



SMARTdiagnostics®
IoT HUB Product Guide v.1.0

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Revision History

Date	Version	Author	Details
5/4/2020	1.0	R. Korte, E. Sankey	Document Published

1 Product Overview

1.1 Introduction

The HUB is the central part of a product system that is designed to meet the following needs in the industries we serve:

- Fill the gap where deploying KCF's wireless vibration sensors is not feasible due to access, size, environment, etc.
- Update the KCF's General Input Nodes' capability to ingest standard, 3rd-party transducer data into SMARTdiagnostics®
- Extend our monitoring capability with the ability to collect data at the same time across multiple sensors
- Extend our monitoring capability with the ability to "trigger" data collection so that we can collect data when it matters- when a machine is running or at specific times during a machine's cycle

1.2 How It Works

The HUB controls up to seven (7) sensors that are connected to the HUB with a cable. In this way, the HUB can both power the sensors and control how and when those sensors collect data. When data is collected, it is transferred from the sensor to the HUB over-the-wire. The HUB subsequently transmits that data wirelessly to a base station or repeater (using DARTwireless™) which then sends it to SMARTdiagnostics® software for analysis. While the sensors can be installed on multiple or single assets, the ability of the HUB to coordinate/synchronize data collection across multiple sensors on a single asset allows for fully understanding of the asset's overall health.

1.3 Applications

The HUB was designed to address several unique challenges. A few of these are discussed here.

KCF's Wireless Vibration Sensor has a wide operating temperature range that is limited primarily by the battery that powers it. Some industrial applications require sensors that can operate at even more extreme temperatures. Rated for -40°C to 125°C, the vibration sensor in The HUB ecosystem can withstand some of the harshest environments.

Many assets are either partially or fully enclosed in shielding for safety reasons. This can present an installation issue if the space where the sensor needs to be installed is not large enough for a wireless sensor to fit. Safety enclosures can also be an issue for wireless connectivity and battery maintenance. The HUB's vibration sensor is a much lower profile and smaller footprint than its wireless counterpart, making it ideal for such locations.

Collecting data on a timed interval, such as what KCF's Wireless Vibration Sensors do, is a great way to continuously monitor equipment that is running all the time. For machines that operate intermittently, such as conveyors or other machines on a fixed cycle, a sensor operating on a timed interval may collect data even when the machine is not running and will collect data

at a different place in the cycle when it is. The HUB resolves this issue by allowing an external process to tell The HUB when the asset is running through trigger signals.

Finally, it is desirable to collect other data from an asset in addition to vibration data. Examples are pressure, fluid quality, temperature, power consumption, etc. The HUB's ports are designed to accommodate any type of sensor. Primarily, the HUB Analog Adapter supports all sensors that output 4-20mA or 0-10V. As the HUB ecosystem grows, adapters will be added for piezoelectric accelerometers, thermal probes, and other common transducers. With a full suite of sensors to collect a wide variety of data from an asset, the HUB will enable unprecedented ability to provide real-time asset health information.

2 Product Specifications

2.1 IoT HUB

2.1.1 Mechanical Specifications

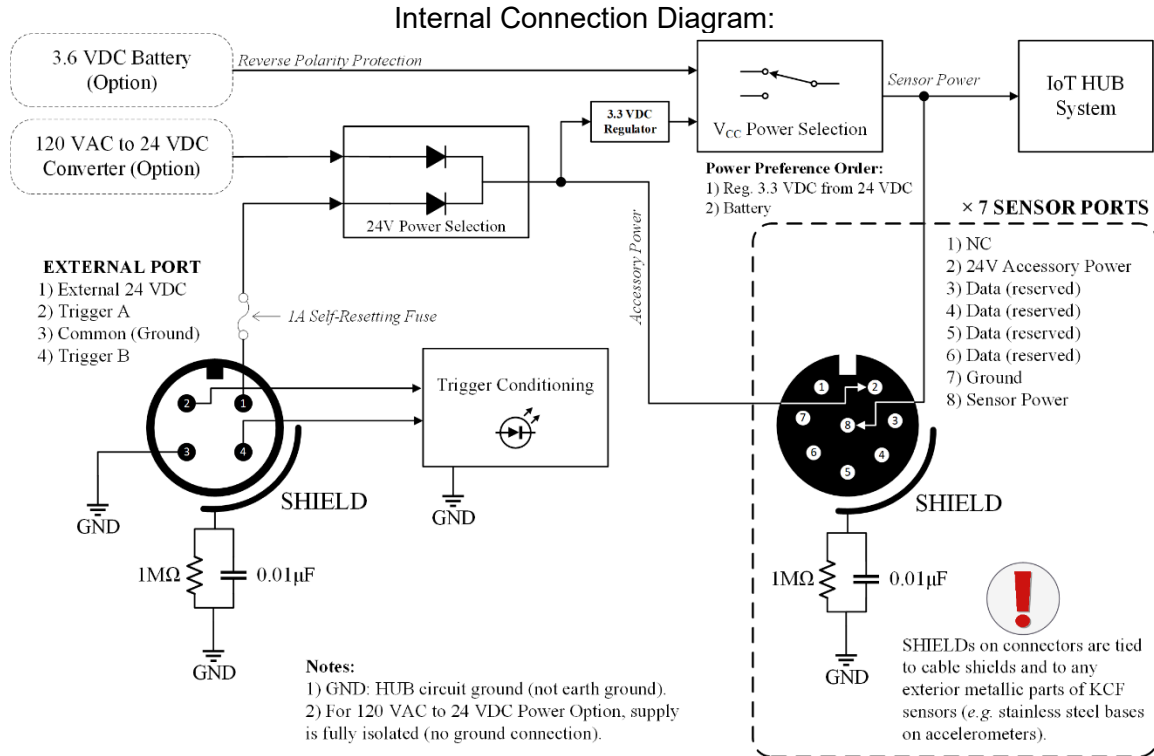
Weight:	672 g (with Battery Power Module) 621 g (with AC Power Module)
Enclosure Material:	Radel R5800
Mounting:	Magnetic or Hard Mount, #10 or M5 Socket Head
Maximum Mounting Bolt Torque:	15 in-lb [1.7 N·m]

2.1.2 Electrical Specifications

<u>AC Powered</u>	
Input Power:	120 VAC, 25 watts max., < 1 Watt typ., 0.55 P.F.
Access. Power (provided by HUB):	24 VDC $\pm$ 5%, 750mA ($T_A = 20^\circ\text{C}$), 150 mA ($T_A = 85^\circ\text{C}$)
<u>Battery Powered</u>	
Input Power:	3.6 VDC Nom. (2.8–3.7 VDC op.), <2.5 A pk., <1 mA typ.
Access. Power (provided by HUB):	None (unless specially provided by Sensor)
Battery Life:	{TBD}
<u>Externally Powered</u>	
Input Power:	24 VDC Nom. ¹ (8–36 VDC op.), <1 A (fused ²), <1 mA typ.
Access. Power (provided by HUB)	Up to 1A at External Voltage +0/-5%
External Trigger Signal Level:	24 V Nom., 10 mA max., 10 ms minimum pulse width

¹ Any accessories (such as the analog adapter) that are configured to provide pass-thru power will utilize this power source for attached transducers. Ensure your transducers operate satisfactorily with your provided external input voltage.

² Self-resetting fuse.



2.1.3 Environmental Specifications

Storage Temperature Range: -40°C to 125°C (-40°F to 257° F)
Operating Temperature Range: -40°C to 85°C (-40°F to 185° F)
IP Rating: IP67
Hazardous Certification: Class 1, Division 2 (planned)

2.1.4 Wireless Radio Specifications

Radio: KCF DARTwireless™ 2.4GHz ISM band
Antenna: Internal dipole antenna
FCC ID: Z5IHB1
IC: 24664-HB1

See Section 4 for Wireless Radio Certification Statements.

2.1.5 Input Options

Collection Mode: Timed Interval
Triggered
Input Types: 24 VDC edge trigger (optional)
7 KCF Sensor Ports (caps available for unused ports)
Sensor Types: KCF Vibration Sensor
KCF Analog Adapter

2.1.6 Part Numbers

The following variants are available for The HUB. Please use the complete part number for all components to ensure the correct product and configurations are shipped.

SD-HUB-1-[magnet][power]

Magnet Options:	Power Module Options:
Magnet: M	Battery: B
No Magnet: X	120-240VAC: A

Examples:

Hub w/magnets and battery module:	SD-HUB-1-MB
Hub w/magnets and AC module:	SD-HUB-1-MA
Hub w/out magnets and battery module:	SD-HUB-1-XB
Hub w/out magnets and AC module:	SD-HUB-1-XA

2.2 Wired Vibration Sensor

2.2.1 Mechanical Specifications

Weight:	100 g
Enclosure Material:	Radel R5800 and 303 Stainless Steel
Mounting:	Magnetic or Hard Mount, #10 or M5 Socket Head
Maximum Mounting Bolt Torque:	30 in·lb max [3.4 N·m]

2.2.2 Environmental Specifications

Storage Temperature Range:	-40°C to 125°C (-40°F to 257° F)
Operating Temperature Range:	-40°C to 125°C (-40°F to 257° F)
IP Rating:	IP69
Hazardous Certification:	Class 1, Division 2 (planned)

2.2.3 Acceleration

Range:	+/- 19 g typical, +/- 16 g nominal
Resolution:	0.866 mg nominal
Noise Floor:	1.496 mg RMS @64 Hz / 13.01 mg RMS @ 8192 Hz
Transverse Sensitivity:	10% typical
Frequency Response:	+/- 5% 0-2700 Hz +/- 3% 2700-4000 Hz
Samples per Acquisition:	4096
Spectral Lines:	2048
Anti-Aliasing Filter:	4000 Hz low-pass cut-off, 3 rd order Sallen-Key
Sampling Frequency:	64 Hz – 8192 Hz configurable

2.2.4 Temperature Sensor

Range: -40°C to 125°C (-40°F to 257° F)
Resolution: +/- 0.5°C (+/- 1°F)

2.2.5 Part Numbers

The following variants are available for wired vibration sensor. Please use the complete part number for all components to ensure the correct product and configurations are shipped.

SD-WVS-1-[cable][magnet][incendive]-[temp][foot][connector]

Cable Options:

5 Meter: 05
10 Meter: 10

Incendive Options:

Regular: R

Foot Styles:

Pointed Feet: A
Flat Feet: B

Magnet Options:

Magnet: M
No Magnet: X

Temperature Options:

Industrial: T

Connector Options:

Standard M12 C

Examples:

5m cable, magnet, industrial temp, pointed feet, M12 connector:

SD-WVS-1-05MR-TAC

10m cable w/out magnet, industrial temp, flat feet, M12 connector:

SD-WVS-1-10XN-TBC

3 Installation and Setup

3.1 Special Tools Needed

In addition to standard tools used for an installation, it is strongly recommended that you have the following tools on hand for installing The HUB, specifically needed for keeping the wires for the sensors safe and organized.

- Cable Ties: used to secure and attach cables from the wired sensors to the asset and away from moving parts that could pinch/damage cables or pose a tripping risk.
- Cable Tie Gun: easily tightens cable ties and clips the ends neatly without sharp edges.
- Wire Snips/Snippers/Nippers: used to cut cable ties apart

3.2 Hardware Installation Procedures

Installation of the HUB and wired sensors is conducted by trained Field Operations staff to ensure optimal performance for your HUB solution. Please refer to the Field Services Installation Guide for detailed installation instructions.

3.3 Software Setup Procedures

The software setup procedures for The HUB in SMARTdiagnostics® are similar to those for V3 sensors.

3.3.1 Adjusting HUB and Sensor Settings

1. Once a HUB has been added to SMARTdiagnostics®, it appears in the Location Network settings under the IoT HUBs tab on the screen.
2. The Hardware Status Overview displays the number of HUBs at the Location as well as their current Reporting Status. To view details for a specific HUB, use the dropdown to select the hardware for which you want to view. The screen updates to display settings for the selected HUB.
3. The HUB settings are automatically updated for the selected device, including the Serial Number, Firmware Version, Last Update, Number of Sensors Reporting and Power Type. For the initial release, the Voltage and Temperature values in this table are set to a default value of -1 and will not update, therefore users should ignore these values for the time being. The IoT HUB Name is editable if you want to rename the HUB.
4. When the HUB checks into the network to report status, the Sensors attached to the HUB will also check in and populate the Sensor table at the bottom of the screen.
5. Each Sensor has configuration settings that can be adjusted.
 - a. Nickname – Rename the sensor for easier reference.
 - b. Trigger Type – Triggers can be set to External or Timer-based
 - c. Trigger – If the Trigger Type is set to External, select whether the sensor's trigger will be off Trigger A or Trigger B

- d. Trigger Delay – Triggers can be set to a specific delay. Enter the delay in milliseconds
- e. Minimum Interval – Select the appropriate Minimum Interval from the dropdown list. Intervals can range from 60 seconds up to 24 hours.
- f. Sampling Frequency – Select the appropriate Sampling Frequency from the dropdown list. Frequency can range from 64 Hz to 8192 Hz.

IoT HUB Hardware Overview in SMARTdiagnostics

Hardware Alerts | Sensor Status | Hardware Event Logs | Notification Settings | Manage Network | IoT HUBs

4 IoT HUBs 0 Reporting

IoT HUB Name	7 Empty Ports
Serial Number	D0000013
Firmware Version	
Last Update	a month ago
# Sensors Reporting	0/7
Power Type	Battery
Voltage	-1V
Temperature	-1°F

Sensor ID	HUB Port	Nickname	Trigger Type	Trigger	Trigger Delay	Minimum Interval	Sampling Frequency	Latest Long Burst	Collect
n/a	1	--	--	--	--	--	--	--	--
n/a	2	--	--	--	--	--	--	--	--
n/a	3	--	--	--	--	--	--	--	--
n/a	4	--	--	--	--	--	--	--	--
n/a	5	--	--	--	--	--	--	--	--
n/a	6	--	--	--	--	--	--	--	--
n/a	7	--	--	--	--	--	--	--	--

IoT HUB Hardware Overview in SMARTdiagnostics

5

a

b

c

d

e

f

Sensor ID	HUB Port	Nickname	Trigger Type	Trigger	Trigger Delay	Minimum Interval	Sampling Frequency	Latest Long Burst	Collect
A00021ED	1	Current Shire QA Desks IoT HUB	External	A	11 ms	60 seconds	4096 Hz	16-Mar-2020 05:21:07 PM	Run Long Burst
A00021EC	2	Current Shire QA Desks IoT HUB	External	B	-- ms	60 seconds	2048 Hz	--	Run Long Burst
A00021EE	3	Current Shire QA Desks IoT HUB	External	A	-- ms	60 seconds	2048 Hz	--	Run Long Burst
0001AE17	4	V3.0.40 Dev Shire Joe IoT HUB	Timer	--	--	60 seconds	8192 Hz	--	--
0001AE18	5	V3.0.40 Dev Shire Joe IoT HUB	External	A	0 ms	60 seconds	8192 Hz	06-Mar-2020 09:12:42 AM	Run Long Burst
0001AE19	6	V3.0.40 Dev Shire Joe IoT HUB	External	A	5 ms	60 seconds	8192 Hz	In progress	Run Long Burst

3.3.2 Collecting Long Burst Data

- A long burst allows you to capture readings over a longer period of time in order to determine where to set your Trigger Delays and Intervals. To start a long burst collection, click the Run Long Burst button. The Latest Long Burst column displays "In Progress" to indicate that a long burst is being collected.
- Once the long burst is complete, a link to the long burst data appears in the Latest Long Burst column. Hovering over the value in this table displays the username that collected this long burst and the date/timestamp of the collection. Click on this cell to download an Excel file of the long burst data.

Collecting Long Burst Data in SMARTdiagnostics

Sensor ID	HUB Port	Nickname	Trigger Type	Trigger	Trigger Delay	Minimum Interval	Sampling Frequency	Latest Long Burst	Collect
A00021ED	1	Current Dev Shire QA Desks 1	External	B	-- ms	60 seconds	2048 Hz	16-Mar-2020 05:21:07 PM	Run Long Burst
A00021EC	2	Current Dev Shire QA Desks 2						--	Run Long Burst
A00021EE	3	Current Dev Shire QA Desks 3						--	Run Long Burst
0001AE17	4	V3.0.40 Dev Shire Joe	Timer	--	--	60 seconds	8192 Hz	--	--
0001AE18	5	V3.0.40 Dev Shire Joe	External	A	0 ms	60 seconds	8192 Hz	06-Mar-2020 09:12:42 AM	Run Long Burst
0001AE19	6	V3.0.40 Dev Shire Joe	External	A	5 ms	60 seconds	8192 Hz	In progress	Run Long Burst

4 Product Support, Warranty, and Certification Information

4.1 KCF Contact Information

If you need any assistance setting up and using your IoT HUB or SMARTdiagnostics® system, please contact our team and we'll be happy to help!

KCF Support Team: 814-867-4097 x2

4.2 Product Warranty and Return Policy

KCF Technologies, Inc. (“Seller”) warrants that (i) all products (except spare parts, replacement parts and spare kits) shall be free from material defects in workmanship for a period of one (1) year from the date shipped from Seller’s distribution center; and (ii) all spare parts, replacement parts, and spare kits shall be free from material defects in workmanship for a period of ninety (90) days from the date of invoice issued by Seller or its authorized distributor. Seller warrants that it will implement commercially reasonable measures consistent with generally accepted practices to safeguard the software and Buyer’s data contained in it against accidental or unlawful loss, access, or disclosure; provided, however, that Buyer is responsible for properly configuring and using products and taking Buyer’s own steps to maintain appropriate security, privacy, and backup of your data.

The foregoing limited warranties are void with respect to (i) any product which, in Seller’s sole judgment, has been subjected to abuse, accident, alteration, modification, tampering, negligence, misuse, faulty installation, lack of reasonable care, repair, or service by anyone other than Seller that is in any way not contemplated in the documentation for such product; (ii) any product, of which the model or serial number has been altered, tampered with, defaced, or removed; (iii) operational adjustments not covered in the operating manual for such product; (iv) maintenance, calibration, or recalibration of any product by anyone other than Seller; (v) damage occurring in shipment or due to acts of nature, failures due to power surges, or other force majeure causes beyond Seller’s control; (vi) cosmetic damage; (vii) any product or service provided or furnished by anyone other than Seller; (viii) any product that has been installed or used outside Seller’s technical specifications as provided on the product datasheets and care and handling application notes; (ix) refurbished products and services; (x) the failure to install any required software or firmware update; and (xi) products that have been purchased through an inventory clearance or liquidation sale or other sale specifying that such product is being sold “as is.”

The foregoing limited warranties are the only warranties made by Seller under this Agreement. Except as otherwise set forth explicitly herein, Seller does not make, and hereby disclaims, any representations or warranties, express, implied, or statutory, regarding (i) products and services (including hardware, software, and related services) and (ii) the acts or omissions of users of the products and services, including (without limitation) implied warranties of merchantability, fitness for a particular purpose, title, non-infringement of third party rights, and any warranties arising by course of dealing or custom of trade. Seller makes no representation or warranty that any products or services are accurate, complete, appropriate, reliable, or timely. Seller also makes no representations or warranties that the products and services will meet Buyer’s requirements, or that Buyer’s access to and use of the products and services will be uninterrupted or error-free, free of viruses, malicious code, or other harmful components, or otherwise will be secure.

By accepting delivery of any product, Buyer acknowledges and agrees that (i) the value and use of such product is unrelated to the value or cost of any real or personal property in connection with which such product may be used or any services related to such product which are furnished by any person; (ii) Seller makes no warranty that such product will avert, detect, or prevent occurrences or the consequences thereof which such products may have been

designed to detect, avert, or prevent, or that such product may not be compromised, disabled, or circumvented; (iii) Seller has made no representations or warranties, express or implied, to Buyer or for Buyer's benefit that contradict any of the foregoing; and (iv) "false alarms" and "false readings" from Seller's products may occur for any number of reasons, and Seller does not warrant against such false results.

Some jurisdictions do not allow the exclusion of certain warranties. Accordingly, some of the above exclusions may not apply to Buyer.

Seller's sole obligation with respect to any product which is found to contain any material defect in workmanship within the applicable warranty period shall be, at Seller's sole discretion, either to repair or replace such product at no charge to the Buyer, or to refund the purchase price upon return of the defective product to Seller. The replacement product need not be new (i.e., it may be used or reconditioned) nor be of identical make, model or part, so long as Seller has reasonably determined that it is substantially equivalent or superior in all material respects to the product being replaced. Repaired or replacement products will be warranted for the remainder of the original applicable warranty period. All products (including any part thereof) replaced by Seller or for which the purchase price is refunded shall become the property of Seller upon replacement or refund. Unless otherwise designated in writing by Seller, Seller is the only party authorized to perform warranty service on Seller products and services.

If a product is believed to be defective and is still in warranty, or if Seller has otherwise agreed to accept return of a product, Buyer shall (unless otherwise instructed in writing by Seller) (i) if the product is alleged to be defective, provide Seller with a written description in sufficient detail to allow Seller to confirm such defect; (ii) obtain a Return Merchandise Authorization ("RMA") number from Seller; (iii) if requested by Seller, provide written proof of purchase of the product (such as a copy of the dated purchase invoice for the product); (iv) after an RMA number is issued, package the product securely in the original or other suitable shipping package to ensure that it will not be damaged in transit, with the RMA number prominently marked on the outside of the package; and (v) within fifteen (15) days of issuance of the RMA, ship the product at Buyer's sole expense to Seller or its distribution center, as indicated by Seller. In addition:

1. If the product is being returned for maintenance, calibration, recalibration or repair, Buyer must not include any manuals or accessories in the shipping package. Seller will only replace the defective portion of the product and will not ship back any accessories.
2. Buyer is responsible for all shipping charges to Seller. No Cash on Delivery ("COD") is allowed. Products sent COD will either be rejected by Seller or become the property of Seller, at Seller's sole discretion.
3. Buyer shall fully insure any product for return to Seller, and Seller shall in no event be responsible for any shipment lost in transit.
4. Repaired or replaced products will be shipped to Buyer via UPS Ground or any common carrier selected by Seller, with shipping charges prepaid by Seller. Expedited shipping is available if shipping charges are prepaid by Buyer and only upon request.
5. Seller may reject or return any product that is not packaged and shipped in strict compliance with the foregoing requirements or for which an RMA number has not been obtained or is not visible from the outside of the package. The product owner agrees to pay Seller's reasonable handling and return shipping charges for any product that is not packaged and shipped in accordance with the foregoing requirements or that is determined by Seller not to be defective or nonconforming.

SELLER'S LIABILITY FOR ALL CLAIMS, WHETHER BASED ON BREACH OF CONTRACT, NEGLIGENCE, PRODUCT LIABILITY, OR OTHERWISE, SHALL NOT EXCEED THE PRICE PAID BY BUYER FOR SUCH DEFECTIVE PRODUCT. IN NO EVENT WILL SELLER BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES (INCLUDING, WITHOUT LIMITATION, LOSS OF USE, LOSS OF PROFIT, AND CLAIMS OF THIRD PARTIES), HOWEVER CAUSED, WHETHER BY THE NEGLIGENCE OF SELLER OR OTHERWISE.

4.3 Certification Information

FCC STATEMENT

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. This equipment complies with the FCC RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator and any part of your body. Changes or modifications not expressly approved by KCF Technologies could void the user's authority to operate the equipment.

INDUSTRY CANADA STATEMENT

The term IC before the Certification/Registration number only signifies that the Industry Canada technical specifications were met. This device complies with Industry Canada's license-exempt RSSs Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This equipment complies with the IC RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator and any part of your body.

FVIN: 3.2.0