
# VMG

## RGB Video Multiprocessing Gateway

RGB's Video Multiprocessing Gateway (VMG) product line offers the industry's first high-density, carrier-class platform for the delivery of advanced video services, including high definition (HD) and standard definition (SD) video, as well as multi-resolution MPEG-4/H.264 and MPEG-2 video streams. The VMG is an integrated solution specifically designed to address a number of critical applications, including advanced ad insertion, transrating, transcoding and re-coding, in a highly integrated and flexible configuration. The VMG's modular blade architecture represents a future-proof investment that scales well in the rapidly-evolving video marketplace.

### The Industry's Most Advanced Video Processing Platform

- Integrated, multi-application platform offers operational simplicity—various functions, typically handled by different devices in a legacy headend, are now performed by one or multiple blades in an integrated chassis.
- High-capacity, multi-in/multi-out stream processing allows a complete channel lineup to be processed by a single, high-availability device with many output 'profiles' optimized for a variety of receiving consumer devices.
- High-availability, carrier-class platform with multi-level redundancy features: chassis component redundancy, 1:1 controller module redundancy, N:M application module redundancy, and service/program-level redundancy.
- Multi-processor architecture offers future-proofing for new applications, while achieving the greatest density/cost benefits for proven functions.
- Concurrent support for multiple screen resolutions and MPEG-2 and MPEG-4/H.264 compression allows seamless transition from legacy networks to MPEG-4/H.264, or conditioning of live content for next-generation distribution networks.
- 'Pay-as-you-grow,' modular model allows for initial service deployment at only the level required for current implementation.
- Two different chassis sizes provide flexibility in meeting current service and space needs, while allowing for a growth path through enabling licenses or adding modules to available slots.
- Ultra-dense platform conserves rack space and reduces power requirements.

rgb NETWORKS

RGB's carrier-class Video Multiprocessing Gateway (VMG) is the ideal platform for video service providers seeking to accelerate the growth and profitability of their video services in the most cost-effective manner. With the VMG, telecom, cable and other operators can concurrently deliver MPEG-2 and MPEG-4/H.264 digital broadcast or on-demand video services targeting a variety of consumer video devices.

The flexibility of the VMG allows it to be used for the implementation of a variety of applications critical to the success of today's video service providers. In the core of the network (or super headend), centralized functions are performed in the areas of transcoding, grooming, national/regional ad insertion and program substitution. Edge-level deployment allows for local content transcoding, grooming, local/zoned ad insertion and program substitution, as well as statistical multiplexing and transrating for optimal downstream delivery.

#### Content Repurposing

With MPEG-4/H.264 now permeating all facets of 'large screen' TV distribution, as well as being the dominant choice for video delivery to PC and handheld devices, operators worldwide are now in the midst of establishing and implementing MPEG-2 to MPEG-4/H.264 transition strategies. In the large screen distribution model, what started as a telco IPTV-only trend has now grown well beyond that to all other market segments with the need for a variety of transcoding and re-coding modes: MPEG-2 to MPEG-4/H.264, MPEG-4/H.264 to MPEG-4/H.264, MPEG-4/H.264 to MPEG-2 and even MPEG-2 to MPEG-2.

The VMG supports these network evolution needs utilizing its flexible transcode and re-code mode support, via RGB's Transcoding Module (TCM). It performs any operation between MPEG-4/H.264 and MPEG-2, at various screen resolutions, ranging from high definition 1920 x 1080 all the way down to picture-in-picture (PIP) and handheld device resolutions. Furthermore,

VMG content repurposing is best-in-class for its high capacity, allowing for the repurposing of up to 144 high definition-level and over 400 multi-resolution output operations in a single chassis. This capability allows complete channel lineup transcoding/re-coding, as well as multiple profile output support where one input is coded into different resolutions, bitrates or compression parameters to handle downstream network and consumer device needs. Superior video quality control is also a key benefit with bitrate control, programmable Group of Pictures (GOP) structure (including hierarchical GOP for MPEG-4/H.264), advanced noise filtering techniques, and picture resolution control.

### Ad Insertion

Utilizing the advanced ad insertion features of the VMG, operators can capture a significant piece of the emerging targeted advertising opportunity that can fuel revenue growth and profitability. With an SCTE 30/35-based approach and a proactive partnership program, the VMG integrates seamlessly into advertising solutions for deploying centralized or targeted (regional or zoned) advertising. The VMG can be deployed in a headend for centralized advertising or at the hub level for targeted advertising. Both MPEG-2 and MPEG-4/H.264 ad insertion is supported, even on the same module inside a VMG chassis, enabling a smooth upgrade path for operators transitioning from MPEG-2 to MPEG-4/H.264.

### Transrating & Statistical Multiplexing

Leveraging RGB's extensive experience in MPEG-2 statistical multiplexing and transrating, the VMG includes the following key bandwidth-saving modes:

a) 'Open loop' MPEG-2 statistical multiplexing where the operator does not have control of the originating real-time encoder, or the encoder is located remotely and cannot be controlled real-time.

b) MPEG-2 to MPEG-2 rate capping for output single program transport stream (SPTS) services for switched digital video or IPTV distribution.

c) MPEG-2 output stat muxes with streams ingested as either MPEG-2 or MPEG-4/H.264, and MPEG-4/H.264 streams are transcoded in the same chassis to MPEG-2.

The VMG also enables Quality of Service (QoS) control using operator-set relative rate reduction among programs sharing the same downstream bandwidth, and even allowing chosen programs to pass unaltered.

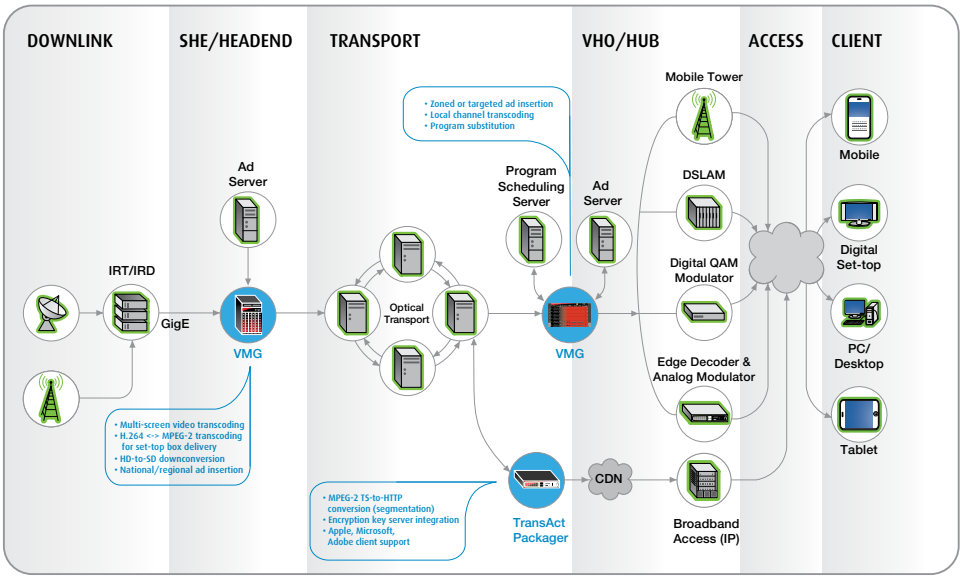
Stat mux pool size selection is flexible, covering not only QAM bandwidths in different regions globally, but also pool sizes exceeding typical QAM bandwidth for terrestrial or satellite backbone carriage.

### Digital Program Substitution

Leveraging the VMG's seamless splicing capability for multiple screen resolutions (HD, SD, PIP) and various compression codec support (MPEG-2, MPEG-4/H.264, Dolby Digital, AAC, MPEG-1 Layer II), digital program substitution allows a specific output to be seamlessly switched (spliced) between two different input programs under the control of a standards-based scheduling server.

This long-form seamless video switching technique allows network/local feed time-sharing for a given output, local blackouts due to content rights rules, or local/international time-sharing on an output to comply with regulatory requirements.

***RGB's VMG Enables a Number of Critical Applications***



### Operational Simplicity with the VMG

Operators can now benefit from advances in IP-based video headends and distribution, and the high-capacity, modular VMG platform fully leverages these next-generation network designs, with the added benefit of aggregated Gigabit and 10-Gigabit Ethernet links.

Legacy headends typically deployed transcoding and re-coding in a full decode, re-encode model that consisted of a chain of devices performing discrete functions. Furthermore, redundancy was handled at a network level with complex network management systems controlling third-party devices like baseband serial digital interface (SDI) and DVB-ASI routers to properly handle signal routing during a switchover. Service expansion also meant discrete devices required the availability of additional rack space, re-wiring of the network, and then a service-affecting upgrade to the network management system to incorporate the new additions.

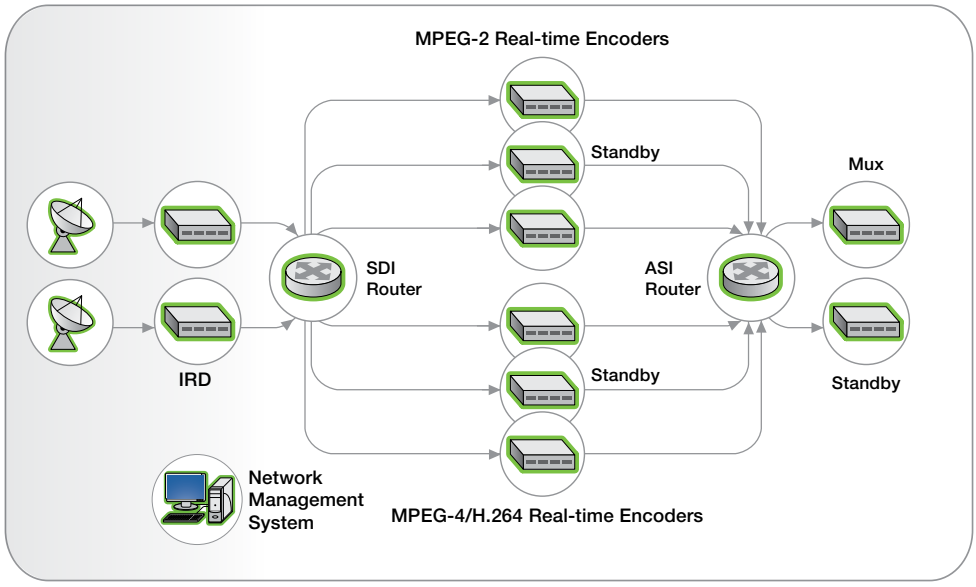
VMG-powered next-generation networks drastically reduce complexity and make service upgrades a much smoother experience. ASI links are terminated upstream in the chain and converted into Gigabit Ethernet, using a device such as RGB's Modular Media converter (MMC). At that point, Ethernet links connect through switches and routers for external routing and interface with the VMG chassis, with the switches performing aggregation of streams. The VMG then receives, processes, and outputs efficient IP links, utilizing its own redundant backplane for distribution of streams between modules inside the chassis. This internal switched backplane also performs automatic redundancy at a module level without the need for any external devices or complex network management systems. The VMG is instead controlled and monitored via a web browser-based Element Manager. Service expansion is handled in a modular fashion with empty chassis slots increasing hardware capacity, without any need to free up rack space or perform complex cabling.

### VMG: The Carrier-Class Video Platform

In order to ensure uninterrupted service delivery, the VMG delivers very high levels of reliability. It has been designed from the outset to meet the highest levels of redundancy via a multi-level redundancy architecture. Exceptional reliability and fault-tolerance are enabled by the VMG's carrier-class chassis design, which incorporates extensive fail-over capabilities, comprehensive hardware and software component redundancy, as well as program and service level redundancy in case of program service failure, to ensure the highest levels of availability.

The 13-rack unit VMG-14 has 14 module slots, two of which are dedicated to the Network Processing Module (NPM) and the remainder available for any combination of application modules, today consisting of the Video Processing Module (VPM), Transcoding Module (TCM) and Application Media Processor (AMP). The NPM performs chassis control functions, external Gigabit Ethernet and 10-Gigabit Ethernet interfacing via SFP/XFP, as well internal backplane switching and routing of streams. The NPM, through its virtual IP and MAC address features, can be configured as 1:1 redundant. Its internal backplane switching allows automatic N:M application module redundancy where input and output streams to a given operational module are reconfigured to a standby module in the chassis with video services back up in a matter of seconds. The same architecture and identical NPM, VPM, TCM and AMP modules are available on the 7-rack unit VMG-8 chassis, which has eight slots, two of which are dedicated to the NPM controller.

***Complex Legacy Network Layout with 'Pizza Box' Devices***

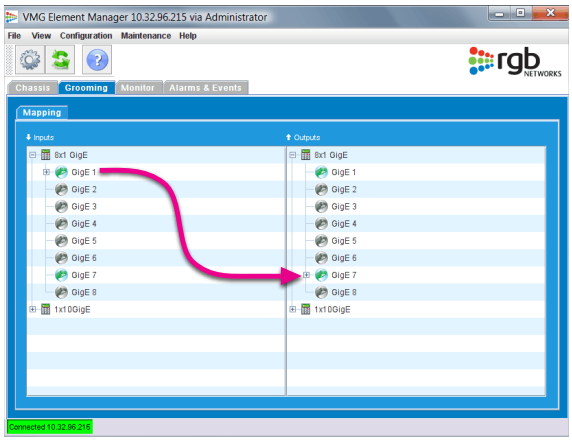


## Intuitive, Flexible Operations with VMG

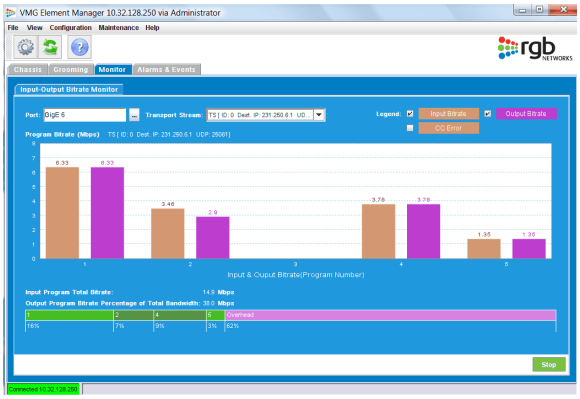
The VMG is monitored and configured through a web-based graphical user interface that is Java-based, allowing a variety of local or remote control consoles. The VMG's SNMP support also allows monitoring and/or configuration through third-party network management systems which may have a plant-wide scope of operations. The easy-to-use interface offers a variety of features that simplify the set-up and operation of the VMG, including program and transport level drag and drop grooming; simultaneous bitrate analysis of input and output transport streams grouped by input/output physical interfaces; alarms and system logs; and extensive diagnostics and troubleshooting capabilities.

The VMG interface supports multiple tiers of user access and password protection to prevent any unintentional operational issues, and additionally supports Remote Authentication Dial In User Service (RADIUS) and Terminal Access Controller Access Control System Plus (TACACS+) for more granular user authentication and authorization.

The VMG on-board database allows backup and FTP-based restore operations for quickly configuring high-capacity networks while avoiding entry errors and time-consuming manual data entry.

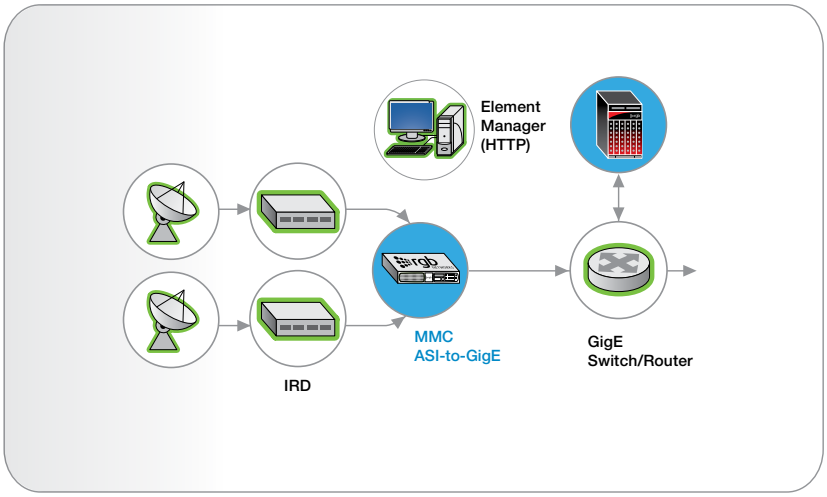



*VMG GUI:*
*Drag and Drop Grooming*




*VMG GUI: Bitrate Monitor*
*(brown input/purple output)*

*Simple Network Configuration with the VMG*




**RGB Networks, Inc.**
390 West Java Drive, Sunnyvale, CA 94089 USA
T: +1.408.701.2700 | F: +1.408.701.2710
www.rgbnetworks.com

## RGB VMG Specifications : VMG-14 & VMG-8

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|---|---|
| **MODULES** | |
| Network Processing Module (NPM) | Runs host software and includes control, GigE, 10-GigE input/output interfaces |
| Video Processing Module (VPM) | Performs MPEG-2 and H.264 transrating, seamless switching, multiplexing applications |
| Transcoding Module (TCM) | Performs real-time transcoding and re-coding functions for HD, SD and adaptive streaming-capable resolutions in MPEG-2 and H.264 codecs |
| Application Media Processor (AMP) | A general-purpose compute platform with applications including real-time audio transcoding |
| **INPUT / OUTPUT INTERFACES (NPM)** | |
| Gigabit Ethernet | 1-Gigabit Ethernet, 8 x SFP ports (copper or fiber), IEEE-802.3z compliant<br>10-Gigabit Ethernet, 2 XFP ports (fiber), IEEE-802.3ae compliant (future support) |
| Fast Ethernet | 1 10/100 BaseT control and management interface, RJ-45 connector |
| **INPUTS** | |
| Compression Formats | MPEG-2 up to Main Profile at High Level<br>H.264 up to High Profile at Level 4.1 |
| Transport Level | Multi Program Transport Stream (MPTS)<br>Single Program Transport Stream (SPTS)<br>Up to 8,192 Elementary Streams |
| Resolutions, Scan | 480i60 (30 or 29.97 fps) (Vertical: 480; Horizontal: 720, 704, 544, 528, 352)<br>720p60 (60 or 59.94 fps)<br>1080i60 (30 or 29.97 fps)<br>576i25 (Vertical: 576; Horizontal: 720)<br>720p50<br>1080i50 (25 fps) |
| **OUTPUTS** | |
| Compression Formats | MPEG-2 Main Profile at Main Level (SD)<br>MPEG-2 Main Profile at High Level (HD)<br>H.264 High Profile up to Level 4.1<br>H.264 Main Profile up to Level 4.1<br>H.264 Baseline Profile up to Level 4.1 (PIP, MBR-TS output modes) |
| Transport Level | Multi Program Transport Stream (MPTS) (VPM)<br>Single Program Transport Stream (SPTS) (VPM, TCM/AMP) |
| Video Bitrates (TCM) | MPEG-2 HD: 8-15 Mbps<br>MPEG-2 SD: 1-7 Mbps<br>H.264 HD: 2-15 Mbps<br>H.264 SD: 0.2-7 Mbps<br>H.264 PIP: 0.1-1 Mbps<br>H.264 MBR-TS: 0.1-8 Mbps |
| Resolutions, Scan | VPM: Same as input<br>TCM: SD: User-configurable horizontal resolution on output, follow-input vertical resolution, scans<br>SD on output with HD (both 1080i and 720p) on input, SD output with user-configurable horizontal resolution<br>HD: User-configurable horizontal resolution on output, follow-input vertical resolution, scans<br>Multi-bitrate mode:<br>High resolution: 1280x720, 960x720, 960x540<br>Medium resolution: 720x576, 864x486, 848x480, 720x480, 640x480<br>Low resolution: 640x360, 624x352, 480x368, 480x320, 480x272, 448x336, 416x240, 400x360, 400x224, 352x288, 352x240, 320x240, 320x180, 320x176, 192x192, 128x96, 96x96<br>Picture-in-picture (PIP):<br>352x288 (25 / 50 fps input)<br>352x240 (29.97 / 59.94 fps input)<br>192x192<br>128x96<br>96x96 |
| **VIDEO PROCESSING** | |
| Processing Density (TCM) | Up to 36 SD programs per TCM when transcoding SD-SD or SD-PIP<br>Up to 12 SD or HD input programs per TCM and 24 outputs in full-screen transcode + PIP mode<br>Up to 12 SD or HD programs per TCM when transcoding HD-HD, HD-SD or HD-PIP<br>Up to 12 SD or HD input programs per TCM and 48 outputs in MBR-TS mode<br>Up to 12 TCMs per VMG-14 chassis[1]<br>Up to 6 TCMs per VMG-8 chassis |
| Transcode Modes (TCM) | MPEG-2 to H.264; H.264 to MPEG-2; H.264 to H.264; MPEG-2 to MPEG-2<br>PIP and MBR-TS outputs are transcoded to H.264 outputs regardless of input |
| H.264 Video Processing (TCM) | Programmable GOP structure; adaptive GOP based on scenes2; all intra prediction modes; ¼ pixel interpolation;<br>multiple reference frames; P and B pictures; block sizes: 16 x 16, 8 x 8, 16 x 8, 8 x 16; coding: CABAC entropy coding |
| Rate Control (TCM) | CBR or VBR input; CBR output |
| Noise Reduction (TCM) | Motion Compensated Temporal Filter (MCTF) noise reduction |
| Film Processing (TCM) | Telecine (MPEG-2) |
| Transrating (VPM) | MPEG-2 SD and HD statistical multiplexing; mixed mode MPEG-2 / H.264 SD and HD statistical multiplexing (H.264 re-multiplexed) |
| Digital Program Insertion (DPI) (VPM) | Seamless MPEG-2 and H.264 HD, SD, sub-SD splicing<br>SCTE 30 (DVS 380, DVS 638) and SCTE 35 (DVS 253) compliant<br>SCTE 30 to SCTE 35 conversion<br>SCTE 35 forwarding |
| Quality of Service (QoS) (VPM) | Ability to set priority for level of transrating desired (including transrater bypass) |
| Error Correction (VPM) | Pro-MPEG COP3r2 FEC decoding and encoding two-dimensional checksum (L x D <= 100) |
| Max Video Processing Bandwidth (VPM) | 800 Mbps per VPM3 |
| Max Output Programs (VPM) | 320 per VPM, subject to chassis-level constraints |
| Mux Capacity (MPTS output per VPM) | 16 (with MPTS at 38 Mbps)<br>8 MPTS at 52 Mbps<br>Includes MPEG-2 statistical multiplexing, as well as mixed mode H.264/MPEG-2 MPTS outputs |
| DPI, Program Substitution Capacity (VPM) | See System Capacity section |

## RGB VMG Specifications : VMG-14 & VMG-8 (continued)

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| **SYSTEM CAPACITY** | | | |
| Max Unique IP Multicast Inputs | 600 per host | | |
| Max Unique IP Multicast Output | 508 per host | | |
| DPI and Program Substitution Capacity | 200 SD or 100 HD concurrent / VMG system (chassis); applies to H.264 or MPEG-2 or a mix | | |
| **AUDIO PROCESSING** | | | |
| Audio Formats | Dolby Digital (AC-3); AAC-LC; MPEG-1 Layer II; MPEG-2 Audio; HE-AAC v1/2 | | |
| Output Audio Codecs | Pass-through (in modes other than PIP or multi-bitrate); AC-3; AAC-LC; HE-AACv1/2, and MPEG-1/2 Layer II output in transcode modes | | |
| Transcoded Audio Output Data Rate | 6 - 448 kbps, specified values depending on output codec selected | | |
| Transcoded Audio Sampling Rate | 8kHz, 11.1, 12, 16, 22.1, 24, 32, 44.1, 48 kHz depending on output codec selected | | |
| Transcoded Audio Gain Control | -24 dB to +24 dB, increments of 1 dB | | |
| Transcoded Audio Channels | 5.1 / 2 / 1 input; 5.1 / 2 / 1 output | | |
| **ANCILLARY DATA PROCESSING** | SUPPORT FOR<br>Closed captioning: SCTE 21 (including EIA-608, EIA-708) for MPEG-2, SCTE 128 for H.264<br>SCTE 35 pass-through | | |
| **SYSTEM SPECIFICATIONS** | | | |
| IP Networking | IP/UDP; RTP; IGMPv3 | | |
| Device Latency | <1.5 sec (no transcoding); <4 sec (with transcoding) | | |
| Multiplexing & Table Processing | MPEG-2 and H.264 multiplexing and re-multiplexing<br>MPTS, SPTS, multicast and unicast support<br>CBR and VBR support<br>PAT and PMT generation<br>PID filtering and re-mapping<br>Generation and pass-through of ATSC PSIP tables (including A/65)<br>DVB-SI tables regeneration | | |
| Network Jitter Tolerance | +/- 100 msec | | |
| **CONTROL/MANAGEMENT** | | | |
| Module Redundancy | All modules hot swappable; 1:1 NPM, AMP module redundancy; N+M TCM, VPM module redundancy | | |
| Program/Service Redundancy | Yes - common to VMG platform; backup program pre-defined and used in case of loss of primary input[4] | | |
| Management | Embedded web-based UI using XML/RPC protocols; Java-based application; SNMPv1 / v2c; multi-user access control; AAA (Radius, TACACS+) | | |
| **REGULATORY COMPLIANCE** | | | |
| Safety | UL / CUL / CB 60950-1 | | |
| Electro Magnetic | FCC part 15 Class A; FCC - Title 47 CFR Part 15, Subpart B; Canada - ICES-003, Issue 2, April 1995;<br>CE Mark - EN55022 2006 and EN55024:1998 + A1:2001 + A2:2003<br>FCC Part 15, Class A, EN55022, EN55024, EMC, EMI | | |
| **ELECTRICAL/MECHANICAL** | **VMG-14** | **VMG-8 DC** | **VMG-8 AC** |
| Input Power | -48 VDC nominal (-41 to -60 VDC range)<br>30 Amps per power feed (total 4 + 4 feeds)<br>Overcurrent protection: 30 Amp fuse per feed | -48 VDC nominal (-41 to -60 VDC range)<br>60 Amps per power feed (total 1+1 feeds)<br>Overcurrent protection: 60 Amp circuit breaker per feed | 120/220 VAC nominal<br>15 Amps per power feed (total 2+2 feeds)<br>Overcurrent protection: 15 Amp circuit breaker per feed |
| Power Consumption | 2700 Watts maximum—fully loaded5 | 1700 Watts maximum—fully loaded5 | 2000 Watts maximum—fully loaded5 |
| Dimensions | 13 rack units<br>571.6 H x 482.6 W x 506.54 D mm<br>(22.51 H X 19.00 W X 19.94 D in)) | 7 rack units<br>309.9 H x 447.1 W x 508.0 D mm<br>(12.2 H x 17.6 W x 20.0 D in) | 7 rack units<br>309.9 H x 447.1 W x 508.0 D mm<br>(12.2 H x 17.6 W x 20.0 D in) |
| Weight (assembled) | 67 lbs. (30.6 kg) | 55.7 lbs. (25.3 kg) | 67.3 lbs. (30.6 kg) |
| Cooling | Front (bottom) to rear (top)) | Right to left | |
| **OPERATIONAL ENVIRONMENT** | | | |
| Storage Temperature | -40° to 70° C (-40° to 158° F) | | |
| Operating Temperature | 0° to 45° C (32° to 113° F) | | |
| Ambient Temperature (transient operation) | +5° to 55° C (41° to 131° F) | | |
| Humidity | 5% to 85%, non-condensing;<br>Transient operation: +5% to +90%, non-condensing | | |

1. Multi-bitrate mode benchmarked with 9+1 TCM and 1+1 AMP configuration (54 inputs, 432 outputs with a 1:8 output profile ratio); consult RGB for configuration-specific maximum tested TCMs per VMG-14 chassis.
2. Full resolution transcode mode.
3. Contact RGB Networks for specific conditions for this specification.
4. As defined by input PAT/PMT tables or video elementary stream, differs by module.
5. Watts maximum for fully loaded VMG chassis with currently available VMG modules, consult RGB for futureVMG module power requirements

**RGB Networks, Inc.**
390 West Java Drive, Sunnyvale, CA 94089 USA
T: +1.408.701.2700 | F: +1.408.701.2710
www.rgbnetworks.com