KAM/WSI/104

LORD wireless sensor network interface module

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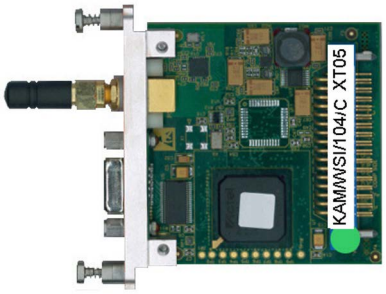


Key Features

- LXRS® wireless protocol supported on IEEE 802.15.4 compliant wireless radio
- Acquires data from LORD MicroStrain® wireless sensor nodes
- Node-to-node synchronization up to ±32 µs
- Scalable, long range wireless sensor networks up to 2 km
- Lossless data throughput under most operating conditions
- Aperiodic transmission of packetized samples from each sensor node in IENA-P, M, and iNET-X formats

Applications

- Wireless sensor networks

Overview

The KAM/WSI/104 enables simultaneous, high-speed sensing and data aggregation from a wireless sensor network. The LORD MicroStrain LXRS® Wireless Sensor Networks are ideal for sensor monitoring, data acquisition, performance analysis, and sensing response applications.

The LXRS wireless communication protocol between remote wireless nodes and the KAM/WSI/104 enables high-speed sampling, ±32 µs node-to-node synchronization with a transmission range of up to 2 km and lossless data throughput under most operating conditions.

Sampled data can be read from the KAM/WSI/104 synchronously as an analog parameter or asynchronously as a packetized buffer, which can be assembled into an Ethernet frame in an Ethernet controller.

Each channel on a remote LXRS node is represented as an analog channel on the KAM/WSI/104. Each analog channel presents data as a single parameter, which can be placed in PCM or Ethernet frames.

The KAM/WSI/104 can also optionally packetize each LXRS node transmitting to the KAM/WSI/104 in both iNET-X and IENA formats.

When reading data synchronously from the KAM/WSI/104, any variable delay due to the transmission of data over a wireless medium is removed by the application of a fixed latency of one second to all parameters.

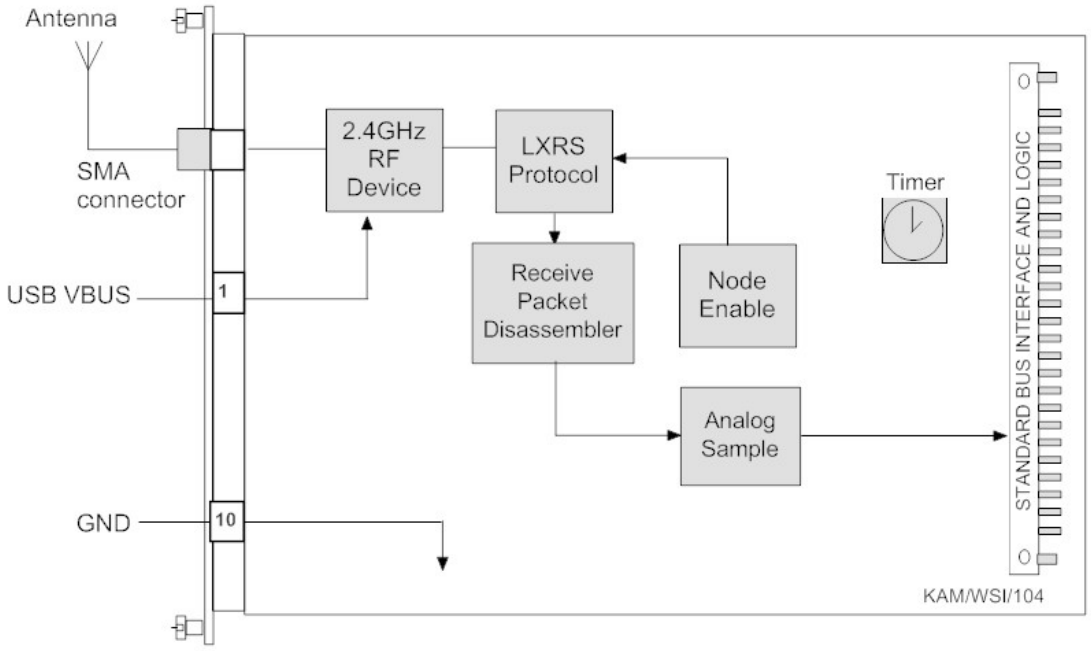


Figure 1: Wireless sensor interface block diagram

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under "Environmental ratings" in the "General specifications" table.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	90	–	g	Value includes antenna ; module only 73g (2.6 oz).
	–	3.17	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
including antenna	35	–	110	mm	Blade antenna can be folded 90° to reduce height.
including antenna	1.34	–	4.33	in.	
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	–	159	175	mA	
±7V	–	0	0	mA	
±12V	–	0	0	mA	
total power	–	795	875	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	80	°C	Chassis base/side plate temperature.
storage temperature	-40	–	80	°C	

TABLE 2	WSDA® Base Station RF characteristics[1]				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Operating frequency range	2405	–	2470	MHz	Direct sequence, spread spectrum method over 14 channels, license-free worldwide. IEEE 802.15.4- compliant, FCC-compliant.
RF data transmission rate	–	–	4	ksps	LXRS protocol, maximum rate for a single sensor channel on a single node.
Antenna impedance	–	50	–	Ω	
RF transmit power	0	–	20	dBm	Radiated power programmable from 0 dBm to 20 dBm.

1. Description taken from data sheet of standalone WSDA-Base-LXRS® base station.

TABLE 3	USB 2.0 interface				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	1	–	USB 2.0 compatible.

Setting up the KAM/WSI/104

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAM/WSI/104/C	KAM/WSI/104/C	The instrument part reference.
SerialNumber	AAA1234	AAA1234	Unique name for each module.
Settings	-	-	-
Enable Beacon	True False	True	Enables the beacon on the KAM/WSI/104/C. Switching on the beacon enables remote node sampling and the transmission of sampled packets. Disabling the beacon puts the nodes to sleep thereby saving power.
Channels	-	-	-
LXRSAnalog(30:0) *Analog Input*	-	-	The sampled parameter from the channel on the LXRS node with one second latency.
Settings	-	-	-
Wireless Node Address	0 to 65535	65535	The address of the remote LXRS wireless sensor node.
Channel Number	1 to 8	1	The channel number on the remote wireless sensor node.
LXRSRaw *LXRSRaw Input*	-	-	The raw LXRS Synchronized Sampling Packet received from the link transmitter.
Settings *Packetizer*	-	-	-
Packetizer Format	iNET-X IENA	iNET-X	Selects the packetizer header format for all channels.
Stream Id	00 to FFFFFFFF	FFFFFFFF	iNET-X stream ID for selected channel if a packet is generated via the assertion of Packetization Enabled. This is a conditional setting and is only active when the Packetizer Format is set to iNET-X.
IENA Type	M	M	Describes the IENA parameter type of the packet payload. This is a conditional setting and is active when the Packetizer Format is set to IENA.
IENA Key	0 to FFFF	0	IENA Key for selected channel if a packet is generated via the assertion of Packetization Enabled. This is a conditional setting and is active when the Packetizer Format is set to IENA.
Packetization Enabled	True False	False	Enables the transmission of an iNET-X or IENA-M packet containing the contents of this channel if an aperiodic transmitter is present in the chassis. This setting is only supported in DAS Studio 3.
IENA-M Param ID	0 to FFFF	0	Used to define the Param field when IENA packetizer is enabled.

SETUP DATA	CHOICE	DEFAULT	NOTES
Packetization Sink	All Controller Only Slot 1 Slot 2 Slot 3 Slot 4 Slot 5 Slot 6 Slot 7 Slot 8 Slot 9 Slot 10 Slot 11 Slot 12 Slot 13 Slot 14 Slot 15	All	Selects which modules the packetizer package will be sent to for transmission or storage.
LXRSNode(23:0) *LXRSNode Input*	-	-	Packetized data from the remote LXRS node.
Settings *Packetizer*	-	-	-
Packetizer Format	iNET-X IENA	iNET-X	Selects the packetizer header format for all channels.
Stream Id	00 to FFFFFFFF	FFFFFFFF	iNET-X stream ID for selected channel if a packet is generated via the assertion of Packetization Enabled. This is a conditional setting and is only active when the Packetizer Format is set to iNET-X.
IENA Type	P	N/A	Describes the IENA parameter type of the packet payload. This is a conditional setting and is active when the Packetizer Format is set to IENA.
Packetization Enabled	True False	False	Enables the transmission of an iNET-X or IENA-P packet containing the contents of this channel if a suitable transmitter is present in the chassis. This setting is only supported in DAS Studio 3.
IENA Key	0 to FFFF	0	IENA Key for selected channel if a packet is generated via the assertion of Packetization Enabled. This is a conditional setting and is active when the Packetizer Format is set to IENA
Wireless Node Address	0 to 65535	65535	The address of the remote LXRS wireless sensor node.

SETUP DATA	CHOICE	DEFAULT	NOTES
Packetization Sink	All Controller Only Slot 1 Slot 2 Slot 3 Slot 4 Slot 5 Slot 6 Slot 7 Slot 8 Slot 9 Slot 10 Slot 11 Slot 12 Slot 13 Slot 14 Slot 15	All	Selects which modules the packetizer package will be sent to for transmission or storage.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
Report Reports the status of the module	BitVector	BitVector	16	R[15:0] R(15) ReportEvent - An event condition occurred since last read. R[9:4] Connected Node Count - A count of the number of unique nodes connected to the KAM/WSI/104 since the start of the current second. R(2) UnsupportedDataType - Receiving data from a node with non-16bit word sizes. This is not supported in Analog mode R(1) Reserved - R(0) NoNodesConnected - No nodes connected in the past 2 seconds.
LXRSAnalog(30:0) Parameters				
Analog Sampled analog data (16 bits wide) parameter with 1 second latency.	Count	OffsetBinary	16	R[15:0]

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\

Getting the most from the KAM/WSI/104

The KAM/WSI/104 requires an Ethernet backplane controller (KAD/BCU/14X series) such as KAD/BCU/140/D.

The KAM/WSI/104 supports up to 24 different network nodes in the packetizer and up to 31 different nodes in the analog placed parameters. A maximum of 24 LXRS packetizers are supported in one chassis.

Packetizer payload formats

The following four figures show the payload formats for LXRSNode and LXRSRaw.

0								1								2								3							
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Vers				Opt Words				Reserved								Message Flags															
Stream ID																															
Sequence Number																															
Packet Length																															
PTP Timestamp																															
	Lost Count															PIF															
EB	Error Code							Quad Bytes								Channel Count															
Data Format								Reserved								Sample Count															
NanoSecond Tick																															
Fractional Nanosecond tick																Reserved															
Channel Mask																															
Channel #1 Sample #1																Channel #2 Sample #1															
Channel #3 Sample #1																Channel #1 Sample #2															
Channel #2 Sample #2																Channel #3 Sample #2															
...																...															
Channel #3 Sample #N																Pad if required															

Figure 2: Analog iNET-X packetizer format

0								1								2								3							
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
IENA Key																size															
Time																															
Time																Key								N2 Status							
Sequence Numnber																Channel #1 Sample #1															
Channel #2 Sample #1																Channel #3 Sample #1															
Channel #N Sample #1																Channel #1 Sample #2															
Channel #2 Sample #2																Channel #N Sample #2															
...																....															
...																....															
...																Channel #1 Sample #M															
...																Channel #N Sample #M															

Figure 3: LXRS node IENA-P format

NOTE: The fields in the following LXRS raw packets (see Figure 4 and Figure 5) are described in the LXRS Data Communication Protocol- Synchronized Sampling Packet document at this link:
http://files.microstrain.com/Wireless-Sensor-Networks-LXRS-Data-Communication-Protocol.pdf
The LXRS raw packetizer is for debug use only.

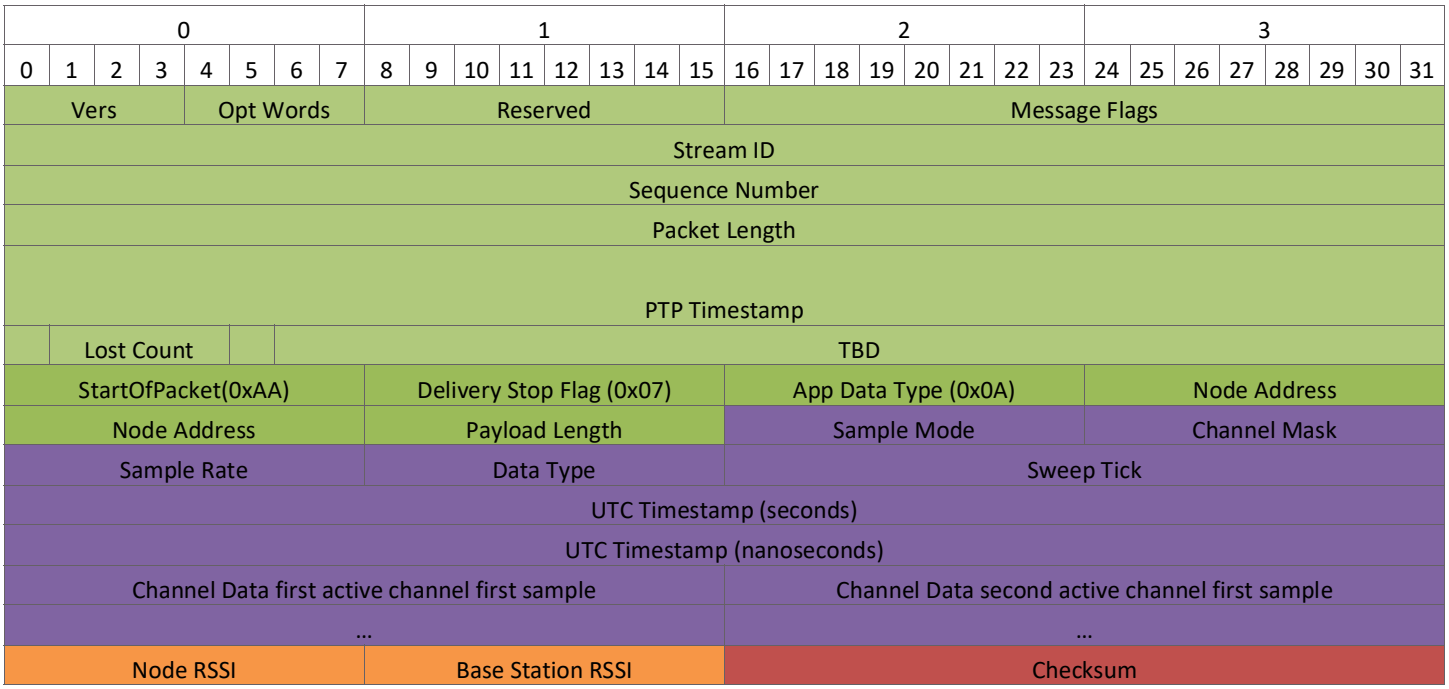


Figure 4: LXRS raw iNET-X packetizer format

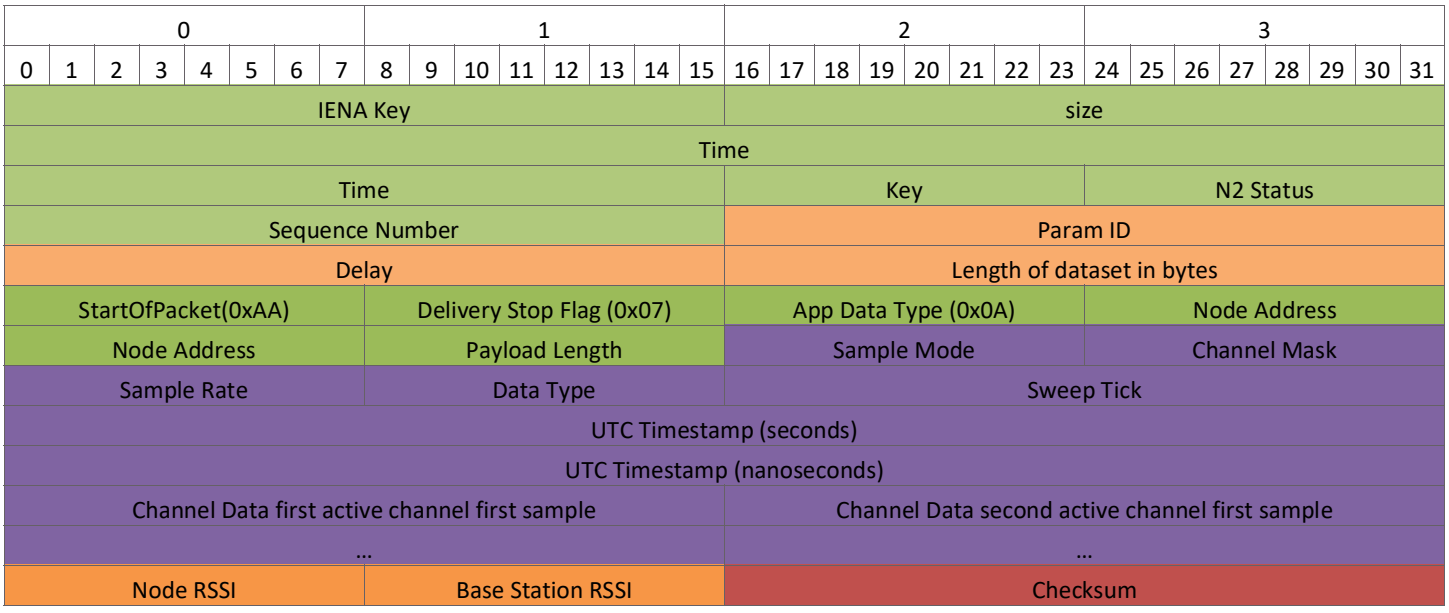


Figure 5: LXRS raw IENA-M format

Quick start to node sampling setup

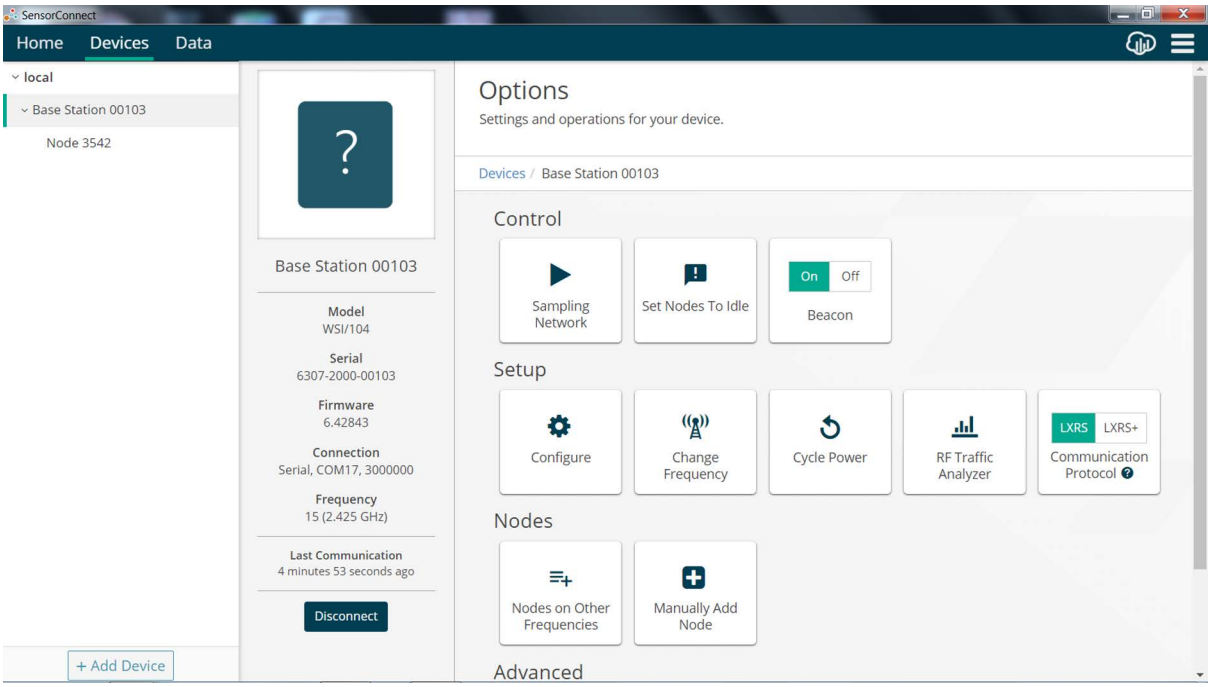
The KAM/WSI/104 acts as a base station for remote nodes in LORD MicroStrain wireless sensor networks.

Download and install SensorConnect from https://www.microstrain.com/software/sensorconnect to a PC.

With the KAM/WSI/104 and a KAD/BCU/14x controller in a KAM chassis, connect the USB cable ACC/CON/051 to the KAM/WSI/104 top block and to the PC.

SensorConnect configuration

1. Power up the KAM chassis and start SensorConnect.
   In SensorConnect, the KAM/WSI/104 appears as a Base Station.

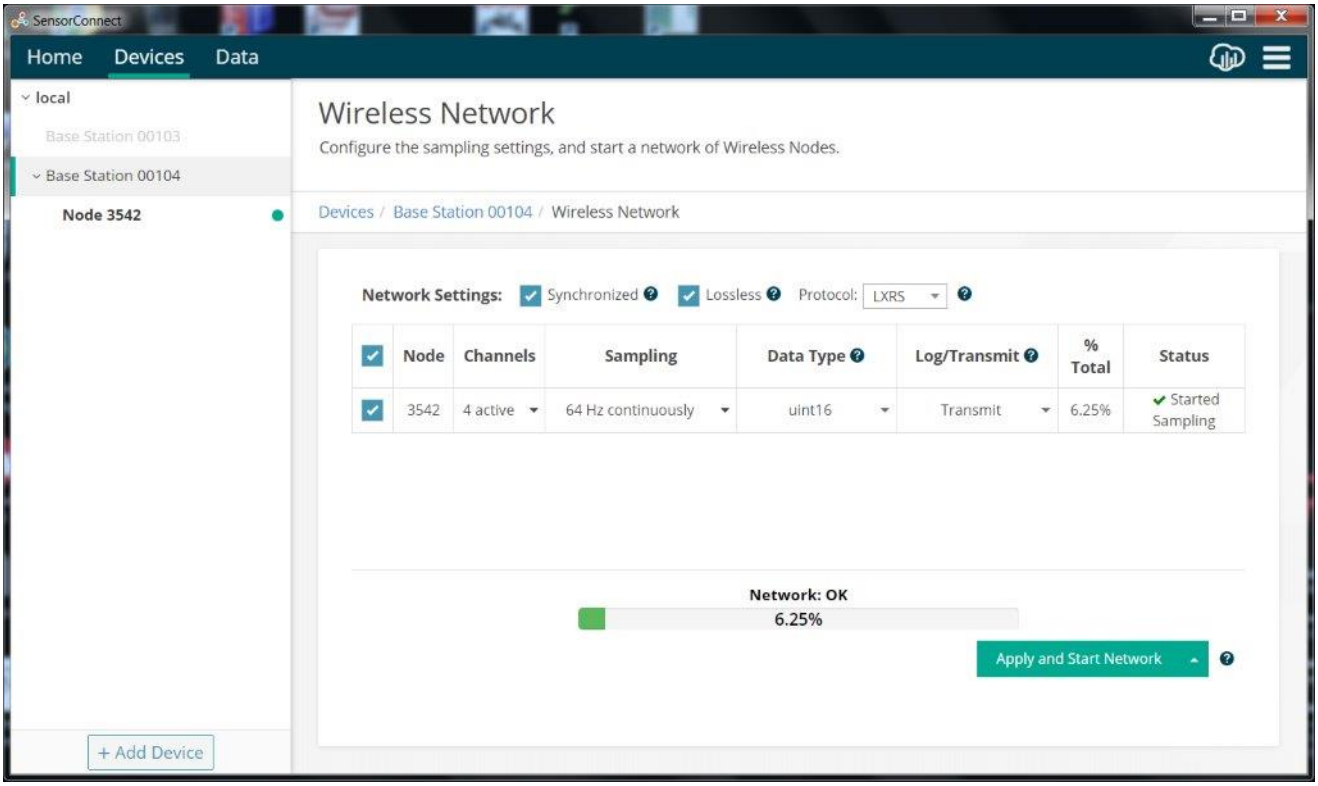


2. On the **Beacon** control, click **On** to enable the beacon.

3. Power up the remote node(s).
   After a few seconds (assuming factory default settings) the nodes appear in the SensorConnect device list.
4. Click **Set Nodes To Idle** to put the nodes in idle mode.

5. Click **Sampling Network**.

The following **Wireless Network** screen opens.



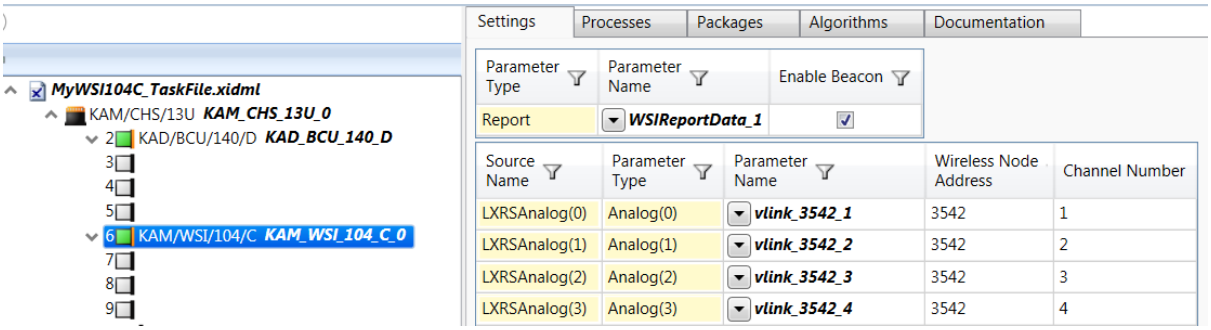
6. Select the sampling frequency for each node.
   The recommended settings are [Synchronized=TRUE, Lossless=TRUE, Protocol=LXRS, Data Type=uint16, Log/Transmit=Transmit].
7. Click **Apply and Start Network**.

If all commands are sent to the nodes successfully, SensorConnect confirms the network has started and prompts you to view live data. You can now close SensorConnect and disconnect the USB cable.

Programming with DAS Studio 3

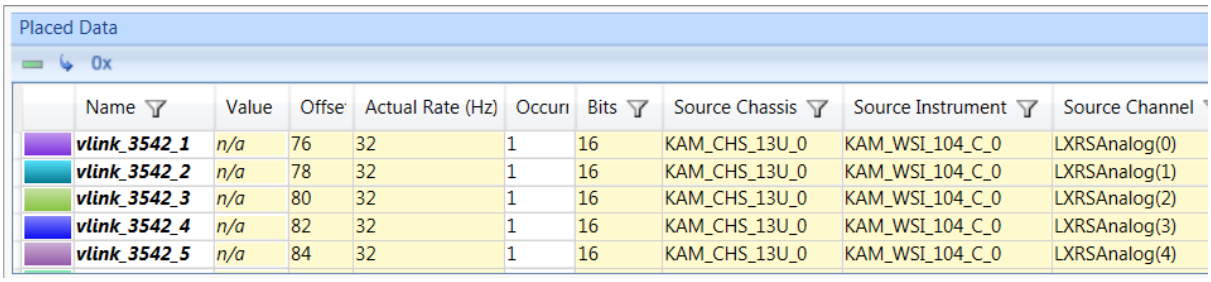
The KAM/WSI/104 must be programmed with DAS Studio 3 and a KAD/BCU/14x controller.

1. Open DAS Studio 3 and set up an instrumentation task file for the KAM/WSI/104.
   The KAM/WSI/104 can map specific node channels to placeable parameters, and also packetize node data into streams.



2. In the **Wireless Node Address** and **Channel Number** columns, enter the wireless node address (as printed on the node, or visible in SensorConnect) and channel number respectively to create a mapping to a parameter.
3. Set any unused parameters to address **65535**.
4. Select the **Enable Beacon** check box.

5. Ensure that placed parameters from the KAM/WSI/104 have the same sampling frequency as set up for their corresponding node in SensorConnect. This example uses 32 Hz.



Name	Value	Offse	Actual Rate (Hz)	Occurr	Bits	Source Chassis	Source Instrument	Source Channel
vlink_3542_1	n/a	76	32	1	16	KAM_CHS_13U_0	KAM_WSI_104_C_0	LXRSAnalog(0)
vlink_3542_2	n/a	78	32	1	16	KAM_CHS_13U_0	KAM_WSI_104_C_0	LXRSAnalog(1)
vlink_3542_3	n/a	80	32	1	16	KAM_CHS_13U_0	KAM_WSI_104_C_0	LXRSAnalog(2)
vlink_3542_4	n/a	82	32	1	16	KAM_CHS_13U_0	KAM_WSI_104_C_0	LXRSAnalog(3)
vlink_3542_5	n/a	84	32	1	16	KAM_CHS_13U_0	KAM_WSI_104_C_0	LXRSAnalog(4)

6. Program the KAM configuration in the usual manner; data collection begins automatically.

NOTE: If the KAM/WSI/104 is already programmed, it holds its configuration after a power cycle, however the wireless network may have to be restarted using the SensorConnect configuration steps.
Even in Lossless mode, if a node is out of contact for too long, the placed parameters run out of buffered data. When this is detected, a fixed value 0xDEAD is substituted for the missing data.
In Lossless mode, if loss of contact with the node exceeds 1 second, then data in the analog channels is corrupted until the node has *caught up* with the 1-second live capture. This time typically exceeds the time that the contact was lost.

Disclaimer: The firmware on the base station as shipped has been tested with the Acra KAM-500 module interface. Curtiss-Wright is not responsible for incompatibilities with the KAM-500 system resulting from changes or updates to base station firmware by the user. Under rare occurrences, (1 in 70,000) the node packetizer can return a corrupted packet.

For additional information, see *TEC/NOT/084 - Using the KAM/WSI/104* and LORD MicroStrain documentation.

Connector pinout of the KAM/WSI/104

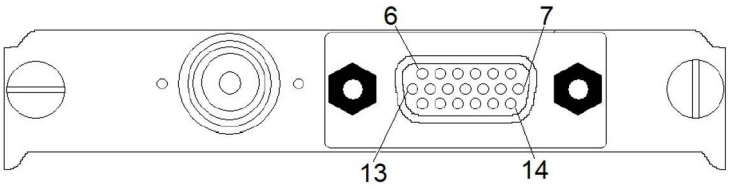


Figure 6: 19-way DD-type connector plus SMA connector

19-way connector

PIN	NAME	DESCRIPTION	COMMENT
1	USB VBUS	USB Bus Power	
2	USB D+	USB Data+	
3	USB D-	USB Data-	
4	USB ID	USB ID	Do not connect
5	USB GND	Internal ground	
6	DNC		Do not connect
7	DNC		Do not connect
8	DNC		Do not connect
9	DNC		Do not connect
10	GND	Internal ground	
11	DNC		Do not connect
12	DNC		Do not connect
13	DNC		Do not connect
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	DNC		Do not connect
18	DNC		Do not connect
19	CHASSIS	Chassis	

Reverse-polarity SMA connector

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
Center	RF-IO	WSDA® Base Station RF characteristics	RF signal; connect directly to SMA antenna or through 50Ω co-axial cable
Outer shell	RF_GND	WSDA® Base Station RF characteristics	RF ground reference; connect to shield if using co-axial cable

SMA torque setting

The recommended torque setting for the SMA connector is 0.45 Nm (0.33 ib-f).

Antenna

The KAM/WSI/104 ships with an antenna folded and attached to the SMA connector. Unfold the antenna before use.

Ordering information

PART NUMBER	DESCRIPTION
KAM/WSI/104/C	LORD wireless sensor network interface module

By default, one USB programming cable (ACC/CON/051) is included with each module in the order. Its part number will be added to the Confirmation of Order unless an alternative option is specified. The antenna is included as part of the module part number; it cannot be ordered separately.

Revision history

REVISION	DIFFERENCES	STATUS
KAM/WSI/104/C	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
SensorConnect™	Desktop sensing software, used to configure wireless node networks (see www.microstrain.com)

Related products

MODULE	DETAILS
DEV/KIT/002	Wireless Data Acquisition starter kit
ACC/CON/051	USB to 19 way cable for the KAM/WSI/104
DVRT-Link WSDA®-1500-SK G-LINK®-200 V-LINK®-200 TC-LINK®-200 RTD-LINK-200 SG-LINK®-200 TORQUE-LINK-200 IEPE-LINK-LXRS G-LINK-200-OEM SG-LINK-200-OEM TC-LINK-200-OEM	Compatible with all LXRS sensor nodes and all legacy 2.4 GHz nodes For information on these products, see www.microstrain.com/wireless/sensors

WSDA®, LXRS®, TC-Link®, G-Link®, V-Link®, SG-Link®, SensorConnect™, and MicroStrain® are trademarks of LORD Corporation.

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation
TEC/NOT/084	Using the KAM/WSI/104