D5: INTEGRATING HIGH DEFINITION DIGITAL AMATEUR TELEVISION INTO YOUR HAM STATION

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For Amateur Television
Digital Video Broadcasting Systems Manufacture
Topics...

• What is DVB and why is it being used for DATV?
• PC/USB Dongle TX/RX and software
• Stand-alone Transmitter and Receiver
• Building a DVB interface
• Configuring your station
• Repeater
• On-line resources for DVB-T
• Demo
What is DVB?

• Digital Video Broadcasting – Terrestrial is a European developed TV system introduced in the UK (1998)
• Uses modern compression techniques and efficient modulation schemes to deliver SD and HD video

Why use DVB-T and not our US ATSC Standard?

- Lower transmitter cost
- Adjustable bandwidth down to 1MHz
- Adjustable Transmission parameters
- Excellent multi-path performance
- Readily available hardware... Almost Plug-n-Play
DVB-T signal advantage over Analog

- Video Quality
- Digital signal
- Locked Perfect Pic
- Analog signal
- Signal Strength
Some DVB history...

- Before the 90s, it was not technically or economically possible to digitize TV
- Japan, Europe and finally U.S. threw a lot of money into developing digital TV/HDTV in the 80s/90s
- **Motion Picture Expert Group** compression standards were developed for moving pictures (MPEG 1, later 2, 4)
- Europe’s ELG defined and standardized DVB in 1993
- By the late 90s, 3 DVB variants S/M/T were available
- Later MPEG4/H.264/AVC was developed for HDTV

Satellite TV uses DVB-S/S2
DVB-T has over a billion users worldwide.

ATSC  Advanced Television Systems Committee
ISDB-T  Integrated Services Digital Broadcasting
DTMB  Digital Terrestrial Multimedia Broadcast

DVB has over a billion users worldwide
Basic DVB-T Digital ATV Station

- **Transmitter/Receiver** from HiDes company
- **Amplifier** - Class A 10 watts
- **Antenna Relay** – UHF Coaxial SMA/BNC/N
- **WebCam** - Logitech C920 or built-in a laptop
- **HDMI Camera** - Sony/Cannon Camcorder (optional)
- **Yagi** - 70cm - 10 elements
- **PC** - Win 7, 8, 10 (HDMI video out optional)
Who makes this D-ATV gear and where may I find it?
## Peripheral Transceiver/ Transmitter/ Receiver

<table>
<thead>
<tr>
<th>DVB-T</th>
<th>Transceiver RxBW: 5~8Mhz</th>
<th>Transceiver RxBW: 2/3/4Mhz</th>
<th>Transmitter</th>
<th>Receiver, BW:2/3/4Mhz</th>
</tr>
</thead>
<tbody>
<tr>
<td>VHF/UHF</td>
<td>--</td>
<td>--</td>
<td>PT-100(4-Channel)</td>
<td>UT-100D</td>
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<tr>
<td>VHF/UHF, 1.2G(Tx only)</td>
<td>UT-100A</td>
<td>UT-100B</td>
<td>UT-100C</td>
<td>UT-100C Opencastor</td>
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<tr>
<td>4-Band</td>
<td>--</td>
<td>--</td>
<td>UT-210</td>
<td>UT-130</td>
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<table>
<thead>
<tr>
<th>ISDB-T/-Tb</th>
<th>Transceiver</th>
<th>Transmitter</th>
</tr>
</thead>
<tbody>
<tr>
<td>VHF/UHF</td>
<td>UT-200AJ</td>
<td>UT-200C</td>
</tr>
<tr>
<td>VHF/UHF, 1.2G(Tx only)</td>
<td>UT-200AJH</td>
<td>UT-200CH</td>
</tr>
</tbody>
</table>
ITE TECH, INTEGRATED TECHNOLOGY EXPRESS
HiDes UT-100B Transceiver

- Modulator(TX) Demodulator(RX) USB2 PC port connection
- *Full hardware implementation* and Full Duplex capable
- 2-4 MHz RX and 1-8 MHz TX bandwidth
- 50-950 MHz RX, 50-950/1200-1350 MHz TX 1KHz Steps
- Up to 1080p HD H.264/MPEG-4 Advanced Video Coding

$230 on eBay

DCC 2016 St Petersburg
Free Windows Software...

- **BDA** (MS Std) **Viewer Plus**: Receive/Record/View
- **TS Player**: TX Transport Stream (TS) Files Player
- **Media2TS**: Video File converter to TS file

**Others**...

- **PC2TV**: TX/Record Cameras and PC desktop
- **Digital TV**: Receive/Record/View
- **TS Capture**: Record TS files
- **VLC**: Media Player and **Win10 Cam** software

*Broadcast Driver Architecture
*Video LAN Client
*TS = Packetized Elementary Streams + FEC/Sync
Logitech C920 USB WebCam

$60

amazon
Logitech HD Pro Webcam C920, 1080p Widescreen Video Calling and Recording

by Generic

5,246 customer reviews
1000+ answered questions

#1 Best Seller in Webcams

Was: $67.99
Price: $59.99 Prime
You Save: $8.00 (12%)

In Stock.
Want it Tuesday, May 31? Order within 1 hr 40 mins and choose Two-Day Shipping at checkout. Details
Ships from and sold by Amazon.com. Gift-wrap available.

Style: Webcam Only

Webcam + Logitech G633 Gaming Headset Bundle

Webcam Only

- Full HD 1080p video calling (up to 1920 x 1080 pixels) with the latest version of Skype for Windows
- 720p HD video calling (up to 1280 x 720 pixels) with supported clients. Full HD video recording (up to 1920 x 1080 pixels)
HiDes UT100B in USB port
UT-100B TX/RX PC Software
AirHD PC2TV TX software

Selects Desktop or Camera
Transport .TS Player for UT-100B

Sets Frequency, Bandwidth and Channel Coding parameters
“Scanning” for a Receive Frequency
RTSP with TS Player

```
<table>
<thead>
<tr>
<th>Send</th>
<th>Type</th>
<th>PID</th>
<th>Bitrate(bps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PAT</td>
<td>0x0000</td>
<td>12063</td>
</tr>
<tr>
<td>2</td>
<td>PMT Program</td>
<td>0x01E0</td>
<td>12063</td>
</tr>
<tr>
<td>3</td>
<td>Comp. Program</td>
<td>0x01E1</td>
<td>40645</td>
</tr>
<tr>
<td>4</td>
<td>Comp. Program</td>
<td>0x0810</td>
<td>1839925</td>
</tr>
<tr>
<td>5</td>
<td>Comp. Program</td>
<td>0x0814</td>
<td>174308</td>
</tr>
<tr>
<td>6</td>
<td>Null packet</td>
<td>0x1FFF</td>
<td>399854</td>
</tr>
</tbody>
</table>
```

- **Increase PTS/DTS**: 0 ms
- **PCR/PTS Adaptation**: Unchecked
- **Runtime TDT**: Time zone: UTC-06:00
- **RTSP out**: Checked
- **Port Number**: 8554
- **Stream Name**: wildlife1.ts
- **Network URL**: rtsp://192.168.2.124:8554/wildlife1.ts
- **RF Encryption**: Key: 0x00000000
VLC Media Player
TS Player streaming over network
The HiDes “T” Line
Separate Transmitter and Receiver
HIDes has over 60 products
Stand alone TX and RX

**HV-120 RX**
- $209

**HV-320E TX**
- $369

REMOTE OSD
Dual Diversity HV-122 Receiver

For improved Mobility (Doppler) Performance

Connect 1 or 2 Antennas

170-862MHz and 2400-2500MHz 1-8MHz BW Both CVBS and HDMI + S/Audio out  $269
Some RX/TX specs...

- Full 1080x1920p HD using H.264/MPEG-4AVC
- Additional A-D input for NTSC analog camera (480i)
- 1/2/2.5/3/4/5/6/7/8 MHz Spectrum Bandwidth
- 100~950 MHz and 1150~2650 MHz in 1KHz steps
- Channel coding effectively combats multipath/noise
- TX power output up to 5 mW 100mW on board amp
- AAC/MPEG-2 audio compression for hi-fi stereo
TX Configuration

- Signal strength determines not only the reach but smooth frame rate (FPS), resolution and latency.
- For weak signal work, try QPSK and <2 MHz BW 100% FEC and >1kbps bit rate (content with low resolution)
- With a good signal >-90dBm and SNR >12dB, then try QPSK16, 4Kbps and 4MHz for high frame rate, resolution and low latency (1920x1080p, >30FPS, 1 sec latency)
- Typically, 4MHz BW, 16QAM Constellation (modulation), 1/2 Code Rate (FEC), 1/16th Guard interval, 3200bps will give you “metro” reach and full motion 1080p with ~1 sec latency running 10 watts/10+ elements at 30 ft.
AV Sender/Tx Configuration

- **Video Input Port**: AUTO
- **Video Input Mode**: AUTO
- **Video Encoding Type**: H264
- **Video Encoding Resolution**: AUTO
- **Video Encoding Width**: 1920
- **Video Encoding Height**: 1080
- **Video Encoding Frame Rate (fps)**: 30
- **Video Frame Rate Drop**: AUTO
- **Video aspect ratio**: 16:9
- **Video Encoding GOP Length**: 60
- **Video Encoding B Frame Num**: 0
- **Line in Mode**: Stereo
- **Line in Gain (db)**: 0
- **Audio Encoding Type**: MPEG2
- **Audio Encoding Bit Rate (Kbps)**: 192
- **Audio Source**: Embedded Audio
- **Fast Playback**: Disable
- **System Info**
  - **Video Input Port**: AUTO
  - **Video Source Frame rate**: 60
  - **Video Source Width**: 1920
  - **Video Source Height**: 1080
  - **Audio Source Sample Rate**: 48
  - **Audio Source Width**: 1920
  - **Audio Source Height**: 1080
  - **Audio Source Compression**: Compression data
  - **Video Scan Mode**: Progressive
  - **Video Enc Width**: 1920
  - **Video Enc Height**: 1080
  - **Resolution**: 1920x1080P@60
Receiver Configuration on Screen Display
HV110/120 RX OSD Freq Scan

Installation

Country
ATV(US)-2/3/4M

OSD Language
English

Time Zone
GMT+08:00

Summer Time
Off

LCN
Off
..display settings for TV/Monitor

- Display Mode: 1080P60
- Aspect Ratio: Auto
- Video Output: RGB
- PAT Mismatched: Disable
- Signal OSD: OFF
- RF Key: 00000000
- Low Latency Mode: ON
- Decrypt Mode: OFF
- Decrypt Start Byte: 004
- Decrypt Key: 00000000-00000000-00000000-00000000
- Edit Key:

Select: 
Adjust: 
Save: 
Exit: 

SAMSUNG
...saves stations scanned
...records RX transmissions to .TS files
...OSD info sig, call, freq, BW
Received signal information
HDMI out Camcorder
to HV-320 Transmitter
$90 Video Card with HDMI out
Transmitter HDMI Switching
“Content is king” - keep ATV interesting!

8 Position
eBay ~$50

HD-SigGen
ColorBars

5 Position Auto Sensing eBay
~$40
HDMI Audio Inserter/Extractor

From MCM Electronics $39
Media Player with HDMI/1080p

Model MP62

Clabs

eBay $70
HD TVI 1080p cam’s video to HDMI out converter

Allow use of low cost $39 Security Cameras for High Def ATV
HiDes DC-105 Camera with 70-1450 MHz DVB-T TXs

$225
Used in high altitude Balloon flights.

$279
OE7DBH Class A Amplifiers for HiDes

50-55dB gain

Euro 180.-
DVB-T OFDM Multi-Carrier Signal

Orthogonal Frequency Division Multiplex
RA60H4047M1
RoHS Compliance, 400-470MHz 60W 12.5V, 2 Stage Amp. For MOBILE RADIO

DESCRIPTION

The RA60H4047M1 is a 60-watt RF MOSFET Amplifier Module for 12.5-volt mobile radios that operate in the 400- to 470-MHz range.

The battery can be connected directly to the drain of the enhancement-mode MOSFET transistors. Without the gate voltage ($V_{GG}=0V$), only a small leakage current flows into the drain and the nominal output signal ($P_{out}=60W$) attenuates up to 60 dB. The output power and the drain current increase as the gate voltage increases. The output power and the drain current increase substantially with the gate voltage around 0V (minimum). The nominal output power becomes available at the state that $V_{GG}$ is 4V (typical) and 5V (maximum). At $V_{GG}=5V$, the typical gate currents are 5mA. This module is designed for non-linear FM modulation, but may also be used for linear modulation by setting the drain quiescent current with the gate voltage and controlling the output power with the input power.

FEATURES

- Enhancement-Mode MOSFET Transistors
  ($I_{DD}=0$ @ $V_{DD}=12.5V, V_{GG}=0V$)
- $P_{out}>60W, \eta>40\%$ @ $V_{DD}=12.5V, V_{GG}=5V, P_{in}=50mW$
- Broadband Frequency Range: 400-470MHz

BLOCK DIAGRAM

1. RF Input ($P_{in}$)
2. Gate Voltage ($V_{GG}$), Power Control
3. Drain Voltage ($V_{DD}$), Battery
4. RF Output ($P_{out}$)
5. RF Ground (Case)
Simple interface to HiDes

Notes:
1 - Scrubber protection diodes across relay coils not shown.

Digital ATV Station

DVB-T Interface
TV-40
Schematic
K0PFX 23Mar15 REV 1
HiDes DVB-T Interface that you can build
Cheaper by the...
Rear view
Front/Rear Panel

Front Panel

Rear Panel

Notes:
1. Not to scale
2. Bud box CU-3009A
3. Paint: Rust-Oleum Self-Etching Primer followed with Krylon ColorMaster Black Satin

DVB-T Interface

TV-41 Front-Rear Panel Assembly
KOPFX 23Mar15 Rev 1
Chassis assembly Bud Box

Notes:
1. Not to scale
2. Bud box CU-3009A
3. Hardware is 4-40 screws, lock washers and nuts for "L" relay mtg brackets.
4. Feet and DC Relay mounted with 6-32 screws, lockwashers and nuts.
5. Refer to TV-16 "L" bracket dwg for mounting RF relays.
6. Use metric M-3 hardware supplied with DC-DC converter.
7. Mount NTE599 RP Rect with 1/4" nylon 4-40 spacer and 4-40 screws. Flat and lock Rectifier must be isolated from the chassis.
8. Fasten 9v (#76 case) battery holder with (2) #2.56 screw/washer/nut.

DVB-T Interface

<table>
<thead>
<tr>
<th>TV-43</th>
<th>Chassis Floor Assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td>KOPFX</td>
<td>23Mar15 Rev 1</td>
</tr>
</tbody>
</table>
### DVB-T (simple) ATV Interface BOM

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>MFR</th>
<th>Part Number</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Cable #1, SMA Male to Female Panel Mount</td>
<td>Various</td>
<td>6” Pigtail RG-316</td>
<td>eBay/Amazon</td>
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<tr>
<td>2</td>
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<td>4</td>
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<td>5</td>
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<tr>
<td>7</td>
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<td>Cable, PS DC Power, Red/Black</td>
<td>Various</td>
<td>6” Pigtail RG-316</td>
<td>eBay/Amazon</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>Cable, SMA Male to Male (for ground)</td>
<td>Various</td>
<td>6” Pigtail RG-316</td>
<td>eBay/Amazon</td>
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<tr>
<td>9</td>
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<td>---</td>
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<td>---</td>
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<tr>
<td>10</td>
<td>1</td>
<td>Conn, Banana Binding post Red/Black</td>
<td>Various</td>
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<td>Conn, plastic housing, 2 pc</td>
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<td>13</td>
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<td>Conn, Contact, crimp, male</td>
<td>Various</td>
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<td>eBay/Amazon</td>
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<td>14</td>
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<td>Various</td>
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<td>Display, 0-10A, Digital, LED</td>
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<td>eBay/Amazon</td>
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<td>18</td>
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<td>Enclosure, Bud Box, 6D x 8</td>
<td>Various</td>
<td>6” Pigtail RG-316</td>
<td>eBay/Amazon</td>
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**Hardware**

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<tr>
<th>ITEM</th>
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<th>DESCRIPTION</th>
<th>MFR</th>
<th>Part Number</th>
<th>SOURCE</th>
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</thead>
<tbody>
<tr>
<td>64</td>
<td>1</td>
<td>Spacer, nylon, 4-40 threaded 5/16” standoff (fasten Rev Polarity Rectifier to bottom base)</td>
<td>Keystone</td>
<td>534-1947</td>
<td>Mouser</td>
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<tr>
<td>65</td>
<td>4</td>
<td>Screw, Metric, machine pan head slotted (fasten 10W Amp to heat sink) (see Note 2)</td>
<td>Hillman</td>
<td>M3-.50 x 20</td>
<td>Various</td>
</tr>
<tr>
<td>66</td>
<td>4</td>
<td>Screw, Metric, machine pan head slotted (fasten DC-DC Converter Buck Boost Volt PCB)</td>
<td>Hillman</td>
<td>M3-.25 x 20</td>
<td>Various</td>
</tr>
<tr>
<td>67</td>
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<td>Screw, machine, binding, slotted w/washer/nut (fasten 30A DC relay to base)</td>
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<td>8-32 x 1/2</td>
<td>Various</td>
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<td>68</td>
<td>2</td>
<td>Screw, machine, binding, slotted w/washer/nut (fasten Relay #1 and #2 to chassis floor)</td>
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<td>4-40 x 5/16”</td>
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<td>69</td>
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<td>Screw, machine, binding, slotted w/washer/nut (fasten 9volt bat holder to chassis floor)</td>
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<td>Screw, machine, binding, slotted w/washer/nut (fasten Relay #1 and #2 to “L” bracket mount)</td>
<td>Various</td>
<td>4-40 x ¾”</td>
<td>Various</td>
</tr>
<tr>
<td>71</td>
<td>1</td>
<td>Grommet, black rubber, ¾” chassis hole Dia, 1/8” hole ID</td>
<td>Buna-N</td>
<td>3MRG2</td>
<td>Grainger</td>
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<td>72</td>
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<td>Screw, machine, binding, slotted, internal tooth (3) flat washers, and (2) nuts (Ground term)</td>
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<td>8-32 x ¾”</td>
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<td>73</td>
<td>4</td>
<td>Screw, machine, binding, slotted w/washer/nut (fasten rubber feet to chassis base floor)</td>
<td>Various</td>
<td>6-32 x ¾”</td>
<td>Various</td>
</tr>
</tbody>
</table>
Measure and mark the Bud box
Drill/cut holes out in the Bud box
Use OE7DBH’s heatsink or your own for the amplifier
Mount amplifier on Bud Box top
Lay out the parts...
DC-DC Converter for 28v Relays

3.5V-28V input, any value output 1.25V-26V

$5

$2
Cable Assemblies MCX, N, SMA

$3-6/ea
RF Relay... Transco, RLC, Teledyne

Notes:
1- Material 1/16th thick aluminum.
2- All holes .125"
3- Fasten RF Relay #1 (and #3 if same type used) with (2) 4-40 x 3/4 inch screws, flat and lock washers.
4- Fasten L bracket to chassis bottom with (2) 4-40 x 5/16th inch screws, flat and lock washers.
Dwg not to scale.

$30-35
Mount parts in the Bud box
Wire it up...
Stand-alone RX and TX with HDMI Output/Input
HiDes DVB-T Interface
Measuring OFDM Multi-Carrier Power

DAIWA – 10W Average Power

BIRD 43 – 10w 25w Element

BIRD AMP16 – 5w Average Power
Yagi Antennas

Old Antenna Labs
5L-70cm w/5 or 10 elements

Directive Systems  DSEFO432-25ATV
423-440Mhz Yagi Ant for DATV
70cm LNA w/Bypass relay

DC Powered w/HiDes
HV-120 built-in Bias-T

$119
70cm Pre-Amp from DEMI

Use in the ham shack RX line
(no bypass relay) $55 kit
Downeast Microwave Inc
DVB-T Digital ATV Station

HD-TV 1080p
HD-Receiver

HiDes* HV-120
SMA

HiDes* Transmitter HV-320
SMA

PC or Laptop w/internal camera
USB

Logitech 920

OE7DBH’s* RF Amp 10W Class A
SMA

PS 15 Amp 13.6v vdc

Yagi 70CM

Daiwa WattMeter CN-100

PreAmp (optional)

Amp DC Relay

Antenna RX/TX Rly

UHF Bias-T

(Bud box enclosure)

DC Power to PreAmp (optional)

* Compatible with all HiDes Transmitters, Cameras and Receivers

DVB-T Interface

<table>
<thead>
<tr>
<th>TV-42</th>
<th>System Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>KOPFX</td>
<td>23Apr15</td>
</tr>
</tbody>
</table>
Options for Separate TX and RX to control Pre-amp, RX and TX delay
Interface rear panel for separate TX and RX
DVB-T Interface options for Separate TX and RX

Digital ATV Station with Pre-amp ctrl, RX pwr ctrl and TX off delay ctrl

1 - SW1 4PDT Toggle Switch (ON:CTR OFF:ON)
Spare contacts 10, 11, 12.
2 - Nominal 12.6 to 13.6v
Do not exceed 13.6v!

Notes:

- DC Relay #3
- DARKO's 10W Amp Class A
- USB3 Hub 5V@1A
- 1/8th Jk Isolated PS DC-
- (light) to sw'd dc jack

1000hm 1-2W

16Sep16 DCC 2016 St Petersburg
Notes:
USB Powered Cam1, RX and TX controlled using a USB3 HUB w/3amp 5V PS. DC103 is controlled using HUB switch 2 via +12vdc interface.
Second Receiver (HV110) and External-Transmitter (EXT-TX) options are included in this configuration (TV-26 to 31 dwg).

1 = DC-101 CAM
2 = DC-103 CAM via 12v Intf
3 = HV-310E Transmitter
4 = HV-110 Receiver
KH6HTV Digital class A 70cm Amp

kh6htv.com
DVB-T On-the-Air
“Always a good picture...”
KØPFX Digital-ATV Station
D-ATV on Flight BLT-45 Wharton Texas August 20, 2016

Take off!

24 minutes in flight...
Digital ATV repeater?
Yes and it is easy to build one...

From Jim, KH6HTV
App note An-23
Block diagram of a DVB-T Repeater

1 - "TT Pwr" under remote control using touchtones via 2m/144.34 FM
In-Band 70cm Repeater components..

Transmitter with HDMI, Ethernet and USB

423MHz and 441Mhz Band Pass Filters
WJ9J DTMF controller

Chinese import relay board

DTMF decoder with 8 outputs for relay control
HiDes HV-110/120 RX for Repeater

Mod From KH6HDV

VALID Signal PTT Mod
Low cost Relay control modules

1-8 relays, 10Amp rating

With timing control options

With Temp Sensor for amp
Repeater antennas for TX and RX

G6 Series 6 dB  

Spirit Series 6-9dB
10 dollar DVB-T Receive only dongle

[Image: A photo of a DVB-T dongle with a remote control and a CD.]

[Link: ebay]
On the web...

HiDes, Inc. Web Site:  
www.hides.com.tw/index_eng.html

OE7DBH Class A RF Amps:  
http://dl1mfk.de/Sonstiges/Darko/

Jim Andrews DATV App notes:  
http://kh6atv.com

KØPFX, my web site:  
www.melwhitten.com/
Operating and Tech Info...

- digitalATV Yahoo Group  [www.groups.yahoo.com](http://www.groups.yahoo.com)
- ATV Television Quarterly  [http://ATVQuarterly.com](http://ATVQuarterly.com)
- British Amateur Television Club  [www.batc.org.uk](http://www.batc.org.uk)
- Digital Amateur TV Primer  [www.g7lt.com/datv.html](http://www.g7lt.com/datv.html)
- Digital Video Broadcasting Organization  [www.dvb.org](http://www.dvb.org)
- Digital Television Herve Benoit, 3rd Edition (Amazon)
Thanks
and
C U on D-ATV!