



RAM AIRCRAFT, LIMITED PARTNERSHIP
WACO, TEXAS 76708

**INSTRUCTIONS FOR
CONTINUED AIRWORTHINESS and
MAINTENANCE MANUAL SUPPLEMENT FOR
RAM 1719-3 PROPELLER SYNCHROPHASER
AND RAM 1406 PROP SYNCH SYSTEM
INSTALLED PER STC #'S**

**SA09105SC, SA09469SC, SA09574SC, SA2346SW, SA4241SW,
SA4011SW, SA4379SW, SA5998SW, SA4546SW, SA7382SW,
SA7365SW, SA7463SW, SA7570SW, SA8424SW, SA8604SW,
SA8727SW, SA8727SW, SA8920SW, and SA8989SW.**

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1. INTRODUCTION

- A. SCOPE: Information in this Maintenance Manual Supplement provides additional data required to insure the satisfactory operation, maintenance, and repair of the RAM 1719-3 propeller synchrophaser controller. This manual must be used in conjunction with the applicable basic Aircraft Maintenance/Service Manual. Information in this Maintenance Manual Supplement supercedes the information in the applicable basic Aircraft Maintenance/Service Manual, unless otherwise specified.

RAM p/n 1406 prop sync system: Some aircraft may have been modified by STC or otherwise FAA approved to incorporate the RAM p/n 1406 prop sync system. The RAM p/n 1406 prop sync system is identical to the McCauley MC-1 system. For maintenance, inspection, troubleshooting, adjustment, and testing of the RAM p/n 1406 prop sync system, use McCauley Manual MPC-25 (or p/n 791005) unless specifically addressed herein.

Applicable STC's are SA09105SC, SA09469SC, SA09574SC, SA2346SW, SA4241SW, SA4011SW, SA4379SW, SA5998SW, SA4546SW, SA7382SW, SA7365SW, SA7463SW, SA7570SW, SA8424SW, SA8604SW, SA8727SW, SA8727SW, SA8920SW, and SA8989SW.

- B. PURPOSE: This manual is intended to satisfy the requirements of 14 CFR Part 23.1529, Instructions for Continued Airworthiness, for RAM propeller synchrophaser controller.
- C. APPLICABILITY: McCauley MC-1 synchrophaser system using RAM part number 1719-3 synchrophaser controller rather than McCauley B-28000 controller.
- D. PRECAUTIONS:
- (1) **WARNING!** SHUT DOWN ENGINES before making any governor adjustments.
- E. REFERENCES:
- (1) RAM Drawing 1739, Master Drawing - RAM Propeller Synchrophaser.
 - (2) RAM Drawing 1406, McCauley MC-1 Synchrophaser and Governor Installation.
 - (3) McCauley Manual 791005, McCauley Synchrophaser System Manual for the MC-1.
 - (4) McCauley Manual 780401, McCauley Synchrophasing Governor Manual for Series 290 Governors.
 - (5) McCauley Service Letter 1984-7, MC-1 Synchrophaser Servicing.
- F. UPDATES: Manual updates will be made available upon request. Complete copies of this Maintenance Manual Supplement can be obtained by contacting RAM's Customer Service Department.

2. DESCRIPTION

Aircraft equipped with a McCauley MC-1 propeller synchrophaser system may use RAM part number 1719-3 synchrophaser controller in place of McCauley part number B-28000 synchrophaser controller. The RAM synchrophaser controller functions within the basic architecture of the McCauley MC-1 synchrophaser system.

The RAM synchrophaser controller continuously monitors and maintains propeller synchronization and phasing, working in conjunction with McCauley 290 series synchrophasing governors. The controller consists of a printed circuit board assembly contained in the synchrophaser electronic control box. The control box is mounted under the aircraft's glove box located on the copilot's side of the cockpit and has a plug receptacle to connect the existing McCauley MC-1 system synchrophaser wiring harness. The wiring harness links the synchrophaser controller to the propeller governors. Wiring harness electrical connections are interchangeable between the RAM and McCauley control boxes.

The RAM controller's method to synchronize propellers and modify propeller phasing differs from the McCauley controller. When turned on, the RAM controller energizes each governor with a 28-volt pulse train signal (increasing propeller speed), analyzes the phase relationship between the left and right propeller (governor) speed signals, and regulates the continuous, variable square wave, 28-volt pulse train signal to each governor in order to control governor output and achieve propeller synchronization and phase control. When one propeller speeds up, the controller detects the phase angle of one governor channel advancing relative to the other. In order to maintain synchronization between propellers, the controller decreases the period of the square wave signal (decreasing pulse train) to the governor of the advancing propeller and increases the period of the square wave signal (increasing pulse train) to the governor of the lagging propeller. The advancing propeller slows while the lagging propeller speeds up until both propellers return to the synchronized state.

The two 28-volt square wave signals energize each governor speed control coil to affect the governors' control mechanism. The McCauley 290 series governor control mechanism consists of fly-weights rotating through a magnetic field created by the governor control coil and an internal vernier pressure valve. An increasing or decreasing pulse train signal to the control coil excites the magnetic field, which, in turn, induces a change in the fly-weight position. The fly-weight position affects the vernier pressure valve, which regulates the pressure of the oil controlling the propeller blade pitch. The mechanism allows precise control of the propeller rotation speed over a limited range of authority. The RAM synchrophaser system allows an 80 to 85 RPM increase in propeller speed when a 28 VDC signal is applied to the control coil, except for 404, 421B, and 421C aircraft. On 404, 421B, and 421C aircraft, the RAM synchrophaser system allows a 70 ± 3 RPM increase in propeller speed when a 28V DC signal is applied to the control coil.

The pilot may rotate the phase control knob to adjust the phase angle between propellers. Rotating the knob commands the RAM synchrophaser controller to skew the pulse train

NOTE: Refer to the McCauley Synchrophaser System Manual for the MC-1, Manual no. 791005, for a description of and guidance for the McCauley MC-1 system. Unique instructions that apply to the McCauley MC-1 system utilizing the RAM synchrophaser controller are specified in this manual.

3. OPERATION INFORMATION

A. BASIC OPERATION:

- (1) The synchrophaser controller is turned on and off by a switch on the cockpit control panel, and operating status is shown by an ON/OFF indicator light.
- (2) To synchronize the propellers, set engine power and manually synchronize the propellers within 25 RPM. Turn the synchrophaser switch to the ON position.
- (3) To adjust the propeller phase relation, rotate the phasing control knob next to the ON/OFF switch. A momentary speed change will accompany a phase adjustment.
- (4) Refer to Table 1 for basic operating specifications of the RAM synchrophaser controller.

NOTE: The propeller synchrophaser system may be ON for take off and landing operations.

B. SYSTEM GROUND CHECK:

- (1) Set the synchrophaser switch OFF.
- (2) Set engines to cruise power engine speed, then reduce speed by 200 RPM using the pitch control to insure that the governors are controlling engine speed.
- (3) Synchronize the propellers manually within 25 RPM using pitch control.
- (4) Turn the synchrophaser switch to the ON position.
- (5) If propellers do not rise to an equal speed, refer to the troubleshooting section to evaluate the problem.

C. SYSTEM FLIGHT CHECK:

- (1) Set the synchrophaser switch OFF.
- (2) After reaching a safe altitude, set engines to cruise power.
- (3) Synchronize the propellers manually within 25 RPM.
- (4) Turn the synchrophaser switch to the ON position.
- (5) If propellers do not rise to an equal speed, refer to the troubleshooting section to evaluate the problem.
- (6) Check the synchronization split by advancing the propeller control of one engine until the synchronizing lock is broken. The split should be 80 RPM minimum, except on 404, 421B, and 421C aircraft. On 404, 421B, and 421C aircraft, the split should be 67 RPM minimum (measure with a calibrated tach. sensor).
- (7) Adjust the phase knob to check that the propeller phasing functions accordingly.
- (8) If the synchrophase system does not operate properly, refer to the troubleshooting section to evaluate the problem.

Supply voltage	12 to 30 VDC
Normal current draw	300 ma at 12 VDC 700 ma at 30 VDC
Normal operating frequency	25 to 60 Hz (1500 to 3600 RPM)
Captivity range	2 Hz (120 RPM)
Nominal input pulse amplitude	1.5 to 1.75 volts, peak

Table 1. RAM Synchrophaser Controller Operating Specifications

4. MAINTENANCE INSTRUCTIONS

The RAM synchrophaser controller does not require periodic maintenance, and there is no component overhaul required for controller. However, the following inspection interval must be followed to insure the continued safe operation and airworthiness of the RAM synchrophaser controller and McCauley MC-1 system. The ensuing maintenance instructions should be followed to correct a malfunction of the synchrophaser system. Refer to the troubleshooting section for guidance.

- A. INSPECTION INTERVAL: Every 200 HRS or 1 YEAR, whichever comes first, check security and condition of propeller synchrophaser system components, including the synchrophaser controller plug, pins, and box, and check for loose, chafed, or broken wires.
- B. SYSTEM WIRING CHECK:
- (1) Turn Master Switch OFF, pull synchrophaser circuit breaker OUT, and disconnect wiring harness from synchrophaser controller.
 - (2) Refer to Fig. 1 to see the system wiring diagram; see also Ref. 2 & 3.
 - (3) Test wiring by connecting an ohmmeter to the wiring harness plug connector pins according to the chart and plug illustration shown in Fig. 2.
 - (4) If faults are discovered, use the information in the chart in Fig. 2 to correct the problem.
- C. McCAULEY GOVERNOR TEST & ADJUSTMENT:

NOTE: Refer to the McCauley Synchrophasing Governor Manual for Series 290 Governors, Manual no. 780401, for additional information about McCauley governors, including illustrations.

- (1) Speed pick-up transducer check (ground test).
 - a. Before proceeding, check the governor speed pick-up wiring by following the System Wiring Check procedures.
 - b. Disconnect synchrophaser wiring harness plug from synchrophaser controller and connect an oscilloscope to plug terminals TP1 and TP2 (ref. Fig. 2) for the RH engine or TP2 and TP3 for the LH engine.

- c. Run engines and set engine speed to 1800 RPM, operating under governor control except on 404, 421B, and 421C aircraft. On 404, 421B, and 421C aircraft, if the transducer is checked on the aircraft, the engines should be set at 1500 propeller RPM.
 - d. Set synchrophaser circuit breaker IN and switch ON.
 - e. Using the oscilloscope, measure the governor's magnetic speed pick-up transducer voltage. Voltage should be within 1.50 ± 0.25 VAC from base line to positive peak at 1800 RPM. Base line noise should not exceed 0.3 VAC.
 - f. If the governor speed pick-up transducer supply voltage is not within the specified tolerance, adjust voltage by turning transducer clockwise to increase or counterclockwise to decrease.
 - g. When proper setting is obtained, tighten the transducer jam nut down against the governor body and torque nut to 18 to 24 inch-pounds.
 - h. If the voltage is too low and will not adjust properly, and the system wiring is not at fault, the transducer connector maybe faulty. Replace the transducer connector.
- (2) Control coil/RPM gain check (ground test).
- a. Before proceeding, check the governor control coil wiring by following the System Wiring Check procedures.
 - b. Disconnect the synchrophaser wiring harness plug from the synchrophaser controller and jumper plug terminals to provide supply power (28 VDC) to the governor control coil. Only test one coil at a time.
 - i) Make jumper wire using three inches of 2-111224-30 gauge insulated wire and two Molex 02-06-2103 crimp terminals.
 - ii) Connect (jumper) pins TP5 to TP7 and TP10 to TP11 on the wiring harness plug (ref. Fig. 2) to power the RH engine governor control coil.
 - iii) Connect (jumper) pins TP5 to TP9 and TP11 to TP12 on the wiring harness plug (ref. Fig. 2) to power the LH engine governor control coil.
 - c. Run engines and set engine speed to 2300 RPM, operating under governor control.
 - d. Set synchrophaser circuit breaker IN and switch ON.
 - e. Using a calibrated tach. sensor, measure the speed increase. The engine should exhibit an 80 to 85 RPM increase for the powered control coil except for 404, 421B, and 421C aircraft. On 404, 421B, and 421C aircraft, to compensate for gear reduction on GTSIO-520 engines, the propeller should exhibit 70 ± 3 RPM increases for the powered control coil.
 - f. If the speed increase is not within the specified tolerance, adjust the governor RPM gain.
 - i) SHUT DOWN engines and remove power from control coil.
 - ii) Adjust coil and pole piece assembly nuts located on governor top cover.
 - iii) If the speed increase is less than 80 RPM (67 RPM on 404, 421B, and 421C aircraft), turn the nuts counterclockwise to increase RPM gain.
 - iv) If the speed increase exceeds 85 RPM (73 RPM on 404, 421B, and 421C aircraft), turn the nuts clockwise to reduce RPM gain.

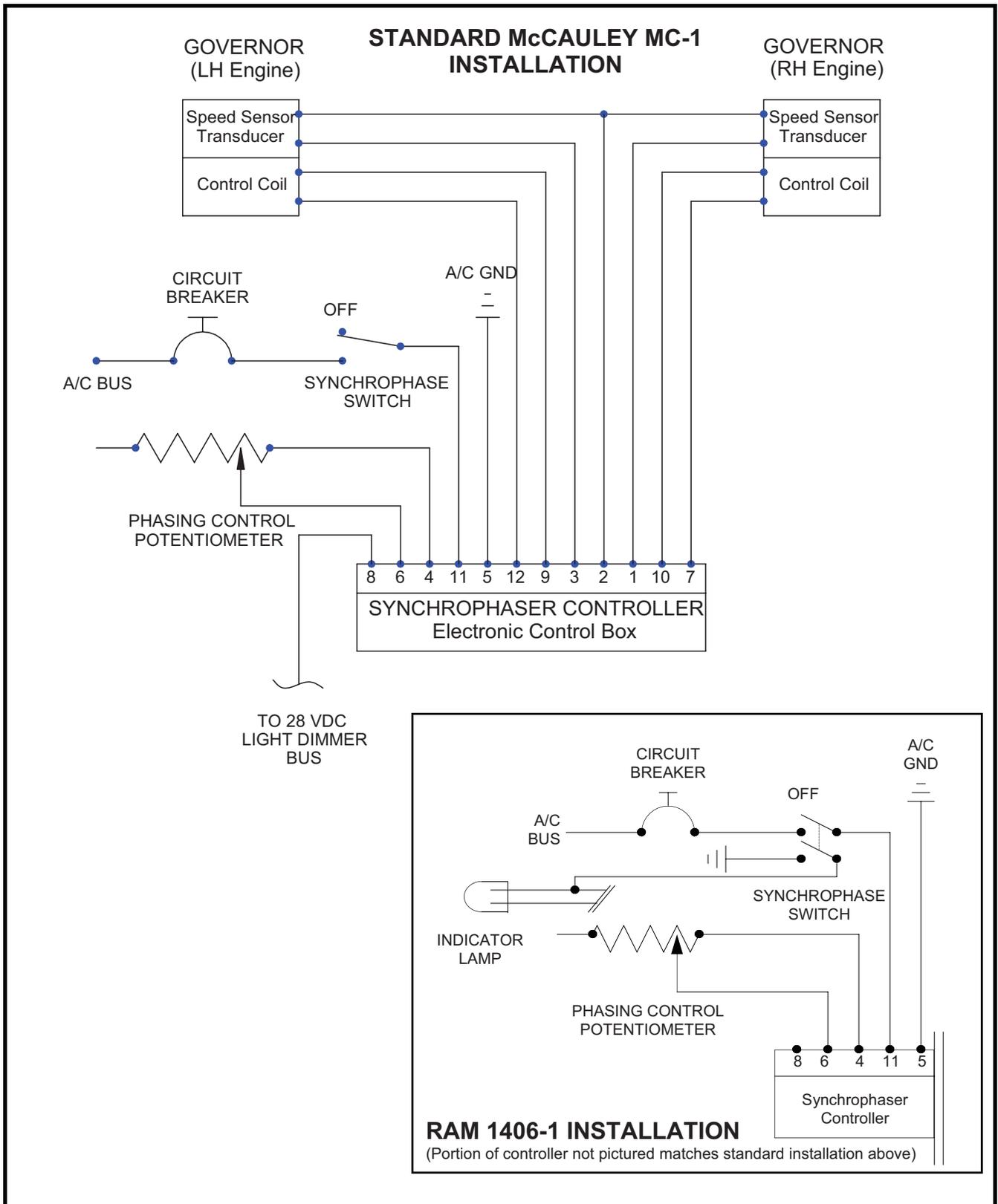
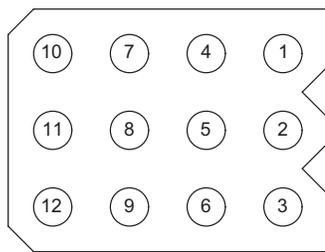


Figure 1. Synchrophaser System Wiring Diagram.

TO CHECK:	CONNECT METER LEADS TO:	REQUIRED READING:	IF FAULT, THEN:
Airframe to ground connection	TP5 and airframe	0 ohms (short circuit)	Repair ground lead.
Primary power (Master switch OFF)	TP5 and TP11	∞ ohms (open circuit)	Repair power lead or circuit breaker.
Primary power (Master switch ON, circuit breaker SET)	TP5 (-) and TP11 (+)	Supply voltage, 28 VDC	Check aircraft wiring, circuit breaker, and ground, then repair or replace accordingly.
Right governor speed pick-up	TP5 and TP1	∞ ohms (open circuit)	Repair or replace wiring or connector. Replace transducer if it indicates open or shorted to ground.
	TP5 and TP2	∞ ohms (open circuit)	
	TP1 and TP2	52 to 68 ohms	
Left governor speed pick-up	TP5 and TP2	∞ ohms (open circuit)	
	TP5 and TP3	∞ ohms (open circuit)	
	TP2 and TP3	52 to 68 ohms	
Right governor control coil	TP5 and TP7	∞ ohms (open circuit)	Repair or replace wiring or connector. Replace control coil if it indicates open or shorted to ground, or if wiring not at fault.
	TP5 and TP10	∞ ohms (open circuit)	
	TP7 and TP10	28.8-35.2 ohms (54 to 64 ohms on some models)**	
Left governor control coil	TP5 and TP9	∞ ohms (open circuit)	
	TP5 and TP12	∞ ohms (open circuit)	
	TP9 and TP12	28.8-35.2 ohms (54 to 64 ohms on some models)**	
Synchrophaser indicator lamp	TP5 and TP8*	∞ ohms (open circuit, indicator lamp removed)	Replace lamp if burned out.
Phasing control	TP4 and TP6	0 to 50K ohms, variable (operate control through full range)	Repair or replace wiring. Replace potentiometer if reading intermittent or out of spec., or if wiring not at fault.



Synchrophaser Wire Harness Plug
Connector Pin Locations

Synchrophaser Wire Harness Plug
Connector Pin Functions

- TP1 - Speed pick-up, RH engine
- TP2 - Speed pick-up, RH & LH engine (common)
- TP3 - Speed pick-up, LH engine
- TP4 - Phasing (potentiometer end)
- TP5 - Airframe ground
- TP6 - Phasing (potentiometer wiper)
- TP7 - Control coil, RH engine
- TP8 - Propeller synchrophaser light*
- TP9 - Control coil, LH engine
- TP10 - Control coil, RH engine
- TP11 - Ship power, 28 VDC
- TP12 - Control coil, LH engine

*NOT CONNECTED IN RAM 1406-1 INSTALLATION

**Coils in early production governors on 404 and 421C aircraft.

Figure 2. Synchrophaser System Wiring Checks

5. TROUBLESHOOTING INFORMATION

- A. If the synchrophaser system initially works, but occasionally loses synchronization, or the engine speed surges or hunts, or the system is marginally stable and does not achieve the specified synchronization split, the governor may not be calibrated correctly. Check the governor RPM gain by following the McCauley Governor Test and Adjustment procedures.
- B. If the synchrophaser circuit breaker trips, there is a short in the power lead. Check the wiring by following the System Wiring Check procedures.
- C. If the synchrophaser system is inoperative:
 - (1) Check for broken or chafed wires in the synchrophaser wiring harness from the governor to the engine firewall.
 - (2) Check the synchrophaser wiring harness plug for loose wires, and check the control box plug receptacle for loose, bent, or damaged pins (box located at the back of the glove box in the cockpit).
 - (3) Check to see the system is getting power by following the System Wiring Check procedures.
 - (4) Check the governor speed pick-up and control coil for each engine by following the McCauley Governor Test & Adjustment procedures.
 - (5) Check the phasing control by following the System Wiring Check procedures.
- D. After completion of troubleshooting procedures, perform an operational check of the synchrophaser system using the System Ground Check or Flight Check procedures.
- E. If the system remains inoperative after satisfactorily completing all troubleshooting procedures, replace the RAM synchrophaser controller following the replacement procedures. Contact RAM Aircraft Customer Service for replacement parts or additional help.

NOTE: Refer to McCauley Service Letter 1984-7 for additional propeller, governor, and synchrophaser system troubleshooting procedures (Steps 3 & 4 are not applicable to the RAM controller).

6. REMOVAL AND REPLACEMENT

- A. **REMOVAL:** To remove the synchrophaser controller (electronic control box), disconnect the synchrophaser wiring harness plug and remove the two nuts, washers, and screws attaching the box to the aircraft's glove box.
- B. **REPLACEMENT:** If troubleshooting determines that the synchrophaser controller is malfunctioning, return controller to RAM Aircraft for repair or replacement.
- C. **INSTALLATION:** Install the synchrophaser controller in the reverse order using two MS35206-245 screws, two NAS1149FN882P washers, and two MS21083N08 nuts. Be sure to reconnect the ground strap to the controller box.

7. AIRWORTHINESS LIMITATIONS

The Airworthiness Limitations section is FAA approved and specifies maintenance required under Parts 43.16 and 91.403 of the Federal Aviation Regulations unless an alternative program has been FAA approved.

There are no airworthiness limitations for RAM 1719-3 synchrophaser controller. Changes to Airworthiness Limitations will be published in FAA Airworthiness Directives (AD).