DVB-S2 Modem
SK-IP / SK-DV / SK-TS

WORK Microwave’s high-speed DVB-S2 IP modem SK-IP provides operators with a platform for transferring IP/Ethernet data over DVB-S2 satellite connections. Ethernet frames and IP packets are encapsulated directly within DVB-S2 baseband frames, resulting in low encapsulation overhead.

In order to achieve speeds up to 356 Mbit/s, only the fastest and most bandwidth efficient encapsulation and modulation parameters are supported. For maximum bandwidth efficiency and ease of operation the device uses Generic Stream Encapsulation according to TS 102 606 and Multiprotocol Encapsulation according to EN 301 192.

The modem SK-TS is used for transmitting and receiving signals as MPEG transport streams. DVB-S as well as DVB-S2 modulation types are supported.

DaVid technology
Utilizing DaVid technology, WORK Microwave’s DVB-S2 Modem SK-DV system offers simultaneous transportation of IP data (i.e., network connection) and live broadcasting (i.e., video content) over a single satellite carrier. The DaVid technology works by aggregating multiple transport streams and IP data into a DVB-S2 multiplex while providing end-user control of all transmission types.

OptiACM
An integrated OptiACM controller provides adaptive or variable FEC- and modulation setting for point-to-point or point-to-multipoint IP applications.

VideoACM
An integrated VideoACM controller provides adaptive or variable FEC- and modulation setting for point-to-point or point-to-multipoint Transport Stream transmissions.

Predistortion
Broadcast Predistortion and Extended Predistortion - operating in the background during regular transmission - mitigates the negative effects in the filters and amplifiers of satellites by automatically compensating for linear and non linear distortions. Subsequently the satellite link can be operated with less back off/higher power and a higher signal-to-noise ratio increases beam coverage ensuring higher throughput and availability for the satellite operator.

Flexible RF connectivity
The modulator provides the modulated signal from 50 to 180 MHz IF or at L-band. With the L-band output, a 10 MHz reference signal for a block upconverter can be enabled on the TX port, as well as DC power 24 V or 48 V (Option DC24 or DC48).

The demodulator accepts an L-band signal in the range from 950 to 2150 MHz on two inputs or alternatively an IF signal in the range from 50 to 180 MHz on a single input. On L-band devices, LNBs can be powered directly over the inputs.

High signal integrity
Low spurious emissions make the modem perfect for use in environments with demanding requirements, like high-power uplinks. Sophisticated temperature compensation guarantees output stability over a very wide temperature range.

Operating and control - easy integration into your system
The modem can be operated via push buttons on the front panel using intuitive display menus or via remote control (RS232, RS422/485 and TCP/IP over Ethernet). For the remote control addressable packet-based commands, a Web interface (HTTP browser) or SNMP can be used. Detailed monitoring of system parameters is possible.

Key features
- DVB-S2 - ETSI EN 302 307-1
- DVB-DSNG - ETSI EN 301 210
- DVB-S - ETSI EN 300 421
• DVB-S2 modulations:
  QPSK / 8PSK / 16APSK / 32APSK
  normal, short
• DVB-S and DVB-DSNG:
  QPSK / 8PSK / 16QAM modulation
  (SK-TS)
• DVB Carrier ID - ETSI TS 103 129
• Broadcast Predistortion including automatic group delay and dynamic constellation predistortion for QPSK and 8PSK (option XB)
• Extended Predistortion including automatic group delay and static constellation predistortion up to 32APSK (option XE)
• Normal and short FEC frames, pilots on or off (DVB-S2)
• Physical layer framing with scrambling codes 0 to 262141 according to DVB-S2 standard
• Symbol rates from 60 ksps to 80 Msps
• Roll-Off: 35 %, 25 %, 20 %, 15 %, 10 %, 5 %
• Adjustable digital gain slope equalizer
• Low spurious output
• An output signal multiplexer integrated within the L-band version allows to combine the modulated signal, the 10 MHz reference signal and DC power (option DC24 or DC48) to drive an external power block upconverter
• Automatic integrated uplink power control (option)
• DiSEqC 1.1 support on LNB L-band input
• OptiACM system for optimized bandwidth usage and extended weather insensitivity for IP transmission
• Gigabit Ethernet data interface
• IP and baseband traffic shaping
• Generic Stream Encapsulation (GSE) direct to DVB-S2 baseband frames
• Multiprotocol Encapsulation (MPE)
• Operates as Layer 2 Bridge, Layer 3 Bridge or Layer 3 Router

• 2 ASI Input and 2 ASI Output Interfaces
  (SK-DV, SK-TS)
• Transport Stream Input for DVB-S2 Multiple Input Stream operation, capacity calculator, optional capacity limitation per TS input (SK-DV only)
• Transport Stream over IP Inputs (option TI1,TI2)
  (SK-DV, SK-TS only)
• Support of 2 Multiple Transport Stream Inputs and Outputs (SK-DV, SK-TS)
• VideoACM system for optimized bandwidth usage and extended weather insensitivity for Transport Stream video transmission
• BISS-E encryption of transport streams on transmit side (option BI), supports multi program transport stream
• Transmit mute input
• Tx Monitor Output on Frontpanel
• Remote control through RS232, RS422/485 (2-wire or 4-wire) interfaces, TCP/IP over Ethernet, Web browser interface, SNMP with MIBs downloadable form the device
• 10 MHz Reference OCXO included
• Summary alarm output with dual change over switch contacts
• Operating temperature range 0 °C to 50 °C (32 °F to 122 °F)
• CE compliant
• 3 years warranty
### DVB-S2 Modem
**SK-IP / SK-DV / SK-TS**

#### Modulator Part of Modem Type:

<table>
<thead>
<tr>
<th>SK-IP / SK-DV / SK-TS</th>
<th>SK-IP / SK-DV / SK-TS</th>
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</thead>
<tbody>
<tr>
<td><strong>Signal Outputs:</strong></td>
<td></td>
</tr>
<tr>
<td>SK-xx-Lx-xx:</td>
<td>1 x L-band output</td>
</tr>
<tr>
<td>SK-xx-Vx/Lx-xx:</td>
<td>1 x VHF-band output</td>
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<tr>
<td></td>
<td>(950 ... 2150 MHz)</td>
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<tr>
<td></td>
<td>1 x L-band output</td>
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<td></td>
<td>(50 ... 180 MHz)</td>
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<tr>
<td>L-band Output</td>
<td></td>
</tr>
<tr>
<td>950 ... 2150 MHz</td>
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<tr>
<td><strong>IF-Output Frequency:</strong></td>
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<tr>
<td>L-band Output</td>
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<tr>
<td>50 ... 180 MHz</td>
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<tr>
<td><strong>Frequency Resolution:</strong></td>
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<tr>
<td>L-band Output</td>
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<tr>
<td>1 Hz</td>
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<tr>
<td><strong>Phase Noise:</strong></td>
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<td>10 Hz</td>
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<td>-90</td>
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<tr>
<td>1 MHz</td>
<td>-100</td>
</tr>
<tr>
<td>max. values in dBc/Hz</td>
<td>-115</td>
</tr>
</tbody>
</table>

#### Signal Outputs:

- **SK-xx-Lx-xx**: 1 x L-band output (950 ... 2150 MHz), can be alternatively enabled
- **SK-xx-Vx/Lx-xx**: 1 x VHF-band output (50 ... 180 MHz), 1 x L-band output (950 ... 2150 MHz)

#### IF-Output Characteristics:

- **Impedance**: 50 Ω or 75 Ω
- **Output Power**: -25 dBm ... 5 dBm, 0.1 dB steps, ±0.5 dBm accuracy
- **Output Power muted**: < -85 dBm
- **Connector**: BNC female

#### Monitoring Output (on front panel):

- **Output Power**: -20 dB of IF Output
- **Impedance**: 50 Ω
- **Return Loss**: > 20 dB
- **Connector**: SMA female

#### Spurious Outputs:

- **Signal related**: < -70 dBc, unmodulated carrier, 50 ... 90 MHz or 100 ... 180 MHz
- **< -45 dBc, unmodulated carrier, out of band**:

#### Frequency and Clock Stability

- **Symbol Rate**: ±2 x 10⁻⁸ (at 30 °C ... 60 °C, after warm up), aging: ±1 x 10⁻⁶ per day, ±1 x 10⁻⁶ per year

#### Modulation / Coding

**DVB-S2**:

- **Outer BCH Code**: FEC-Frames
- **Inner LDPC Code**: QPSK, 8PSK, 16APSK, 32APSK
- **Physical Layer Framing**: yes
- **Physical Layer Signaling**: yes
- **Pilots Insertion**: on / off
- **Physical Layer Scrambling**: N = 0 ... 262141

**DVB-S / DVB-DSNG**:

- **Outer Reed Solomon Coding**: 188/204, T=8
- **Convolutional Interleaving**: Depth l = 12
- **Inner Coding depending on**: BPSK or QPSK 1/2, 2/3, 3/4, 5/6, 6/7, 7/8 (Convolutional K=7)
- **Firmware Option**: (according ETSI EN 300421, 301210)
- **Transport Stream Adaption**: 16QAM 3/4, 7/8 (Pragmatic Trellis)

**SK-TS only**

#### Carrier ID:

**DVB-CID according to ETSI TS 103 129**

**Signal Spectrum Mask**:

- **α**: 0.35, 0.25, 0.20 (according ETSI EN 302307)
- **β**: 0.15, 0.10, 0.05 (with Firmware Option ...S, other values on request)

#### Transport Stream Adaption

**DVB-S2**:

- **CRC-8 Encoder**: yes
- **Merger/Slicer**: yes
- **Baseband Header Insertion**: yes
- **Stream Adaption**: yes
- **Baseband Scrambling**: yes

**DVB-S / DVB-DSNG**:

- **Transport Stream Adaption**: yes
- **Randomization**: yes

Specifications continued next page
Transport Stream Inputs:  
- 2x ASI (BNC female 75 Ω) (SK-DV only)
- Supporting 1 Multiple Transport Stream Input (auto switching dual input)
- With option MT2:  
- 2x ASI (BNC female 75 Ω) (SK-DV only)
- Supporting 2 Multiple Transport Stream Inputs or 1 Multiple Transport Stream (auto switching dual input)
- Additionally with option T1I or T2I up to two individual Transport Stream over IP Inputs (Connector RJ-45, 100/1000 Mbps, auto sensing), IPv4, UDP and RTP support, FEC according SMPTE 2022 1/2, Jitter tolerance 1… 500 ms, Conversion TS over IP to TS. (SK-DV, SK-TS only)

Multiple Transport Stream Input Operation:  
- Individual modulation and FEC (MODECOD) configuration per TS input, capacity calculator, capacity limitation per TS input can be activated. Input stream synchronization and Null-Packet deletion according to ETSI EN 302307, Annex D.2, D.3. (SK-DV, SK-TS only)

Transport Stream Frames Size:  
- 188 or 204 bytes (SK-DV, SK-TS only)

Packet Stuffing:  
- TS Null packet or TS All Zero packet insertion (SK-TS only)
- or Dummy PLFRAME insertion (SK-IP, SK-DV only),
- when the data rate to transmit is higher than the data rate at the input.
- Null packet deletion can be enabled to remove incoming null packets (SK-TS only).
- PCR (program clock reference) correction (with Null packet insertion/deletion) for max 250 PID streams with PCRs included (SK-TS only, not supported in case of DVB-S2 multiple input stream operation). (SK-DV, SK-TS only)

Still Picture Playout:  
- As standard a color bar pattern is transmitted for main profile at main level (MPML) MPEG-2 encoding, 4:3 aspect ratio, 25 Hz frame rate, interlaced (suitable for PAL or SECAM). As option an alternative, customized still picture can be loaded (different content, different aspect ratio, different frame rate). (SK-DV, SK-TS only)

Demodulator Part of Modem Type:  

| Signal Inputs: | SK-xx-xx-L75: 2x L-band input (950 ... 2150 MHz), can be alternatively enabled  
| SK-xx-xx-Vx/L75: 1x VHF-band input (50 ... 180 MHz)  
| 1x L-band input (950 ... 2150 MHz), can be alternatively enabled |
| IF-Input Frequency: | SK-IP / SK-DV / SK-TS |
| SK-xx-xx-L75: 50 ... 180 MHz  
| SK-xx-xx-Vx/L75: 50 ... 180 MHz  
| 1x L-band input (950 ... 2150 MHz), can be alternatively enabled |
| IF-Input Characteristics: | SK-IP / SK-DV / SK-TS |
| Impedance: 50 Ω or 75 Ω  
| Return Loss: >18 dB  
| Input Power: -60 dBm ... -15 dBm (total aggregate power)  
| IF-Connector: BNC female |
| Impedance: 75 Ω  
| Return Loss: >13 dB  
| Input Power: -70 dBm ... -20 dBm (total aggregate power)  
| IF-Connector: 2x F female, input selectable  
| LNB DC-Feed: 13.5V or 18 VA (450mA) switchable, 22 kHz tone on/off, DISEqC 1.1 short circuit protected |
| Symbol Rate: Max. Range: 60 kbps ... 76 Mpbs (QPSK, BPSK, 16APSK)  
| 60 kbps ... 62 Mps (32APSK)  
| Step size: 1 sps |
| Demodulation / Decoding DVB-S2: | SK-IP / SK-DV / SK-TS |
| Outer BCH Code: FEC-Frames  
| nldpc = 46400 (normal FEC Frame)  
| Inner LDPC Code: QPSK  
| 1/4, 1/3, 2/3, 1/2, 3/2, 3/4, 4/5, 5/6, 8/9, 9/10  
| 16APSK  
| 3/4, 3/5, 4/5, 5/6, 6/7, 7/8 (Convolutional K=7)  
| Demodulator auto detection: Modulation- and FEC-type, pilots on/off are automatically detected  
| Decoding DVB-S2:  
| Physical Layer Scrambling:  
| Convolutional Interleaving: Depth h-12  
| Inner Code: QPSK 1/2, 2/3, 3/4, 5/6, 6/7, 7/8 (Convolutional K=7)  
| automatically selected  
| all according ETSI EN 302307 |
| Demodulation / Decoding DVB-S: | SK-IP / SK-DV / SK-TS |
| Outer Reed Solomon Code:  
| Convolutional Interleaving: Depth h-12  
| Inner Code: QPSK 1/2, 2/3, 3/4, 5/6, 6/7, 7/8 (Convolutional K=7)  
| automatically selected  
| all according ETSI EN 300421 |
| Signal Spectrum Mask: x = 0.35, 0.25, 0.20 according ETSI EN 302307  
| y = 0.15, 0.10, 0.05 (compatible) |
| Transport Stream Output:  
| 2x ASI (BNC female 75 Ω)  
| Supporting Single Transport Stream Operation or 1 Multiple Transport Stream Operation (Dual Output)  
| Processing of 2 Multiple Transport Streams (can be assigned arbitrarily to Output) (Option MT2)  
| Support of Null Packet Reinsertion according to ETSI EN 302307 Annex G.3 (SK-DV, SK-TS only)  
| Transport Stream Frame Size: 188 bytes (SK-DV, SK-TS only) |

Specifications continued next page
DVB-S2 Modem
SK-IP / SK-DV / SK-TS

Common Parameters: SK-IP / SK-DV / SK-TS

Baseband Channels: 16 baseband channel with separate DVB-S2 baseband settings (MODCOD, FEC frame length, pilots, encapsulation type, multistream ID, timeout) (SK-IP, SK-DV only)

OptiACM: CCM / VCM / ACM functionality for point-to-point and point-to-multipoint links 16 ACM channels with separate MODCOD range and Es/N0 sensitivity ACM channels arbitrary assignable to baseband channels (SK-IP, SK-DV only)

BB Traffic Shaper: Baseband channel limits based on symbol rate for virtual share of the carrier Guaranteed and limited bandwidth individually configurable (SK-IP, SK-DV only)

Data Interface: Ethernet (1xRJ-45, 10/100/1000 Mbps auto sensing) (SK-IP, SK-DV only)

IP Data Rate: up to 356 Mbps or 8000pps (SK-IP, SK-DV only)

Network Operation: Layer 2: Bridge (Ethernet frame transmission) STP/RSTP Layer 3: Bridge/Router (IP packet transmission), IPv4, IPv6 256 IP/subnet routes per port 16 DVB-S2 baseband channels (SK-IP, SK-DV only)

Data Encapsulation: Generic Stream Encapsulation (GSE) according ETSI TS 102006 Multiprotocol Encapsulation (MPE) according to ETSI EN 301192 (SK-IP, SK-DV only)

IP Traffic Shaper: 64 independent rules Guaranteed and limited bandwidths Fixed or dynamically integrated into ACM (bind to MODCOD) Match criteria: source/destination IP subnet, source MAC, UDP/TCP port ranges, TOS/DS field, packet size (Active IP Traffic shaper reduces max. packet rate to typ. 50000pps) (SK-IP, SK-DV only)

Transport Stream Security (Option BI): BISS-E Scrambler on transmit side, compliant to EBU Tech 3392 rev. 2 For use with unit supporting 1 Multiple Transport Stream input. Supports Single or Multi Program Streams in BISS Mode 0, 1 and E BISS Mode 0: no scrambling, MPEG transport stream is transferred untouched BISS Mode 1: MPEG transport stream is scrambled using 12-hexadecimal-character Clear Session Word BISS Mode E: MPEG transport stream is scrambled using a session word which is derived from a 16-hexadecimal-character Encrypted Session Word and 14-hexadecimal-character Injected Identifier Max. input rate for Clear Session Word and Encrypted Session Word: - 10 times per 5 minutes - 1 time per 10 seconds

Important note: Option BI operates exclusively with single stream operation.

Broadcast Predistortion (Option XB): Hardware and signal processing can be enabled through customer field selectable firmware options. An external windows PC is required to run the application program, which optimizes the predistortion parameters in the background of live transmissions (if activated), by reading information from a reference demodulator. For all communication between the reference demodulator, the application program and the modulator IP connectivity is used.


Alarm Interface: Alarm: two potential free contacts (DPDT); Mute Input: TTL logic input with internal pull up Connector DSUB9

Internal Fan: FAN included

Temperature Range: 0°C ... 50°C operating -30°C ... 80°C storage

Relative Humidity: < 95% non condensing

Mains Power Input: 100 … 240 V AC nominal, 90 … 264 V AC max, 50 … 60 Hz

Mains Power Consumption: Typ.: 65 VA / 45 W, Max 190 W (with option DC24, DC power on) Max 300 W (with option DC48, DC power on)

Mains Power Input Connector: IEC C14

Mains Fuse: 2 x 3,15 A time-lag fuse (standard) 2 x 5 A time-lag fuse (with option DC24 or DC48)

Dimension and Weight: 483 x 447 x 224 mm³ (WxHxD); 1 RU (19”) approx. 8 kg (standard) approx. 10 kg (with option DC24 or DC48)

Specifications are subject to change

2015-09-07
DVB-S2 Modem
SK-IP / SK-DV / SK-TS

Order Information:
SK-[Device Type]-[Output Band Output Imp]-[Input Band Input Imp]-[Options]-[Modulator Firmware Option]

Device Types:
- **IP**  DVB-S2 IP Modem
- **DV**  DaVid Technology Modem (combination of TS and IP into one carrier)
- **TS**  DVB-S/S2 Transport Stream Modem

Possible Options are:
- **BBO**  Baseband frame input and output
- **DC24**  24 V DC power on L-band output
- **DC48**  48 V DC power on L-band output
- **TI1**  one TS over IP input interface
- **TI2**  two TS over IP input interfaces
- **BI**  BISS scrambling and descrambling for Transport Stream
- **MT2**  Support of 2 Multiple Transport Stream inputs and outputs
- **XB**  Broadcast Predistortion
- **XE**  Extended Predistortion

<table>
<thead>
<tr>
<th>Modulator Firmware Option</th>
<th>Max Symbol Rate, Supported Modulation Types and other Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2L</td>
<td>15 Msps, QPSK / 8PSK</td>
</tr>
<tr>
<td>P2N</td>
<td>30 Msps, QPSK / 8PSK</td>
</tr>
<tr>
<td>P2M</td>
<td>45 Msps, QPSK / 8PSK</td>
</tr>
<tr>
<td>P2H</td>
<td>60 Msps, QPSK / 8PSK</td>
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<tr>
<td>P2E</td>
<td>80 Msps, QPSK / 8PSK</td>
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<td>A2L</td>
<td>15 Msps, QPSK / 8PSK / 16APSK / 32APSK</td>
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<td>A2N</td>
<td>30 Msps, QPSK / 8PSK / 16APSK / 32APSK</td>
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<td>60 Msps, QPSK / 8PSK / 16APSK / 32APSK</td>
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<td>A2E</td>
<td>80 Msps, QPSK / 8PSK / 16APSK / 32APSK</td>
</tr>
<tr>
<td>...S</td>
<td>Support of Roll-Off-Filters down to 5%</td>
</tr>
</tbody>
</table>

Examples:
- **SK-IP-L50-L75-DC24-A2H**  IP Modem with L-band Output 50 Ω and L-band Input 75 Ω, DC24 Volt
- **SK-IP-L50-L75-DC24-A2HS** IP Modem with L-band Output 50 Ω and L-band Input 75 Ω, DC24 Volt, Roll-Off-Filters down to 5 %
- **SK-IP-V50/L50-V75/L75-P2N**  IP Modem with VHF-band and L-band Output, VHF-band and L-band Input
- **SK-DV-V75/L50-V75/L75-A2L**  DaVid Technology Modem with VHF-band and L-band Output and Input

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