXMICRO.COM

April 06, 2015
Version 1.0

**PICLINKRS 915-MHZ
ISM WIRELESS DSP**

USER'S MANUAL



©2015 TUXMICRO DEVICES ALL RIGHTS RESERVED.

For more information, visit our website at <http://www.tuxmicro.com>

1. INTRODUCTION.....	3
1.1 KEY FEATURES	3
1.2 SPECIFICATIONS.....	4
2. PICLinkRS DSP IO	5
2.1 RS485 PORT.....	5
2.2 ICSP PORT.....	5
2.2 USB to RS485 ADAPTER	5
3. PICLinkRS DSP PROTOCOL.....	6
3.1 DSP FRAME.....	6
3.2 DSP VFHLAN.....	6
3.3 DSP SYNTAX.....	7
3.4 DSP COMMANDS.....	8
4. PICLinkRS DSP CONFIGURATION.....	9
4.1 CONFIGURATION COMMANDS.....	10
4.2 DISPLAY MODES.....	10
4.3 COUNTER MODE.....	11
4.4 TIMER/ALARM MODE.....	11
4.5 FLASH MODE.....	12
4.6 ADDRESS DETECT.....	12
5. PICLinkRS WIRELESS DEVICES.....	13
5.1 USBWM Wireless Modem.....	13
5.2 RS458-to-GFSK90 Wireless Bridge.....	13
6. FIRMWARE UPGRADE.....	14
6.1 Firmware License.....	14
7. WARRANTY.....	15

1. INTRODUCTION

The PICLinkRS DSP Wireless Display Module is a 4 Digit by 7-Segment smart display system which incorporates TuxMicro Devices proprietary PICLinkRS DSP Wireless Display Protocol. PICLinkRS DSP was developed to provide display and packet switching support for RS485, USB-to-RS485, LPD433 and 915-MHz ISM enabled devices which support supervisory control and data acquisition (SCADA) systems. There are built-in protocol features which enable the DSP to function as an addressable wireless-to-RS485 and RS485-to-wireless Bridge as well as an addressable switch which can store and forward PICLinkRS packets between host endpoint devices. In addition the DSP supports Date, Time, Counter, Timer, Alarm, floating Decimal Point and Segment Flash modes of operation.

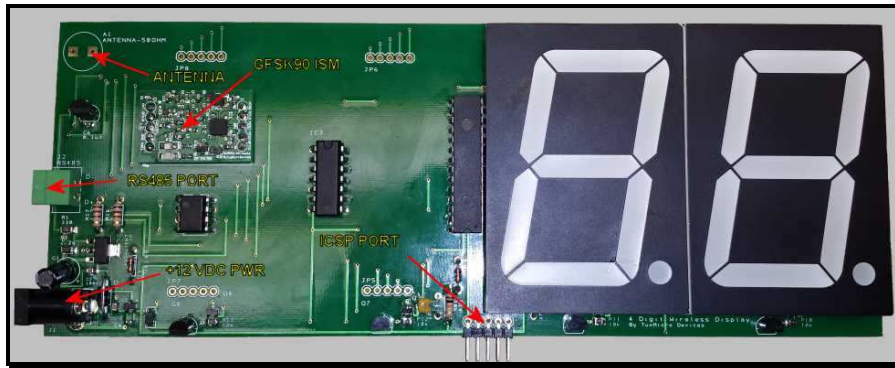
1.1 KEY FEATURES

- GFSK90 915-MHz or LPD433 ISM Radio
- Frequency Hopping Spread Spectrum (FHSS)
- 100 Programmable Channels
- 1 Kilometer Range using 2dBi antenna (+20dBm)
- 38.4 to 115.2 Kbps programmable Data Rate
- RS485 Wireless Bridge w/ Packet Switching
- VFHLAN (Variable Frequency Hopping LAN)
 - ◆ 253 addressable host devices per channel
 - ◆ Automatic address and multicast detection
- PICLinkRS Protocol
- RTC Real-time Clock Date Mode
- RTC Real-time Clock Time Mode
- RTC Real-time Clock Alarm Mode
- Timer Mode w/ Presetable Alarm event
- Presetable Counter Mode
- 4x7 Segment Flash Mode
- Programmable Decimal Point
- Bright Red 2.3" Segments 30mcd
- Wavelength 660nm
- RoHS Compliant

1.2 SPECIFICATIONS

Items	Description
RS485 Parameters	Parity : None Data Bits : 8 Flow Control : None Baud Rate: 38.4 Kbps Programmable to 115.2 Kbps
GFSK90 ISM Radio	LPD433 and 915-MHz Bands +3 to +20dBm Power Range Sensitivity = -118 dBm GFSK modulation Digital RSSI Data Rate: 38.4 – 115.2 Kbps
Power Supply	DC +12V 250 mA
Input Voltage	DC +12V
Current Consumption	150 mA
ICSP	1VPP = 13V, 2VDD = 5V, 3GND, 4PGD, 5 PGC
Segments	Red 2.3" Segments 30mcd Wavelength 660nm
Temperature	-40 to +85 °C temperature range

2. PICLinkRS DSP IO



2.1 RS485 PORT (J2)

PICLinkRS DSP supports TIA/EIA-485 standard via J2 (3.8 mm x 2 pos) which provides the capability of driving >32 unit loads plus a parallel termination of 60 Ω . This port also provides Open-circuit and overload protection. With no signal applied J2 input D+ will be more positive than D- which holds the receivers input at logic 1. The DSP incorporates a fail-safe circuit for disconnected or shorted nodes. The port is ITU compliant with V.11 and X.27 and provides a driver output capability of ± 60 mA Max. The receiver features a minimum input impedance of 12k Ω , an input sensitivity of ± 200 mV with a typical input hysteresis of 50 mV. Port is compatible with transmission-line applications employing the SN75176, SN75172, SN75174 quadruple differential line drivers and SN75173 and SN75175 quadruple differential line receivers.

2.2 ICSP PORT

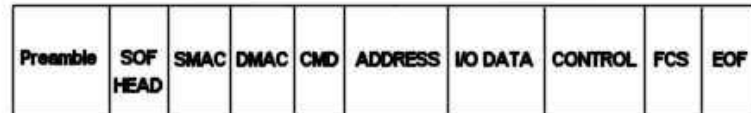
DSP module supports firmware upgrades via 5-pin ICSP which conforms to Microchip ICSP specifications. Pin 1 (left most pin) is VPP, pin 2 VDD, pin 3 GND, pin 4 PGD and pin 5 PGC. This port supports firmware upgrades via PICKIT 2 & 3 as well as [USBPIC](#) programmers. When updating the controller's firmware insure the programmers VDD is set to +5.0 VDC. Upgrades and support will be available to licensed customers as required.

2.2 USB to RS485 ADAPTER

PICLinkRS DSP supports common +5 and +3V USB to RS485 level converters sold separately. The USB to RS485 converter is required to setup and configure the DSP via a PC terminal. TuxMicro Devices recommends our PICLinkRS USB-to-RS485 converter PN# PICLinkRS485USB-v0.1. In addition, our USB-to-RS485 915-MHz Wireless Modem PN# PICLinkRSUSBWM-v0.1 supports both wireless and wired configuration of the DSP. Contact us via email at <http://tuxmicro.com/contactus> or see section 5.1 for more information.

3. PICLinkRS DSP PROTOCOL

3.1 DSP FRAME



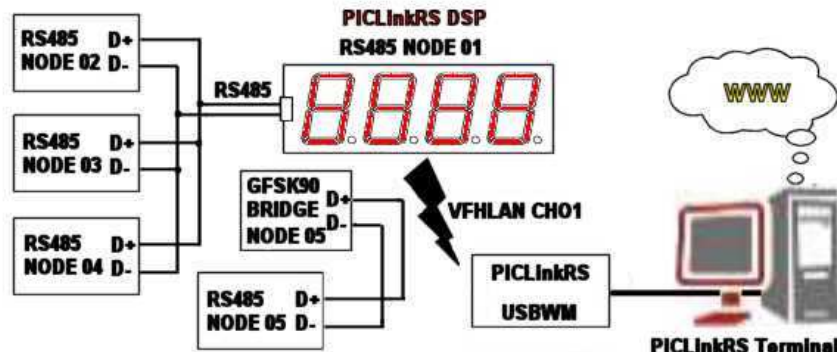
PICLinkRS Protocol Frame

Physical Layer PDU

Figure 1

The DSP module utilizes our proprietary PICLinkRS protocol v1.0 which essentially elevates the Hardware Abstraction Layer (HAL) and internal CPU peripheral devices of the DSP to the application as addressable endpoints. Each individual endpoint device within the CPU maintains a unique address which accepts a series of commands followed by peripheral I/O control data. DSP payload is encapsulated by a MAC layer PDU, which provides the necessary control information for device switching and forwarding. The physical layer PDU is transferred by the VFHLAN phy via a unique light weight embedded protocol which controls frequency, channel selection and monitors RSSI.

3.2 DSP VFHLAN

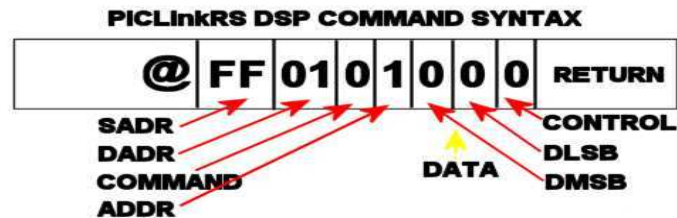


PICLinkRS TIA/EIA-485 via VFHLAN

Figure 2

The USBWM-v0.1 may be used to construct a basic VFHLAN which supports simulcast, unicast, and broadcast forms of supervisory control communications. Using VFHLAN RS485 nodes may directly communicate with host terminal application and other nodes on an individually negotiated channel. In addition, a single node may choose to share control and data information with all nodes via a broadcast on channel 1. In figure 2 the PC's USBWM could store received information from nodes address 02-05 while updating the DSP. Notice the USBWM (sec 5.1) is sending and receiving packets from nodes 02-04 via the GFSK90 wireless radio on board the DSP. RS485 Node 05 may also communicate with all other nodes as well as the DSP and USBWM via a GFSK90 Bridge module (sec 5.2). PICLinkRS and VFHLAN support both multi-drop party-line and multi-point communication systems. VFHLAN prevents "data collision" problems which is often present in these types of networks.

3.3 DSP SYNTAX



DSP Command Syntax
Figure 3

PICLinkRS DSP is configured and controlled via PICLinkRS commands, which can easily be sent from any PC or microcontrollers serial interface. Similar to other hardware devices which utilize serial AT commands the PICLinkRS DSP utilizes commands which are prefixed with the '@' character and terminates via a 2 byte line feed carriage return (0x0D & 0x0A). The complete command structure is comprised of 12 ASCII bytes with each byte field carrying a specific designation.

The 12 byte field designations are as follows:

'@' - Command Delimiter (1 byte)
SADR - Sender or Source Node Address (2 bytes)
DADR - Destination Node Address (2 bytes)
COMMAND - Command (1 byte)
ADDR - Peripheral Address (1 byte)
DMSB - Peripheral Data MSB (1 byte)
DLSB - Peripheral Data LSB (1 byte)
CONTROL - Control (1 byte)
RETURN - Line feed Carriage Return (2 bytes)

All command bytes are in ASCII format. The SADR and DADR character bytes must be in ASCII format which is converted to a hexadecimal unit (0-F). For instance a SADR (2 bytes) in ASCII of FF (0x46, 0x46) would be converted to the equivalent source node address of 255 in decimal. Thus, any node which owns address 0xFF (DADR) would receive the command. Upon boot the DSP will automatically determine its node address and announce its assignment via broadcast to all communications interfaces. See section 4.6 ADDRESS DETECT for more information.

3.4 DSP COMMANDS

Table 2 is a descriptive list of commands currently supported by the DSP. Each byte field is listed followed by the required address, data and control bytes. Refer to the previous section for syntax related information concerning the position of each field within the command structure.

COMMAND	ADDRESS	DATA	CONTROL	DESCRIPTION
P	0	00	5	Send ECHO Request to node address (DADR)
0	1	##	1	Set Time in Hours ## (00-23)
0	2	##	1	Set Time in Minutes ## (00-59)
0	3	##	1	Set Time in Seconds ## (00-59)
0	4	##	1	Set Date Month ## (01-12)
0	5	##	1	Set Date Day of month ## (01-31)
0	6	##	1	Set Date Year YY ## (15-99) **
0	7	##	1	Set Alarm event Time Hours ## (00-23)
0	8	##	1	Set Alarm event Time Minutes ## (00-59)
0	9	##	1	Set Alarm event Day of Month ## (01-31)
D	A	01	1	01 Enable or 00 Disable DSP Alarm event
D	C	##	1	Counter mode Increment DSP by ## (00-99)
D	C	R0	1	Counter mode Reset DSP value to 0000
D	D	00	1	Date Mode DSP value is MM/DD
D	T	00	1	Time Mode DSP value is hh:mm
D	F	##	1	Set DSP Channel (ISM Frequency 01-99)
D	F	00	1	Display Channel (ISM Frequency)
D	H	##	1	Set Display MSB 2 Segments (00-99)
D	L	##	1	Set Display LSB 2 Segments (00-99)
D	R	00	1	* Display reset (DH00, DL00)
D	M	0#	1	Set Display Mode (0 = Update or 5 = Flash)
D	P	##	1	Set Display Decimal Point (Data SEG# MSB = 1 - 4, LSB = 1 On or 0 Off)

Table 2

Notes:

- ASCII number range (0-9)

* - Future support only not currently implemented

** – Century is set automatically

Decimal Points:

Command DP11 sets and DP10 clears the Segment 1 (right) decimal point.

Command DP21 sets and DP20 clears the Segment 2 (right) decimal point.

Command DP31 sets and DP30 clears the Segment 3 (right) decimal point.

Command DP41 sets and DP40 clears the Segment 4 (right) decimal point.

4. PICLinkRS DSP CONFIGURATION

The following steps and commands are required to perform the initial DSP configuration after booting up the DSP module. It is recommended the initialization be completed before sending data to the display.

4.1 CONFIGURATION COMMANDS

Step 1:

Connect the DSP module RS485 Port (J2) D+ and D- signals to your USB-to-RS485 converter module. After enumeration of the USB device, start your PC's terminal application and configure the COM port setting to 38.4kbps, 8 Data bits, no parity, no flow control and 1 stop bit then open (or connect) the terminal session.

Step 2:

Connect an AC-to-DC +12VDC 300mA (positive center) power supply and power the device. If the DSP is powered, your terminal should now display the DSP DADR address response:

@01FFXM010

Step 3 (ECHO REQUEST to node DADR):

Type command: @FF01P0005 [ENTER]

Response (ECHO REPLY from node DADR):

@01FFP0004

If the DSP does not return a response, try replacing the “@FF##P” with the 2 digit number immediately following the XM response in step 2. This number is your DSP assigned node destination address or DADR.

Step 4: (Set Time Hours in 24 HR format ## = 00-23)

Type command: @FF0101##1 [ENTER]

Response (for 23 HRS):

@01FFX1230

Step 5: (Set Time Minutes ## = 00-59)

Type command: @FF0102##1 [ENTER]

Response (for 12 Min):

@01FFX2120

Step 6: (Set Time Seconds ## = 00-59)

Type command: @FF0103##1 [ENTER]

Response (for 40 Sec):

@01FFX3400

4.1 CONFIGURATION COMMANDS (cont.)

Step 7: (Set Date Month ## = 01-12)

Type command: @FF0104##1 [ENTER]

Response (for Month = 04):

@01FFX4040

Step 8: (Set Date Day of Month ## = 01-31)

Type command: @FF0105##1 [ENTER]

Response (for Day of Month = 08)

@01FFX5080

Step 8: (Set Date Year ## = 15-99)

Type command: @FF0106##1 [ENTER]

Response (for Date Year = 2015)

@01FFX6150

Step 9: (Set DSP Display Mode to Time)

Type command: @FF01DT001 [ENTER]

The DSP responds by displaying the current Time in hh:mm. If the DSP time displayed is incorrect repeat step 4, step 5 and step 6 to correct hour and minute values.

Step 10: (Set DSP DL = 00 and DH = 00)

Type command: @FF01DL001 [ENTER]

Type command: @FF01DH001 [ENTER]

DSP will display 0000 for about 120 seconds then return to idle (sleep) mode.

4.2 DISPLAY MODES

There are 6 DSP modes of operation which are automatically controlled by the DSP module and are listed in Table 3. Modes 0 DSP Update and 5 DSP Flash are the only modes which may be used manually. Listed are the commands which cause the DSP to switch modes.

COMMAND	MODE	DESCRIPTION
DH, DL	0	DSP Update - Automatic (default)
DT	1	DSP Time - Automatic
DD	2	DSP Date - Automatic
DC	3	DSP Counter - Automatic
DA	4	DSP Alarm - Automatic
DM05	5	DSP Flash - Manual or on Alarm event - Auto

Table 3

Mode commands return an XM response to the requesting host (response for DM00):

@01FFXM000

4.3 COUNTER MODE

The DSP supports Counter mode and can count up to 9999 before the display is again cleared. In Counter mode, the 2 byte data field (bytes 8-9) sets the increment value. Passing 00 in the data field portion of the command will cause a read of the counter and pass its value to the display. Each time an increment is issued, the display will respond by incrementing by that value. Resetting is done by issuing the Counter Reset command. ASCII Command bytes 4-5 set the destination address (DADR) portion of the command and byte 9 sets the ones unit increment by value.

Enable Counter mode and increment by # command: @FF01DC0#1

Counter Reset command: @FF01DCR01

- ASCII number range (0-9)

4.4 TIMER/ALARM MODE

In Timer / Alarm mode and after an Alarm event preset time is expired, the DSP will activate the Alarm mode event bit and put the DSP into Flash mode. The DSP is capable of flashing the event hour and minute until acknowledged by the user. An Alarm mode event time is preset through commands 07, 08, 09 and an event becomes activated after reception and acknowledgement of the DA01 command. After an event is activated, the DSP will display the current time until expiration of the event time or until reception of a DH, DL or DC command. After expiration, the DSP Alarm will override the previous value, enter Flash mode and flash the events hh:mm value until cleared via an Alarm disable DA00, DH, DL or DC command, which then overrides the Timer/Alarm display value.

To preset and Alarm event for the day of month and time:

Set Alarm event Hours (00-24): @FF0107##1

Command Response: @01FFX7##:

@01FFX7110

Set Alarm event Minutes (00-59): @FF0108##1

Command Response: @01FFX8##:

@01FFX8150

Set Alarm event Day of Month (01-31): @FF0109##1

Command Response @01FFX9##:

@01FFX9090

Enable (or arm) the Alarm event: @FF01DA011

Command Response:

@01FFXA010

Disable (or acknowledge) an Alarm event: @FF01DA001

Command Response:

@01FFXA000

4.5 FLASH MODE

The DSP supports 4 Segment Flash Mode and is automatically entered upon the expiration of an Alarm event. Flash mode may be entered from display update mode or counter mode, which flashes a value on the display. To enable flash mode for a display value, issue command DM05 after updating the display value with the DH, DL or DC commands.

To flash a value (0000-9999) on the display:

Set Data High value (00-99): @FF01DH##1

Set Data Low value (00-99): @FF01DL##1

Set Display Mode Flash (05): @FF01DM051

Command Response:

@01FFXM050

DSP will flash the value until another DH, DL or DC command is received.

4.6 ADDRESS DETECT

To support VFHLAN the DSP module must, upon initial boot, negotiate and initialize a DADR node address on channel 1. The DADR address is used during M2M communications to uniquely identify the DSP node. In order that we may eliminate potential node address conflicts, the address detect feature, upon initial boot, negotiates an available node address. Upon first bootstrap, the DSP sends an ECHO Request (broadcast) with a DADR of 01 to all listening nodes. If the requested node address is available, the DSP will then permanently store the address and generate an XM response. After the initial node address determination, the DSP will announce its address upon subsequent boots to indicate the node is online and ready.

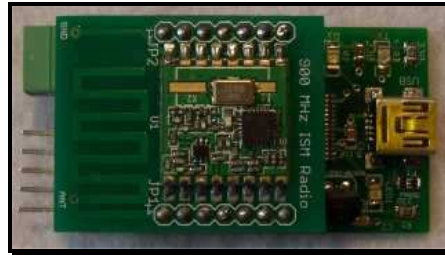
Address Detect node address 01 upon initial bootstrap of the DSP:

@FF01P0001

Address Detect M2M broadcast address 01 was available:

@01FFXM010

5. PICLinkRS WIRELESS DEVICES



USB-to-RS485 Wireless Modem (USBWM)

5.1 USBWM Wireless Modem

Section 3.2 briefly discusses an implementation of VFHLAN which uses the USBWM module to implement a supervisory control and data acquisition (SCADA) system which gathers and analyzes real time data from remote nodes. The USBWM module interfaces with a PC's USB port, which captures and stores both wired and wireless PICLinkRS communications. The USBWM monitors channel 1 and supports unicast, simulcast and broadcast M2M communications. In addition, the USBWM may be used to initialize, control and update the DSP module from a PC terminal or other application software.

5.2 RS485-to-GFSK90 Wireless Bridge



RS485-to-GFSK90 Wireless Bridge

Section 3.2 briefly discusses an implementation of VFHLAN, which uses the GFSK90 ISM Bridge module to convert wireless ISM signals to RS485. The wireless bridge module converts a wired RS485 node into a wireless VFHLAN compatible device by extending PICLinkRS protocol support to a connected RS485 device. In addition, the bridge may be used to initialize, control and update the DSP module from a non PICLinkRS compatible RS485 node.

6. FIRMWARE UPGRADE

Firmware upgrades are implemented via the DSP ICSP PORT (sec 2.2) and requires a compatible ICSP programmer. Compatible low cost flash programmers include Microchip's PICkit2, PICkit3 and [USBPIC](#). When updating the controller's firmware, insure the programmer's VDD is set to +5.0 VDC. Firmware upgrades and support are only available to licensed customers as they become available.

6.1 Firmware License

Firmware License Agreement

1. This is an agreement between TuxMicro Devices (Licensor) and Licensee, who is being licensed to use PICLinkRS DSP Firmware.
2. Licensee acknowledges that this is only a limited nonexclusive license. Licensor is the owner of all titles, rights, and interests in Firmware.
3. This License permits Licensee to install the Firmware, upgrades or patches on one DSP, as long as the binary HEX file will not be used on more than one device simultaneously. Licensee will not make copies of the Firmware binaries or allow copies to be made by others, unless authorized by TuxMicro Devices. Licensee may store one copy of the Firmware for backup purposes only.
4. The Firmware is subject to a limited warranty. Licensor warrants to Licensee that the medium on which this Firmware is distributed is free from defects under normal use; the Firmware will perform according to its printed documentation, and to the best of Licensor's knowledge Licensee's use of Firmware is in accordance with the printed documentation is not an infringement of any intellectual property rights. This limited warranty lasts for a period of 1 YEAR after purchase. To the extent permitted by law, THE 7.WARRANTY REPLACES ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, AND LICENSOR DISCLAIMS ALL IMPLIED WARRANTIES INCLUDING ANY IMPLIED WARRANTY OF TITLE, MERCHANTABILITY, NONINFRINGEMENT, OR OF FITNESS FOR A PARTICULAR PURPOSE. Any action for breach of this limited warranty must be commenced within one year of the expiration of the warranty. Because some jurisdictions do not limit the length of an implied warranty, the above limitation may not apply to this Licensee. If the law does not allow disclaimer of implied warranties, then any implied warranty is limited to 30 days after delivery to Licensee. Licensee has specific legal rights pursuant to this warranty and, depending on Licensee's jurisdiction, may have additional rights.
5. In case of a breach, Licensee's exclusive remedy is as follows: Licensee will return all copies of the Firmware to Licensor, at Licensee's cost, along with proof of purchase.
6. Notwithstanding the foregoing, LICENSOR IS NOT LIABLE TO LICENSEE FOR ANY DAMAGES, INCLUDING COMPENSATORY, SPECIAL, INCIDENTAL, EXEMPLARY, PUNITIVE, OR CONSEQUENTIAL DAMAGES, CONNECTED WITH OR RESULTING FROM THIS LICENSE AGREEMENT OR LICENSEE'S USE OF PRODUCT.
7. Licensee agrees to defend and indemnify Licensor and hold Licensor harmless from all claims, losses, damages, complaints, or expenses connected with or resulting from Licensee's business operations.
8. Licensor has the right to terminate this License Agreement and Licensee's right to use Firmware upon any material breach.
9. Licensee agrees to return to Licensor and destroy all copies of the Firmware upon termination of the License.
10. This License Agreement is an exclusive agreement between Licensor and Licensee regarding the Firmware. This License Agreement replaces and supersedes all prior negotiations, dealings, and agreements between Licensor and Licensee.
11. This License Agreement is governed by the law of the State of Kansas applicable to Kansas contracts.
12. This License Agreement is valid without Licensor's written acknowledgement and becomes effective upon the purchase of PICLinkRS DSP or other products manufactured by Licensor.

7. WARRANTY

TuxMicro Devices warrants our products and its parts against defects in materials and workmanship under normal use for period of ONE (1) YEAR after the date of original purchase. During this period, TuxMicro will repair or replace defective parts free of charge.

Warranty Conditions:

1. The warranty applies only to products distributed by TuxMicro Devices or an authorized distributor.
2. The warranty covers only defects as mentioned in 7.WARRANTY. The warranty applies only to defects which occur during normal use and does not cover damage to products or parts which result from alternation, repair, modification, installation or product abuse; damage to products or parts resulting from misuse, poor maintenance, or used in a fashion not compliant of instructions provided in this manual; damage occurring in shipment or any damage caused by lightening, line surge or faulty power supply.

To Obtain Warranty Service:

1. Contact TuxMicro Devices to obtain an RMA (Return Merchandise Authorization) within the applicable warranty period.
2. Send the defective product to TuxMicro Devices with the RMA Authorization number. Products returned for warranty must be packaged using packing materials which are compliant with our shipping policy and should include adequate impact protection.