

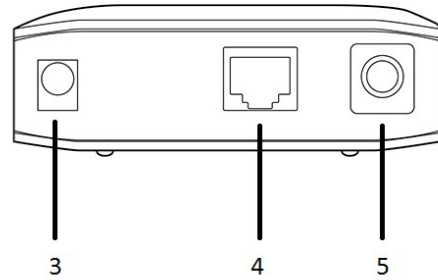
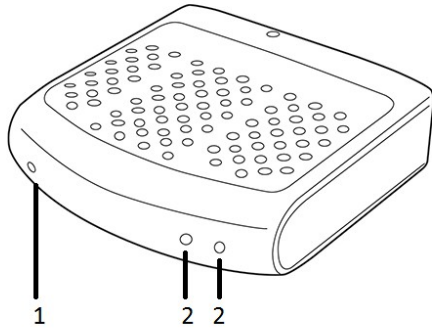
SiliconDust USA, Inc.

Tech/HDRack
Operations Manual

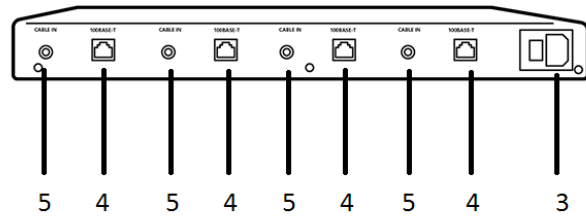
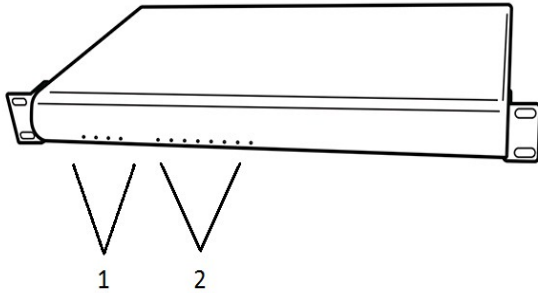
October 2, 2014

Hardware

TECH3 (dual tuner)



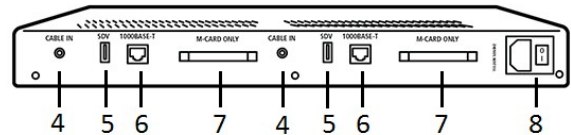
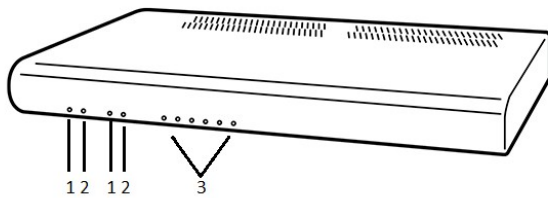
HDRack (8 tuner ATSC/QAM/DVB-T/DVB-C)



1. Power/Network
2. Tuner

3. Power
4. Ethernet
5. Coax in (ATSC/QAM/DVB-T/C)

HDRack (6 tuner CableCARD)



1. Power/Network LED
2. CableCARD LED
3. Tuner LEDs

4. Coax in (digital cable)
5. USB (for tuning adapter)
6. Ethernet
7. M-CARD
8. Power

Power

All devices should be used with the included power supply (dual-tuner models) or power cable (HDRack models).

Ethernet

Connect the Ethernet port(s) to a network switch. On models with multiple ports, all ports must be connected in order for all tuners to be accessible. A single port can be directly connected to the network interface on a PC to access that specific device. All ports are auto-crossover so a standard Ethernet cable can be used.

Additional Tools and Software

Software Installation

The latest HDHomeRun drivers, code, and firmware can be found on the SiliconDust website:

<http://www.silicondust.com/downloads>

Windows

Download and install the latest Windows release of the HDHomeRun software.

The HDHomeRun Setup wizard is optional.

When the installation process is complete it is recommended that the HDHomeRun program directory be added to the PATH so that the hdhomerun_config utility can be run from a cmd prompt. The default program directory is "C:\Program Files\SiliconDust\HDHomeRun\"

Linux/*BSD/Solaris

Download and extract the libhdhomerun archive.

Run "make" to compile hdhomerun_config (systems that use a non-GNU make by default may need to install and use "gmake" instead).

Copy hdhomerun_config to /usr/local/bin

Using the Command Line Configuration Utility (hdhomerun_config)

Open a command prompt or terminal window and change directory to the HDHomeRun installation directory: "C:\Program Files\SiliconDust\HDHomeRun\"

The list of supported commands can be obtained by running `hdhomerun_config` without any parameters:

```
hdhomerun_config discover
hdhomerun_config <id> get help
hdhomerun_config <id> get <item>
hdhomerun_config <id> set <item> <value>
hdhomerun_config <id> scan <tuner> [<filename>]
hdhomerun_config <id> save <tuner> <filename>
hdhomerun_config <id> upgrade <filename>
```

Discover devices on the network

The discover command will find devices that are on the same subnet as the host:

```
hdhomerun_config discover
```

Sending commands to a specific device

The “<id>” shown above represents a unique identifier for a device, this can be either Device ID, or IP address:

```
hdhomerun_config <device id> get help
hdhomerun_config <ip address> get help
```

To address by Device ID the device must be on the same subnet as the host.

A Device ID of FFFFFFFF can be used as a wild card for the first device found on the network. Do not use this syntax if there are multiple devices on the network, as the device used will be random based on discovery order, which may change between commands.

Supported Commands

The get/set options supported by a specific device can be queried using the get help command:

```
hdhomerun_config <id> get help
```

Example output:

```
/card/status          Get status of CableCARD (6CC only)
/oob/channel <modulation>:<freq>  Get/set out of band channel (6CC only)
/oob/debug           Get out of band channel debug info (6CC only)
/oob/status          Get out of band channel status info (6CC only)
/sys/boot <config>     Get/set boot configuration
/sys/copyright        Get copyright information
/sys/debug           Get/set system debug information
/sys/features         Get system feature information
/sys/hwmodel          Get system hardware model string
/sys/ipaddr dhcp|"<ip> <mask> <gw> <dns>"  Get/set system IP address
/sys/model            Get/set model string
/sys/restart <resource>  Restart device/component
/sys/version          Get firmware version
/tuner<n>/channel <modulation>:<freq|ch>  Get/set channel
/tuner<n>/channelmap <channelmap>  Get/set channelmap
/tuner<n>/debug       Get tuner debug information
/tuner<n>/filter "0x<nnnn>-0x<nnnn> [...]"  Get/set tuner PID filter
/tuner<n>/lockkey     Get/set tuner locking
/tuner<n>/plotsample  Get raw plotsample data from tuner
/tuner<n>/program <program number>  Get/set MPEG program
/tuner<n>/streaminfo  Get list of programs on current channel
/tuner<n>/status      Get tuner status
/tuner<n>/target <ip>:<port>  Get/set stream target
/tuner<n>/vchannel <vchannel>  Get/set virtual channel number (6CC only)
/tuner<n>/vstatus     Get/set subscription/protection status (6CC only)
```

Channel scan

To run a channel scan:

```
Format: hdhomerun_config <id> scan /tuner<n> [log filename]
Example: hdhomerun_config FFFFFFFF scan /tuner0 scan0.log
```

This command will scan all channels on the selected channel map plus any additional channel maps associated with the selected channel map. All standard modulation types for the selected channel map are tested.

When a digital channel is found it will identify the programs on the channel.

The log filename is optional; if included it will log to the given filename.

Tuning a physical channel

To set a channel use the set channel command:

```
Format: hdhomerun_config <id> set /tuner<n>/channel <modulation>:<frequency>
Format: hdhomerun_config <id> set /tuner<n>/channel <modulation>:<channel>
Example: hdhomerun_config FFFFFFFF set /tuner0/channel auto:651000000
Example: hdhomerun_config FFFFFFFF set /tuner0/channel auto:60
```

To auto-detect the modulation type use “auto” for the modulation.

Supported modulation types can be queried with the get sys-features command:

```
hdhomerun_config <id> get /sys/features
```

To stop the tuner set the channel to none:

```
Format: hdhomerun_config <id> set /tuner<n>/channel none
Example: hdhomerun_config FFFFFFFF set /tuner0/channel none
```

Tuning a virtual channel (TECH3-6CC-3x2 only)

To set a virtual channel use the set vchannel command:

```
Format: hdhomerun_config <id> set /tuner<n>/vchannel <virtual channel>
Example: hdhomerun_config FFFFFFFF set /tuner0/vchannel 702
```

To stop the tuner set the vchannel to none:

```
Format: hdhomerun_config <id> set /tuner<n>/vchannel none
Example: hdhomerun_config FFFFFFFF set /tuner0/vchannel none
```

Checking the signal strength

The basic signal information can be obtained by using the get status command:

Format: `hdhomerun_config <id> get /tuner<n>/status`
Example: `hdhomerun_config FFFFFFFF get /tuner0/status`

Example output:

```
ch=qam:33 lock=qam256 ss=83(-10dBmV) snq=90(29dB) seq=100 bps=38807712 pps=0
```

- ch = channel requested
- lock = actual modulation detected
- ss = signal strength.
- snq = signal to noise quality (MER).
- seq = symbol error quality (based on the number of uncorrectable digital errors detected).
- bps = raw channel bits per second.
- pps = packets per second sent through the network.

More advanced information can be obtained by using the get debug command:

Format: `hdhomerun_config <device id> get /tuner<n>/debug`
Example: `hdhomerun_config FFFFFFFF get /tuner0/debug`

Example output:

```
tun: ch=qam:33 lock=qam256 ss=84 snq=88 seq=100 dbg=22081-6930
dev: resync=0 overflow=0
ts: bps=38809216 ut=94 te=0 miss=0 crc=0
flt: bps=38809216
net: pps=0 err=0 stop=0
```

Each line contains a prefix to indicate the type of data, followed by the values.

- tun = tuner status
 - see above section
- dev = device status
- ts = transport stream
 - bps = bits per second
 - ut = utilization percentage (100% is filled to capacity)
 - te = transport error counter (uncorrectable reception error)
 - miss = missed packet counter (jump in sequence numbers)
 - crc = crc error counter
- flt = results after pid filtering
 - bps = bits per second
- net = network status
 - pps = packets per second
 - err = packets or TS frames dropped before transmission.

- stop = reason for stopping the stream

The counters are reset to zero upon a channel change, but may indicate a small number of errors caused before the tuner locks on the channel. As a result, diagnostics should be based on the change in values over time, and not the initial values. Detecting the programs on a physical channel:

The device will detect the programs (sub-channels). Use the get streaminfo command to query the detected programs:

```
Format: hdhomerun_config <id> get /tuner<n>/streaminfo
Example: hdhomerun_config FFFFFFFF get /tuner0/channel streaminfo
```

The output format is:

```
<program number>: <virtual major>.<virtual minor> [<name>] [(<flags>)]
```

Example output:

```
3: 20.1 KBWB-HD
4: 20.4 AZTECA
```

Digital cable does not always provide the channel name or virtual channel number:

```
1: 0.0
2: 0.0 (encrypted)
3: 0.0 (control)
```

It may take several seconds after setting the channel for the stream information to be fully populated (depending on how long the channel takes to lock and how often the stream information is sent by the broadcaster/cable provider).

Filtering by program (sub-channel)

TECH3 supports automatic PID filtering by program number or virtual channel number:

```
Format: hdhomerun_config <id> set /tuner<n>/program <program number>
hdhomerun_config <id> set /tuner<n>/program <virtual channel number>
```

```
Example: hdhomerun_config FFFFFFFF set /tuner0/program 3
hdhomerun_config FFFFFFFF set /tuner0/program 11.2
```

When filtering by program the MPEG TS tables are generated by the device. The result is a valid single-program transport stream.

The program filter is cleared when a set channel or a set filter command is received.

Advanced: By default the PAT and PMT are generated. To also generate a ATSC-style TVCT use:

```
hdhomerun_config <id> set /tuner<n>/program "<program number> tvct_from_pmt=<virtual major>.<virtual minor>(<name>)"
```

```
Example: hdhomerun_config <id> set /tuner0/program "3 tvct_from_pmt=11.2(TEST)"
```

Filtering by PID

The TECH3 supports arbitrary hardware PID filtering:

```
Format: hdhomerun_config <id> set /tuner<n>/filter <filter>
Example: hdhomerun_config FFFFFFFF set /tuner0/filter "0x0000-0x1FFF"
         hdhomerun_config FFFFFFFF set /tuner0/filter "0x0000 0x0030-0x0033 0x1FFB"
```

When filtering by PID the stream is filtered but otherwise unmodified.

The filter is cleared to pass-all (0x0000-0x1FFF) when a set channel command is received.

Saving a stream

The hdhomerun_config command can be used to automate the process of saving to the local filesystem:

```
Format: hdhomerun_config <id> save /tuner<n> <filename>
Example: hdhomerun_config FFFFFFFF save /tuner0 capture.ts
```

While saving the stream, a single period “.” will be displayed every second. Errors will be indicated by a letter.

Example output:

```
.....n.....n.....ts.....
-- Video statistics --
23323 packets recieved, 2 network errors, 1 transport errors, 1 sequence errors
```

Advanced: A filename of “null” indicates no file should be created, allowing the use of the save command as a diagnostic tool.

Advanced: “-” may be used as a filename to indicate standard output, allowing the save command to be used as a pipe on supported platforms.

```
Example: hdhomerun_config FFFFFFFF save /tuner0 - | vlc -
```

Streaming to a target machine

Set the target IP address and port number using the set target command:

```
Format: hdhomerun_config <id> set /tuner<n>/target udp://<ip>:<port>
Format: hdhomerun_config <id> set /tuner<n>/target rtp://<ip>:<port>
Example: hdhomerun_config FFFFFFFF set /tuner0/target udp://192.168.1.100:5000
Example: hdhomerun_config FFFFFFFF set /tuner0/target rtp://192.168.1.100:5000
```

The target machine must be listening on the given UDP port. The TECH3 will automatically clear the target if a ICMP port unreachable message is received when sending to a unicast address. To override this, add `no_clear` to the target.

```
Format: hdhomerun_config <id> set /tuner<n>/target "udp://<ip>:<port> no_clear"
Format: hdhomerun_config <id> set /tuner<n>/target "rtp://<ip>:<port> no_clear"
Example: hdhomerun_config FFFFFFFF set /tuner0/target "udp://192.168.1.100:5000 no_clear"
Example: hdhomerun_config FFFFFFFF set /tuner0/target "rtp://192.168.1.100:5000 no_clear"
```

A global broadcast (255.255.255.255), subnet broadcast, or multicast target can be specified however care must be taken to ensure that the traffic will not cause problems with other devices on the network. If the local network is bridged to a wireless network then the AP will typically transmit at a low broadcast speed saturating the wireless network.

The time-to-live (TTL) defaults to 64. To configure a lower TTL use the following format (quotes required):

```
Format: hdhomerun_config <id> set /tuner<n>/target "udp://<ip>:<port> ttl=<n>"
Format: hdhomerun_config <id> set /tuner<n>/target "rtp://<ip>:<port> ttl=<n>"
Example: hdhomerun_config FFFFFFFF set /tuner0/target "udp://192.168.1.100:5000 ttl=8"
Example: hdhomerun_config FFFFFFFF set /tuner0/target "rtp://192.168.1.100:5000 ttl=8"
```

Example: Streaming to VLC

Run VLC: Media, Open Network Stream. Select UDP/RTP. Specify port 5000.

Discover the device:

```
hdhomerun_config discover
```

Run a channel scan:

```
hdhomerun_config FFFFFFFF scan /tuner0 scan0.log
```

Set the physical channel:

```
hdhomerun_config FFFFFFFF set /tuner0/channel auto:651000000
```

Check sub-programs:

```
hdhomerun_config FFFFFFFF get /tuner0/streaminfo
```

Select a sub-program:

```
hdhomerun_config FFFFFFFF set /tuner0/program 3
```

Set the target:

```
hdhomerun_config FFFFFFFF set /tuner0/target udp://<ip address of pc>:5000
```

HTTP Streaming (TECH3-6CC-3x2 only)

TECH3-6CC-3x2 models can be used to stream via HTTP (unicast only) to VLC or other clients.

Format: `http://<ip address of device>:5004/auto/v<vchannel number>`

Example: `http://10.10.10.2:5004/auto/v721`

Lineup file (TECH3-6CC-3x2 only)

TECH3-6CC-3x2 units support virtual channel lineup information transmitted by the cable provider and received via the CableCARD. This is available in XML and JSON format.

`http://<ip address of device>/lineup.xml`

`http://<ip address of device>/lineup.json`

Datacast operation

TECH3 units support Datacast TCP/IP over OTA broadcast. Datacasting often provides news, weather, traffic, stock market, and other information which may or may not relate to the program[s] it is carried with. An electronic program guide is usually included. Datacast TCP-IP packets are reassembled and then routed to the LAN port.

Example:

Discover the device:

```
hdhomerun_config discover
```

Set the physical channel:

```
hdhomerun_config FFFFFFFF set /tuner0/channel auto:651000000
```

Set the datacast PID:

```
hdhomerun_config FFFFFFFF set /tuner0/filter 0x0A00
```

Set the target:

```
hdhomerun_config FFFFFFFF set /tuner0/target datacast
```

Using /sys/boot

The /sys/boot variable allows the TECH3 unit to automatically set variables at startup, allowing you to preserve settings across power outages or simply set the power on defaults.

The syntax for the /sys/boot consists of multiple lines of text; a variable name followed by a single space and then the value: (there should not be any space before the variable name)

```
<variable1> <value of variable1>
<variable2> <value of variable2>
...
<variableN> <value of variableN>
```

Example (save as boot.txt):

```
/tuner0/channelmap us-cable
/tuner0/channel 103
/tuner0/program 4
```

To store the configuration to the device:

Format: hdhomerun_config <id> set /sys/boot - < filename

Example: hdhomerun_config FFFFFFFF set /sys/boot - < boot.txt

Changes will be applied the next boot; to execute the new /sys/boot immediately:

Format: hdhomerun_config <id> execute

Example: hdhomerun_config FFFFFFFF execute

Static IP assignment

A static IP address can be configured using the following command (the quotes are required as shown):

Format: hdhomerun_config <old ip> set /sys/ipaddr "<new ip> <subnet> <gateway>"

Example: hdhomerun_config 169.254.34.98 set /sys/ipaddr "10.10.20.43 255.255.255.0 10.10.20.1"

Note: The TECH requires a gateway when used to stream multicast, even if on the same subnet.

Reverting to DHCP

The TECH3 can be configured for DHCP operation (default) using the following command:

Format: hdhomerun_config <old ip> set /sys/ipaddr dhcp

Example: hdhomerun_config 169.254.34.98 set /sys/ipaddr dhcp

Setting the channel map

The channel map is a non-volatile configuration option that is used to set the channel to frequency table, to configure the channel scan table, and to optimize the auto-modulation detection.

GUI: The channel map can be set for each tuner by running HDHomeRun Config (GUI).

Command line: The channel map can be set for each tuner using the following command:

```
Format: hdhomerun_config <ip|id> set /tuner<n>/channelmap <channelmap>
Example: hdhomerun_config 10001000 set /tuner0/channelmap us-cable
Example: hdhomerun_config 10001000 set /tuner1/channelmap us-cable
```

Channel maps supported by HDHR-TECH-US hardware:

Name	Description	Location
us-bcast	Digital Antenna (ATSC).	US, Canada
us-cable	Digital Cable - Normal frequency layout.	US, Canada
us-hrc	Digital Cable - HRC frequency layout.	US, Canada
us-irc	Digital Cable - IRC frequency layout.	US, Canada

Channel maps supported by HDHR-TECH-EU hardware:

Name	Description	Location
au-bcast	Digital Antenna (Australia).	Australia
au-cable	Digital Cable (Australia).	Australia
eu-bcast	Digital Antenna (Europe).	Europe, New Zealand
eu-cable	Digital Cable (Europe).	Europe, New Zealand
tw-bcast	Digital Antenna (Taiwan).	Taiwan
tw-cable	Digital Cable (Taiwan).	Taiwan

Multicast

TECH3 supports multicast streaming within a network.

- 1) Using HDHomeRun Config GUI or `hdhomerun_config` choose a desired channel and program number for each tuner. In this example we will use channel 19 program 3 on tuner 0 and channel 30 program 1 on tuner 1.
- 2) Choose a multicast IP address for each stream. As a general rule the multicast address should be in the range of 239.255.0.0 to 239.255.255.255. In this example we will use 239.255.1.1 and 239.255.1.2
- 3) Choose a destination (client) port number. The port should be outside the the well-known ports range (we recommend 50000+) and should be unique for each stream. In this example we will use 59001 and 59002.

- 4) Write the boot script (text file):

```
/tuner0/channelmap us-bcast
/tuner0/channel 19
/tuner0/program 3
/tuner0/target rtp://239.255.1.1:59001 ttl=64

/tuner1/channelmap us-bcast
/tuner1/channel 30
/tuner1/program 1
/tuner1/target rtp://239.255.1.2:59002 ttl=64
```

- 5) Write the boot script to the device:

```
hdhomerun_config 10010003 set /sys/boot - < boot.txt
```

- 6) Execute the boot script:

```
hdhomerun_config 10010003 execute
```

- 7) Check the tuner status and target for each tuner. The packets-per-second “pps” number should be non-zero indicating that the device is sending the stream.

```
hdhomerun_config 10010003 get /tuner0/debug
hdhomerun_config 10010003 get /tuner0/target
hdhomerun_config 10010003 get /tuner1/debug
hdhomerun_config 10010003 get /tuner1/target
```


Example Boot Script Configurations

Tuning 2 ATSC channels and streaming to multicast addresses using RTP:

```
/tuner0/channelmap us-bcast
/tuner0/channel 31
/tuner0/program 3
/tuner0/target rtp://239.255.1.1:59001
/tuner1/channelmap us-bcast
/tuner1/channel 8
/tuner1/program 1
/tuner1/target rtp://239.255.1.2:59002
```

Tuning 3 digital cable channels using a CableCARD and streaming to multicast addresses using RTP:

```
/tuner0/vchannel 702
/tuner0/target rtp://239.255.1.1:59001
/tuner1/vchannel 740
/tuner1/target rtp://239.255.1.2:59002
/tuner2/vchannel 771
/tuner1/target rtp://239.255.1.3:59003
```

Tuning 2 DVB-T channels in Australia and streaming to multicast addresses using UDP:

```
/tuner0/channelmap au-bcast
/tuner0/channel 5
/tuner0/program 20121
/tuner0/target udp://239.255.1.1:59001
/tuner1/channelmap au-bcast
/tuner1/channel 44
/tuner1/program 28753
/tuner1/target udp://239.255.1.2:59002
```

Tuning 2 DVB-C channels in Europe and streaming to a single PC, ignoring rejection messages from the PC due to a closed port:

```
/tuner0/channelmap eu-cable
/tuner0/channel 646
/tuner0/program 231
/tuner0/target udp://192.168.0.22:59001 no_clear
/tuner1/channelmap eu-cable
/tuner1/channel 770
/tuner1/program 24112
/tuner1/target udp://192.168.0.22:59002 no_clear
```

HDHomeRun QuickTV (Windows)

HDHomeRun QuickTV is a lightweight viewer suitable for playing multicast video from the TECH3. HDHomeRun QuickTV is installed with the full HDHomeRun software or can be installed stand-alone using the separate HDHomeRun QuickTV installer.

HDHomeRun QuickTV uses a “.qtv” channel file to support friendly selection between mutlicast channels. This file would typically be placed on a file server or intranet download page where it can be accessed by users.

File format (example):

```
<?xml version="1.0" standalone="yes"?>
<QtvLineup>
  <Program>
    <Name>KOFYDT</Name>
    <Number>20.1</Number>
    <Url>hdhomerun://239.255.1.1:59001/current</Url>
  </Program>
  <Program>
    <Name>KQEDDT</Name>
    <Number>9.1</Number>
    <Url>hdhomerun://239.255.1.2:59002/current</Url>
  </Program>
</QtvLineup>
```

Name the file with a “.qtv” extension and then double-click to launch QuickTV.

QuickTV should display the channel list and start playing when a channel is selected.

VideoLAN VLC

VideoLAN VLC is a third party video player suitable playing unicast and multicast for use with the TECH3:

<http://www.videolan.org/vlc/>

Using VLC

- Run VLC and select Media, Open Network.
- Set the protocol to RTP.
- Set the address to 239.255.1.1 and the port to 59001.
- Click play.

TSReader

TSReader is a third party Transport Stream analyzer for Windows that works with the TECH3:

<http://www.coolstf.com/tsreader/>

FCC Notice (US TECH models):

This device complies with part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Notice (US HDRACK models):

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. 2) This device must accept any interference received, including interference that may cause undesired operation.

This product has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This product generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the manufacturer's instruction manual, may cause harmful interference with radio communications. Operation of this product in a residential area is likely to cause harmful interference, in which case you will be required to correct the interference at your own expense.

Trademarks:

HDHomeRun is a registered trademark of Silicon dust USA Inc.

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