



# User's Technical Manual of Leadtek GPS EVK III

# *LR 9500*









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# **1** Introduction

GPS 9500 EVK-III is an evaluation kit designed to demonstrate the performance of Leadtek GPS modules. It supports Leadtek 9540, 9543, and 9547 modules. GPS 9500 EVK-III not only helps customers to evaluate our GPS modules performance but also can be used to update new firmware for the GPS modules.

# **2** Product Features

- \* Easy Installation and operation of GPS modules
- \* Support Leadtek GPS 9540, 9543, 9547 modules.
- \* Testing and programming the GPS modules.

# **3** Technical Specifications

#### ■EVK

Power Input	DC 5V
PC Interface	Two RS232 serial ports
Size (H x W x D) in mm	120.5 x 99.5 x 26mm
Weight	140 g (No GPS module)
Accessories	RS232 cable
	5V DC adapter
	USB cable
	GPS active antenna (Please refer to the
	Appendix B.)

#### ■General specification of GPS Module

General		
Frequency	L1, 1575.42 MHz	
C/A code	1.023 MHz chip rate	
Channels	12	
Accuracy (Open Sky)		
Position	10 meters, 2D RMS	
	7 meters 2D RMS, WAAS corrected	
	1-5 meters, DGPS corrected	
Altitude	< 35m Vertical (95%)	
Velocity	0.1 meters/second	
Time	1 microsecond synchronized to GPS time	
Acquisition Rate (Open sky, stationary condition)		
Reacquisition	0.1 sec., average	





0

Snap start	2 sec., average		
Hot start	8 sec., average		
Warm start	38 sec., average		
Cold start	45 sec., average		
<b>Dynamic Conditions</b>			
Altitude	18,000 meters (60,000 feet) max.		
Velocity	515 meters/second (1	000 knots) max.	
Acceleration	4g, max.		
Jerk	$20 \text{ meters/second}^3, \text{ meters/second}^3$	lax.	
Power			
GPS Chipset	SiRFstarIIe	SiRFstarIIe/LP	
Supply Current (without antenna)	≈160mA	≈65mA	
Other			
Datum	WGS-84		
Interface	Two full duplex TTL level serial ports		
Protocol	SiRF binary and NM	EA-0183	

# 4 Mechanical dimensions



# **5** Outline and Descriptions









Boot Select Button Reset Button

Functional kit	Description
<b>Power ON/OFF</b>	Power ON/OFF button for GPS 9500 EVK-III. Push down
	will turn on power.
GPS Antenna	Connect GPS active antenna with SMA connector
Power & Status LED	Two colors LED shows power and data transmitting status.
	The green is for power status and the red is for GPS data
	output status.
Port 1	This port outputs GPS messages. You have to use RS232
	cable to connect EVK to PC or laptop.
Port 2	This port is used for RTCM message input for DGPS
	correction.
Power 5V DC Jack	Connection to AC adapter.





<b>Reset Button</b>	Reset GPS module and force a cold start.
<b>Boot Select Button</b>	Please refer to details on technical manual of CD-ROM for
	download instructions. To download firmware, push reset
	button once while hold down this button. The GPS module
	will enter into forced download mode. Perform reset to
	leave download mode.

# 6 Inner Photos of EVK

# **EVK** without GPS module

<Note> You can place a lithium battery in the battery socket to perform the battery backup function of GPS module. This lithium battery should be CR2305 type.







#### ■ GPS module

Module	9540	9543
Photo		
Module	9547	
Photo		

## ■EVK with GPS 9540 module







■EVK with GPS 9543 module



**EVK with GPS 9547 module** 







# 7 Operation of GMonitor software with GPS EVK III

### 7.1 Normal operation

In GPS monitor main screen, click **data source setup** button indicated in the figure below.



<Note>Go to view menu to choose desirable information windows you like to observe.





Next, please choose Com Port.







Next, click **connect** button.

💆 Leadick GFS Monitor Rev 1.1.0.1	ha anna ann		X
	cial Window Help I III DTA RTS		R Leadtek
Contention       Update         SW Version       Update         Clock Status       Update         Week       TDW(s)       Svs         Clock Drift(Hz)       Clock Bias(ns)         Navigation Parameters       Update         AltConstraint:       AltMode         Altitude:       DegradedMode         DRT imeoul(s):       TrackSmoothMode:         DGPS Mode:       DGPS Timeoul(s):         ElerMask:       PowerMask(dbH2):         SteadyDetectThreshold(m/s*2):       [S         LP State:       LP DulyCycle(%):         Velocity(m/s):       0         Lat:       24.9575         Mode:       GPS Weighter         DOP:       12         Velocity(m/s):       0         012:       SteadyDetect Time:         02:       124.9575         Mode:       GPS Weighter         07       Svs Used in Fib:         07       Svs Used in Fib::         10:       Connect Time         10:       Local Time:         20:3/7/10:17	Aub detect protocol and baudrate          Aub detect protocol and baudrate         Time[ms]         AtSource(m):         DegradedTimecu4(s):         DOPMaskMode         EdiResidualThreshold         StaticNavThreshold         LP OnTime(ms):         Ats:         X         Z         StaticNavThreshold         StaticNavThreshold	<ul> <li>Covelopment Data Yiew</li> <li>SCPENC, 032138: 566A, 2459.8723 N, 12123 2504 E, 0.0, 147.3, 100703, * SCPVT G, 147.3, T, M. 0.0.N, 00, K*G1</li> <li>SCPPER, 042739: 568A, 2459.8728 N, 12123 2504 E, 0.0, 147.3, 100703, * SCPVT G, 147.3, T, M. 0.0.N, 00, K*G1</li> <li>SCPER, 042140, 566A, 2459.8729 N, 12129 2603E, 1.07, 1.2, 107.1, M., 00</li> <li>SCPPER, 047.3, T, M. 0.0.N, 00, K*G1</li> <li>SCPPER, 047.41, 568.2459.8729 N, 12129 2603E, 1.07, 1.2, 107.3, M., 00</li> <li>SCPPER, 047.41, 568.2459.8729 N, 12129 2603E, 1.07, 1.2, 107.3, M., 00</li> <li>SCPPER, 047.41, 568.2459.8729 N, 12129 2603E, 1.07, 1.2, 107.4, M., 00</li> <li>SCPPER, 047.41, 568.2459.8729 N, 12129 2603E, 1.07, 1.2, 107.4, M., 00</li> <li>SCPPER, 047.41, 568.2459.8729 N, 12129 2603E, 1.07, 1.2, 107.4, M., 00</li> <li>SCPPER, 047.41, 568.2459.8729 N, 12129 2603E, 1.07, 1.2, 107.4, M., 00</li> <li>SCPPER, 047.41, 568.2459.8729 N, 12129 2603E, 1.07, 1.2, 107.4, M., 00</li> <li>SCPPER, 047.43, 154.40, 52.048.37, 06, 1123.37, 16, 06, 203.76</li> <li>SCPPER, 047.43, 154.40, 52.048.37, 06, 1123.37, 16, 06, 203.76</li> <li>SCPPER, 047.43, 154.40, 52.048.37, 06, 1123.37, 16, 06, 203.76</li> <li>SCPPER, 047.43, 154.40, 52.048.37, 06, 1123.37, 16, 06, 203.76</li> <li>SCPPER, 047.43, 154.40, 52.048.37, 06, 1123.37, 16, 06, 203.76</li> <li>SCPPER, 047.43, 154.40, 52.048.37, 06, 1123.37, 16, 06, 203.76</li> <li>SCPPER, 047.43, 154.40, 52.048.37, 06, 123.37, 16, 06, 203.76</li> <li>SCPPER, 047.43, 1568.2459.8723 N, 12129, 2603.5, 10, 147.3, 100703, *</li> <li>SCPPER, 047.43, 1568.2459.8723 N, 12129, 2603.5, 10, 147.3, 100703, *</li> <li>SCPPER, 047.445, 567.2459.8723 N, 12129, 2604.5, 10, 147.3, 100703, *</li> <li>SCPPER, 147.21, M, 00, 00, 00, SCB1</li> <li>SC</li></ul>	DA    X       DA    X       D0 r08    X       D0 r09     D2       D0 r08    X       D0 r09    X       D0 r08    X       D0 r09    X       D0 r09    X       D0 r09    X       D0 r00    X       D0 r01    X       D0 r02    X       D0 r03    X       D0 r04    X       D0 r05    X       D0 r06    X       D0 r07    X       D0 r08    X       D1 r09    X       D1 r09    X       D2 r10    X       D1 r09    X
COM1 4800 01:23:49 Auto detect	baud rate and protocol.		





Next, please click on **Auto detect protocol and baud rate** button. The GPS software will go on detecting protocol for GPS module.

Setus       Year Action       Respective field       Sepecial       Under Help         Image: Setus       Atto detect protocol and bendrate       Image: Setus       <	🜿 Lesdisk OPS Monitor Rev 1.1.0.1		-82
Records View         Alto detct protocol and bandnels         Image: Control of the c	Setto Yew Action Revipeiton foil Special Window Help		R Leadte)
	Auto detect protocol and bandrate         SW Version         Update         Clock Status         Update         Week         TOW(s)         Sws         Clock Status         Update         Week         TOW(s)         Sws         Clock Drift(Hz)         Clock Bias(m)         Navigation Parameters         Update         Altrocostraint         DegradedMode         DegradedTimeoul(s)         TrackSmoothMode         DGPSMode:         DGPSTmeoul(s)         ElevMask:         Poster         LP DutyCycle(%):         Velocity(m/s):         0         0         DDP: 1.2         Re: Fix: Fix in SPS         Time:	VE         Development Data View           SGPFIMC.092138 558.A.2459 6723N.12123.2604.E.0.0.147.31007030A         SGPVTG.147.3T.M.0.0N.0.0.K.51           SGPFIMC.092139.562.2459 6723N.12123.2604.E.1.07.1.2.105.5.M0000-08         SGPFIMC.09213.562.2459 6728N.12129.2603.E.1.07.1.2.107.1.M0000-09           SGPFIMC.09213.0562.2459.6728N.12129.2603.E.1.07.1.2.107.1.M0000-09         SGPFIMC.09214.0588.2459.6728N.12129.2603.E.1.07.1.2.107.1.M0000-09           SGPFIMC.09214.0588.2459.6728N.12129.2603.E.1.07.1.2.107.1.M0000-09         SGPFIMC.09214.0588.2459.6729N.12129.2603.E.1.07.1.2.107.3.M0000-04           SGPFIMC.09214.1589.2459.6729N.12129.2603.E.1.07.1.2.107.4.M0000-04         SGPFIMC.09214.1589.2459.6729N.12129.2603.E.1.07.1.2.107.4.M0000-04           SGPFIMC.09214.1589.2459.6729N.12129.2603.E.1.07.1.2.107.4.M0000-04         SGPFIMC.09214.258.2459.8729N.12129.2603.E.1.07.1.2.107.4.M0000-06           SGPFIMC.09214.588.2459.6729N.12129.2603.E.1.07.1.2.107.4.M0000-06         SGPFIMC.09214.258.2459.8729N.12129.2603.E.0.0.147.310070300           SGPFIMC.09214.2588.2459.8729N.12129.2603.E.0.0.147.310070300         SGPFIG.147.3.1.M.0.0N.0.0.K.51           SGPFIMC.09214.2588.2459.8729N.12129.2603.E.0.0.147.310070301         SGPFIMC.09214.2588.2459.8729N.12129.2603.E.0.0.147.310070301           SGPFIMC.09214.2588.2459.8729N.12129.2603.E.0.0.147.310070301         SGPFIMC.09214.5587.2459.8729N.12129.2603.E.0.0.147.310070301           SGPFIMC.09214.557.2459.8729N.12129.2603.E.0.0.147.310070301         SGPFIMC.09214.557.24598729N.12129.2603.E.0.0.147.310070301	





#### 7.2 Cold/Warm/Hot start time measurements

You can use the GPS EVK device and GPS Monitor software to measure hot, warm and cold start time of the GPS module. To perform this operation, you need to switch GPS protocol to SiRF Binary mode.

Click on Action function of main menu and choose Switch to SiRF Protocol item.



Next, please switch baud rate to 38400.

Initialize   NM	IEA SIRF	Main Port	DGPS Port	Operating Mode	Power Manager
Baud Rate	38400				🗸 ок
Data Bits	]8				X Cancel
Stop Bit	1				
Parity	None				Default





Next, please press the right button of mouse on window of **development data view**. It will pop up the menu and you have to choose **Hold on fixed** item.







Next, please click on Initialize Data Source button.



This example shows how to measure hot start time. Please choose **Hot Start** item and click on **OK** button.

Initialize NMEA SiP	IF   Main Port	DGPS Port Operating Mode Powe	r Manager 🛃
Initialize Position and	Time		$\frown$
X: 768	m	Load From Default	🗸 ок
Y; 1107296256	m		Y Canool
Z: 1358954240	m	Save To Default	Carlos
Clock: 0	Hz	Load Period	ic Reset(sec)
Week Number: 0			<b>.</b>
Time of Week: 0		Save	
Time or week. Jo	\$		
000000000000000000000000000000000000000			
Channels: 12			
Reset Mode		Messages	
Channels: 12 Reset Mode: Hot Start Warm Start(No Init	t)	Messages:	Data
Channels: [12 Reset Mode C Warm Start C Warm Start(No Init C Warm Start(Init)	0	Messages Enable Raw Track	Data





Finally, please wait a moment and you will get time of hot start.



Please repeat above the steps and you will get time of warm and cold start.

# <Warm Start>

nitialize NMEA	SiRF   Main Port nd Time	DGPS Port Operating Mode Power Manager
X: 0	m	Load From Default
Y: 0	m	
Z: 0	m.	Save To Detault
Clock: 0	Hz	Load Periodic Reset(sec)
Week Number:	)	
Time of Week:	)	s Save
Channels: 12		
Reset Mode:		Messages:
<ul> <li>Hot start</li> <li>Warm Start(No</li> </ul>	lnit)	💉 Enable Raw Track Data
C Warm Start(Init	)	Enable Development Data

SpecCheck-> Mode: warm	Acq: 1.000s (0 sv) Fix: 37.5s
	orĎ





<Cold Start>

Initialize Position a	nd Time	
X: 0	m	Load From Default
Y: 0	m	
Z: 0	m	Save To Default
Clock: 0	Hz	Periodic Reset(sec)
Week Number:	0	
Time of Week:	0 s	Save
Reset Mode:		Messages:
Hot Start Warm Start(No.	s lesit)	Coshla Raw Track Data
C Wann Start(NC	() ()	
🕻 🐘 Warm Start(ini		📝 Enable Development Data
Cold S tyt		

SpecCheck-> Mode: cold Acq: 1.000s (0 sv) Fix: 48.3s

OK

Sund







# 8 Download the firmware to GPS module

**Step 1**>Double click the GMonitor desktop icon to run software in order to download firmware.

The Main screen is shown as follows.



 $\langle \text{Step } 2 \rangle$  Choose the Setup $\rightarrow$  GPS Flash $\rightarrow$  Star II option from of main menu.







The following screen shows the download options.

Bum Flash					×
Source File	Select FW	🔽 Erase All	Force	e Download	
C:\s\sdk2ei	220.s			-	Browse
Progress					
Xfer		100%			
Prog		100%			
Control paran	neters Baud Rate	Chip Offset	Chip Selec	t Extra S	etting
Timing(sec) Total 2	6.0 Erase	6.3	Burn	3.2	
File type	mation S-MOTOROLA	Lowest Ad	ldress	Highest Ac	ldress 83
Flash Informa Manufactur	ition er <u>AMD</u>	Model A	M29LV400	BB Chips	1
	Execute		ī		

#### <Download Options>

1			
Erase All	Uncheck this box and program will only clear the portion of the flash memory that the new firmware will occupy.		
	Check this box will clear the entire flash memory space before firmware burn-in.		
<b>Force download</b>	Uncheck this box and GMonitor will use only software command in GPS module to download the update firmware. This is called software download method.		
	Check this box and holding the boot select button in EVK while press and release reset button will force GPS module into Force Download mode, which can only break by press reset button again. This is the preferred download method and should be use whenever possible.		

To use EVK to download new firmware, perform the following steps.

- 1. Check "Erase All" and "Force Download" options
- 2. Click "Browse" button to locate the new firmware you want to upgrade.
- 3. Click "Execute button to start download.
- 4. After download finish, click "Close" to close the download screen.





#### <Note>

- 1. To use Software Download method, uncheck "**Force Download**" box and follow the reset of the download operations. For some Leadtek products that do not have boot select and reset switches, software download is the only way to upgrade firmware.
- 2. When you cannot finish updating firmware by software download, we suggest that you use the force download. This method can only be performed when GPS hardware support the boot select and reset switch. Before executing software to update firmware you have to push reset button once while hold down boot select button and make GPS module enter into download mode.





# 9 Measure Power consumption of GPS module in different operation modes

You can use the GPS EVK device and oscilloscope to measure power consumption or current of the GPS module. We will use 9547 module for demonstration here.

#### ■Step 1.

Replace the resistor value of R24 to1.1 Ohm. Measure the voltage for both side of this resister. Base on the difference in voltages between the right and left side of this resister, you can figure out the current of GPS module.







#### ■Step 2.

The following figure shows the current of GPS 9547 module. We can calculate the current value. The value is about 64 mA and this operation is based on continuous mode without active antenna.









#### ■Step 3.

You can switch continuous mode to Trickle Power mode and observe the current consumption changes. Use GMonitor to enable trickle power mode and set the parameters to 2 seconds of update rate and 200 milliseconds of on time.

#### (Update rate = 2 sec, On time = 200 msec)

	R Leadtek
SW Version Update	Consideration 1 State     Throughput: 13% AccumRTC: 2670751 prevRTC: 2654920 cumRTC: 5959978 prevPRTC: 5941655     Time: 00000014 lint: 012/012/012 ms: 0018 * 37 00 00 * 00 00 37 * 00 00 00 * 00 00 00 1000000     TC RTC extended
Clock Status:         Update           Week         [115]         TOW(s)         16.99         5vs         0           Clock Dath(Hz)         95542         Clock Bias(ns)         \$70336         1         Action	NC, FIC F01 90 00 Nockdust(RMM, 0): swtaw = 11.000000 ButAlocFailure = 15; avail. butiers = 22 Throughput: 10% AccumRTC: 2700099 prevRTC: 2670751 curRTC: 5892750 prevPRTC: 5859978 37 00 00 * 00 00 37 * 00 00 00 * 00 00 33 1000000
Navigation Parameters Update     Initiatze NMEA SIRF Main Port DGPS I     AlkConstrant AlMode:     J PowerMode     Continuoua     DRTimecul(s) TrackSmoothMode:     DV C Trickle Power	Port Operating Mode Power Manager 1 1 12515 Corr 16328 2174 SNR 75 Er -6391 C: 2700099 curRTC: 5956870 prevPRTC: 59592750
DGPSMode DGPSTmeout(s) C Push To Fix ElevMask: PowerMask(dbHz) EditR SteadyDetectThreshold(m/s*2) StaticNax Adaptive TP LP State: LP DutyCycle(%) L Update Hate(sec)	X Cancel         37 00 00 + 00 00 37 + 00 00 00 + 00 00 37 1000000           37 00 00 + 00 00 37 + 00 00 00 + 00 00 37 1000000           Default         2: 2758816 cumRTC: 6023871 prevPRTC: 5931106           37 00 00 + 00 00 37 + 00 00 00 + 00 00 37 1000000
Image: Constraint of the sector of	37 00 00 ° 00 00 37 ° 00 00 00 ° 00 00 37 1000000 : 2817130 cumRTC: 6039439 prevPRTC: 6056537 3F 00 00 ° 00 00 37 ° 00 00 037 ° 00 00 00 37
Mode: None[DDP Mask Exceeded] GPS Week: 127 DOP: 500 Fix: Unvalidated Time(s): 16:39 0 Svs Used in Fix: Concertime   Local Time: 2002/1/27/08:00.16	
	30         00         0         0.0           14         37         0         9         9.8         atclassification         atclasiclassification         atclasiclassificat
	11 00 0 0 0.0            3 00 0 0 0.0
	21     80     8     8.0       15     80     8     8.0       6     37     8     36.4
COM1 38400 02:19:24 Fix Invelident	





#### ■Step 4.

The following figures show the current of EVK with GPS 9547 module and active antenna operated at trickle power mode. The active antenna has a current consumption of 6.4 mA in this example.

I = V / R = 77 mV / 1.1 Ohm  $\approx$  70 mA I<sub>Active antenna</sub>  $\approx$  70 - 63.6 = 6.4 mA







# **10 Install the USB Driver**

# <Note>Please do not plug in USB serial cable before installation of USB Driver!

# ■Step 1.

Insert the software CD in your CD-ROM drive. The Autorun program will display a setup screen as the figure to the right.

Note: You can also start the setup program by running install.exe in the main directory of the CD.



# ■Step 2.

Please click on the **USB Driver** button for installation. You will see the following picture on your screen.

🗙 Leadie	<u>k</u>		
Operation Syste Please press in	Operation System is Windows 2000/XP Please press install button to install the driver.		/XP the driver.
	Install	Exit	Detail >>

# ■Step 3.

You can begin installing the USB driver by click on the **Install** button. Then you can also see the following picture on your screen.







#### ■Step 4.

Finally you will click on **OK** and **Exit** buttons to finish installation.



## ■Step 5.

Perform a reboot of PC and then insert the USB serial cable. GMonitor should now be able to detect a new serial port for the USB serial cable.





# 11 Uninstall the USB Driver

## ■Step 1.

Insert software CD in your CD-ROM drive. Run **Remover.exe** at **E:\USB Driver**\ (assuming E: is the CD-ROM drive). A dialog box as the figure to the right appears

휅 USB-Serial Driver 🛛	Remover 🛛 🔀
Press OK to remove o	Iriver.
Cancel	OK
	L

#### ■Step 2.

A message telling you the driver has been removed appears. Close the message box.



#### ■Step 3.

A dialog box appears prompting you to restart your computer. Click "Yes" to finish removing the driver and reboot.



# Appendix A GPS EVK schematic

You can find this file from CD-ROM.

# (Path: \\User Manual\GPS EVK-III\9500EVK\_schematic.pdf)











# Appendix B Specification of GPS active antenna

Active GPS Antenna

Model: LR9400

Specifications



Performance			
Center Frequency	L1 (1575.42 MHz, +/- 1.023 MHz)		
Impedance	50 Ohm		
Bandwidth	10 MHz (min)		
VSWR	2.0 (max)		
Polarization	RHCP (Right Hand Circular Polarization)		
Gain Characteristics of Antenna	+3 dBic (typical, at zenith)		
Element	-1 dBic ( typical, at 10° elevation)		
Axial Ratio	3 dB (max)		
LNA Gain	27 dB (typical, without cable loss)		
Filtering	-30 dB@ 1675MHz (typical)		
	-30 dB@ 1475MHz (typical)		
Noise Figure	< 1.7dB (typical), 2.0 (max)		
Electrical			
Power Requirements	3V +/- 0.3Vdc for 3V Version		
	5V +/- 0.5Vdc for 5V Version		
Power Consumption	10 mA (typical), 15 mA (max)		
Physical			
Dimensions	42 x 40 x 11 mm		
Weight	< 90 grams (including 5 meter cable and connector)		





Plastic Color	Black		
Mount	Magnetic		
Cable	RG-174 type coaxial cable 5 meters long		
Connector	BNC, SMA, SMB, MMCX, etc		
Environmental			
Operating Temperature	-40°C to +85°C		
Storage Temperature	-50°C to +100°C		
Humidity	95% non-condensing		
Waterproof	100% Waterproof		

**<Note 1>** Accessory of GPS EVK, active antenna operates in 3V. It has a SMA connector for GPS EVK and 3 meters cable length.

**<Note 2>**Part number of LR9400 is 39000052.





# Appendix C The Contents of CD-ROM

Folder	Path or files	Description
Winfast Navigator	WinFast-Nav.EXE	The software supplied by Leadtek applies to
		demonstration of GPS receiver
GPSMonitor	GMSetup1093.EXE	The software applies to Leadtek's GPS
		module testing.
Acrobat Reader	Path:\\Acrobat Reader	This is a free software which Adobe
	6.0\Installer\ setup.exe	company supplied.
USB driver	InstallDriver.exe	This program is for USB installation.
	Remover.exe	This program is for USB uninstallation.
User Manual	GPSMonitor	The folder includes the manual of GPS
		Monitor software.
	GPS EVK-III	The folder includes the quick start manual,
		user's technical manual and schematic of
		GPS EVK.
	GPS module	The folder includes three kinds of manuals
		about Leadtek 9540, 9543, 9547 GPS
		module.
Leadtek Products	*.pdf	The folder includes the product guides of
		Leadtek GPS product.



#### We Make Dreams a Reality

Leadtek Research Inc.:

Leadtek U.S.A.:

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