MPEG Test System

MTS300

The Tektronix MTS300 MPEG Test System is a high-performance MPEG protocol diagnostic and analysis tool giving you innovative solutions to meet the challenges of designing, verifying and characterizing products and systems using MPEG-2 technology. The MTS300 offers powerful acquisition and computational capabilities for analyzing designs based on MPEG, DVB, ATSC and ISDB standards. These flexible and expandable capabilities include real-time monitoring, data rate analysis and Tektronix-exclusive timing analysis to help diagnose the most challenging problems and characterize real-time performance. In-depth, deferred-time (off-line) analysis helps fully verify compliance to standards and diagnose problems in complex transport streams. Easy-to-use transport stream capture, playout and on-line storage let you build extensive suites of test streams and use these streams to exercise your designs. Additional stream editing capability, with error and jitter injection and real-time multiplexing, gives you the ability to create and playout test sequences that fully stress and characterize design parameters.

Features & Benefits

Real-time Monitoring and Compliance Testing of MPEG, DVB, ATSC and ISDB Transport Streams for Complete Application Flexibility

Status and Error Logging for Capturing Intermittent Problems or Creating Test Records

Dolby Digital AC-3 Compliance Testing and AAC Stream Monitoring for Testing Advanced Audio Capabilities

Tektronix-exclusive PCR Overall Jitter, Drift and Offset Measurements Allow You To Diagnose the Most Challenging Real-time Performance Problems

Detailed Off-line Analysis of Transport Streams, Program Streams and Elementary Streams Available to Fully Verify Design Performance

ASI/M2S, SPI (LVDS), SMPTE310M and DHEI Interfaces Available To Support a Variety of Design Configurations

Optional Real-time Multiplexing of Elementary and Transport Streams Provides Flexible Real-time Manipulation of Stream Content and Parameters

Capture, Playback and On-line Storage of Transport, Program and Elementary Streams

Optional Editing Capability Allows You to Create Custom Transport Streams and Inject Errors or Jitter to Fully Stress Your Design

Applications

Evaluation and Verification of MPEG, DVB, ATSC and ISDB Designs

Design and Verification of Digital Video Set-top Boxes (STBs)

Stress and Characterization of Circuits and ICs Developed for Products Using MPEG-2 Compressed Digital Video Technology

Real-time Monitoring

The MTS300 uses intuitive icons and colors to indicate the current status of MTS300 I/O ports and any MPEG transport stream under analysis. A simple, easy-to-use display indicates:

- The current usage and status of the MTS300 I/O ports. You can install up to four I/O ports on an MTS300
- The current status of monitored transport streams and the programs within monitored transport streams. Highly visible indicators let you quickly identify the transport stream or program with problems
- The type of problem detected in a monitored transport stream. Intuitive icons show problems in transport stream protocol, timing errors, or problems in the video or audio elementary streams

Using this display, you can easily configure and control the product in real-time testing applications, to quickly identify and diagnose problems with designs or to characterize design or system performance.

Real-time Analysis

In addition to being an MPEG-2 protocol monitor, the MTS300 gives you powerful real-time analysis capability to help diagnose difficult real-time performance problems. The MTS300 real-time analysis capabilities include:

- The evaluations recommended by DVB standard TR 101 290 to verify decodability, quality and reliability
- Tektronix-exclusive timing analysis, including PCR overall jitter and wander measurements
- Flexible, intuitive displays of data rates and program allocations
- Analysis of Mega-frame Initialization packets used in DVB-T Single Frequency Network applications
- Real-time analysis of transport streams used in data broadcasting applications based on ISO/IEC 13818-6 (DSM-CC) and EN 301 192 standards
- Fully selectable monitoring depth, fault criteria, and error reporting and alarms
- Triggered capture of transport streams for later in-depth analysis
- Status and error logging

Deferred-time Analysis and Custom Transport Stream Creation

A collection of optional MTS300 software gives you powerful tools for analyzing MPEG-2 transport streams in detail and for creating your own custom streams to use in functional and stress testing.

- **Option DT –** Deferred-time analysis and stream creation: software tools for detailed syntactic and semantic analysis of the transport stream, including T-STD buffer simulation, and for creating custom streams, including error and jitter injection utilities
- **Option ES –** MPEG video and audio elementary stream analysis: Software tools for detailed analysis of MPEG video elementary streams, including GOP (Group of Picture) structure and I-frame decoding, and for detailed analysis of MPEG audio elementary streams, including extraction of audio content into .WAV files
- **Option AC3 –** Dolby Digital AC-3 analysis: Software for detailed analysis of Dolby Digital AC-3 audio content
- **Option TM –** Transmission Multiplexing Configuration Control (TMCC) Combiner: Software for adding TMCC information into transport streams

New Advanced Multiplexer and DVB/ATSC Table Editor – Multiplexer (Option MTS3FMX)

The software can re-multiplex:

- MPEG-2 Video elementary streams
- MPEG-2 Audio elementary streams
- AC-3 Audio elementary streams
- MPEG-2 Video PES (packetized elementary streams)
- MPEG-2 Audio PES
- AC-3 Audio PES
- PIDs from other transport streams
- Other data – the bit rate must be specified

The Solution

The multiplexer allows the user to collect together components from streams recorded off hard disk or CD/DVD-ROM, manipulate them in an unlimited manner and then rebuild a fully compliant output stream for whatever use is desired. Along the way, the system's in-built syntax knowledge of tables and descriptors ensure compliance and high quality output of the final multiplex transport stream.

Decompose Existing Streams

MTS300's off-line multiplexer accepts any recorded transport stream as an input source. The user can then decompose this transport stream into its component PES. The user can then save resulting PES and ES streams onto disk.

Regroup Them with Stored Streams
These PES or elementary video and audio streams can be grouped together into logical groups – "Programs" of video, audio and other associated data (private data, e.g., teletext). The original timing relationships are preserved. These streams and/or other pre-recorded PES or ES streams can then be reassembled together to build up a totally new transport stream as the user desires. Regrouping of elementary streams or programs can be achieved within an existing transport stream, by allowing the individual stream identifiers (PIDs) to be remapped as required.

Map, Check and Rebuild Your Own Multiplex
These streams can then be rebuilt into a larger multiplex stream and new system information tables can be customized and added. Powerful syntax auto-check warn the user of mis-mapped, reserved or duplicate PIDs, including the Program Paradigm, by checking and automatically updating PAT, PMT and derivable fields (in its "standard" mode) accordingly, to create a final legal and DVB or ATSC-compliant output stream. MTS300's multiplexer allows the user to be able to construct a transport stream for any rate equal to or greater than the sum of the individual components to be multiplexed. Another facility offered is the ability for the multiplexer to insert correct PCR values on the PIDs defined by the user. This allows for PCRs to be on a separate PID or embedded on an existing PID.

Generate Compliant Timing and Output Bit Rates As Required
The multiplexer is able to insert the PCRs at the correct repetition rate and also allows the user to specify the PCR repetition rate, if desired.

Create, Add or Modify SI Flexibility
The multiplexer allows all of the standard MPEG/DVB/ATSC system information tables (SI) and descriptors to be edited. The user is permitted to generate illegal conditions that allow stress of decoder or transmission chain equipment to verify its robustness. It is also possible to generate private tables and descriptors.

Test Feature – Deliberately Create Illegal Streams
The software can be set to generate an optional warning when certain illegal conditions have been generated. This is visible clearly on the user interface. In a similar manner, the multiplexer allows all legal descriptors to be added to each table. The repetition rate for each table can be changed, overriding the default value. A conditional warning is generated if an illegal repetition rate is defined.

"Expert" and "Standard" Modes
Standard Mode will calculate related fields and table pointers (e.g., checksums) for the user without having to worry, but an Expert Mode is also provided to allow the user to set these to illegal conditions for test conditions as described above.

New **Advanced Video and Audio Elementary Stream Analysis and Display – ES Analyzer (Option MTS3FIN)**
This application brings to MTS300 not only the ability to actually view the moving picture from within a PES stream, but also to carry out a whole range of sophisticated new tests on the lower layers of an elementary stream within a transport multiplex. This gives added confidence when analyzing streams because encoder performance can be verified right down to slice and block layer together with motion vectors (see Figures 1 and 2).

- Display and analysis of GOP, Picture, Slices and Macroblock layer
- Picture quality analysis including Quantizer Scale distribution, motion vector graphs, macroblock and picture-size plots
- DCT Analysis and display
- Teletext analysis (PES and VBI)
- Closed Caption Analysis to EIA 608, 708, 746
- DVB Subtitle analysis and display over picture
- Analysis of MPEG-2 audio to provide plots of allocation bits, scalefactor grouping and SCFSI against sub bands
- Audio analysis of MPEG-2 audio to provide plots of allocation bits, scalefactor grouping and SCFSI against sub bands
- Audio analysis of Dolby Digital (AC-3), AAC, AdiFF and ADTS
- Regression test report generator

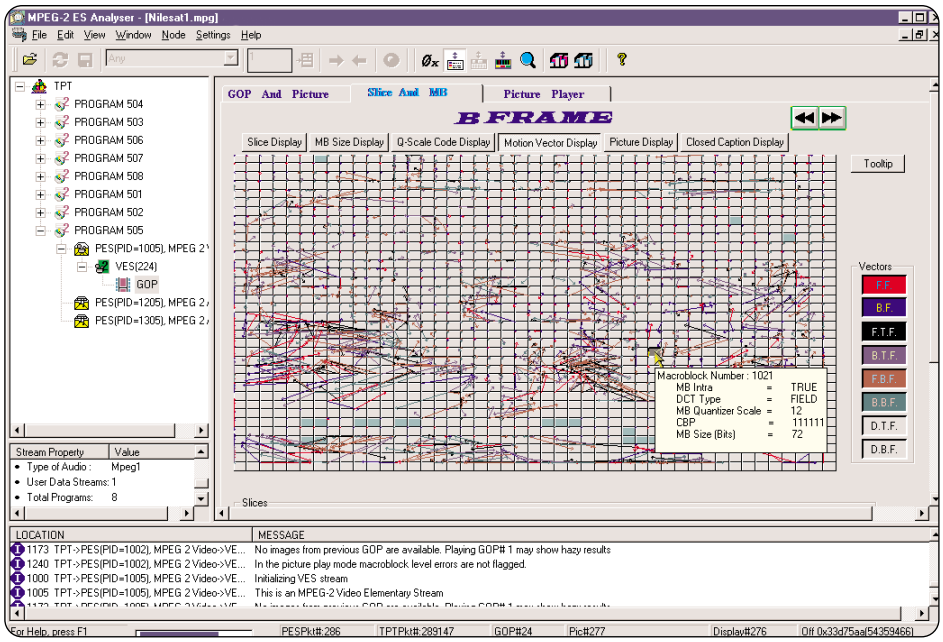

Figure 1. *Advanced ES Analyzer Motion Vector display.*

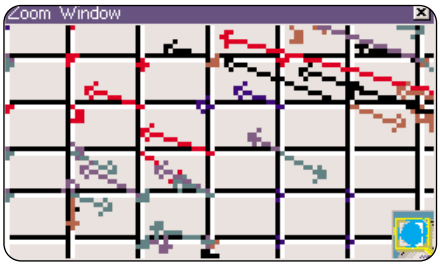

Figure 2. *Enlarged section showing Macroblocks and associated Motion Vectors using Zoom Window.*

The sequence header can be viewed along with the extensions. The picture rate, chroma format and the video type (NTSC, PAL, etc.) appear in the status bar when the sequence headers are displayed. The stream can be run through with the option of analysis of the stream at picture level or at the macroblock level. When analyzing the group of pictures (GOP), it is possible to randomly access any picture from within the group, view the picture type, spectrum and display picture size plots.

The user can zoom in on the picture to see details at the slice or macroblock levels or view the encoded picture. Picture player (see Figure 3) can be operated until degradation in quality is seen, the picture paused and the details reviewed down to the macroblock level. An easy mechanism is provided to switch between the picture display and the data analysis windows.

Macroblocks can be selected and detailed coding investigated. The picture analysis can be performed with special displays of quantizer scale distribution, slice size distribution, macroblock-size spectrum and motion vector plots.

Quantizer matrices can be downloaded for any picture, at most four matrices, namely intra-quantizer matrix, non-intra-quantizer matrix, chroma intra-quantizer and chroma non-intra-quantizer matrix.

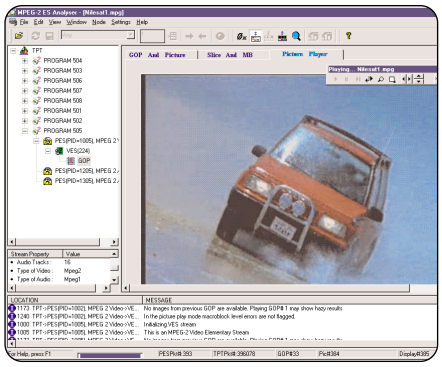

Figure 3. *Advanced ES Analyzer picture player.*

The picture coding extension is always displayed, while the other picture extensions are displayed on tabbed folders; these are copyright extension, picture display extension (PDE), picture spatial scalable extension (PSSE) and picture temporal scalable extension (PTSE). The B and P frame motion vector displays allow you to select Macroblock Intra, pattern motion backward and forward together with macroblock quantization, quantizer scale DCT type and motion vector format.

Comprehensive error logging is provided during stream analysis and selectable error filters are available. There is also an automated “regression” test mode that can save data from selected fields to report files for viewing later.

The audio analysis capability includes navigation to any audio frame and viewing its details, header, frame data plots. Audio descriptors are interpreted and displayed in higher level streams and validated against the stream.

New Solution for High Performance Data Analysis of MPEG-2, DVB and ARIB Transport Streams – Carousel Analyzer (Option MTS3FDB)

In-depth off-line analysis of MPEG-2, DVB and ISDB Transport Streams containing DSMCC data broadcast protocols including IP, Data and Object Carousels lets you fully verify product, system design and performance.

Applications

- Interactive television
- Software development
- MHP set top box design
- Carousel multiplexing
- Data broadcasting systems installation and integration
- Equipment design and verification

Stream Analysis

- DVB data and object carousel analysis
- BIOP, DSI, DII, DDB and DSM-CC section display and interpretation (see Figures 4 and 5)
- Bit rate and repetition rate display of blocks, modules, objects, UN messages, SI tables and video/audio PIDs (see Figure 6)
- Display of MHP AIT table
- ARIB B15/B24 Data Carousel Analysis
- MPE analysis including syntax of datagram sections
- Display of PSI/SI/PSIP tables with Huffman decoding
- Transport stream packet content
- PCR timing information
- Boot Timing statistics and graphs

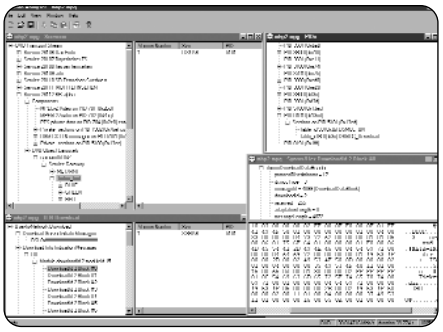

Figure 4. *Carousel Analyzer DDB analysis.*

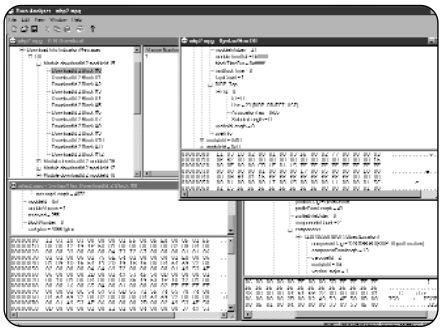

Figure 5. *Carousel Analyzer DII analysis.*

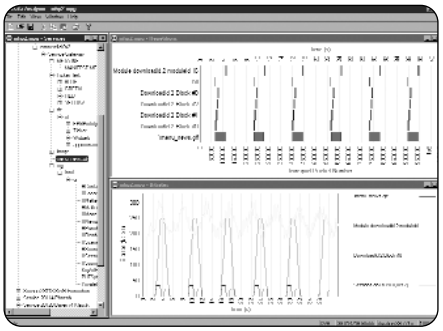

Figure 6. *Carousel Analyzer Carousel Content Repetition Rate and Bit Rate view.*

Transport Stream Recording and Playback

The MTS300 comes standard with easy-to-use transport stream record and playback capability. An optionally available real-time multiplexer lets you manipulate parameters of the generated stream in real time, giving you the power and flexibility needed to fully exercise product or system designs.

I/O for Acquisition and Generation

You can install up to four (4) rear-panel I/O interface ports on the MTS300 for external acquisition and generation, choosing any of the following options: ASI (M2S), SPI (LVDS), SMPTE310M, and DHEI (GI-Digicypher).

Modular System Design

The modular architecture of the MTS300 supports future system upgrades. You can purchase the system with only the capabilities you need now and can purchase field upgrades later to expand the capability of your system as your needs change or as new tests and technologies emerge.

The MTS300 uses the Windows NT operating system and runs on a high-performance platform for maximum flexibility and upgradeability.

▶ Characteristics

System Characteristics

MPEG Monitoring, Analysis and Generation Characteristics – Supports MPEG-2, DVB, ATSC and ISDB protocols.

Analyzes transport streams in real-time and reports problems with multiplex format, system information (PSI, SI, and PSIP) tables, and video, audio and data content.

Available deferred-time transport stream, MPEG video, MPEG audio, AC-3 audio, Data Broadcast and program stream analyzers.

Captures and generates MPEG transport streams in multiple formats.

Available transport stream creation and multiplexing tools.

Maximum Data Rate, Real-time Analysis – 180 Mb/s.

Maximum Data Rate, Stream Recorder or Stream Player Operating – 140 Mb/s.

Minimum Data Rate, Stream Recorder or Stream Player Operating – 1 Mb/s.

Maximum Aggregate Data Rate, Stream Recorder and Stream Player Operating – 140 Mb/s.

Number of Input/Output Interfaces – Up to four input/output interfaces with each interface providing input, output, clock and trigger connectors.

Available Interfaces – Asynchronous Serial Interface (ASI/M2S), Synchronous Parallel Interface (SPI/LVDS), SMPTE310M Synchronous Serial Interface, DHEI (GI-Digicypher).

Stream Recorder Storage Capacity – 27 GB nominal.

Interface Characteristics

Platform

Ethernet – 10/100Base-T; RJ-45.

COM port – RS-232.

Mouse – PS/2.

Keyboard – PS/2.

Printer port – IEEE P1284.

SVGA – 15-Pin, High density, D-sub.

Graphics – 1024x728, 32 K colors minimum.

Real-time Monitoring/Analysis and Stream Player/Recorder Applications

ASI/M2S (Option AS) – BNC, Maximum analysis data rate: 180 Mb/s. Maximum record/play-out data rate: 140 Mb/s.

DHEI – GI-Digicypher (Option DE) – 26-Pin D, Maximum analysis data rate: 40 Mb/s. Maximum record/play-out data rate: 40 Mb/s.

Platform Characteristics

Operating System – Windows NT 4.0, (service pack 5).

Disk Space – System: 6 GB.

MPEG storage: 27 GB.

RAM – 256 MB.

CD-ROM Drive – 8X.

Display – LCD, 800x600.

Character Input – Touch screen and keypad.

Keyboard and Mouse – Standard.

Power Characteristics

Source Voltage – 100 VAC to 240 VAC_{RMS}, 47 Hz to 63 Hz.

Power Consumption – 170 W, typical.

Environmental and Safety

Safety Class – Class 1.

Equipment Type – Test and measurement.

Temperature – +5 to +40°C.

Relative Humidity – 80% up to 31°C.

Altitude – 2000 meters.

Overvoltage Category – Category II.

Pollution Degree – 2; rated for indoor use only.

Low Voltage – Meets EN 61010-1:1993.

EC Declaration of Conformity – Meets EN 55103-1/2:1996; Electromagnetic environment E4.

Emissions – EN 55022, class A; EN 55103-1, Annexes A, B, and E; IEC 61000-3-2.

Immunity – IEC 61000-4-2, -3, -4, -5, -6 and -11; EN 55103-2, Annex A.

Australia Declaration of Conformity – Meets AS/NZS 2064.

FCC Compliance – Meets FCC CFR Title 47, Part 15, Subpart B, Class A.

Physical Characteristics

Dimensions	**cm**	**in.**
Width	43.2	17
Height (without feet)	21.6	8.5
Depth	56.0	22
Weight	**kg**	**lb.**
Net	17.3	38
Rack Space	**Height**	**Depth**
Net	5 rack units	Standard

▶ Ordering Information

MTS300 Hardware Products

Includes: MTS300 platform, real-time analyzer, stream recorder and stream player, software protection key and license sheet, rackmount kit, read this first manual (071-0666-xx), user manual (071-0658-xx), technical reference manual (071-0667-xx), stream creation applications manual (071-0778-xx), applications CD-ROM (063-3325-xx), operating system CD-ROM (063-3366-xx).

MTS300 Options

Interface Options – Each adds two input/output pairs, clock and trigger connections. Customers must select at least one interface option. System maximum capacity is any two interfaces, except as noted below.

Opt. AS – ASI/M2S asynchronous serial interface.

Opt. DE – DHEI (GI-Digicypher) interface.

Note: Can only be ordered with Opt. AS.

Opt. LV – SPI (LVDS) synchronous parallel interface.

Note: Can only be ordered with Opt. AS.

Opt. SS – SMPTE310M (SSI) synchronous serial interface.

Software Options

Opt. DT – Deferred-time analysis system, including multiplexer, table editor, error injector, jitter adder and STRM102 compliance streams. User manual (071-0659-xx).

Opt. AC3 – Dolby Digital (AC-3) analyzer. User manual (071-0661-xx).

Opt. OC – ViAccess conditional access. (Requires Option DT.)

Opt. OM – OpenMux™ real-time multiplexer. User manual (071-0778-xx).

Opt. ES – MPEG audio/video elementary stream analyzer. User manual (071-0663-xx, 071-0664-xx).

Opt. PS – Program stream analyzer. User manual (071-0662-xx).

International Power Cord Options

Opt. A1 – Universal Euro power cord.

Opt. A2 – United Kingdom power cord.

Opt. A3 – Australia power cord.

Opt. A5 – Swiss power cord.

MTS300 Upgrade Kits

All of the MTS300 upgrade kits require that you run the Sales Wizard file MTS3Wiz.Zip. The latest version is available from www.tektronix.com.

Interface Upgrade Kits

MTS3FAS – Adds ASI/M2S interface to an existing MTS300.

MTS3FDE – Adds DHEI interface to an existing MTS300.

MTS3FLV – Adds LVDS interface to an existing MTS300.

Note: Systems may not contain two LVDS interfaces.

MTS3FSS – Adds SMPTE310 interface to an existing MTS300.

Software Upgrade Kits

MTS3FDB – Adds Data Broadcast Analysis – Carousel Analyzer – to an existing MTS300.

MTS3FDT – Adds Deferred-time analysis to an existing MTS300 (same as Option DT).

MTS3FAC – Adds Dolby Digital (AC-3) analysis to an existing MTS300 (same as Option AC3).

MTS3FOC – Adds ViAccess Conditional Access to an existing MTS300 (same as Option OC).

(Requires Option DT or MTS3FDT upgrade kit.)

MTS3FMX – Adds advanced off-line stream creation and multiplexing to an existing MTS300.

MTS3FOM – Adds OpenMux Real-time Multiplexer to an existing MTS300 (same as Option OM).

MTS3FES – Adds MPEG audio/video elementary stream analysis to an existing MTS300 (same as Option ES).

MTS3FIN – Adds Advanced Elementary Stream Analysis – ES Analyzer – to an existing MTS300.

MTS3FPS – Adds program stream analysis to an existing MTS300 (same as Option PS).

MTS300 Software-Only Products (requires Windows NT)

Includes: Deferred-time analysis and stream editing software. Customers must select at least one software option. All software is provided on CD-ROM.

Opt. DT – Deferred-time analysis system, including multiplexer, table editor, error injector, jitter adder and STRM102 compliance streams. User manual (071-0659-xx).

Opt. AC3 – Dolby Digital (AC-3) analyzer. User manual (071-0661-xx).

Opt. OC – ViAccess conditional access. (Requires Option DT.)

Opt. ES – MPEG audio/video elementary stream analyzer. User manual (071-0663-xx, 071-0664-xx).

Opt. PS – Program stream analyzer. User manual (071-0662-xx).

Related Products

- MTX100 and MTG300 MPEG Generators
- MTM300 MPEG Transport Stream Monitor
- PQM300 Picture Quality Analysis System
- PQM300 Program Quality of Service Monitor

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Updated 18 April 2002

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06/02 HB/XBS 20W-14033-3

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