

A Series of Mobile Television Units for Color Broadcast

By CHARLES M. EINING

The design and construction of color television mobile units for the fast-growing field requirements take the engineer into many complex and diverse areas not usually encountered in studio design and construction. Gross vehicle weight, load distribution, tire loading and suspension systems become familiar terms. The requirements for heating and air-conditioning also differ from the conventional in many respects. In response to these requirements, four mobile units of three distinct types were developed and built by the engineering staff of WMAQ-TV in Chicago. One or a combination of these should meet the field needs of almost any television station or network.

IN 1956, WNBQ, Chicago (now WMAQ-TV), became the "world's first all-color TV station," with film and live camera facilities maintaining full color programming. Color videotape was added in 1959 when the equipment became available. At the time, a six-camera monochrome unit represented WNBQ's only mobile capability, and this was used primarily for originating network sports programs.

CG-1 and CG-2

In 1965, in response to the need for a mobile unit that could go into the field on a moment's notice and move rapidly to the scene of a disaster, fire, riot or other newsworthy event, a compact, self-powered, monochrome videotape unit was planned. This unit needed to possess its own power generating equipment and videotape recorder, and had to be capable of taping while in motion. When the TR-5 tape recorder was developed, the CG-2 was constructed (Fig. 1).

The vehicle used was a 1966 Ford Econoline Window Van, and had a 5-kW air-cooled engine generator to supply power for equipment, air-conditioning, and limited lighting. Audio was single-channel, with automatic gain control. Tracks from the side door facilitated removal of the videotape recorder. An equipment cabinet was also removable so that it could be taken into a building for taping.

In early 1967, a Cohu three-vidicon color camera was added to the CG-2 to convert the unit to color. The camera was next modernized with Plumbicon tubes, and was used, although in a different vehicle, until December 1970, when it was replaced with a Norelco PCP-70 backpack portable camera. That unit

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was then redesignated CG-1. CG-2 had a PCP-70 camera installed in the fall of 1968.

Normal technical crew on each unit was two men, one to operate the camera and the other to serve as a combination video-audio-VTR engineer, and this staffing has been maintained on later units. An audio engineer was added to the staff for other than one-mike pickups, and a lighting engineer joined for other than simple lighting.

Because these units were rather unusual at the time, it took several months before they were put to other than experimental use. As their flexibility became recognized, the units were heavily scheduled for documentary and news

assignments. One unit was assigned to gather stories for the Noon News Show. Because little happens in the civic and governmental offices until sometime after 9:00 or 10:00 a.m., there frequently was not time for film processing before the news was aired. Tapes could be passed to a motorcycle messenger for delivery to the studios, while the unit went on to another location. The present record for this type of unit at our station is nine stories at nine different locations in seven working hours.

CG-1 and CG-2 did yeoman service for the station, but they more or less "just grew" instead of being engineered. As the vehicles began to wear out, these units were completely redesigned and engineered (Fig. 1). The vehicle chosen was the Dodge Maxivan, which gave additional floor space and weight-carrying capability. The TR-5 tape machines were high-banded, and the engine generator was upgraded to 6.5 kW. The body was foam insulated and custom air-conditioned with a 15,000 Btu unit. These units with their upgraded facilities have proven even more useful than the originals.

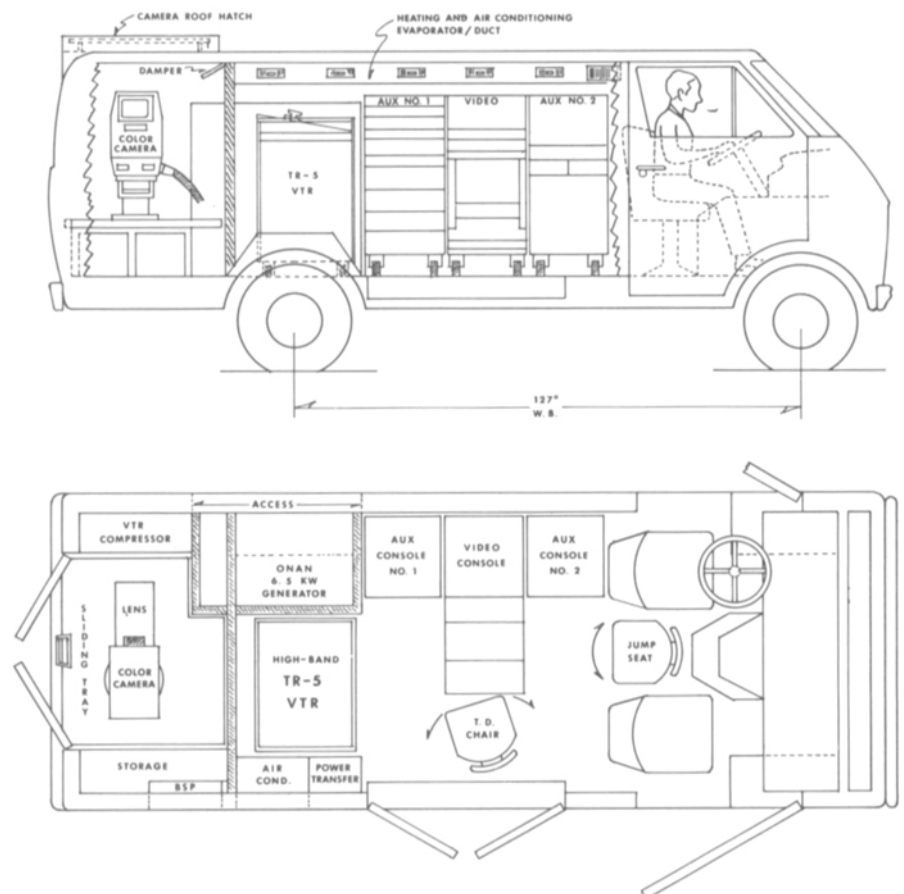


Fig. 1. Layout of the second generation videotape mobile units, CG-1 and CG-2.

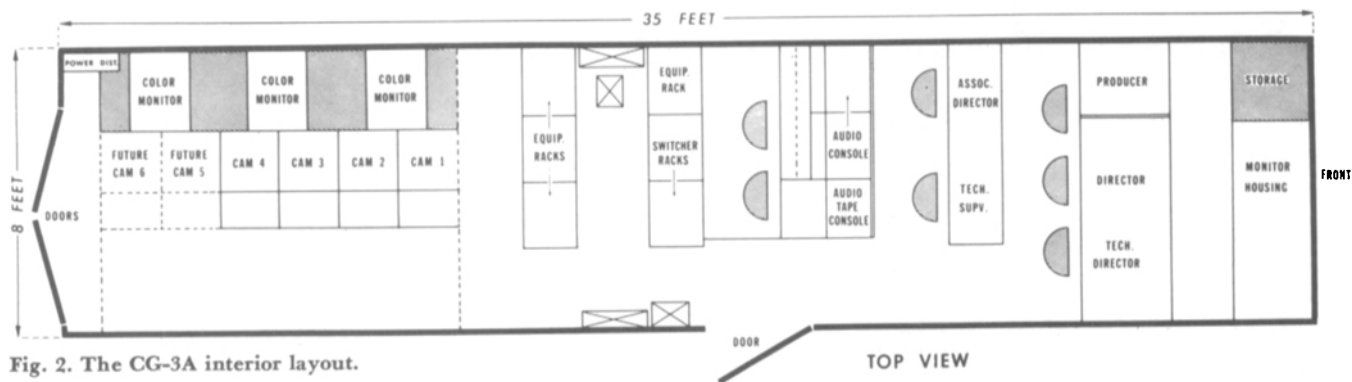


Fig. 2. The CG-3A interior layout.

CG-3

CG-3, WMAQ-TV's next van, was designed as a major facility with complete capability for network sports coverage, probably the most demanding routine program requirement in existence today. This unit is actually in two parts, each a custom-built 35-ft (10.70-m) semi-trailer with a stainless-steel exterior. Air-bag suspension is used on both vehicles. The "B" unit acts as a carryall for the cameras, tripods, pan heads, dollies, cables, mikes and other items that are needed for a large pickup. There is also a videotape room in the front.

CG-3A

The "A," or control, unit vehicle (Fig. 2) is air-conditioned by two four-ton units mounted in the skirt compartments in front of the wheels. These air-conditioners have hot-gas bypasses so that the compressors do not cycle on and off, thereby avoiding large variations in power load. Each of these air-conditioners has 12 kW of electric heating.

Forward of the air-conditioner on the curb side is the broadcast services panel with audio, video, interphone, studio address (SA) and squawk-box terminations. Also located here are interconnection facilities for marrying the systems with other units. On the street side is a similar compartment where all telephone terminal equipment is located, with lug strips and other connectors installed by telco personnel. This compartment is reserved entirely for their use.

Interior Layout

Starting at the front of the vehicle (Fig. 2), the monitor housing has 16 monochrome monitors, two color monitors and a monochrome off-the-air receiver. The storage area contains a file cabinet for instruction books and blueprints, with coat-hanging space above. Immediately to the rear are a console for the technical director and the director and a drop-leaf table for the producer. The next console provides work space and communications for the technical supervisor and the associate director. The audio area is elevated eight inches to allow the audio engineers a better view of the monitors. The audio patch

rack is in back of the audio engineers next to the wall, and the other two racks in this row house the main and auxiliary video switching systems. The next row of racks houses the rubidium frequency standard, three sync generators, pulse and video distribution amplifiers and the transmission engineer's monitoring, switching, and communications equipment. There are no dead-back racks; all equipment is accessible from rack front or back. The rear-most area is the video control area.

Video

The CG-3 has five Norelco PC-70 color cameras, with space and facilities for a sixth. At present, a monochrome camera used for titles is installed in the sixth position. This area is located in the rear of the vehicle. There is a color monitor for each pair of cameras, and each is switchable by a 22-input switcher. The leading video engineer also has a vectorscope available.

Video from the cameras is routed to the auxiliary switching system. The auxiliary switcher is a 22-input and 10-output International Nuclear Corp. reed relay crossbar, with SCR-controlled overlap switching. The six outputs used are: insert camera selection and emergency program switching; videotape feed isolation bus; transmission engineer monitor and scope switching; and three for video control color monitor switching.

The main switching system is a relay-type switcher, which is basically a two-bus switcher with a lap-dissolve function between the two buses. A and B effects buses are provided, with 29 different choices of wipes, spotlight, additive and nonadditive mix, and insert effects. Three isolated videotape feed buses are also provided: two are on the main switcher and the third is from the auxiliary switcher. The insert camera-emergency switching bus of the auxiliary switcher is also located on this panel.

For purposes of adding titles to pictures, an "instant insert" mixer is provided just prior to switcher output. The insert camera bus provides one input to this mixer and the switcher provides another input. The title (which can be colorized and black edged) can then be

inserted or taken out by a single alternate action pushbutton, without having to use the effects buses at all.

Audio

The audio installation is built around 10 four-channel remote amplifiers, providing facilities for 32 microphone inputs, plus regular and emergency program amplifiers. Ten nemo inputs with individual level set controls and preview keys are provided. Utility amplifiers, with input combining networks and isolated outputs with individual level setting for each input and output, complete the program audio setup. Reel and cartridge tape recorders are also provided.

Communications

The CG-3 carries a large crew of production and engineering people who must be able to communicate surely and swiftly with the outside world. Typically, 25 to 28 people may be involved at a remote location, plus others at the studio control point and in addition there are telephone company (telco) personnel. The three basic systems of communications in the CG-3 are interrupted feedback/studio address/cue (IFB/SA/CUE), squawk box, and interphone and telco private line.

IFB/SA/CUE System

This system is basically for production use, although the technical director and the audio and video engineers are cross-connected into it. There are interrupted feedback circuits to handle six different inputs, a capacity which is seldom used but is very important when needed. The SA function of this system allows talk from the unit to two separate remote communication boxes for instructing talent and similar purposes. The cue system is fed to all cameras, and may be used for program orders in event of failure of the normal camera interphone system.

Squawk Box

The squawkbox is a system of engineering intercommunication; it connects the technical director, lead video engineer, audio, VTR, transmission engineer, and two remote points.

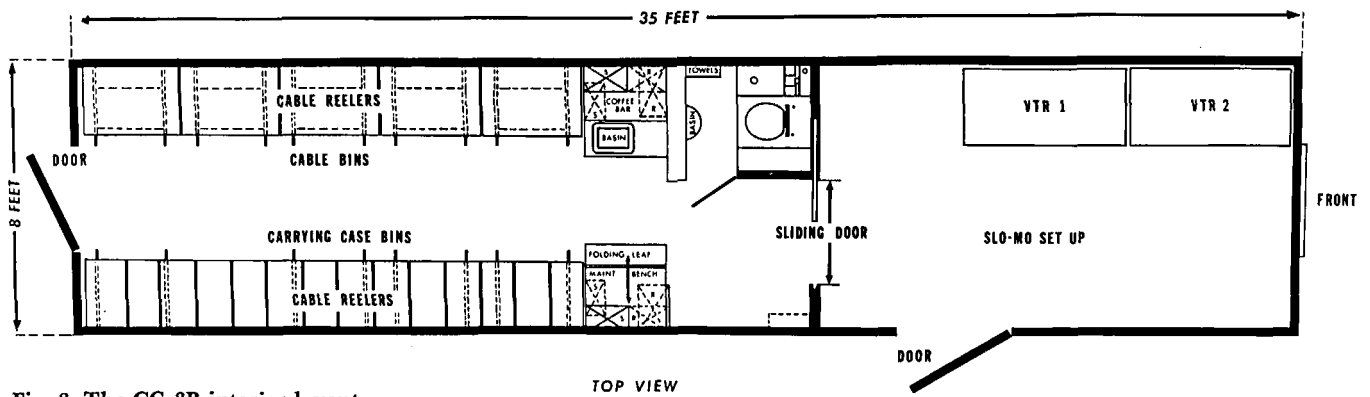


Fig. 3. The CG-3B interior layout.

Interphone and Telco Private Line System

This is the largest system of communications. It interconnects completely all production and engineering personnel at the remote location who have any need for communicating with others. The telephone company communications are also tied into this system. Not all stations on the system have access to all other stations, but are set up on a need for access and on a priority basis.

The CG-3 is designed so that the video consoles in the rear may be removed, leaving a large area with three switchable color monitors and, by the addition of a long table and chairs, a "Command Post" setup is made available for coordinating a large number of incoming feeds. With this configuration, the unit can act as a regional switching and communication center for coverage of such an event as a national election.

CG-3B

The CG-3B unit (Fig. 3), as mentioned above, is best described as a cargo (or carryall) videotape unit. It carries cameras, lenses, tripods, dollies, cable, microphones, and all the items that go into a major television coverage effort. It is fully heated and air-conditioned, with facilities equal to the CG-3A.

The front portion of the CG-3B unit is the videotape room, which provides space for two videotape machines and a Slo-Mo disk. The rear room of the vehicle

is compartmented to hold the many individual items of cargo. After cargo is cleared out, the rear room may be used for title camera or video-graph setup. A technical maintenance work bench is also in this area. There are hydraulic lift gates at the rear and side doors so that the heavy items may be unloaded with ease.

An important function of the carryall is crew comfort. Coverage of a baseball game or golf match in a broiling sun, or of a football game in sub-freezing weather is difficult enough under the best conditions, so a 110-gal (416-l) capacity stainless-steel water tank, foam-insulated underneath the floor between the air-conditioners, a coffee urn, a water cooler, a 10-gal (39-l) electric water heater, two washbasins and a jet-aircraft-type water closet are provided.

CG-4

The CG-4 (Fig. 4) is another type of color unit — an expansion on the compact videotape unit concept. It is a two-Plumbicon camera unit with a high-band tape machine (equipped for electronic editing), with its own engine generator for power, heat, air-conditioning and program lighting.

The chassis has air bag suspension instead of conventional springs, air brakes, a 534-in³ (8.75-l) industrial V-8 engine, a six-speed forward automatic transmission and power steering. The body has two three-ton air-conditioners with hot-gas bypasses and 8 kW of

electric heat. A 30-kW engine generator supplies power for technical, air-conditioning, and lighting use. As may be seen in Fig. 4, the engine generator is in the left rear and the air-conditioners in the right rear, with cargo space between. Two TK-44A cameras, each with 200 ft (61 m) of camera cable, may be carried in heated condition for rapid setup and taping when arriving on location. Just forward of this area is the monitor bridge, which also holds the power panel, the audio monitoring speaker and the sync generator. Below the bridge, on the right side of the vehicle, is the audio console with two video consoles next to it and additional space for a third. On the left side, just forward of the audio and video consoles is a TR-60 tape machine with an electronic editing facility. Forward of this, and elevated 10 in (25 cm) above the floor in the center of the vehicle, is the technical director-director console. This console contains the entire electronics and control head of a Grass Valley switcher which has 12 inputs, preset and program buses with cutbar and flip-flop switching, as well as two special-effects buses and a special-effects package with spotlight and positioner. Communications for the technical director and director are built into this package also.

The CG-4 mobile unit is designed to be readily stripped, so that the equipment may be moved into a building. Audio and video consoles may be taken out by removing two bolts in each. Four bolts

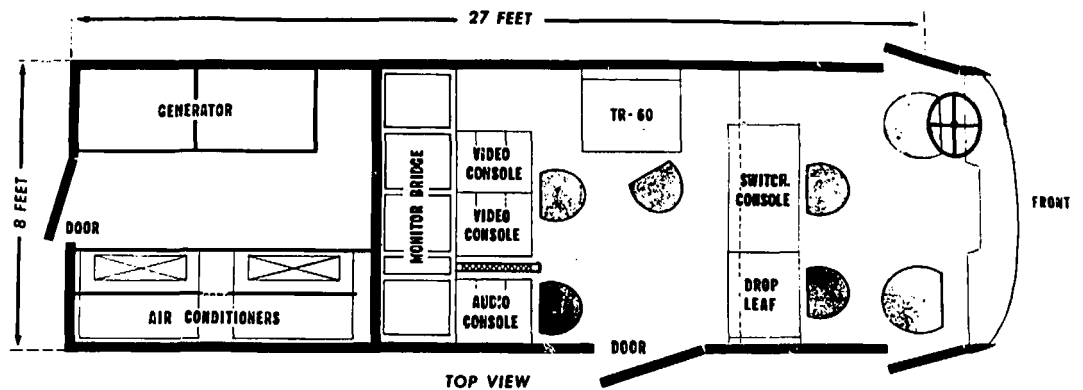


Fig. 4. The CG-4 interior layout.

hold the videotape machine and the switching console. With the exception of the videotape machine, the equipment is light enough to be removed by manpower without mechanical aid.

The audio console consists of two four-channel remote amplifiers, and is set up so one amplifier submasters the other, making available seven inputs. The console also contains an audio oscillator for test purposes, and an interrupted feedback is being added.

The vehicle has a subway-grill type of roof plate. By use of "J" bolts, it is possible to mount trainable seats and cameras or microwave dishes for taping or microwave operation in motion. Also provided is space for a 30-ft (9 m) pneumatically operated mast with a remote control head for a microwave dish.

Marriage Capability

With a group of mobile units such as described, the technique known as "marriage" is frequently used, whereby a number of units are lined up and one unit switches all cameras and tape machines as necessary. Normally, the sync generators of the slave units are gen-locked to the primary unit. Audio is usually handled by the primary unit. Connectors are provided on each unit for communications and for camera tally light switching.

Divorce Capability

Once in a great while — for example, on election night when a number of campaign headquarters are covered simultaneously — a large number of one- and two-camera pickups is desirable. The overall planning of mobile capability provides this in one form or another. CG-2, with its single camera, has the sync generator and communications system mounted in the console. The console may be lifted out of the vehicle by removing two bolts. This package, plus a remote audio amplifier and a color monitor, constitutes one remote setup.

The large unit, CG-3, has its cameras packaged 2, 2, 1 and 1. The one-camera packages are interchangeable with the one in CG-2 or those in CG-4. The double-camera consoles may be switched by means of a mechanically interlocked pushbutton switcher.

As we replaced our 13-year-old TK-41 studio cameras with TK-44A's in 1970 they were packaged in the same console as those used in the field, with communications internal, but without sync generators. By stripping mobile units of cameras, sync generators and remote amplifiers and by utilizing studio cameras as well, it is possible to create combinations to meet a large variety of situations.

Future Design Considerations

As recently as six years ago, when WMAQ-TV built its first videotape mobile unit, choice of vehicles, air-conditioners and engine generators was very limited. Now, however, there is a variety of small van-type vehicles on the market, with considerably increased weight-carrying capacity. Foam insulation kits and interior finish are available at reasonable prices. Roof-mounted air-conditioners are available with the evaporator and condenser in the roof package. Two of these units may be supplied by a compressor driven by the truck engine without overheating the engine, even when parked. This reduces the power drain necessary from the engine generator, and power becomes available for additional lighting. Engine generators may be slid out on built-in tracks for servicing.

Many attractive items of equipment are now on the market. Cableless RF (radio-frequency) cameras would certainly increase mobility and coverage. Multiple RF mikes would increase audio mobility. A lightweight miniature quadruplex high-band tape machine is available. With such new equipment, we have been able to plan the rebuilding of the one-camera units. The state-of-the-art had advanced so much in the years since the units were built that they seemed quite obsolete.