Application Note

Aircraft Type: Embraer Legacy, 135 & 145

Procedure: Transient Vibration Survey

Part Number: 11-200-0188

AppNote Number: A-EA-EMB145-4040-TVS

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Application Note

Application Note Number	A-EA-EMB135/145-4040-TVS
Version	1.1
Function	N1 & N2 Tracked Transient Vibration Survey
Airframe	Embraer ERJ135/145 & Legacy
Engine	Rolls-Royce AE3007E
Other Application Notes Required	None
ACES Systems Analyzer	Viper 4040
Firmware Version	1.04 or greater
Procedure Cards	N/A

Introduction

This Application Note is number 1 of 1 Application Notes required to perform an N1 & N2 tracked transient vibration survey on a Embraer Legacy, ERJ135, or ERJ145 with Rolls-Royce AE3007E engines. This Application Note describes the steps necessary for set up and operation of the Viper 4040 analyzer and associated equipment.

Required Equipment: The following equipment is required to accomplish this survey.

Item	Quantity	Description	Part Number
1.	1EA	Analyzer, Viper 4040	10-100-4040
2.	4EA	Cable, Vibe, 6 Pin Generic, 50 Ft.	10-320-0127
3.	1EA	Cable, Interface, FADEC N1 & N2, EMB145	10-320-0314
4.	1EA	Cable, Interface, ERJ145 EVM, Vibration	10-320-0144
5.	4EA	Cable, Tachometer, Generic, 50 Ft.	10-320-0126
6.	1EA	Option, 4040 Transient Vibration Survey	11-900-0008

Optional Equipment: None

A. Equipment Set Up

1. Remove the flapper valve cover from the pressure blowout door at the aft bulkhead, right side baggage compartment by removing four (4)-retaining nuts. (REF EMB-135/145 AMM)

2. Wrap a 1x2 inch strip of masking tape around both ends of all four generic vibration cables and all four generic tach cables. Mark the tape at both ends of two generic vibe cables (item 2.) to read "VIBE 1". Mark both ends of the remaining two generic vibe cables "VIBE 2". Mark the tape at both ends of two generic tach cables to read "N1". Mark both ends of the remaining two generic tach cables to read "N2".

3. Route the socket end(s) of one generic vibration cable (item 2.) marked "VIBE 1" and one generic vibration cable market "VIBE 2" through the flapper valve and into the aft electronics compartment. Route the socket end of one generic tach cable (item 5.) marked "N1" and one generic tach cable marked "N2" through the flapper valve and into the aft electronics compartment. Place approximately 4 feet of all cables through the valve. Place the excess cable remaining in the baggage compartment near the lavatory pressure blow out door at the left forward end of the baggage compartment. You may alternately route the cables out the opened access panel 272DR and along the fuselage to the over wing escape hatch. If you exercise this option, secure the cable(s) every 36 inches along the underside of the fuselage with duct tape or speed tape to prevent possible ingestion into the engine. (Ref. EMB135/145 AMM)

4. Open the aft electronics bay door (Access panel 272DR) on the right side of the aft fuselage. Enter the compartment and connect the ERJ145 vibration interface (item 4.) to the front EVM Unit Test Connector. The EVM unit is located on the upper equipment rack adjacent to the Flight Data Recorder. (See photo on page 3.)

5. Disconnect the J4 (bottom right) connector from the FADEC you intend to use for the N1 / N2 speed signals. Use the FADEC most accessible. Install the FADEC N1 & N2 interface cable on the FADEC J4 connection where the system cable was removed and attach the system cable to the opposite end of the FADEC N1 & N2 interface. (See photo and illustration on page 4.)

6. Connect the yellow leads from the EVM interface cable as follows:

   a. Connect the lead marked "Vibe 1A" if surveying the left (#1) engine or "Vibe 2A" if you are surveying the right (#2) engine, to the six pin generic vibe cable marked as VIBE 1 in step 2 above.

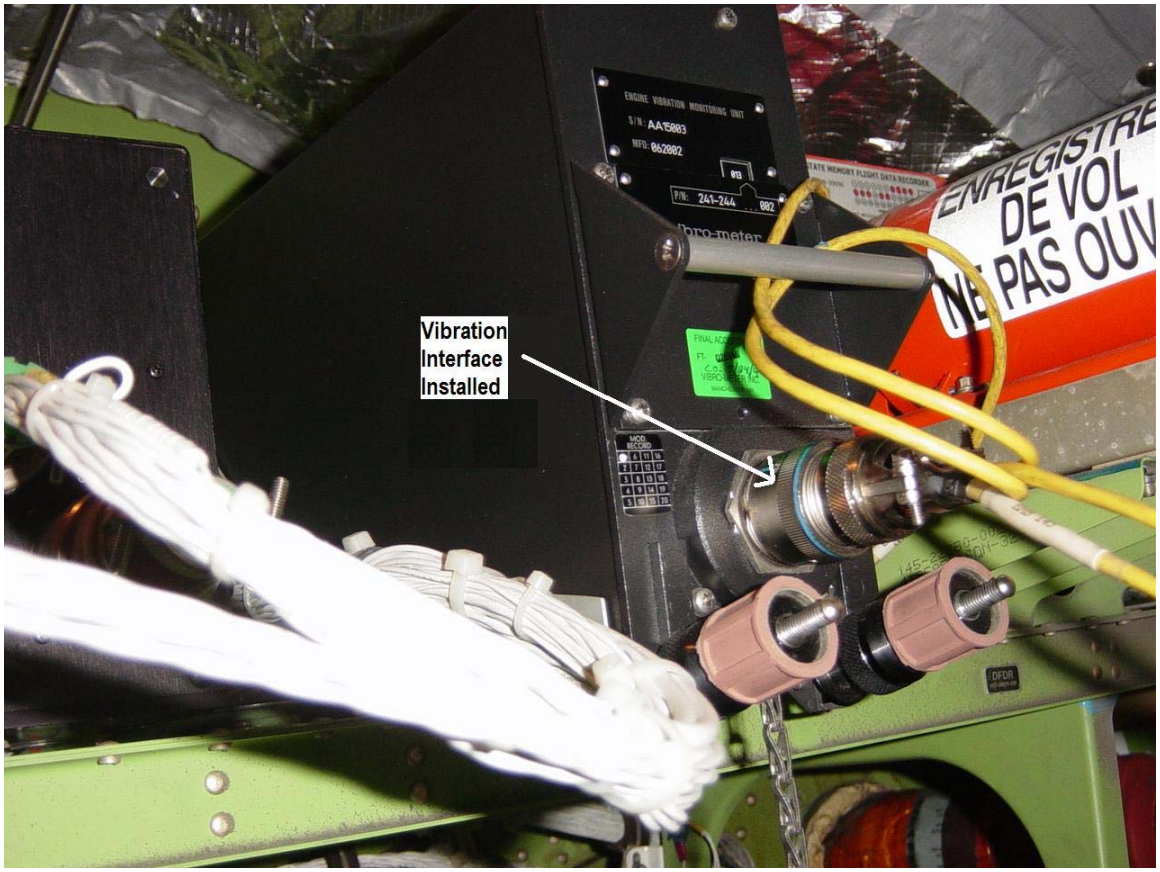
   b. Connect the lead marked "Vibe 1B" if surveying the left (#1) engine or "Vibe 2B" if you are surveying the right (#2) engine, to the six pin generic vibe cable marked as VIBE 1 in step 2 above.

7. Connect the yellow leads from the FADEC N1 & N2 interface as follows:

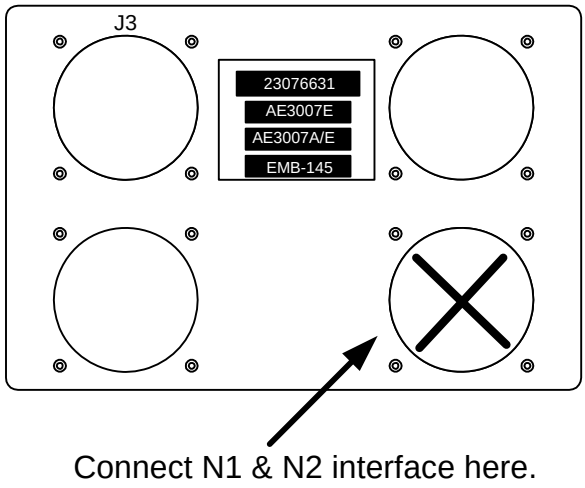
   a. Connect the lead marked N1 to the generic tach cable marked N1 in step 2 above.

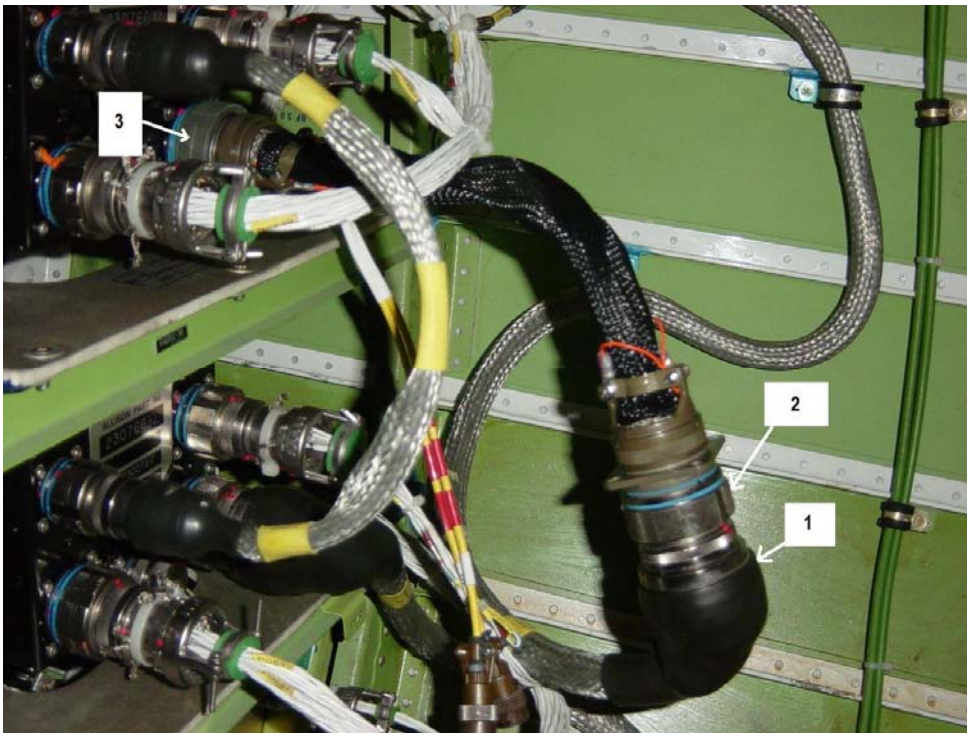
   b. Connect the lead marked N2 to the generic tach cable marked N2 in step 2 above.

8. From the lavatory side of the aft lavatory bulkhead, remove the pressure blowout door at the lower left side of the bulkhead. Route the generic vibration cables (item 2.) and the generic tach cables, (item 4) from the baggage compartment through the opening and toward the cockpit. Drape the cables over passenger seat arms to avoid entanglement with feet. Attach the second set of 50-foot cables to the first set, matching the identifying tags as you do. Continue routing the second set of cables to the cockpit or where the analyzer will be operated.



EVM unit with vibration interface cable attached. Notice the orange Flight data recorder to the right and slightly above the EVM unit. The yellow cables from the interface terminate with six pin connectors, which are connected to the generic vibe cables.





Key: 1. The system cable disconnected from the FADEC.

2. The N1 & N2 interface connected to the system cable which was disconnected from the FADEC.

3. The N1 & N2 interface connected at the FADEC.

9. Place the 4040 (item 1) analyzer in the cockpit or locate it where the operator will use it. Connect the various cables as follows:

9.1 Connect the generic vibe cable marked VIBE 1 to the six pin connector marked "**CHANNEL A**"

9.2 Connect the generic tach cable marked N1 to the three pin connector marked "**TACH 1**"

9.3 Connect the generic vibe cable marked VIBE 2 to the six pin connector marked **"CHANNEL B"**

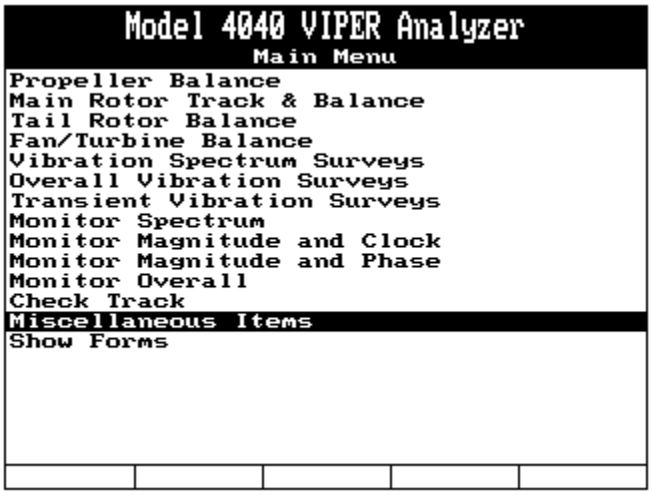
9.4 Connect the generic tach cable marked N2 to the three pin connector marked "**TACH 2**"

10. Transient Vibration Survey Setup.

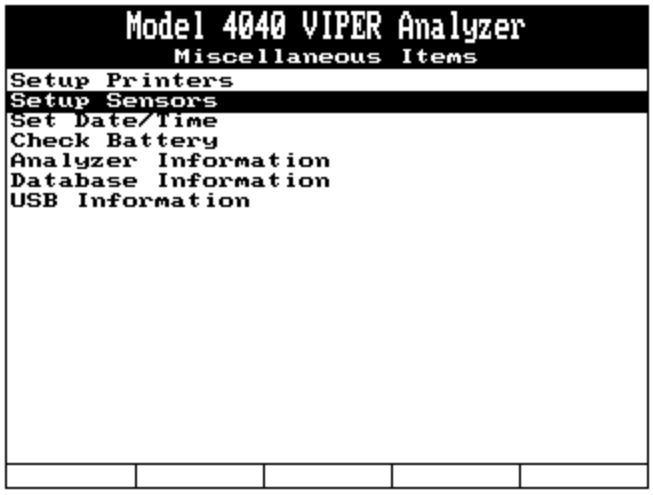
10.1 This section will give you the steps to enter the AE3007 Transient Vibration Survey Setup into the Viper Analyzer. If the setup has been previously entered, you need not repeat this step. If the setup is available, go to section B. Data Acquisition. Otherwise proceed to 11.2 below.

10.2 Turn the analyzer on by pressing the [ON/OFF] key.

10.3 From the Main Menu, select Miscellaneous Items.

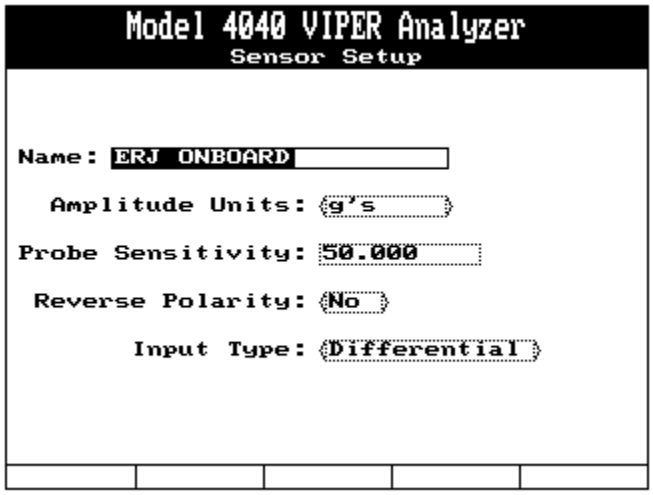


11. From the Miscellaneous Items menu, select "Setup Sensors".



11.1 Complete the Sensor Setup screen, shown below, as follows:

11.2 In the **Name:** field, enter “ERJ ONBOARD”. This will indicate this sensor is installed permanently on the engine of the Embraer RJ. Press the [⇩] key to move to the next field.



11.3 In the **Amplitude Units:** field, use the ⇨ key to select “g’s”. This is the engineering unit of output for the onboard sensor. It will be converted to IPS by the analyzer for balancing. Press the ⇩ key to move to the next field.

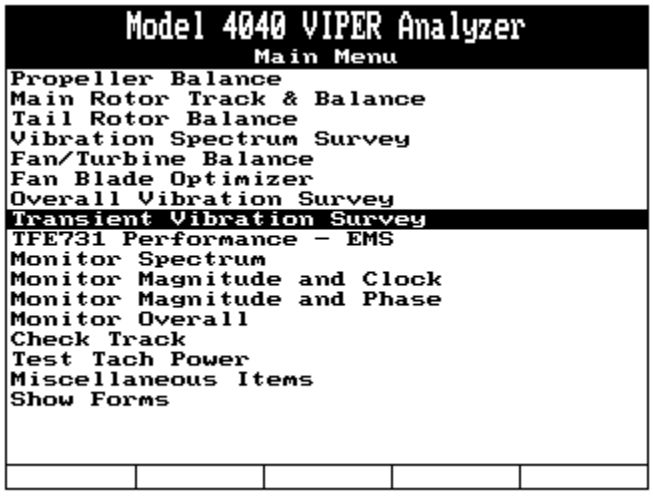
11.4 In the **Probe Sensitivity:** field, enter “50”. This indicates the output of the onboard sensor is 50 mV/g. Press the ⇩ key to move to the next field.

11.5 In the **Reverse Polarity:** field, use the ⇨ key, if necessary, to select “No” indicating the sensor polarity is not reversed. Press the ⇩ key to move to the next field.

11.6 In the **Input Type:** field, use the ⇨ key, if necessary, to select “Differential” indicating the type input to the sensor.

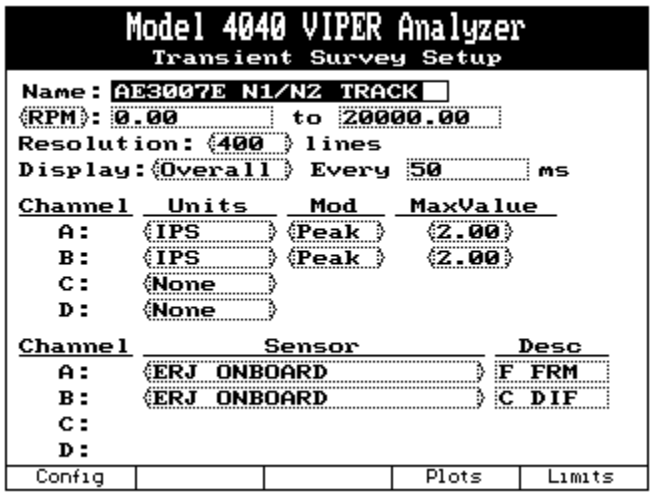
11.7 When all fields are complete, press ENTER to accept and save. The screen will return to the “Manage Sensors” screen. From that screen, press [BACKUP] repeatedly until the Main Menu is again displayed.

12. From the Main Menu, select “Transient Vibration Surveys” and press [ENTER].



13. If there are other setups already in the analyzer, the Setup List banner screen will be displayed. From that screen, press the [F1] “New” key. If no setups are in the analyzer, the “Transient Survey Setup” screen will be displayed automatically. Complete the Setup screen as follows:

13.1 Use the keypad to enter “AE3007E N1/N2 TRACK” in the **Name:** field. Press the ⇩ key to move to the next field.



13.2 In the **<RPM/Hz>:** field, press the [⇨] key (if necessary) until the filed reads “RPM”. Press the [⇩] key to move to the next field.

13.3 In the unlabeled **Minimum frequency** field, the RPM will default to 0.00. If it does not currently show this value, use the keypad to enter 0.00. Press the [⇩] key to move to the next field.

13.4 In the unlabeled **Maximum frequency** field, use the analyzer keypad to enter 20000.00. Press the [⇩] key to move to the next field.

13.5 In the **Resolution:** field, use the [⇨] key to select “400”. Press the [⇩] key to move to the next field.

13.6 In the **Display:** field, use the [⇨] key to select “Overall”. Press the [⇩] key to move to the next field.

13.7 In the **Every:** field, use the analyzer keypad to enter “50”. Press the [⇩] key to move to the next field.

13.8 In the **Units** column of the channel A: row, use the [⇨] key to select “IPS”. Press the ⇩ key to move to the next field.

13.9 In the **Mod:** (Modifier) column of the Channel A: row, use the [⇨] key to select “Peak’. Press the [⇩] key to move to the next field.

13.10 In the **MaxValue:** column of the Channel A: row, use the [⇨] key to select “2.00”. Press the [⇩] key to move to the next field.

13.11 Repeat steps 11.6.8 through 11.6.10 for the Channel B: row, then press the down arrow key three time to move to the Sensor column for Channel A: row.

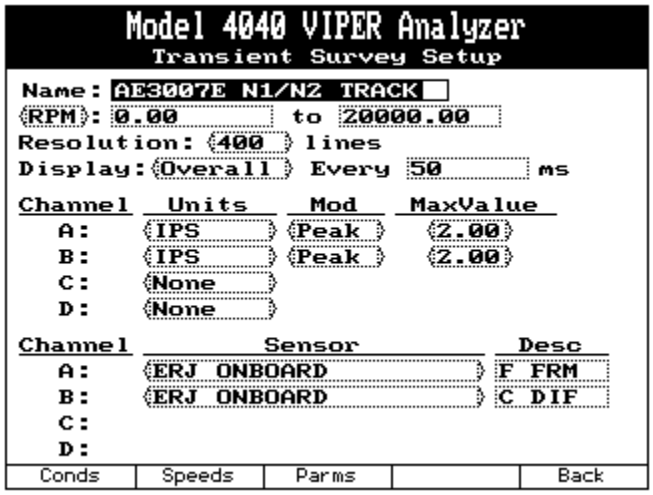
13.12 In the **Sensor** column of the Channel A: row, use the [⇨] key to select “ERJ ONBOARD”. Press the [⇩] key to move to the next field.

13.13 In the **Desc** column for the Channel A: row, use the analyzer keypad to enter “F FRM” for Front Frame. Press the [⇩] key to move to the next field.

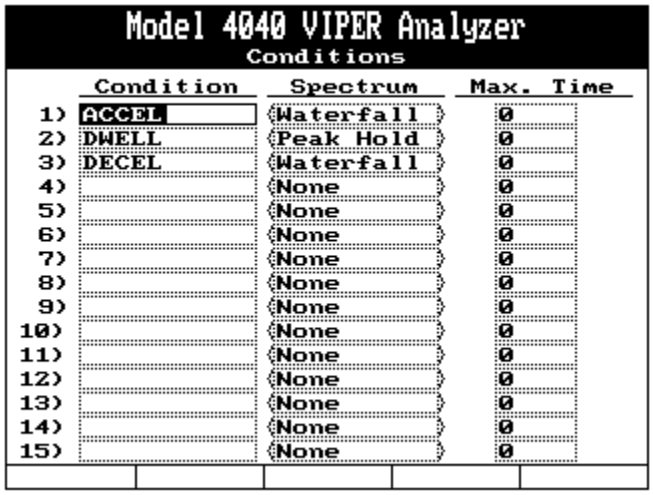
13.14 In the **Sensor** column of the Channel B: row, use the [⇨] key to select “ERJ ONBOARD”. Press the [⇩] key to move to the next field.

13.15 In the **Desc** column for the Channel B: row, use the analyzer keypad to enter “C DIF” for Compressor Diffuser. Press the [F1] “Config” key to continue.

13.16 The function keys at the bottom of the screen will change values as shown in the screen below. Press the [F1] “Conds” key.



14. The “Conditions” screen will be displayed. Complete each field in the screen as follows:



14.1 In the **Condition** column, row 1), use the analyzer keypad to enter “ACCEL”**.** Press the [⇩] key to move to the next field.

14.2 In the **Spectrum** column, row 1), use the ⇨ key to select “Waterfall”. Press the [⇩] key to move to the next field.

14.3 In the **Max. Time** column of row 1), you have two options. If you leave this value at “0” (zero), the analyzer will continue to take data for the condition until you press the [ENTER] key to stop it. If you enter a value higher than zero in this field, the analyzer will take data only for that number of seconds then terminate the data collection. Enter a number of seconds using the analyzer keypad or leave the field at zero per your requirements. Press the [⇩] key to move to the next field.

14.4 In the **Condition** column, row 2), use the analyzer keypad to enter “DWELL”**.** Press the [⇩] key to move to the next field.

14.5 In the **Spectrum** column, row 2), use the [⇨] key to select “Peak Hold”. Press the [⇩] key to move to the next field.

14.6 In the **Max. Time** column of row 2), you have two options. If you leave this value at “0” (zero), the analyzer will continue to take data for the condition until you press the [ENTER] key to stop it. If you enter a value higher than zero in this field, the analyzer will take data only for that number of seconds then terminate the data collection. Enter a number of seconds using the analyzer keypad or leave the field at zero per your requirements. Press the [⇩] key to move to the next field.

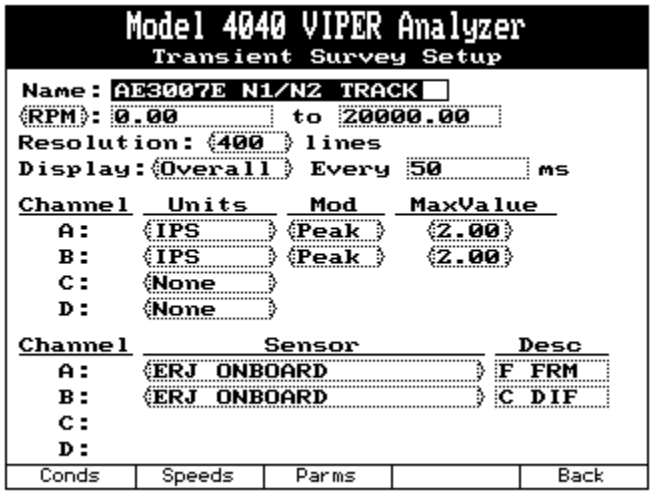
14.7 In the **Condition** column, row 3), use the analyzer keypad to enter “DECEL”**.** Press the [⇩] key to move to the next field.

14.8 In the **Spectrum** column, row 3), use the [⇨] key to select “Waterfall”. Press the [⇩] key to move to the next field.

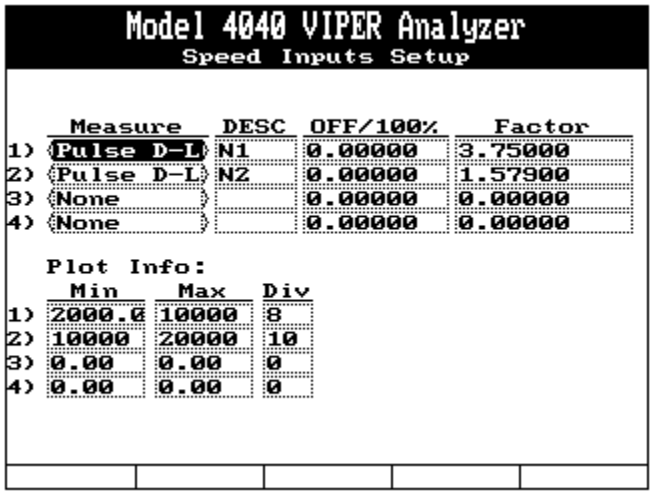
14.9 In the **Max. Time** column of row 3), you have two options. If you leave this value at “0” (zero), the analyzer will continue to take data for the condition until you press the

[ENTER] key to stop it. If you enter a value higher than zero in this field, the analyzer will take data only for that number of seconds then terminate the data collection. Enter a number of seconds using the analyzer keypad or leave the field at zero per your requirements. Press [ENTER] to accept your settings and continue.

14.10 The analyzer will return to the Transient Survey Setup screen. Again press the [F1] "Config" key. The function keys will again return to those shown in the screen below. Press the [F2] "Speeds" key.



15. The analyzer will display the Speed Inputs Setup screen shown below. Complete the screen as follows:



15.1 In the Measure column of row 1), use the [⇨] key to select "Pulse D-L". Press the [⇩] key to move to the next field.

15.2 In the DESC column of row 1), use the analyzer keypad to enter “N1”. Press the [⇩] key to move to the next field.

15.3 Leave the OFF/100% column set at 0.00000 and press the [⇨] key to move to the next field.

15.4 In the Factor column of row 1), use the analyzer keypad to enter “3.75000”. Press the [⇩] key to move to the next field.

15.5 In the Measure column of row 2), use the [⇨] key to select “Pulse D-L”. Press the [⇩] key to move to the next field.

15.6 In the DESC column of row 2), use the analyzer keypad to enter “N2”. Press the [⇩] key to move to the next field.

15.7 Leave the OFF/100% column set at 0.00000 and press the [⇨] key to move to the next field.

15.8 In the Factor column of row 2), use the analyzer keypad to enter “1.57900”. Press the [⇩] key to move to the next field.

15.9 Press the [⇩] key nine times or until the cursor is in the Min column of row 1 of the Plot Info section of the screen. Use the analyzer keypad to enter “2000”. Press the [⇩] key to move to the next field.

15.10 In the Max column of row 1), use the analyzer keypad to enter “10000”. Press the [⇩] key to move to the next field.

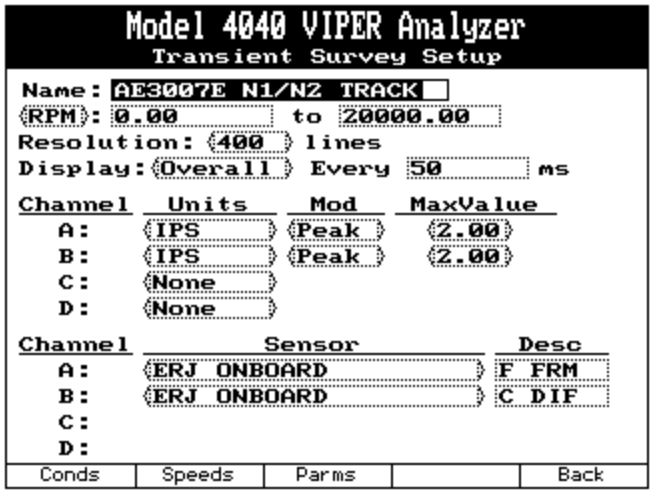
15.11 In the Div column of row 1), use the analyzer keypad to enter “8”. Press the [⇩] key to move to the next field.

15.12 In the Min column of row 2), use the analyzer keypad to enter “10000”. Press the [⇩] key to move to the next field.

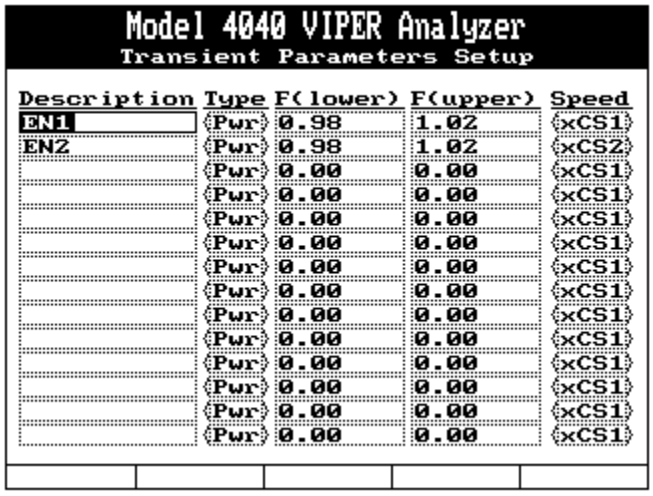
15.13 In the Max column of row 2), use the analyzer keypad to enter “20000”. Press the [⇩] key to move to the next field.

15.14 In the Div column of row 2), use the analyzer keypad to enter “10”. Press the [ENTER] key to accept your inputs and return to the Transient Survey Setup screen.

15.15 The analyzer will return to the Transient Survey Setup screen. Again press the [F1] “Config” key. The function keys will again return to those shown in the screen below. Press the [F3] “Parms” key.



16. The analyzer will display the Transient Parameters Setup screen shown below. Complete the screen as follows:



16.1 In the Description column, first row, use the analyzer keypad to enter “EN1”. Press the [⇩]key to move to the next field.

16.2 In the Type column, first row, use the [⇨] key to select “Pwr” if necessary. Press the [⇩] key to move to the next field.

16.3 In the F (lower) column of the first row, use the analyzer keypad to enter “0.98”. Press the [⇩] key to move to the next field.

16.4 In the F (upper) column of the first row, use the analyzer keypad to enter “1.02”. Press the [⇩] key to move to the next field.

16.5 In the Speed column of the first row, use the [⇨] key to select “xCS1” if necessary. Press the [⇩] key to move to the next field.

16.6 In the Description column of the second row, use the analyzer keypad to enter “EN2”. Press the [⇩] key to move to the next field.

16.7 In the Type column, second row, use the [⇨] key to select “Pwr”, if necessary. Press the [⇩] key to move to the next field.

16.8 In the F (lower) column, second row, use the analyzer keypad to enter “0.98”. Press the [⇩] key to move to the next field.

16.9 In the F (upper) column, second row, use the analyzer keypad to enter “1.02”. Press the [⇩] key to move to the next field.

16.10 In the Speed column, second row, use the [⇨] key to select “xCS2”. Press [ENTER] to accept your settings and return to the Transient Survey Setup screen.

16.11 From the Transient Survey Setup screen, press [ENTER] to store the setup and proceed to Data Acquisition.

B. Data Acquisition

1. Turn the analyzer on by pressing the ON/OFF key.
2. From the Main Menu, use the [⇩] key to select Transient Vibration Survey and Press [ENTER].
3. From the Transient Vibration Survey Jobs menu, use the [⇩] key to select Start Job and press [ENTER].
4. From the Setup List, use the [⇩] key to select “EMB 145 N1/N2 Track” and press [ENTER].
5. In the Job Identification screen, use the analyzer keypad to enter the customer name in the NAME: filed. Press the [⇩] key to move to the next field.
6. In the A/C Registration: field, use the analyzer keypad to enter the aircraft registration number. Press the [⇩] key to move to the next field.
7. In the A/C Total Time: field, use the [⇩] key to itner the total aircraft time in hours and minutes, then press the [ENTER] key to continue.
8. In the Engine Information screen, use the [⇨] key to select the engine Position then press the [⇩] key to move to the next filed.
9. Press the [⇩] key to skip through the Propeller information fields to the Engine information fields.
10. In the Engine S/N (serial number) field, use the analyzer keypad to enter the serial number for the engine. Press the [⇩] key to move to the next field.

11. In the Type field, use the analyzer keypad to enter “AE3007”. Press the [⇩] key to move to the next field.

12. In the TSO field, use the analyzer keypad to enter the Time Since New. Press the [⇩] key to move to the next field.

13. In the TSN field, use the analyzer keypad to enter the Time Since New. Press the [ENTER] key to accept your inputs and continue.

14. The analyzer may display a message saying “Recovering Database Memory”. This is not a malfunction. Please wait while this process is being completed.

15. The analyzer screen will display the informational message “Start the engine and establish normal operating conditions.” At this time, start the engines using normal procedures and the pilot’s checklist. Allow the engine to warm up to normal operating conditions, then Press the [ENTER] key to continue.

16. When the Select Condition screen is displayed, select the desired condition using the [⇩] key, then press [ENTER].

17. The screen will display the “Please Wait” information. DO NOT BEGIN THE ACCELERATION until this information screen is replaced by the “OVERALL VIBTATION” banner screen. You wil see the values of the incoming vibration and speed displayed on the screen. At this time, begin a 1 minute acceleration from IDLE to N1 for the day. When the engine reaches N1 for the day, press [ENTER] to stop acquisition. An information screen will be displayed reading “Store the data?” Press the [F1 “Yes” key to store the information or the [F5] “No” key to discard.

18. Repeat steps 16 and 17 for each condition. When all conditions have been acquired, follow the on screen instructions to complete the job.