REAL TIME

THE *ARTIC-2* CHASSIS DYNAMOMETER CONTROL SYSTEM

REAL TIME INSTRUMENTS

The ARTIC-2 Dynamometer Control System is a multifunction, computerized Controller for chassis dynamometers. Because of its capabilities, it is suitable for a wide range of dynamometers, 2WD, 4WD, twin-roll, motorcycle, mileage accumulation, and high-precision single-roll 48-in certification dynamometers. It is also very appropriate for retrofitting older electric dynamometers, both DC and AC. The control system is highly adaptable and flexible. The following pages briefly describe the scope of operations of which the ARTIC-2 system is capable.

The *ARTIC-2* computerized controller is typically equipped with a keyboard and monitor and operated as a stand-alone system. Optionally, it may be controlled externally over an RS232 serial link from a host or lane computer. The controller offers numerous features. It includes not only the standard road simulation functions, but also sophisticated automated calibration capabilities, with real-time displays and detailed graphic reports. Capabilities of the *ARTIC-2* include:

1. Road simulation testing, including road load, inertia, and grade simulation
2. Multiple, automated coast-downs, with and without vehicle
3. Automated dynamic torque calibration (dead-weight optional)
4. Automated parasitic loss calibration
5. Automated determination of tire losses and derivation of dynamometer-setting ABC's
6. Automated warm-up
7. Automated, electrical, augmented braking as well as mechanical roll brake control
8. Detailed test and calibration reporting
9. Vehicle data handling
10. Selection of engineering units
11. On-screen diagnostic messages
12. Optional host computer communication

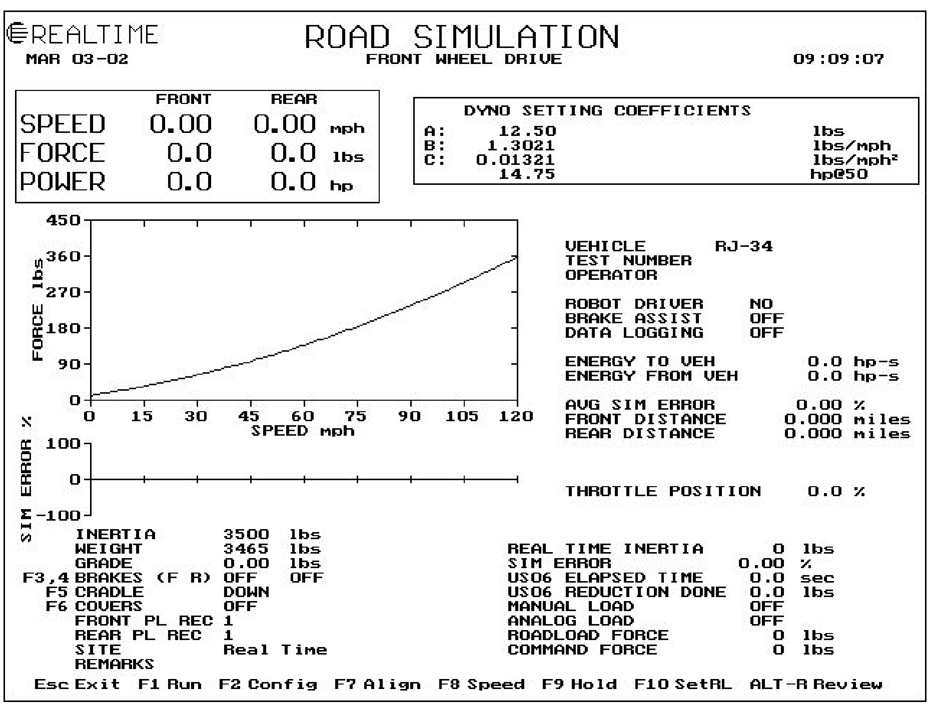

Figure 1. The screen for road load and inertia simulation from a 4WD 48" dynamometer.

SOFTWARE

Examples of some of the principal screen displays of the *ARTIC* control system are included as Figs.1-4. Figure 1 shows the screen at the beginning of a simulation test. The top graph illustrates the current dynamometer-setting road load curve; the bottom graph will plot the real-time simulation error, once the test has been initiated. Also included in the display are dynamometer test settings, status of dynamometer hardware (e.g., brakes), plus a variety of real-time data.

Figure 2 shows the screen obtained by recalling an actual vehicle-off coast-down record. The primary purpose of coasting down the dynamometer without a vehicle is to check the accuracy and repeatability of the dynamometer's road load and inertia simulation. To demonstrate accuracy, the measured coast-down times must be consistently close to the expected times. The data from each coast-down are reported in column form at right. On the left, is a real-time graph of road load force versus speed in which the measured curve is ultimately superimposed over the original dynamometer-setting curve, allowing a visual comparison of the two curves. The coast-down settings (road load coefficients, inertia, and speed points) are entered into the controller computer and saved.

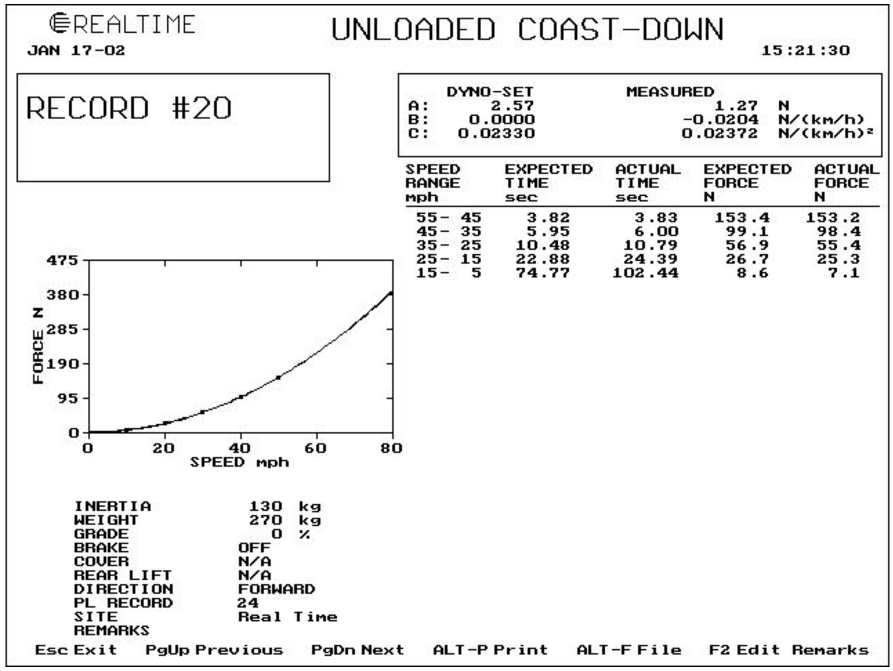

Figure 2. The Unloaded Coast-Down screen from a motorcycle dynamometer.

A very similar display is used for vehicle-on coast-downs. In this case, the real-time graph superimposes the measured curve over the target road load curve. In both cases, all relevant data relating to the coast-downs are included on the right side of the screen.

Fig. 3 shows the record of a parasitic loss calibration. Dynamometer friction is measured by the coast-down method. The rolls are accelerated to just above the highest speed range and coasted down through a pre-set number of intervals. The frictional force acting on the dynamometer at each interval is then derived from the measured coast-down time. The calculated forces are fit with a third-degree polynomial by the least-squares method and the resulting coefficients are saved by the control computer to be used in subsequent parasitic loss compensation.

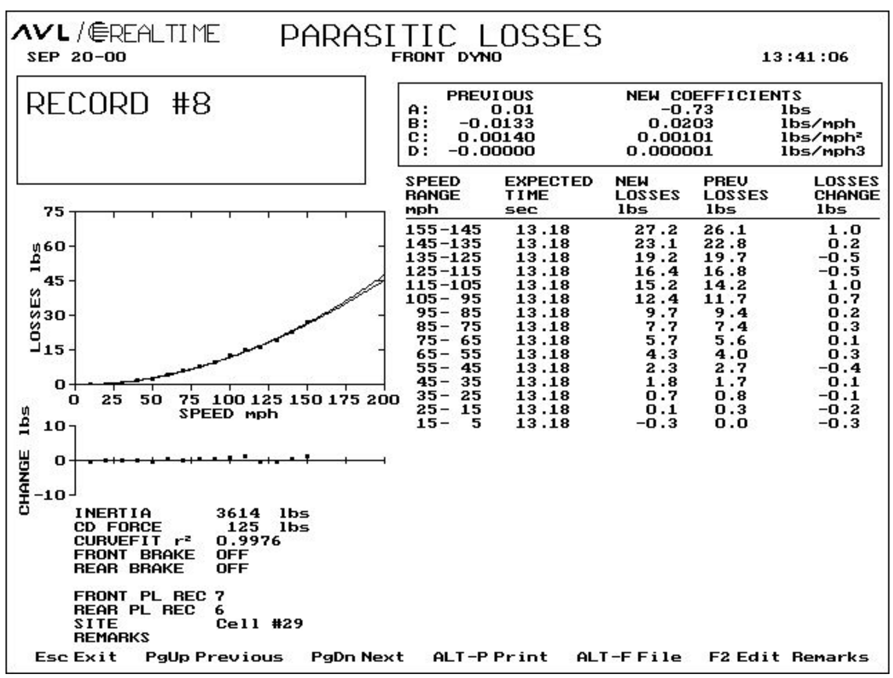

Figure 3. The Parasitic Loss calibration screen from a mileage accumulation 4WD dynamometer.

A "Warm-Up Record" from a motorcycle dynamometer employing the *ARTIC-2* is shown in Fig. 4. The *ARTIC-2* controller uses repeated vehicle-off coast-downs to warm up the dynamometer. When the warm-up feature is initiated, the dynamometer will undergo up to 30 sequential coast-downs and the results of each coast-down is tabulated at the right of the screen. The graph on the left side of the record shows a plot of uncompensated parasitic loss versus time. When the dynamometer is warm, the "Actual Times" will be similar to the "Expected Times", the "Time Diff" and "Force Diff" will be small. Also, the graph will show a line that is very nearly horizontal.

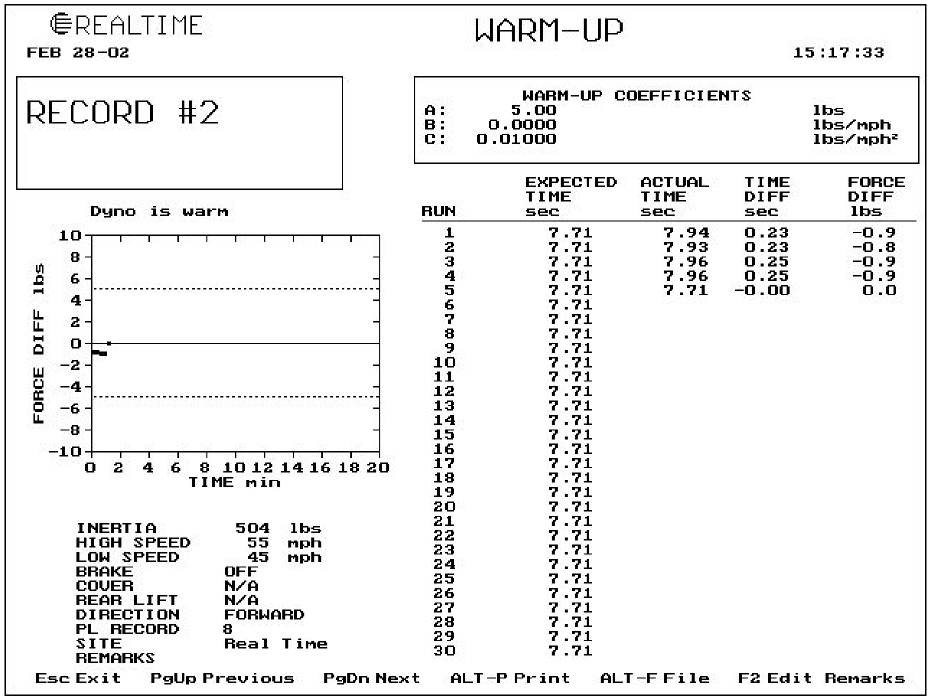

Figure 4. The Warm-up record from a motorcycle dynamometer.

Some other important screens not illustrated here are used for the (a) determination of dynamometer-setting road load coefficients for a vehicle when the track road load is known; (b) automated calibration of torque; (c) local entering of vehicle data; and (d) local entering of parameters and speed points.

HARDWARE

The *ARTIC-2* control system runs on a Pentium processor in a modified industrial computer. The computer includes the digital and analog I/O hardware required for processing torque and speed signal inputs, controlling the dynamometer brake/lift, automated roll cover/restraints, etc., and controlling the power converter. The case has a height of 7" and can be placed on a desk-top or installed in a standard 19" rack cabinet. It employs a standard keyboard and SVGA monitor. It also provides 24 VDC for powering solenoids and relays.

The back of the *ARTIC-2* controller box has several standard D-Sub connectors to which are attached the cables leading to the dynamometer chassis, the motor drive, and lane computer. The connectors are 9-pin, 15-pin, and 25-pin formats.

Depending on the customer's vehicle testing requirements, the *ARTIC-2* control system can be equipped with additional digital and analog I/O. The customer may require, for example, analog output channels for vehicle tractive force, load cell force, acceleration, roll speed, fan speed control, drivers aid signal, etc. These are features that can be specified by the customer and then integrated into the Real Time controller software.

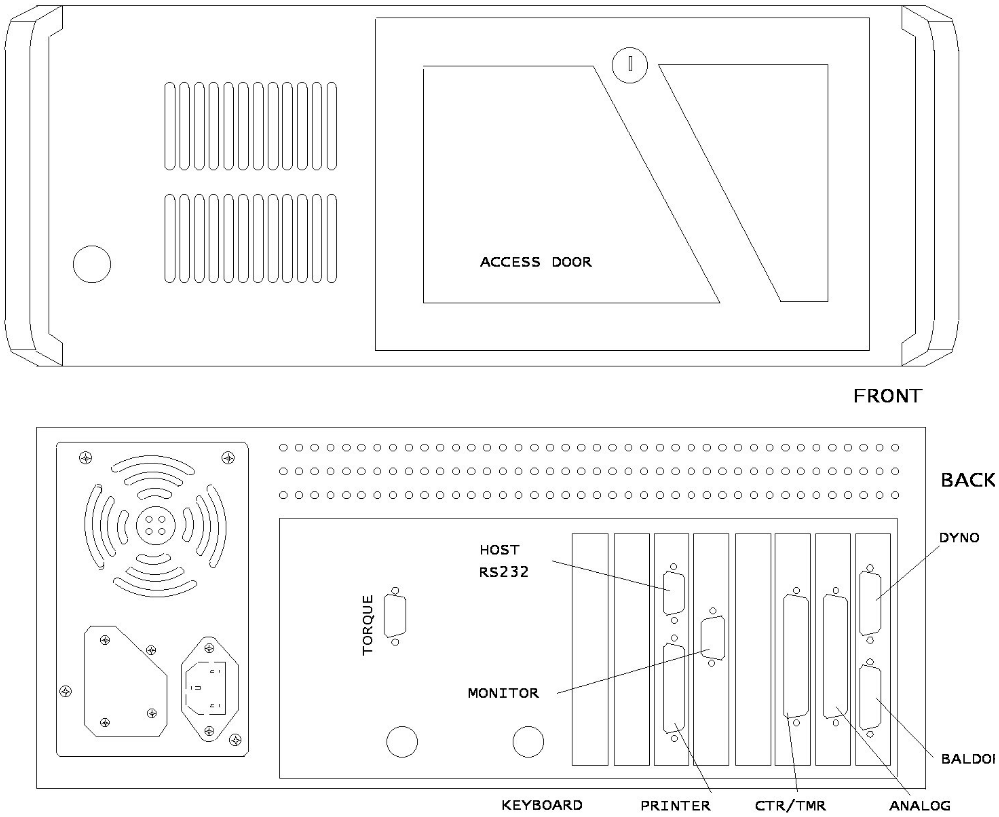

Figure 5. Front and rear views of the standard *ARTIC-2* Dynamometer Controller. The Controller can be either desk-top or rack-mount configuration.

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