DyneSystems
Midwest & Dynamatic
Dynamometers

DTC-1
Digital Throttle Controller
User's Manual

Revised November 2001

DyneSystems Co.
Contact Information

Shipping Address:
W209 N17391 Industrial Drive
Jackson, WI 53037

Mailing Address:
P.O. Box 18
Jackson, WI 53037

Toll Free Phone:
(800)657-0726

Fax:
(262)677-9308

Web:
www.dynesystems.com

Revision History

Item #: MAN-DTC1-00001

May, 2001
Initial Version

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Chapter 1

Specifications

1.0 Introduction

The DTC-1 controls throttle position, RPM, TQ, MAP, or manifold vacuum to ±1 unit accuracy, providing zero regulation and drift of digital setpoints. 16 sets of PID parameters allow the DTC-1 to be adjusted to variations in engine under test or in engine operating point. Teamed with Dyne Systems' Dyn-Loc IV dynamometer controller, all provisions are made for reference and feedback data, instrumentation, and automation control. The DTC-1 may also be used in a stand-alone situation.

2.0 Specifications

2.1 Control Enclosure

- Dimensions: 19" x 7" x 13" rack or bench mounted enclosure.
- Weight: 20 pounds.
- Input Power: 120VAC @ 1 amp.

2.2 Control Output

±20VDC @ 3A max., Actuator Servo Motor drive. Amplifier has instantaneous current limit, and over temperature shutdown. Digital Encoder Excitation: +5VDC @ 50 ma. This feeds only Dyn-Loc's actuator which is considered part of the DTC-1.

2.3 Environmental

- +10 to +40 DegC ambient temperature range.
- Humidity to 95%, non-condensing.

2.4 Power Fail Protection

NICAD battery-backed DC. DC power supplies allow throttle return to idle and orderly system shutdown.

2.5 Actuator Assembly

- Housing Dimensions: 8"L x 3-1/4"D x 3/8" Wall cylinder.
- Foot mounted, 3-1/2" x 2" bolt pattern.
- Drip Proof for Wash-Down protection.
- Actuator: DC Servo Motor/Gearhead/Encoder assembly.

2.6 Actuator Stroke

- Maximum Stroke Length: 4".
- Minimum Stroke Length: 1".
- Maximum Stroke Angle: 70º.
- Maximum Stroke Torque: 2.5 lb-ft. (standard), 5.00 lb-ft. and 10.00 lb-ft. (optional).

2.7 Closed Loop Control

- Highly adaptive, optimum response for all engine conditions.
- Position control, digital, to 0.1% of stroke.
- Torque control, digital to 10,000 lb-ft.
- RPM control, digital, to 25,000 RPM. (Programmable PPR Factor)
- Manifold vacuum: 0 to 29 In. Hg. or MAP control: 0 to 150.00 kpa.
- 0% regulation and drift from set-point.
- RPM and torque feedback, and logic signals available from Dyn-Loc, or customer sources.
- Closed loop control coefficients programmable in setup mode, 16 sets.

2.8 Function Keys

Four programmable function keys may be used from Dyn-Loc basic programs or as Dyne Systems customized keys.

2.9 Remote Operators' Control

- In 7" x 9" x 4" Nema 12 enclosure.
- Provides upper and lower limit set-up, jog PB, and DTC soft shutdown.

2.10 Computer Control

- Programming language: Dyn-Loc Basic.
- Computer control over RS232 serial link, with or without the Dyn-Loc IV control.
- Serial link parameters are settable in DTC setup mode.
- Automatic stand-alone control using internal battery ram 64K NVRAM.
- Analog reference option includes parallel mode control.

2.11 Dyn-Loc Basic

Programs may be downloaded over serial link at up to 19.2K baud for stand-alone operation.

2.12 Auxiliary I/O

- Customer emergency stop input.
- Customer soft shutdown (close throttle) input logic.
- Analog feedback input, may be used for torque or RPM feedback.
- Magnetic pickup input.
- Analog reference input, 0 to +10VDC; 12 bit conversion, optional card.
- 8 bit digital I/O to DS302 PCB: optical logic/power control, optional card.
- Buffered expansion bus for new/custom I/O.
- 0 to +10 VDC analog output representing actuator position, optional card (can be used for electronic throttles).

2.13 Fault Control

- All fault conditions (except amplifier over-temperature) serviced with HELP screen.
- Software stall detection and shutdown, prevents motor damage.
- All critical device connectors interlocked.
- Unloaded engine overspeed trip programmable RPM.
- Dyno control/DTC mode conflicts are trapped and displayed.

Chapter 2

Installation Instructions

1.0 General Wiring Practices

1.1 Signal Wiring

The excellent performance possible with the DTC-1 Digital Throttle Control is dependent on a good signal-to-pulse noise ratio and good physical and electrical isolation from any power sources related to pulse noise generation (including earth grounds). All signal wiring must be shielded and run in separate conduit from any power wiring. Good spacial separation must be maintained from sources connected to any switching type power amplifiers.

Shield connections must be adequately isolated from any possible earth grounds. Insure that shield connections are carried through to the device location.

CAUTION: Do not connect shield at device location unless instructed. If earth ground is unavoidable, DTC-1 wiring must be so connected at one place only.

1.2 MS Connectors General Information

Multi-conductor cable should be 18-22 gauge, fine stranded, foil type shielding (with drain wire) with strong insulating jacket. Avoid nicking wires when stripping away jacket and shield. All connections must be fully inserted and show good solder flow. Avoid excessive solder wicking. Strain relief of connections with shrink tubing is desirable. Clean soldered area with flux cleaner and inspect for shorts, etc. Use shrink tubing to cover area where jacket terminates. Use MS strain relief boot. Follow rear panel connection labeling.

1.3 Sub-D Type Connectors General Information

These connectors are designed for use with round cable, 18 to 22 gauge, fine stranded, foil shielded, drain wire, jacketed.

1. Slip on the back shell boot that best fits your cable.
2. Use the Amp crimping tool and gold plated crimp pins. Insert pins in an orderly fashion to accommodate wire exits from cable. Avoid any strain on wires. Use 3M plastic/plated back shell (or equivalent) with retaining screws.

3 Position wires in such a way as to avoid pinching between backshell sections. Note cable 45 degree exit angle desired before installing backshell. Always use and tighten retaining screws to avoid erratic and intermittent failures.

4 Follow pin-out listings and drawing in pin-out section. Female pins are Amp #205090-1, Male pins are Amp #205089-1.

1.4 120 VAC Power

The DTC-1 has a European-style AC power plug on the rear panel. This power should be as clean as possible. If the Dyn-Loc control is used, make sure the AC power to both controls comes on at the same time. Do this by connecting the DTC to the Dyn-Loc control power terminals (L3 and L4).

Some Dyn-Loc control power is at the 240VAC level. If this is the case, use a small step-down transformer for the DTC control power.

1.5 Mechanical Installation of the Actuator

The actuator should be solidly mounted to a non-vibrating base if possible. It can be mounted in any orientation.

Do not turn the actuator shaft by hand because the 134:1 or 246:1 gear ratio causes undue strain on the gearhead. When you are ready to connect the linkage to the actuator arm, complete the following steps.

1 Rotate the actuator shaft by the control in the setup mode. The system is designed to always use the full 70º arm motion and provides solid stops at both position extremes. The desired linear motion is obtained by adjusting the effective length of the actuator arm. Loosening the bolt which holds the rod end allows sliding it to any position on the arm, thus setting stroke length. The stroke length is approximately 1.2 times the distance from the shaft center to the bolt center (effective length of actuator arm).

2 Rotate the slotted limit plate to the desired position by loosening or removing the screws retaining it. Use a solid rod connected in as straight a line as possible to the throttle. A flexible cable can be used if there is sufficient return force to the closed position. If a cable is used, minimize loops in the cable. Optimum performance can only be achieved if the actuator is solidly connected to the throttle.

1.6 Connecting the DTC to the Actuator

There are two basic connections to be made from the DTC to the throttle actuator. These consist of the connection to the motor armature and connection to the optical encoder. The required connectors are supplied with the DTC or, if desired, the cable can be purchased from Dyne Systems.

The throttle actuator supplied with the DTC uses a 9 pin MS-style connector (Amphenol MS3106A20-16S with boot, supplied by Dyne Systems) as its connection point. This connector is for both armature and encoder connections. Run separate cables (2 or 4 conductor 18 gauge for motor and 14 conductor 18-22 gauge shielded for actuator) to the 9 pin MS for these two functions.

Connection from the actuator to the actuator motor connector on the DTC (requires Amphenol MS3106A14S-6P with boot as mate, supplied by Dyne Systems) should be via two conductor jacketed cable such as Belden 8461. This wiring should never carry more than 5 Amps at higher than 25 Volts DC. Ideally, the cable should be run in a separate conduit which can also contain the encoder cable. Since it is a DC source, it can be run with conductors with instrument wires if a shielded cable is used for the armature leads. Actual connection is displayed in table below.

Actuator End	DTC End
H	D and E
I (center)	A and F
none	Jumper B to C

The jumper wire from B to C on the MS connector is required. If it is omitted, an ACTUATOR FAULT error will result.

If a 4 conductor cable is used for armature wiring, connect separate conductors to both A and F (with this pair connected to I on the 9 pin MS) and D and E. If 2 conductor cable is used, then install jumpers from D to E and from A to F to assure maximum reliability.

The cable to the ACTUATOR ENCODER sub D connector on the DTC should be a 14 or 15 conductor, jacketed, round cable, 18 to 22 gauge, fine stranded, foil shielded, with drain wire, such as Alpha 1299/15 or Belden 9541. The connector should be a 15 pin, female, Amp #205206-1 with backshell (supplied by Dyne Systems). Actual connection is displayed in table below.

Note: Many of the connections are duplicated to increase reliability. Use all redundant cable connections.

Actuator End	DTC End	Color (Alpha 1299/15)	Color (Carol CO766)/Belden
A	11	light brown	white/black
A	3	green	green
B	12	grey	green/black
B	4	pink	orange/black
C	1	yellow	blue/black
C	9	purple	black/white
C	no connection	shield	shield
D	10	red	red
D	2	white	white
E	5	orange	orange
E	13	black	black
F	14	light blue	blue

Actuator End	DTC End	Color (Alpha 1299/15)	Color (Carol CO766)/Belden
F	6	dark brown	red/white
G	7	red/black	red/black
G	15	red/brown	green/white

1.7 Connecting the DTC Remote

Connecting the DTC remote requires a 15 pin, male, Amp #205205-1, typically supplied with control. Use an 8 conductor, jacketed, round cable, 18 to 22 gauge, fine stranded, foil shielded, with drain wire. Connect the shield to logic common, pin 2, at DTC only. This connection is for a simple remote station which allows the operator to set up the upper and lower limits and cause a soft shutdown (throttle return to zero position) from inside the cell near the throttle actuator.

A connector is supplied with the DTC control which jumpers pins 8 and 1 on the REMOTE DTC sub D. If this connection is interrupted, the actuator goes to zero position and a soft shutdown fault screen is displayed. This provides a means for the user to close the throttle from the cell fault system. This connection should be made by isolated contacts on the same relay as is connected to the H20 IL input on the Dyn-Loc (if used).

1.8 Connecting the DTC to the Dyn-Loc

The cable between the DTC and the Dyn-Loc must be purchased from Dyne Systems. Install as labeled. The standard length on this cable is 3 ft. Longer lengths are optional.

1.9 Connecting for Stand-Alone Operation

If the DTC is to be used without a Dyn-Loc, the CONTROL I/O TO DYN-LOC sub D connection requires 25 pin, female, Amp #205207-1. This connector contains pins for the mag. pickup connection and analog input (described below), and the RS232 serial port.

Using the DTC without a Dyn-Loc connected (Stand-Alone Operation) requires some of the interlocks be defeated. Defeat these interlocks via DIP switches on the DS303C and a jumper in the CONTROL I/O TO DYN-LOC sub D connector from pin 13 to pin 16 (see Chapter 6 for pin - out description). A sub D connector with the proper jumper installed can be supplied from Dyne Systems.

Some applications involving stand-alone speed and torque modes may find the DS303 dipswitch inadequate. Refer to the next section, DS303C DIP Switch Settings if you need assistance.

1.9.1 DS303C DIP Switch Settings

The DS303C DIP switch settings are described as follows.

- DIP switch position 1 simulates the MODE signal that would normally come from the Dyn-Loc. Setting this switch ON simulates the Dyn-Loc being in the RPM control mode and allows the DTC-1 to run in the POSITION or TORQUE control mode (vacuum or

MAP modes are equivalent to the torque mode). This DIP switch also defeats any signal coming in on pin 5 of the CONTROL I/O TO DYN-LOC sub D connector. If an external signal is to be used on pin 5, this switch must be set to off.

- Setting DIP switch 1 to OFF simulates the Dyn-Loc being in the TORQUE control mode and allows the DTC-1 to run in the POSITION or RPM control mode.
- If the DTC-1 is to be used in both RPM control mode and TORQUE control mode, a switched contact is required to switch signals to pin 5 of the CONTROL I/O TO DYN-LOC sub D connector and DIP switch 1 must be left off in this case. When the DTC-1 is to be used in the TORQUE control mode, pin 5 should be connected to pin 16. When the DTC-1 is to be used in the RPM control mode, pin 5 should be disconnected and left floating.
- DIP switch position 2 simulates the DYNE ON signal that would normally come from the Dyn-Loc. This DIP switch should be ON for stand-alone operation.
- DIP switch position 3 simulates the +5 VDC signal that would normally come the Dyn-Loc. This DIP switch should be ON for stand alone operation.
- DIP switch position 4 is a spare.

DIP Switch	Function	OFF	ON
1	DL4 regulation mode	TQ mode, allow DTC RPM	RPM mode, allow DTC TQ
2	Dyne on/off	Dyne OFF	Dyne ON, allow DTC TQ
3	+5V signal from Dyn-Loc	DTC/DL4 pair	DTC stand-alone operation
4	<spare>	<spare>	<spare>

1.10 Connecting the Magnetic Pickup

In certain applications, the DTC may be used to regulate engine RPM without using a Dyn-Loc. In other applications, a Dyn-Loc may be used, but the speed of the dyno may not be the same as the speed of the engine (such as during transmission tests where the gear ratio changes). In both these applications, it is necessary to input a speed feedback signal, which is normally provided by the Dyn-Loc, to the DTC. An Electro 3030 magnetic pickup (Mag. PU) or equivalent transducer may be used for RPM feedback. This transducer requires a 2 conductor shielded cable and is connected to pins 24 and 25 of the CONTROL I/O TO DYN-LOC sub D connector.

Connect the shield drain wire to common (pin 23) at the sub D. Jumper pin 18 (the output of the mag. pickup conditioner circuit) to pin 14 (the RPM input) on this connector. The RPM signal from the Dyn-Loc (if a Dyn-Loc is used) is not connected. Transducer air gap should be approximately 0.010". 60 tooth gear runout should be held to less than ±0.002". If the Mag PU is used on a dyno, signals should be checked at start-up under conditions of increasing dynamometer field current for possible demagnetization of pickup magnet due to field leakage flux. If Mag PU signal decreases significantly as field current increases, de-energize the dyno control and reverse field conductor connections. This should cure the problem. Acceptable Mag PU signal level: 2 VRMS to 25 VRMS over operating range.

1.11 Fixed Ratio

Parm 00 can set a fixed speed ratio between the Dyn-Loc RPM and DTC RPM if the DTC receives its RPM frequency from the Dyn-Loc. Parm 00 = 60 for the same RPM display. Set parm 00 from 4 to 59 or from 61 to 250 for the different RPM displayed.

1.12 Connecting the Analog Feedback

An analog feedback signal may be required when the DTC is not working with a Dyn-Loc or for special applications. This input is for a 0 to 10 VDC analog torque or speed feedback signal (speed feedback can also be derived from a mag. pickup as described above). The analog feedback signal is connected to the CONTROL I/O TO DYN-LOC sub D connector, pins 21 (signal input to V/F converter circuit) and pin 23 (common). The shield should also be connected to pin 23. If the analog feedback is torque, jumper pin 17 (output of V/F converter circuit) to pin 1 (torque frequency input) on this connector. If the analog feedback is RPM, jumper pin 17 to pin 14 (RPM frequency input). In either case, the torque or RPM signal from the Dyn-Loc (if a Dyn-Loc is being used) is not connected.

1.12.1 Calibrating the Analog Feedback

Before the calibration of the analog feedback signal can be performed, complete the following.

1. Determine the maximum full scale DC voltage representing the analog feedback of the input voltage. Allow 20% overrange.
2. Determine the units to be displayed and the location of the decimal point if TQ. TQ decimal points are cosmetic. All significant digits imply integer units.
3. Do the setup and jumpering as required per application and calibrate the analog feedback. Below is an example of factor testing and calibration. Use your corresponding numbers and units for full scale. For this example, +5.000 volts = 50.00 ft.lbs. TQ. This means the V/F will produce 5000 hz at +5V. Setup,4,0,0. allows the setting of decimal points for display.

   a – Connect a 0 to 5 volt variable power supply and a precision volt meter to the CONTROL I/O TO DYN-LOC sub D connector (pin 21 is the + voltage and pin 23 is the common). This provides a 0 to +5 volt DC reference voltage to the DS303 V/F circuit.
   b – Preset the voltage source to 0.000 volts.
   c – Turn the DS303 "V/F zero" pot counter clockwise just until a non-zero torque reading is displayed on the DTC screen.
   d – Set the pot clockwise for just zero.
   e – Set the voltage source to +5.000 volts.
   f – Adjust the "V/F span" pot for 50.00 #-ft. torque on the DTC screen.
   g – Set the voltage source to +.500 volts.
   h – Adjust the "V/F zero" pot for 5.00 #-ft. torque on the DTC screen with a ±.1% tolerance.
   i – Repeat steps e through h until the outcome is satisfactory.
   j – Check the linearity at 2.5000 volts. It should be ±.2% max.

The analog feedback input can also be used for special applications such as manifold vacuum or MAP regulation with optional hardware. Contact Dyne Systems for further information.

2.0 Quick Check

2.1 If the DTC is Used with the Dyn-Loc

- The 115 VAC power is connected to the DTC from Dyn-Loc.
- The actuator is mounted and connected.
- Both actuator cables are connected to the DTC.
- The DTC is connected to the Dyn-Loc.
- Jumper in place on REMOTE BASIC sub D connector (if remote is not used) or properly connected to user's fault detection system.

2.2 If the DTC is Used without the Dyn-Loc

- The 115 VAC power is connected to the DTC.
- The actuator is mounted and connected.
- Both actuator cables are connected to the DTC.
- The jumper is in place on the REMOTE BASIC sub D connector (if the remote is not used) or properly connected to user's fault detection system.
- The proper DIP switches are set on the DS303 board, and the jumper is on the CONTROL I/O TO DYN-LOC sub D connector from pin 13 to pin 16.

Chapter 3

Operating Instructions

Before You Begin: Connect the DTC-1 per the previous Chapters in this manual. Do not proceed with power up until all conditions at the end of Chapter 2 have been completed.

1.0 General Information

The control is supplied with rechargeable Ni-cad batteries. These batteries serve two purposes.

- They allow the DTC to ride through a power loss of up to ½ second (if a Dyn-Loc is connected and it loses power, the DTC will trip immediately and display a "HELP 01 (DYNO CONTROL POWER FAILED)". If the power failure is longer than ½ second but less than several seconds, the control will display a "HELP 00 (AC POWER FAIL-SYSTEM HALTED)". The control must then be powered down until the screen goes blank, then powered up again. If the power is out for more than ~6 seconds and comes on again, the screen displays the initial startup screen.
- In the event of a power failure, the control's computer will shut down in a controlled manner, and the actuator will return to zero. Note that whatever position the actuator is in when power is restored is taken to be zero (lower limit).

The batteries are charging whenever the control is powered up and slowly discharging when the control is not. It will take more than two weeks to discharge the batteries and four hours to charge them from complete discharge to a safe level. They are charged before shipping.

The DTC control communicates quite extensively with the Dyn-Loc (if one is used) to interlock some of the functions.

- The controls cannot be in the same mode at the same time if both are ON; therefore, if the Dyn-Loc is ON in RPM mode, the DTC can be in POSITION or TORQUE mode only. Attempting to put the DTC in the RPM mode will cause a "HELP 03 (Dyn-Loc / DTC MODE CONFLICT...)" screen to be displayed. If the Dyn-Loc is ON in the TORQUE mode, the only allowed modes for the DTC are POSITION or RPM.

- If the engine runs faster than programmed RPM and the Dyn-Loc is not ON, a "HELP 10 (SOFT OVERSPEED...)" message is displayed, and the actuator will move to zero position. The engine can run over this RPM only if the Dyn-Loc is ON. If you want to run the engine over this RPM with no load, the Dyn-Loc can be put ON in the TORQUE mode at a very low setting or in the RPM mode at a very high setting (only if the DTC is in the torque mode). The former method (torque mode) will eliminate any torque during speed changes (Dv/dt).
- If the Dyn-Loc is OFF, the DTC cannot be put into TORQUE mode. If this is attempted, "HELP 03 (Dyn-Loc / DTC MODE CONFLICT...)" is displayed.
- Pressing EMERGENCY STOP on either the Dyn-Loc or DTC will cause the dyno to go into full braking (unless this has been defeated), the actuator to move to zero position, and a "HELP 11 (EMERGENCY STOP...)" screen to be displayed.

The DTC has sophisticated stall detection circuitry. If the mechanical system should jam for more than approximately ½ second, the DTC will attempt to move the actuator to zero position. If it is successful, the control will display a "HELP 04 (ACTUATOR STALLED, returned to 0 position successfully) *press CANCEL*" screen. If the mechanical system is not able to return to zero, the control will display a "HELP 05 (ACTUATOR STALLED, unable to return to 0 position) *press CANCEL*" screen. In either case, actuator power is removed to prevent motor damage.

2.0 Power Up

The power switch is located on the back of control above the power cord plug. It can be used to switch the power on and off if the DTC is used without a Dyn-Loc. If the DTC is used with a Dyn-Loc, leave the power switch on and apply power to both controls simultaneously. When the unit is powered up, it should briefly display a full cursor blinking in the upper-left of corner of the screen, then display a message.

Press the ON key to start the system.

The system should now display the main screen. This is the screen that is displayed during normal operation. If a Dyn-Loc is connected, the Torque and RPM areas of the screen should have the same value as shown on the Torque and RPM displays of the Dyn-Loc, although the numbers of decimal places may be different.

3.0 Operation

3.1 Interpreting the Main Screen

```
SPT:   .0(%POS) TRQ:   +.00Ft# RPM:    0
POS:   .0% LAC  25.0   MAN    OFF     .0
```

The main screen is illustrated below as a power up typical default.

- The upper left portion of the screen "SPT:xxxxx" displays the current setpoint.
- Next to that number are the units the setpoint is in: "(%POS)" for percent position in the position mode, "(Ft#)" for foot pounds in the torque mode, and "(RPM)" for RPM in the speed mode. By looking at the units the operator can tell what mode the control is in.
- Next to this is "TRQ:xxxxx Ft#". This is a display of the actual torque being measured.
- Next to this is "RPM:xxxxx". This is a display of actual speed being measured.
- On the bottom line on the left is "POS: xx.x%". This is a display of the throttle position in percent.
- To the right of this is "LAC:xxxx". This is the LAC or ramp rate in units per second. The units are the same as the setpoint units and the value may be different for each mode.
- To the right of this is the word "MAN" or "AUTO". This indicates if the DTC is in the manual mode (front panel control) or auto mode (control via internal program or RS232 serial port).
- To the right of this is the word "ON" or "OFF" indicating if the control is on or off.
- In the lower right hand corner (only if the control is in the manual mode) is a number. This is where a new setpoint appears while it is being keyed in. It stays there until the CANCEL or ENTER key is pressed. If the CANCEL key is pressed the number is set to zero. This function is provided to cancel an erroneous entry. If the ENTER key is pressed the number then becomes the setpoint (appears in the upper left of the screen) and is replaced by zero to wait for another setpoint.

3.2 DTC Basic Operation

1. Press the ON key to turn the control on.
2. Press the POS key to ensure the control is in the position mode (this is a power on default).
3. Press the number keys corresponding to the desired position to enter a setpoint (this will be a position setpoint since the control is in the position mode). For example, press 5 then 0 then 0 (50.0%, the operator must keep track of the decimal point) then the Enter key. The throttle will move to 50.0% throttle. The speed at which it moves depends on the position LAC rate. If a wrong key is accidentally pressed before the Enter key, press Cancel. A new throttle position can now be entered in two ways. Either a new position can be entered with the number keys and the Enter key as above, or the arrow keys can be pressed. Keeping an arrow key pressed causes the setpoint to change in a continuous fashion. If an arrow key is pressed and quickly released the setpoint will change by one least significant digit.

3.3 Throttle Jog Function

In the position mode with the throttle at any position, pressing the F4 key causes the throttle to quickly open to 100%. When the key is released, the throttle will quickly return to its original position (even if it has not yet reached 100%). This is to allow the operator to "pump" the throttle for starting or keeping an engine going. If the engine RPM reaches a high value (a settable parameter) without the Dyn-Loc on, the control may trip out on soft overspeed.

3.4 Starting the DTC with an Engine

1. Check the throttle linkage to assure that 100.0% is a truly open throttle, that 0.0% is truly closed throttle, and that the full (or nearly full) span of the actuator is used. See “Upper and Lower Limit Setup (Screens #S1 and #S2)” on page 5 if you need assistance.
2. Be sure the throttle is at 0.0% position.
3. Start the engine. If the throttle needs to be pumped, the throttle jog function (F4 key) can be used.
4. Once the engine is idling, put the Dyn-Loc (if used) in the RPM mode with a setpoint above idle speed set on the leverwheel switches, and then turned ON. If the Dyn-Loc is on, a new position can be entered. As the throttle is opened the speed should increase until it reaches the speed set on the Dyn-Loc (where it should stay). Further opening should result in increasing torque with the speed staying at the setpoint on the Dyn-Loc.

3.5 Changing to the TQ Mode

1. Once the operator is comfortable with position mode, switch the control to torque mode (push the TQ key) (only if there is a Dyn-Loc or other device loading the engine and controlling speed. If the engine is running without a Dyno, this paragraph does not apply). In this mode the DTC will control the throttle to cause the engine to produce the torque set. When the TQ key is pushed, the control will read the torque being produced by the engine and use that value as the torque setpoint, then switch to the torque mode of regulation.
2. Change the torque setpoint with the arrow keys or by keying in a new setpoint and pushing the Enter key (see above). At any time the DTC can be put back into the position mode by pushing the POS key. The throttle remains at the position it was in when the key was pressed until the operator changes the setpoint.

3.6 Changing to the RPM Mode

If the DTC is being used without a Dyn-Loc, it can be put into the RPM mode by pushing the RPM key. This mode requires the installation of jumpers on the "CONTROL I/O TO DYN-LOC" sub D.

If a Dyn-Loc is being used and is in the RPM mode (as above) then special care must be taken when doing this mode change because it requires changing the mode on the Dyn-Loc as well as the DTC. Changing the mode on the Dyn-Loc from RPM to Torque requires the value of torque the engine is producing be set on the INACTIVE leverwheel switches (the leverwheel switches with the ACTIVE lamp NOT illuminated).

1 Switch to the Torque mode by pushing the TORQUE push button on the Dyn-Loc without causing a transient (bumpless transfer). The DTC will automatically do a bumpless transfer to the RPM mode. If the DTC is in the position mode when the Dyn-Loc is transferred to the torque mode the DTC will not be affected. If the operator attempts to put the DTC into the RPM mode when the Dyn-Loc is ON and also in the RPM mode, this will result in a "HELP 03 (Dyn-Loc / DTC MODE CONFLICT- Mode change rejected)..." message. If the Dyn-Loc is OFF but in the RPM mode, the DTC can operate in the RPM mode but will trip off on soft overspeed if it sees an RPM greater than the value of parameter #1.

2 Change the DTC setpoint via the arrow keys or by keying in a new setpoint and pushing the Enter key.

4.0 Setup

To begin setting up the control, press the SETUP key on the DTC front panel. The setup screen (screen #S), which allows access to all setup functions, is displayed.

4.1 Upper and Lower Limit Setup (Screens #S1 and #S2)

The UL and LL (Upper Limit and Lower Limit) setup function allows the user to set up the limits of the actuator to match it to the throttle. The first thing to determine when setting up the throttle actuator is which direction of rotation is opening the throttle and which direction is closing. This is selected via the "ACTUATOR DIRECTION" switch on the back of the DTC. If, while facing the shaft end of the actuator, increasing throttle is clockwise, then the switch should be in the CW position. If increasing throttle is counterclockwise, put the switch in the CCW position.

It is important to keep in mind during setup that the point where the throttle rod or cable meets the actuator arm is adjustable. This should be adjusted, along with the length of the throttle rod or cable, so that the actuator arm is approximately 1/16" from the lower mechanical stop when the throttle is closed (or at minimum), and 1/16" from the upper mechanical stop when the throttle is open (or at max.). See drawing in Chapter 8. Stoke Length is approximately 1.2 times the distance from shaft center to rod end center.

1 Press the 1 key for Lower Limit (lower limit should always be set before upper limit) on the Setup screen. The arrow keys move the actuator.

2 Confirm that pressing the up arrow key opens the throttle, and the down arrow key closes the throttle. If not, check the position of the "ACTUATOR DIRECTION" switch on the DTC (on back panel). The speed at which the actuator arm moves is determined by the move rate. The higher the number, the faster the actuator arm moves. This can be changed any time and is usually set to a low number to make the fine adjustments near zero and 100% throttle. A high number is useful when moving quickly during the upper limit setup. Press a DTC front panel number key between 1 and 9 to set the move rate. If the new lower limit is below the previous lower limit, bump the down arrow key (press and quickly release). Each bump will move the arm a small amount.

3 Press Enter when the proper position for minimum throttle is achieved.

4 Press the SETUP key (as the display instructs) to get back to the setup screen.

5 Press the 2 key to set the Upper Limit in the same way as the Lower Limit. The Upper Limit may not go below the Lower Limit, and may not go beyond 70º past the lower limit. The DTC-1 displays an error message if the upper limit is not high enough.

6 Check the limits by going into the Position mode and checking 100% and 0% throttle position.

4.2 LAC (Ramp) Setup (Screen #S3)

Linear Acceleration (LAC) is the rate at which the reference changes when a new setpoint is entered. For example, if the control was regulating torque at 200 lb.ft. and a setpoint of 300 lb.ft. was entered, the control would not immediately try to change the torque to 300 lb.ft. If it did, there would be a very fast change which could overly stress the mechanical system. The LAC feature avoids this.

The LAC causes the control to smoothly ramp to the new setpoint at a rate set by the user. The rate is in units per second (RPM per second for speed mode, foot pounds per second for torque mode, percent per second for position mode, and mm HG per second or kPA per second for VAC/MAP mode) and is separately adjustable for the four different modes (screen #S31, #S32, #S33, and S#34).

4.3 Display Setup (Screen #S4)

This function allows the user to configure the display. The functions the user has control of include the following.

- The number of decimal points in the torque display (screen #S400).
- The number of ½ second torque samples that are averaged to compute the torque displayed (screen #S401 - this number should be the same as the averaging on the Dyn-Loc if the controls are used together, otherwise the torque displays on the controls will not agree during a torque change).
- The sign of the torque display (screen #S402).
- The number of ½ second RPM samples that are averaged to compute the RPM displayed (screen #S41).
- Whether the leading zeroes will be displayed (screen #S42).

4.4 Control Setup (Screen #S5)

This function allows the user to configure the closed loop control parameters (screen #S51) or the RS232 serial port parameters (screen #S52).

If a Dyn-Loc is to be used, set the serial port of the DTC to a baud rate of 19,200, 8 data bits, 1 stop bit, and no parity. These are the default values. Any time these parameters are changed, the control must be rebooted by going back to "SERIAL SETUP" and pressing the 5 (Boot) key.

5.0 Parameter Arrays

5.1 Default Parameter Arrays

For default parameter arrays other than those below, contact Dyne Systems' Service Manager.

5.1.1 DTC Version 2.41 Default Parameters

#	Parameter	Set 0-14	Set15
00	Pulses/Revolution	60	60
01	% TQ Integral Used	25	10
02	RPM Error Divisor	10	10
03	TQ Error Divisor	10	10
04	TQ Loop Error Limit	200	400
05	RPM Loop Error Limit	200	400
06	RPM Integral Limit	200	400
07	TQ Integral Limit	400	400
08	RPM Derivative Mul	64	64
09	Current Limit	250	250
10	TQ Derivative Mul	2	2
11	Keypad Lockout Bit	0	0
12	% RPM Integral Used	10	20
13	Speed Trip, DYNE OFF	1800	1800
14	Underspeed Trip:RPM	0	0
15	Spare	0	0

5.1.2 DTC Version 3.87b and 4.05 Default Parameters

#	Parameter	Set0	Set1	Set2	Set3	Set4-15
00	Pulses/Revolution	60	60	60	60	60
01	Speed Trip,DYNE OFF	2800	2800	5000	2300	1800
02	Current Limit	255	250	255	255	255
03	Keypad Lockout Bit	0	0	0	0	0
04	Underspeed Trip:RPM	0	0	0	0	0
05	A2D Averaging Long	4	4	4	4	4
06	A2D Averaging Burst	4	4	4	4	4
07	POS Rounding if 1	0	0	0	0	0
08	RPM Integral Rate	5	2	1	2	75
09	RPM Error Divisor	5	2	2	1	4
10	RPM Error Limit	500	1000	5000	1000	200
11	RPM Integral Divisor	10	10	10	20	15
12	RPM Integral Limit	0	0	0	0	0
13	RPM Derivative/10	225	225	300	410	45
14	RPM Derivative Limit	1000	400	2000	500	400
15	RPM Correction Divisor	75	75	75	50	20
16	RPM Correction Limit	200	200	300	200	200
17	Alt Tune Count Window	0	0	0	0	0
18	Alt Tune Error Divisor	10	10	10	10	10
19	Alt Tune Derivativ Mul	1	1	1	1	1
20	TRQ Integral Rate	25	30	5	25	35
21	TRQ Error Divisor	25	20	5	10	25
22	TRQ Error Limit	600	600	10000	600	200
23	TRQ Integral Divisor	20	20	5	15	5
24	TRQ Integral Limit	0	0	0	0	0
25	TRQ Derivative/10	15	15	15	23	1
26	TRQ Derivative Limit	20	50	10	20	200
27	TRQ Correction Divisor	75	75	100	75	100
28	TRQ Correction Limit	100	50	200	200	200
29	Alt Tune Correction Div	100	100	100	100	100

#	Parameter	Set0	Set1	Set2	Set3	Set4-15
30	Zero Throttle Position	0	0	0	0	0
31	Value (cts/unit)	10	10	10	10	10

5.2 Terminology

Term	Description
Correction	In the case of throttle control, correction is the value of change commanded in throttle position (percent of full motion of throttle) in attempting to arrive at a zero error between reference and feedback. DTC-1 makes this calculation 200 times each second when Version 3.x or 4.x software is installed.
Reference	The desired setpoint of the variable being controlled. For example, 1850 RPM (in RPM mode), 18.6 "Hg (in vacuum mode), and 212.0 #-ft. (in torque mode) would be reference values.
Feedback	The output value of the transducer which is sensing the variable being controlled (magnetic pickup for RPM mode, load cell for torque mode, or vacuum sensor for vacuum mode).
Stability	A system which reaches steady state conditions with a reasonable overshoot within a reasonable time. Unstable systems will continuously oscillate around the reference value.
Instability	Caused by phase (time) shifts in the system, both electrical and mechanical. For example, filtering of feedback signal (either electrical or mechanical) will cause a time delay between a change in the variable and sensing of that change in variable. This greatly increases the possibility that the controller will over-correct. Time delays can also be introduced by system devices such as field inductance.
Error	The difference between reference and feedback. For example, when the system is commanding 1800 RPM (reference) and the system is actually going at 1768 RPM, the error value at that instant is - 32 RPM.
Integral	The algebraic sum of all past errors since changing the mode of control. This function provides the means of controlling to a zero error. With the integral contribution, it is possible to have an offset (a non-zero value) even at a zero-error condition. Integral introduces a delay into the system which can cause instability if improperly entered. Currently, Dyne Systems suggests the integral limit should be set to 0 to disable the integral function of the DTC.
Differential	Differential refers to the rate of change of either the variable being controlled or of this variable's error. Differential provides a stabilizing effect on the system control since it tends to control the rate of change of the variable, making it easier to reduce overshoot when approaching the desired steady state value of the variable. Too large a value of differential will cause a slow, sluggish system response and a high sensitivity to noise in the feedback signal. Too large a value of differential may also cause system instability.

5.3 Parameter Adjustment

The closed loop setup (screen #S51) allows the user to change the control parameters of the closed loop system. This is a series of screens which the user can move through with the arrow keys. On other machines this is done by adjusting pots. The DTC allows the user to set these parameters digitally. Once these are set properly, record these values by uploading them to your PC via TUNE program or by writing them in your log. That way, if they are ever changed, it will be easier to retune the control.

For older versions, there are 16 sets of parameters in version 2.xx. Version 3.x and up provides 32 parameters. You may move between sets using the F2 or F3 keys. A different set of parameters may be used for each different type of engine to be tested in a given cell. Set 15 is automatically used in manifold VAC or MAP mode.

5.3.1 Parameter Array Description for Version 2.xx

Contact Dyne Systems to upgrade beyond version 2.xx. This requires a significant hardware upgrade.

Parameter	Description
00	**Pulses/Revolution.** Number of teeth on speed pickup.
01	**% TQ Integral Used.** Fraction of the torque integral used for the new position reference. It affects performance in the torque mode only. Reducing the value will result in faster response and tighter control; however, making the value too small will cause large overshoot and possible instability.
02	**RPM Error Divisor.** Determines the RPM loop integral which equals the RPM error divided by the value of this parameter. It affects performance in the RPM mode only. Reducing the value of this parameter will result in faster response and tighter control, however, making the value too small will cause large overshoot and possible instability.
03	**TQ Error Divisor.** Determines the torque loop integral which equals the torque error divided by the value of this parameter. It affects performance in the torque mode only. Reducing the value of this parameter will result in faster response and tighter control, however, making the value too small will cause large overshoot and possible instability.
04	**TQ Loop Error Limit.** The value of this parameter is the limit on the maximum error that the control loop will see between torque reference and feedback. It affects performance in the torque mode only.
05	**RPM Loop Error Limit.** The value of this parameter is the limit on the maximum error that the control loop will see between RPM reference and feedback. It affects performance in the RPM mode only.
06	**RPM Integral Limit.** The value of this parameter is the limit on the maximum value that the RPM loop integral will attain. It affects performance in the RPM mode only.
07	**TQ Integral Limit.** The value of this parameter is the limit on the maximum value that the torque loop integral will attain. It affects performance in the torque mode only.
08	**RPM Derivative Mul.** The RPM derivative is multiplied by the value of this parameter (effective in RPM mode only). The RPM derivative is a factor which modifies throttle position by an amount proportional to the rate of change of speed. This function tends to slow the response of the system and the value of this parameter determines how much effect this will have. It affects performance in the RPM mode only.

Parameter	Description
09	**Current Limit.** This value of this parameter is the relative limit on the armature current of the actuator. 255 is maximum, and this number can be lowered if less force is desired from the actuator.
10	**TQ Derivative Mul.** The torque derivative is multiplied by the value of this parameter (effective in torque mode only). The torque derivative is a factor which modifies throttle position by an amount proportional to the rate of change of torque. This function tends to slow the response of the system. It affects performance in the torque mode only.
11	**Keypad Lockout Bit.** V2.10 and up. Set to 0 to avoid technical difficulties. Contact the Dyne Systems Service Manager if you need this function.
12	**% RPM Integral Used.** This parameter is the fraction of the RPM integral used for the new position reference. It affects performance in the RPM mode only. Reducing the value of this parameter will result in faster response and tighter control; however, making the value too small will cause large overshoot and possible instability.
13	**Speed Trip, DYNE OFF.** Overspeed trip RPM, effective only with dyne off.
14	**Underspeed trip: RPM.** Sets the DTC to position mode and off.
15	**<spare>.**

5.3.2 Parameter Array Description for Version 3.xx

There are 16 sets of PID parameter arrays stored in NVRAM. These are numbered 00 through 15 per standard software array identification. Each set contains 32 elements, each related to closed loop control of RPM, Torque, and manifold vacuum or MAP. The manifold vacuum or MAP mode automatically obtains its parameter values from the torque portion of Array number 15. RPM and torque modes may use any set at any time, either by selecting that set using the front panel keypad or by using the serial port commands through the computer Tune program.

Parm	Description
00	**Pulses per Revolution from Speed Sensor.** Enter the number of pulses per revolution of the speed sensor. Higher pulses per revolution provide capability of faster response. Value range from 4 to 250. 60 is the normal value.
01	**Overspeed Trip.** Enter the value of speed at which the overspeed fault to be detected when the dynamometer controller is in the OFF mode or if the DTC-1 is used in stand-alone mode. This parameter has no effect when the Dyn-Loc logic indicates the ON mode. Entries can be made from 0 to 30,000. Exceeding this value will cause the DTC-1 to close the throttle and display a fault message.
02	**Actuator Current Limit.** Default value is 255 (maximum value) and is usually the correct value. It may be reduced for special situations. Significant reductions will cause increased overshoot in position mode during fast transients.
03	**Optional Front Panel Lockout.** Set to 0 to avoid technical difficulties. Contact the Dyne Systems Service Manager if you need this function.

Parm	Description
04	**Underspeed Trip.** Enter the value of speed at which you wish an underspeed fault to be detected when operating the DTC-1 in RPM mode. Normally this should be less than expected idle speed. Loss of speed feedback appears to be an underspeed condition at DTC-1. Failure to achieve this speed will cause the DTC-1 to close throttle and display a fault message. Entries can be made from 0 to 5,000.
05	**(Optional) On-Going Averaging of Reference Data.** This option affects the high speed analog input modification (DS323 PCB) when it is installed. DTC-1 samples the analog reference input every 5 msec. The value entered in this parameter sets the number of 5 msec interval samples to be used in averaging the acquired data. For example, if 4 is entered in this parameter, the data from the previous 3 - 5 msec interval samples will be averaged with the current sample to arrive at the new data value. This parameter provides smoothing of data from a step change source such as a computer D/A output. (See Parameter 06).
06	**(Optional) A/D Data Burst Averaging.** This parameter relates to Parameter 05 and affects the high speed input modification (DS323 PCB) when it is installed. The value entered in this parameter sets the number of samples to be averaged together during each acquisition. For example, if 3 is entered in this parameter, then 3 samples of the analog reference will be acquired and averaged on each 5 msec interval.
07	**Position corr. rounding enable if > 0.** In old DTC firmware, when the RPM or TQ outer loop computed a new POSITION reference, it always rounded down. Set this PARM value to 0 to duplicate old DTC firmware functionality. Set this PARM value to 1 (recommended) to have the new inner loop POSITION reference round up or down based on the next lower digit being 4 or less. Note all higher values become 1 at entry. This can improve stability and hunting at the setpoint.
08	**RPM Integral Rate {1/K0}.** Increasing the value of the RPM integral rate increases the speed at which the integral changes value. A reasonably fast rate is desirable (considering the system mechanical limitations), but too large a value of rate can cause erratic control, particularly with a noisy feedback signal. Too small a value of rate will contribute to system time delays and instability. Not used if parm 12 is set to 0.
09	**RPM Error Divisor {1/K1}.** Decreasing the value of the RPM error divisor increases the effect of the error parameter on the PID equation.
10	**RPM Error Limit {K2>ERROR>-K2}.** Increasing RPM error limit will increase response rates to large changes in reference; however, too large a value will cause overly large throttle position changes during transients.
11	**RPM Integral Divisor {1/K3}.** Decreasing the value of RPM integral divisor increases the effect of the integral on the PID equation. Not used if parm 12 is set to 0.
12	**RPM Integral Limit {K4>INTEGRAL>-K4}.** Increasing the RPM integral limit increases the value achieved by the integral during transients. Allowing the integral to become too large will cause overshoot and longer settling time of the system. Set this value to 0.
13	**RPM Derivative Multiplier {K5}.** Increasing the RPM derivative multiplier reduces the rate at which the system can change to a new RPM setpoint, but it also decreases the system overshoot during transients. It also speeds up the response to externally forced speed changes.
14	**RPM Derivative Limit {K6>DERIVATIVE>-K6}.** Decreasing the RPM derivative limit value reduces its effect during transients more than during steady state operation.

Parm	Description
15	**RPM Correction Divisor {1/K7}.** Increasing the RPM correction divisor reduces the position change commanded after each calculation of the PID equation.
16	**RPM Correction Limit {K8>CORRECTION>-K8}.** Decreasing the RPM correction limit affects the response progressively during larger transients. Steady state response is affected only when the value of this parameter is made very small.
17	**Count threshold for alternative tuning.** The value of this parm determines whether the normal or alternate parameters are actively being used, as compared with the outer loop error count. If the error is larger than this value, the normal parms will be used for all regulator modes. In other words, the alternate parms kick in when the DTC is close to the setpoint. Set this value to 0 to completely disable the alternate parameters 18, 19, and 29. The parm was a spare prior to V3.73.
18	**Alternate Err. Divisor (see parm 17).** This value dynamically replaces the values of parms 09 and 21, but only as long as the outer loop error is less than the value of parm 17. This parm was a spare prior to V3.73.
19	**Alternate Deriv. Mult (see parm 17).** This value dynamically replaces the values of parms 13 and 25, but only as long as the outer loop error is less than the value of parm 17. This parm was a spare prior to V3.73.
20	**Torque Integral Rate {1/K0}.** Increasing the value of torque integral rate increases the speed at which the integral changes value. A reasonably fast rate is desirable (considering the system mechanical limitations), but too large a value of rate can cause erratic control, particularly with a noisy feedback signal. Too small a value of rate will contribute to system time delays and instability. Not used if parm 24 is 0.
21	**Torque Error Divisor {1/K1}.** Decreasing the value of the torque error divisor increases the effect of the error parameter on the PID equation.
22	**Torque Error Limit {K2>ERROR>-K2}**. Increasing torque error limit will increase response rates to large changes in reference. However, too large a value will cause overly large throttle position changes during transients.
23	**Torque Integral Divisor {1/K3}.** Decreasing the value of torque integral divisor increases the effect of the integral on the PID equation. Not used if parm 24 is 0.
24	**Torque Integral Limit {K4>INTEGRAL>-K4}.** Increasing the torque integral limit increases the value achieved by the integral during transients. Allowing the integral to become too large will cause overshoot and longer settling time of the system. Set this parm to 0.
25	**Torque Derivative Multiplier {K5}.** Increasing the torque derivative multiplier will reduce the rate at which the system can change to a new torque setpoint. It also decreases the system overshoot during transients. The typical value is 1.
26	**Torque Derivative Limit {K6>DERIVATIVE>-K6}.** Decreasing the torque derivative limit value reduces its effect during transients more than during steady state operation.
27	**Torque Correction Divisor {1/K7}.** Increasing the torque correction divisor will reduce the position change commanded after each calculation of the PID equation.
28	**Torque Correction Limit {K8>CORRECTION>-K8}.** Decreasing the torque correction limit affects the response progressively during larger transients. Steady state response is affected only when the value of this parameter is made very small.

Parm	Description
29	**Alternate Final Div. (see parm 17).** This value dynamically replaces the values of parms 15 and 27, but only as long as the outer loop error is less than the value of parm 17. This parm was a spare prior to V3.73.
30	**Minimum Throttle Response Position.** If you have an engine which has no response below a given throttle position, enter a value in this parameter which is just below the position where you note a response to a change in throttle position.
31	**M Factor.** A correction related to throttle position and error value as an additional factor in the PID equation. It affects response in the low position area, and a larger value of "M" will cause increasingly faster response in the low throttle range. This factor has no affect in higher throttle position range.

5.3.3 Setting up Parameter Arrays

TUNE software is available from Dyne Systems. It allows entry of parameter values "on-the-fly" via the serial port. Otherwise the values must be entered from the front panel keypad. Using TUNE software, entry of PARMS is accomplished by cursoring to the PARM and entering the value from the computer keyboard.

RPM Mode

1. Enter "0" Integral Limit {PARM 12}.
2. Start the engine and run 3 increasing and 3 decreasing ramps, one each at low, medium, and high rate of change (LAC). Observe initial response and overshoot.
3. Adjust all of the following for best results.
   - Error Divisor {PARM 09}. Suggested initial value - 10.
   - Error Limit {PARM 10}. Suggested initial value - 400.
   - Derivative Multiplier {PARM 13}. Suggested initial value - 300.
   - Derivative Limit {PARM 14}. Suggested initial value - 300.
   - Correction Divisor {PARM 15}. Suggested initial value - 100.
   - Correction Limit {PARM 16}. Suggested initial value - 100.
4. Set the following parms.
   - Set parms 09, 13, and 15 for the best steady state operation.
   - Set parms 10, 14, and 16 for the best transient response.

Torque Mode

1. Enter "0" Integral Limit {PARM 24}.
2. Start engine and run 3 increasing and 3 decreasing ramps, one each at low, medium, and high rate of change (LAC). Observe initial response and overshoot.
3. Adjust all of the following for best results: (Refer to the comments above concerning each parameter).
   - Error Divisor {PARM 21 - Torque}. Suggested initial value - 10.
   - Error Limit {PARM 22 - Torque}. Suggested initial value - 400.
   - Derivative Multiplier {PARM 25 - Torque}. Suggested initial value - 10
   - Derivative Limit {PARM 26 - Torque}. Suggested initial value - 10
   - Correction Divisor {PARM 27 -Torque}. Suggested initial value - 100.
   - Correction Limit {PARM 28 - Torque}. Suggested initial value - 100.
4. Set the following parms.
   - Set parms 21, 25, and 27 for the best steady state operation.
   - Set parms 22, 26, and 28 for the best transient response.

Manifold Vacuum or MAP

Manifold vacuum or MAP is similar to that used for torque, except for the use of a very long sensor tube or other sources of time delay in the sensor, may require much larger values for PARMs 25 and 26 (in PARM set 15, which is used exclusively for manifold vacuum or MAP).

Version 3.xx DTC-1 Parameter Array Relationships Relative to PID Control

The "output" of either the RPM or TQ (includes VAC/MAP which is contained in parameter array #15 only) loops is sent to the position loop as a reference signal, this is labeled POSREF.

The position loop executes at 200Hz, but the TQ loop executes at 10Hz, so the amount of correction sent from the TQ loop to the position loop must be manipulated to achieve TQ loop stability, but still maintain response.

The other parameters are manipulated to obtain the optimum relationship to each other, and to limit the effects as desired.

In the following expression, PARM numbers are used to make it manageable.

- POSREF is the above described position loop reference.
- Error is the proportional error, or: reference (minus) feedback.
- Integral is the time integral of the TQ Error signal.
- Derivative is the time derivative of the TQ signal.
- Correction is the value of the unmodified PID signal.

PID Control

In *POSREF = 28<[Corr/27]<-28*, the value of the POS correction is divided by the value you put in parm 27, and the resulting value is "clamped" between ± the value you put in parm 28.

Corr is the result of the PID calculation. The boldface numbers refer to PARMs, standard face numbers are just that.

The terms include the following.

- *Proportional term.* 22<[Error/21]<-22
- *Integral term.* The integral is "accumulated" at a rate proportional to 1/parm 20; that is, the error value is divided by parm 20 before being summed into the integral. The integral value, modified as above, seen by our PID loop is: 24<[Int/23]-24
- *Derivative term.* 26<[(dT/dt)(25/10)

The complete expression is

CORRECTION =

{22<[Error/21]<-22} + {24<[Int/23]-24} - {26<[(dT/dt)(25/10)<-26}

POSREF = 28<[Corr/27]<-28

The VAC, MAP, and RPM loops pose the same relationships.

V3.73 Alternate Parameter Setpoint Window

DTC-1 firmware versions 3.73 and up (v3.xx and V4.xx only) have five newly defined parameters to use in tuning the Dyne Digital Throttle Control. TUNE version 5.34 and up (IBM-PC compatible tuning software) should be used as it was developed specifically for DTC V3.76 firmware. Use of these should allow reductions in steady-state hunting in RPM, TORQUE, MAP, and VACUUM regulation modes.

PARM 7 controls the rounding of the position correction factor. Preliminary experimental data indicates reduced hunting around the setpoint is likely if PARM 7 is set to 0. Try this first.

PARMs 17, 18, 19, and 29 work together as a set. PARM 17 sets an adjustable window around the setpoint wherein the alternate parms have an effect. Outside the parm 17 window, the main parms have an effect.Setting Parm 17 to 0 will disable the ALTERNATE PARMs from having any effect.

Parameter Name	Main RPM	Alternate RPM/Torque	Main Torque
Error Divisor	PARM 09	PARM 18	PARM 21
Derivative Multiplier	PARM 13	PARM 19	PARM 25
Correction Divisor	PARM 15	PARM 29	PARM 27

Setting PARM 17 for a very large number (like 30000) will use the ALTERNATE PARMs exclusively, and ignore the MAIN PARMs. Setting PARM 17 for a small number can allow using the ALTERNATE PARMs for reduced hunting in a window around the setpoint.

Tuning the DTC with Alternate Parameters

Tune the DTC using PARM 17.

1. Temporarily set PARM 17 to 0.
2. Tune the DTC for quick response to large changes in setpoints.
3. Note the excursions limits above and below the setpoint due to hunting.
4. Temporarily set PARM 17 for 30000.
5. Tune the alternate PARMs to minimize hunting.
6. Set PARM 17 for a value that is a little larger than the excursion limits when previously hunting.
7. Change the setpoint significantly and check for good response to large changes and minimal hunting near the new setpoint. When noting the hunting excursion limits, ignore the decimal points and use all the significant digits. For example, in the TORQUE mode, if the setpoint is 1.00 foot pounds, and the excursion limits are 0.50 to 1.55 foot pounds, that would be a -50 and +55 count excursion. A reasonable PARM 7 count window value is 75 to 100.

   For reduced hunting, increasing each of the ALTERNATE PARMs is the proper direction to go. The DERIVATIVE MULTIPLIER is inherently a noisy signal, and increasing it may soon reach a useful limit point. Also note that there is only one set of PARMs for both RPM and TORQUE. If the DTC will be used in both RPM and TORQUE, and different ALTERNATE PARMs are needed for each case, parm SET 1 might be used for RPM and parm SET 2 might be used for TORQUE.

If your entry for parm 17 is non-zero, then a "control band" of ± that parm value is "placed" around the setpoint value, inside of which some parameters are changed. For example, if you put a value of 10 in parm 17, then whenever the actual TQ value was within 10 units of the setpoint, some of the parm values could change.

6.0 Tune

The Tune program is available from Dyne Systems at no charge. This software has been generated to allow the user to tune the DTC speed, TQ, or Vacuum (parameter set 15, TQ PARMS) loops from a PC keyboard while the DTC is actively controlling. The resulting parameters may be up-loaded to the PC hard drive, or the PC may download a set of parameters (parms) from a previously saved file.

There are two versions of (DTC) PID parameters; a 16 by 16 array used in early DTC versions (up to V3.0), and a 32 by 16 array used in contemporary (V3.0 and higher) DTC versions. TUNE can adapt to these variations. It can be used through a COM serial port, or a DS309 PCB, and can be used with a Dyn-Loc in the system.

The entire state of the DTC machine may also be saved by performing a Tune "clone" operation; this may save considerable time in event of a computer glitch causing a loss of setup and/or parameter data. Clone files may be saved on disk. Cloning is not possible for DTC firmware versions earlier than 3.60.

Chapter 4

Screen Descriptions

The Digital Throttle Control uses a number of menus or screens displayed on the front panel vacuum fluorescent display. These screens allow the user to observe present conditions and to change the operating parameters of the control.

The screen numbers (#On, #S5322E, etc.) are not displayed on the DTC screen. They are used to identify screen displays and to document the keystrokes necessary to access the screen. For example, access screen #S5322E by pressing the following keys: Setup, 5, 3, 2, 2, Enter.

1.0 Initial Power Up Screen

Location	First screen appearing upon powering up.
Description	Displays the DTC has just been powered up or rebooted from screen #S6 or #S525.
Choices for Next Step	Press ON.

2.0 Main Screen #On

Location	Entered from Initial Power-Up screen.
Description	This is the main screen displayed most of the time. It contains all real time information. The operator may change modes between POSITION, RPM, TORQUE, and VACUUM/MAP (Manifold Absolute Pressure). The operator may enter setpoints, read feedback values, and turn the DTC on and off.
Choices for Next Step	Press SETUP. To get to this screen from anywhere in the configuration menu tree, press SETUP, CANCEL.

3.0 Screen #S Setup Mode

Location	Entered from Main Screen #ON.
Description	Allows user to select which setup parameter is to be changed.
Choices for Next Step	• 0 – Show current setup (press 0 to display current setup - screen #S0). • 1 – LL (press 1 to set actuator lower limit - screen #S1). • 2 – UL (press 2 to set actuator upper limit - screen #S2). • 3 – LAC (press 3 to set LAC rates - screen #S3). • 4 – DSP (press 4 to set display conditions - screen #S4). • 5 – CNTRL (press 5 to set control or serial port parameters - screen #S5). • 6 – RSTRT (press 6 to restart the computer). • Press CANCEL to get to the previous step.

4.0 Screen #S0 Show Setup

Location	Entered from screen #S.
Description	Allows the user to select which setup parameters are to be observed.
Choices for Next Step	• 0 – LAC (press 0 to display LAC rate settings - screen #S00). • 1 – RPM (press 1 to display the number of averages of RPM - screen #S01). • 2 – TQ (press 2 to display details of torque display - screen #S02). • 3 – POS (press 3 to display position setup information - screen #S03). • Press CANCEL to get to the previous step.

5.0 Screen #S01 RPM Averages

Location	Entered from screen #S0.
Description	Displays the number of ½ second readings averaged together to arrive at the RPM displayed.
Choices for Next Step	Press CANCEL to get to the previous step.

6.0 Screen #S02 Torque Display Average and Number of Decimal Places

Location	Entered from screen #S0.
Description	Displays the number of ½ second readings that are averaged together to arrive at torque displayed and displays the number of decimal places in the torque display.
Choices for Next Step	Press CANCEL to get to the previous step.

7.0 Screen #S03 Present Position Setup

Location	Entered from screen #S0.
Description	Displays the number of actuator encoder counts (indicating arm position) that the current setup is using for lower limit (usually 2000), the number of actuator encoder counts which the current setup is using for upper limit (12,000 is minimum, approximately 20,000 is strongly recommended, and 30,000 is maximum), and actuator current position (in counts).
Choices for Next Step	Press CANCEL to get to the previous step.

8.0 Screen #S1 Low Limit Set

Location	Entered from screen #S.
Description	Allows the user to establish the lower limit of the actuator arm. The arrow keys cause the actuator arm to move higher (more open throttle) or lower (more closed throttle). The move rate establishes how fast the arm moves when the arrow keys are pressed. • Press 1 to move the arm slowly. • Press 9 to move the arm quickly. • Press any number between 1 and 9 as a compromise movement speed. When the actuator arm is in the desired lower limit position, press ENTER to enter that position as the lower limit. Press CANCEL if a new lower limit is not necessary or to exit the screen. The lower limit must be set first. The lower limit is automatically set as the actual arm position, at Power On.
Choices for Next Step	• Press CANCEL to get to the previous step. • Press ENTER to enter a new setting. The system displays the Low Limit Accepted screen.

9.0 Screen #S1E Low Limit Accepted

Location	Entered from screen #S1.
Description	Displays the current actuator position has been accepted as the lower limit. Reminds the operator there is a high probability that the upper limit should be set.
Choices for Next Step	Press SETUP to get to the SETUP screen, #S.

10.0 Screen #S2 High Limit Set

Location	Entered from screen #S.
Description	Allows the user to establish the upper limit of the actuator arm. The arrow keys cause the actuator arm to move higher (more open throttle) or lower (more closed throttle). The move rate establishes how fast the arm moves when the arrow keys are pressed. • Press 1 to move the arm slowly. • Press 9 to move the arm quickly. • Press any number between 1 and 9 as a compromise movement speed. When the actuator arm is in the desired upper limit position, press ENTER to enter that position as the upper limit. Press CANCEL if a new upper limit is not necessary or to exit the screen. The lower limit must be set first.
Choices for Next Step	• Press CANCEL to get to the previous step. • Press ENTER to enter a new setting. The system displays the High Limit Accepted screen. When back at the MAIN screen, note the position feedback is at 100.0% position.

11.0 Screen #S2E High Limit Accepted

Location	Entered from screen #S2.
Description	Displays the current actuator position has been accepted as the upper limit. Displays the maximum encoder count value. This must be 12,000 or higher or an error screen will be displayed. 20,000 or above is a desirable number, and 30,000 is the maximum.
Choices for Next Step	Press SETUP to go back to the SETUP screen, #S.

12.0 Screen #S3 LAC (Linear Acceleration Control) Set

Location	Entered from screen #S.
Description	Allows operator to choose which LAC reference ramp rate is to be entered or changed (rates are for manual mode only).
Choices for Next Step	• 1 – POS (press 1 to select position mode - screen #S31). • 2 – TQ (press 2 to select torque mode - screen #S32). • 3 – RPM (press 3 to select RPM mode - screen #S33). • 4 – VAC/MAP (press 4 to select VAC/MAP mode - screen #S34).

13.0 Screen #S31 Position Mode LAC Rate Setup

Location	Entered from screen #S3.
Description	Displays a 1 before the word "Rate". Displays the manual LAC rate for the Position mode. The blinking cursor indicates numeric keys can be used to enter a new rate. If the wrong value is keyed before ENTER is pressed, pressing CANCEL clears the erroneous value, returns to the previous value, and allows the correct value to be entered.
Choices for Next Step	• Press ENTER to enter a new setting and go to the previous step. • Press CANCEL to exit to the previous step without entering a new setting.

14.0 Screen #S32 Torque Mode LAC Rate Setup

Location	Entered from screen #S3.
Description	Displays a 2 before the word "Rate". Displays the manual LAC rate for the Torque mode. The blinking cursor indicates numeric keys can be used to enter a new rate. If the wrong value is keyed before ENTER is pressed, pressing CANCEL clears the erroneous value, returns to the previous value, and allows the correct value to be entered.
Choices for Next Step	• Press ENTER to enter a new setting and go to the previous step. • Press CANCEL to exit to the previous step without entering a new setting.

15.0 Screen #S33 RPM Mode LAC Rate Setup

Location	Entered from screen #S3.
Description	Displays a 3 before the word "Rate". Displays the manual LAC rate for the RPM mode. The blinking cursor indicates numeric keys can be used to enter a new rate. If the wrong value is keyed before ENTER is pressed, pressing CANCEL clears the erroneous value, returns to the previous value, and allows the correct value to be entered.
Choices for Next Step	• Press ENTER to enter a new setting and go to the previous step. • Press CANCEL to exit to the previous step without entering a new setting.

16.0 Screen #S34 VAC/MAP Mode LAC Rate Setup Screen

Location	Entered from screen #3.
Description	Displays a 4 before the word "Rate". Displays the manual LAC rate for the VAC or MAP mode. The blinking cursor indicates numeric keys can be used to enter a new rate. If the wrong value is keyed before ENTER is pressed, pressing CANCEL clears the erroneous value, returns to the previous value, and allows the correct value to be entered.
Choices for Next Step	• Press ENTER to enter a new setting and go to the previous step. • Press CANCEL to exit to the previous step without entering a new setting.

17.0 Screen #S4 Display Setup

Location	Entered from screen #S.
Description	Allows the user to choose the display function to be changed.
Choices for Next Step	• 0 – TQ (press 0 to change the torque display - screen #S40). • 1 – SPEED (press 1 to change the speed display - screen #S41). • 2 – Leading 0’s (press 2 to turn leading zeroes on or off - screen #S42). • 3 – VAC/MAP (press 3 to choose between the vacuum or manifold absolute pressure - screen #S43). • Press CANCEL to get to the previous step.

18.0 Screen #S40 TQ Display Setup

Location	Entered from screen #S4.
Description	Allows the user to choose which torque display function is to be changed.
Choices for Next Step	• 0 – dp (press 0 to change torque display decimal places - screen #S400). • 1 – ave (press 1 to change torque display averages - screen #S401). • 2 – sign (press 2 to change polarity of torque display - screen #S402). • 3 – units (press 3 to change TQ display units - screen #S403). • 4 – VAC display (press 4 to have VAC or MAP override torque display on the MAIN SCREEN when not in torque mode - screen #S404). • Press CANCEL to get to the previous step. VAC or MAP would be displayed on the MAIN SCREEN depending on screen #S43 setup.

19.0 Screen #S400 # Decimal Places/TQ Display

Location	Entered from screen #S40.
Description	Allows the user to change the torque display decimal place.
Choices for Next Step	• 0 – No torque decimal place = +0 • 1 – One torque decimal place = +.0 • 2 – Two torque decimal places = +.00 This is displayed as an effect in the torque reference and torque feedback.

20.0 Screen #S401 # Samples/TQ Display

Location	Entered from screen #S40.
Description	Allows the user to change the number of ½ second readings that are averaged together to arrive at the torque displayed (this number should be the same as the averaging on the Dyn-Loc if the controls are used together, otherwise the torque displays on the controls will not agree during changing torque). Allowable values are between 1 and 16. Numeric keystrokes are put into the value at the bottom right corner of the screen, subject to an upper limit of 16. Press ENTER to transfer the value to the left as the current setup variable. If 0 is the value entered, "1" is displayed as the default minimum. If the wrong value is keyed before ENTER is pressed, press CANCEL to clear the erroneous value to 0 and allow the correct value to be entered.
Choices for Next Step	Press CANCEL to get to the previous screen.

21.0 Screen #S402 Torque Inversion

Location	Entered from screen #S40.
Description	Allows the user to invert the polarity of the torque display. Press ENTER to toggle between inverting and non-inverting.
Choices for Next Step	Press CANCEL to confirm the change and get to the previous screen. The condition displayed when CANCEL is pressed is entered as the actual condition.

22.0 Screen #S403 TQ Display Units

Location	Entered from screen #S40.
Description	Allows the user to select what torque units are displayed on the MAIN SCREEN. Note the current torque units are shown in parentheses on the right side of the screen.
Choices for Next Step	• 0 – Ft# (foot pounds). • 1 – NM (Newton-meters). • 2 – LB (pounds). • 3 – NT (Newtons). • 4 – KFC (Kilogram force in centimeters). • 5 – KFM (Kilogram force in meters). • Press CANCEL to confirm the change and get to the previous screen.

23.0 Screen #S404 VAC Display

Location	Entered from screen #S40.
Description	Allows the user to specify the VAC or MAP display override the torque display for the MAIN SCREEN when not in the torque mode. Press ENTER to toggle between VAC/MAP overriding torque and no VAC/MAP overriding torque. • OFF means torque will be displayed in POSITION and RPM modes. • ON means VAC or MAP will be displayed in POSITION and RPM modes. VAC or MAP will be displayed depending on screen #S43 setup.
Choices for Next Step	Press CANCEL to confirm the change and get to the previous screen. The condition displayed when CANCEL is pressed is entered as the actual condition.

24.0 Screen #S41 Speed Display Setup

Location	Entered from screen #S4.
Description	Allows the user to choose which speed display function is to be changed.
Choices for Next Step	• 0 – ave (press 0 to change speed display averages - screen #S410). • 1 – units (press 1 to change speed units - screen #S411). • Press CANCEL to get to the previous step.

25.0 Screen #S410 Samples/RPM Display

Location	Entered from screen #S41.
Description	Allows the user to change the number of ½ second readings that are averaged together to arrive at the RPM displayed. Allowable values are between 1 and 16. Numeric keystrokes are put into the value at the bottom right corner of the screen, subject to an upper limit of 16. Press ENTER to transfer the value to the left as the current setup variable. If 0 is the value entered, "1" is displayed as the default minimum. If the wrong value is keyed before ENTER is pressed, press CANCEL to clear the erroneous value to 0 and allow the correct value to be entered.
Choices for Next Step	Press CANCEL to get to the previous screen.

26.0 Screen #S411 Speed Units

Location	Entered from screen #S41.
Description	Allows the user to select what speed units are displayed on the MAIN SCREEN. Note the current speed units are shown in parentheses on the right side of the screen.
Choices for Next Step	• 0 – RPM (revolutions per minute). • 1 – MPH (miles per hour). • 2 – KPH (kilometers per hour). • 3 – SPD (speed). • Press CANCEL to confirm the change and get to the previous screen.

27.0 Screen #S42 Leading Zeroes

Location	Entered from screen #S4.
Description	Allows the user to turn the leading zeroes on the display on or off. Press ENTER to toggle between ON and OFF.
Choices for Next Step	Press CANCEL to confirm the change and get to the previous screen. The condition displayed when CANCEL is pressed is entered as the actual condition.

28.0 Screen #S43 VAC/MAP Setup

Location	Entered from screen #S4.
Description	Allows the user to select whether the fourth mode and/or display override is VAC or MAP. Either case usually requires a transducer specific to VAC or MAP and an option PCB: either DS313 (obsolescent) or DS323. Both PCBs require calibration potentiometer adjustments. The DS323 PCB has 2 dip switch sections to set for VAC or MAP range. The DS313 requires a resistor change to accommodate MAP. VAC shows 0.00" Hg. at atmospheric pressure and 30.00" Hg. at a perfect vacuum (and will not display outside that range). MAP shows 0.0 mmHg. at a perfect vacuum and approximately 762.0 mmHg. at atmospheric, depending on the current barometric reading. MAP will not display negative. The following screens make reference to this screen: #S3, #S34, #S4, #S404, #S534, #S5340, #S5341, #S5342, #S5342E.
Choices for Next Step	• 0 – VAC. • 1 – MAP. • Press CANCEL to confirm the change and get to the previous screen. The condition displayed when CANCEL is pressed is entered as the actual condition.

29.0 Screen #S5 Control Setup

Location	Entered from screen #S.
Description	Allows the user to change the closed loop control parameters, the RS232 serial port parameters, the A/D CAL, or the parallel I/O.
Choices for Next Step	• 1 – closed loop setup (press 1 to view or change the closed loop control parameters - screen #S51). • 2 – serial setup (press 2 to change the RS232 serial port parameters - screen #S52). • 3 – A/D Cal (press 3 for analog to digital reference calibration - screen S53). • 4 – Par.I/O (press 4 to enable parallel logic input/output - screen #S54). • Press CANCEL to get to the previous screen.

30.0 Screen #S51 Closed Loop Control Parameters

Location	Entered from screen #S5.
Description	A series of screens selected with the arrow or F2 and F3 keys. The arrow keys allow the user to move up or down through a stack of 16 or 32 screens to the desired parameter. The F2 and F3 keys change the set of parameters being used. F2 increases the set number and F3 decreases the set number. There are 16 sets of parameters numbered 0 through 15. Once the user has reached the desired set and parameter, key the desired parameter. If the wrong value is keyed before pressing ENTER, press CANCEL to clear the erroneous value to 0 and key in the correct value. Press ENTER to set the value as the variable. While in process of keying in any value, that maximum value is limited to 30,000. Each parameter may have a local maximum and/or minimum value that will be accepted.
Choices for Next Step	• Press the arrow key to move to another parameter. • Press F2 to increase the parm set number and F3 to decrease the parm set number. • Press CANCEL to get to the previous screen. The condition displayed when CANCEL is pressed is entered as the actual condition.

31.0 Screen #S52 Serial Setup

Location	Entered from screen #S5.
Description	Allows the user to select the RS232 serial port parameter to be changed. Reboot the DTC for the changes to take effect.
Choices for Next Step	• 1 – Baud (press 1 to change the baud rate - screen #S521). • 2 – Parity (press 2 to change the type of parity - screen #S522). • 3 – Dbits (press 3 to change the number of data bits - screen #S523). • 4 – Sbits (press 4 to change the number of stop bits - screen S524). • 5 – Boot (press 5 to reboot the computer. Setup data will not be lost and only serial data will be changed). • Press CANCEL to get to the previous screen.

32.0 Screen #S521 Baud Rate Setup

Location	Entered from screen #S52.
Description	Allows the user to change the baud rate of the RS232 serial port. Key in the desired baud rate (50, 75, 100, 110, 150, 200, 300, 600, 1200, 2400, 4800, 9600, or 19200). Press ENTER to set the value as a variable. If the wrong value is keyed before pressing ENTER, press CANCEL to clear the erroneous value to 0, and enter the correct value. If the value entered is not one of the above number, the next highest value is used (up to 19,200). If the control is working with a Dyn-Loc, set the baud rate to 19200. Obsolete DTC firmware versions may enforce the baud rate at 19,200 and prevent changes.
Choices for Next Step	• Press CANCEL to get to the previous screen. • Press 5 to have the changes take effect.

33.0 Screen #S522 Parity Setup

Location	Entered from screen #S52.
Description	Allows the user to change the parity used in the RS232 serial port.
Choices for Next Step	• 1 – Even (press 1 to establish even parity). • 2 – Odd (press 2 to establish odd parity). • 3 – None (press 3 to establish no parity). • Press CANCEL to confirm the change and go to the previous screen. • Press 5 to have the changes take effect.

34.0 Screen #S523 #Databits Setup

Location	Entered from screen #S52.
Description	Allows the user to change the number of data bits used in the RS232 serial port. • 5 (data bits) • 6 (data bits) • 7 (data bits) • 8 (data bits)
Choices for Next Step	• Press CANCEL to confirm the change and go to the previous screen. • Press 5 to have the changes take effect.

35.0 Screen #S524 #Stopbits Setup

Location	Entered from screen #S52.
Description	Allows the user to change the number of stop bits (1 or 2) used in the RS232 serial port.
Choices for Next Step	• 1 - for 1 stop bit. • 2 - for 2 stop bit. • Press CANCEL to confirm the change and go to the previous screen. • Press 5 to have the changes take effect.

36.0 Screen #S525 Serial Reboot

Location	Entered from screen #S52.
Description	This is not a visible screen. When the user presses 5, the system displays the Power Up screen. This step is necessary for the parameters to take effect.
Choices for Next Step	None. The Power Up screen is displayed.

37.0 Screen #S53 A/D Calibration

Location	Entered from screen #S5.
Description	Allows the user to perform the following functions. • 5 – Enables/disables the reference analog to digital converter circuitry. Do this first. 5=EN(N) means the auto setpoint comes from the serial port, typically "SP 1000 <enter>". • 5 – EN(Y) means the auto setpoint comes from the A/D converter circuitry. • 6 – Tests the A/D digital count output value. • 1,2,3,4 – Calibrates the software digital counts to a usable regulator reference value of position, speed, torque, or VAC/MAP.
Choices for Next Step	• 1 – POS (press 1 to calibrate for position reference - screen #S531). • 2 – SPD (press 2 to calibrate for speed reference - screen #S532). • 3 – TQ (press 3 to calibrate for torque reference - screen #S533). • 4 – VAC/MAP (press 4 to calibrate for VAC/MAP reference - screen #S534). • 5 – EN(=N/Y) (press 5 to toggle the enabling of the reference A/D - screen #S535). • 6 – TEST (press 6 to view the counts matching the analog input - screen #S536). • Press CANCEL to get to the previous screen. If 1, 2, 3, 4, or 6 are pressed while the display shows 5=EN(=N), the equal sign following the "S" flashes between an equal sign and a solid block cursor to remind the user to press 5 to enable these functions.

38.0 Screen #S531 POS. Ref. Cal.

Location	Entered from screen #S53.
Description	Allows the user to choose between setting the position zero voltage, setting the position span (upscale) voltage, or viewing the current position setup values.
Choices for Next Step	• 0 – Show Current (press 0 to show the current setup - screen #S5310). • 1 – Zero (press 1 to calibrate for position zero - screen #S5311). • 2 – Span (press 2 calibrate for position span - screen #S5312). • Press CANCEL to get to the previous screen).

39.0 Screen #S5310 Current A/D Cal. Setup (POS.)

Location	Entered from screen #S531.
Description	Displays the current position A/D setup in terms of the following parameters. • Zero – Digital counts matching analog voltage input that produces 0.0% position in the auto mode. • Span – Digital counts matching analog voltage input that produces F.S.% position in the auto mode. • F.S. – Full scale position value in counts equal to tenths of a percent position reference in the auto mode. F.S. should ideally be 1000 = 100.0%. Span and F.S. should be at least large enough to provide a reasonable upscale calibration point. The input value is permitted to go above the Span and F.S. values, if F.S. is not 1000. The difference between Zero and Span must be greater than 100 counts or an error will result when ENTER is pressed. JP1 on the DS323 can affect the calibration.
Choices for Next Step	Press CANCEL to get to the previous screen.

40.0 Screen #S5311 A/D Ref. in Zero Cal. (Pos.)

Location	Entered from screen #S531.
Description	Allows the user to calibrate the zero point of the analog to digital reference converter. Set the DC voltage for the zero point level at the reference input pin 17 with respect to pin 18 on the 37 pin sub-D connector CON1 on the aluminum optional I/O panel.
Choices for Next Step	• Press ENTER to set the zero point at the current count value called for by the reference input DC voltage, then go to the previous screen. • Press CANCEL to get the previous screen without affecting the zero point. Go to screen #S5310 to check the calibration parameters are reasonable.

41.0 Screen #S5312 A/D Ref. in F.S. Cal. (Pos.)

Location	Entered from screen #S531.
Description	Allows the user to calibrate the span point of the analog to digital reference converter. Set the DC voltage for the span point level at the reference input pin 17 with respect to pin 18 on the 37 pin sub-D connector CON1 on the aluminum optional I/O panel.
Choices for Next Step	• Press ENTER to set the span point at the current count value called for by the reference input DC voltage, then go to the #S5312E screen, where is it possible to set the F.S. corresponding value. • Press CANCEL to get the previous screen without affecting the span point.

42.0 Screen #S5312E A/D Full Scale in Cal. (Pos.)

Location	Entered from screen #S5312.
Description	Allows the user to set the full scale count value for the span point of the analog to digital reference converter. The level of DC voltage for the span point is now set and a full scale value is now needed. Observe upon entering this screen that the previous existing full scale value is shown in the bottom right corner of the screen.
Choices for Next Step	• Press ENTER to confirm the previous existing full scale value is still the proper value and go back to screen #S531. • Press numeric keys to set a new full scale value for the span point, up to a maximum value of 1000. Then press ENTER to go back to screen #S531. • Pressing CANCEL during this process resets the full scale value to 0 to allow starting over numerically. Go to screen #S5310 to check the calibration parameters seem reasonable.

43.0 Screen #S532 SPD. Ref. Cal.

Location	Entered from screen #S53.
Description	Allows the user to choose between setting the speed zero voltage, setting the speed span (upscale) voltage, or viewing the current speed setup values.
Choices for Next Step	• 0 – Show Current (press 0 to show the current setup - screen #S5320). • 1 – Zero (press 1 to calibrate for speed zero - screen #S5321). • 2 – Span (press 2 to calibrate for speed span - screen #S5322). • Press CANCEL to get to the previous screen.

44.0 Screen #S5320 Current A/D Cal. Setup (Speed)

Location	Entered from screen #S532.
Description	Displays the current speed A/D setup in terms of the following parameters. • Zero – Digital counts matching analog voltage input that will produce 0.0% speed in the auto mode. • Span – Digital counts matching analog voltage input that will produce F.S.% speed in the auto mode. • F.S. – Full scale speed value equal to speed reference units in the auto mode. F.S. is ideally maximum speed, but it does not have to be. Span and F.S. should be at least large enough to provide a reasonable upscale calibration point. The input value is permitted to go above the span and F.S. values if F.S. is not the maximum. The difference between zero and span must be greater than 100 counts, or an error will result when the operator presses ENTER.
Choices for Next Step	Press CANCEL to get to the previous screen.

45.0 Screen #S5321 A/D Ref. in Zero Cal.

Location	Entered from screen #S532.
Description	Allows the user to calibrate the zero point of the analog to digital reference converter. Set the DC voltage for the zero point level at the reference input Pin 17 with respect to Pin 18 on the 37 pin sub-D connector CON1 on the aluminum optional I/O panel.
Choices for Next Step	• Press ENTER to set the zero point at the current count value according to the reference input DC voltage, then go to the previous screen. • Press CANCEL to get to the previous screen without affecting the zero point. Go to screen #S5320 to confirm the calibration parameters are reasonable.

46.0 Screen #S5322 A/D Ref. in F.S. Cal. (Speed)

Location	Entered from screen #S532.
Description	Allows the user to calibrate the span point of the analog to digital reference converter. Set the DC voltage for the span point level at the reference input Pin 17 with respect to Pin 18 on the 37 pin sub-D connector CON1 on the aluminum optional I/O panel.
Choices for Next Step	• Press ENTER to set the span point at the current count value according to the reference input DC voltage, then go to the #S5322E screen to set the F.S. corresponding value, if necessary. • Press CANCEL to get to the previous screen without affecting the zero point.

47.0 Screen #S5322E A/D Full Scale in Cal. (Speed)

Location	Entered from screen #S5322.
Description	Allows the user to set the full scale count value for the span point of the analog to digital reference converter. The level of DC voltage for the span point is now set and a full scale count value is needed. Note the previous existing full scale value is displayed in the bottom-right corner of the screen.
Choices for Next Step	• Press ENTER to confirm the previous existing full scale value is still the proper value, then go back to screen #S532. • Press the numeric keys to set a new full scale value for the span point, up to a maximum value of 30,000. Press ENTER to go back to screen #S532. • Press cancel to reset the full scale value to 0. The numbering will start over. • Press CANCEL to get to the previous screen without affecting the zero point. Go to screen #S5320 to confirm the calibration parameters are reasonable.

48.0 Screen #S533 TRQ. Ref. Cal.

Location	Entered from screen #S53.
Description	Allows the user to choose between setting the torque zero voltage, setting the torque span (upscale) voltage, or viewing the current torque setup values.
Choices for Next Step	• 0 – Show Current (press 0 to show the current setup - screen #S5330). • 1 – Zero (press 1 to calibrate for torque zero - screen #S5331). • 2 – Span (press 2 to calibrate for torque span - screen #S5332). • Press CANCEL to get to the previous screen.

49.0 Screen #S5330 Current A/D Cal. Setup (Torque)

Location	Entered from screen #S533.
Description	Displays the current torque A/D setup in terms of the following parameters. • Zero – Digital counts matching analog voltage input that produces 0.0% torque in the auto mode. • Span – Digital counts matching analog voltage input that produces F.S.% torque in the auto mode. • F.S. – Full scale torque value equal to torque reference units in the auto mode. F.S. should ideally be the maximum torque. Span and F.S. should be at least large enough to provide a reasonable upscale calibration point. The input value may go above the span and F.S. values if F.S. is not the maximum. The difference between zero and span should be greater than 100 counts, or an error results when the operator presses ENTER.
Choices for Next Step	Press CANCEL to get to the previous screen.

50.0 Screen #S5331 A/D Ref. in Zero Cal. (Torque)

Location	Entered from screen #S533.
Description	Allows the user to calibrate the zero point of the analog to digital reference converter. Set the DC voltage for the zero point level at the reference input Pin 17 with respect to Pin 18 on the 37 Pin sub-D connector CON1 on the aluminum optional I/O panel.
Choices for Next Step	• Press ENTER to set the zero point at the current count value called for by the reference input DC voltage, then go to the previous screen. • Press CANCEL to get to the previous screen without affecting the zero point. Go to screen #S5330 to check the calibration parameters are reasonable.

51.0 Screen #S5332 A/D Ref. in F.S. Cal. (Torque)

Location	Entered from screen #S533.
Description	Allows the user to calibrate the span point of the analog to digital reference converter. Set the DC voltage for the span point level at the reference input Pin 17 with respect to Pin 18 on the 37 Pin sub-D connector CON1 on the aluminum optional I/O panel.
Choices for Next Step	• Press ENTER to set the span point at the current count value called for by the reference input DC voltage, then go to screen #S5332E to set the F.S. corresponding value if necessary. • Press CANCEL to get to the previous screen without affecting the span point.

52.0 Screen #S5332E A/D Full Scale in Cal. (Torque)

Location	Entered from screen #S5332.
Description	Allows the user to set the full scale count value for the span point of the analog to digital reference converter. The level of DC voltage for the span point is now set, and a full scale count value is needed. Note the previous existing full scale value is displayed in the bottom-right corner of the screen.
Choices for Next Step	• Press ENTER to confirm the previous existing full scale value is still the proper value, then go back to screen #S533. • Press numeric keys to set a new full scale value for the span point to a maximum of 30,000. Press ENTER to go back to screen #S533. • Press CANCEL to reset the full scale value to 0. • Press CANCEL before pressing ENTER or any numeric keys will go to the previous screen and will not affect the full scale value. Go to screen #S5330 to check the calibration parameters are reasonable.

53.0 Screen #S534 VAC Ref. Cal. or MAP Ref. Cal.

Location	Entered from screen #S53.
Description	Allows the user to choose between setting the VAC/MAP zero voltage, setting the VAC/MAP span (upscale) voltage, or viewing the current VAC/MAP setup values. VAC or MAP is displayed depending on the screen #S43 setup.
Choices for Next Step	• 0 – Show Current (press 0 to display the current setup - screen #S5340). • 1 – Zero (press 1 to calibrate for VAC/MAP zero - screen #S5341). • 2 – Span (press 2 to calibrate for VAC/MAP span - screen #S5342). • Press CANCEL to get to the previous screen.

54.0 Screen #S5340 Current A/D Cal. Setup (VAC) or (MAP)

Location	Entered from screen #S534.
Description	Displays the current VAC/MAP A/D setup in terms of the following parameters. • Zero – Digital counts matching analog voltage input that produces 0.0% VAC/MAP in the auto mode. • Span – Digital counts matching analog voltage input that produces F.S.% VAC/MAP in the auto mode. • F.S. – Full scale torque value equal to VAC/MAP reference units in the auto mode. F.S. should ideally be the maximum VAC/MAP. Span and F.S. should be at least large enough to provide a reasonable upscale calibration point. The input value may go above the span and F.S. values if F.S. is not the maximum. The difference between zero and span should be greater than 100 counts, or an error results when the operator presses ENTER.
Choices for Next Step	Press CANCEL to get to the previous screen.

55.0 Screen #S5341 A/D Ref. in Zero Cal. (VAC) or (MAP)

Location	Entered from screen #S534.
Description	Allows the user to calibrate the zero point of the analog to digital reference converter. Set the DC voltage for the zero point level at the reference input Pin 17 with respect to Pin 18 on the 37 Pin sub-D connector CON1 on the aluminum optional I/O panel.
Choices for Next Step	• Press ENTER to set the zero point at the current count value called for by the reference input DC voltage, then go to the previous screen. • Press CANCEL to get to the previous screen without affecting the zero point. Go to screen #S5340 to confirm the calibration parameters are reasonable.

56.0 Screen #S5342 A/D Ref. in F.S. Cal. (VAC) or (MAP)

Location	Entered from screen #S534.
Description	Allows the user to calibrate the span point of the analog to digital reference converter. Set the DC voltage for the span point level at the reference input Pin 17 with respect to Pin 18 on the 37 Pin sub-D connector CON1 on the aluminum optional I/O panel.
Choices for Next Step	• Press ENTER to set the span point at the current count value called for by the reference input DC voltage, then go to the #S5342E screen to set the F.S corresponding value, if necessary. • Press CANCEL to get to the previous screen without affecting the zero point.

57.0 Screen #S5342E A/D Full Scale in Cal. (VAC) or (MAP)

Location	Entered from screen #S5342.
Description	Allows the user to set the full scale count value for the span point of the analog to digital reference converter. The count level of the DC voltage for the span point is now set, and a full scale count value is needed. Note the previous existing full scale value is displayed in the bottom-right corner of the screen.
Choices for Next Step	• Press ENTER to confirm the previous existing full scale value is still the proper value, then go back to screen #S534. • Press numeric keys to set a new full scale value for the span point to a maximum of 30,000. Press ENTER to go back to screen #S534. • Press CANCEL to reset the full scale value to 0. • Press CANCEL before pressing ENTER or any numeric keys will go to the previous screen and will not affect the full scale value. Go to screen #S5340 to check the calibration parameters are reasonable.

58.0 Screen #S535 A/D Ref. in Cal.

Location	Entered from screen #S53.

Description	Press the 5 key to toggle the display from EN(=N) to EN(=Y). N indicates the circuitry is disabled, and the serial port may set the reference. Y indicates the A.D reference converter circuitry is enabled and allows actions where 1, 2, 3, 4, and 6 have an effect.
Choices for Next Step	None. The system displays the #S53 screen.

59.0 Screen #S536 A/D Test Mode

Location	Entered from screen #S53.
Description	Displays the digital counts coming from the A/D reference circuitry. The display will normally show some jitter, even on a very stable DC reference supply. The jitter can be reduced by increasing parameters 5 and 6 of the current parameter set by accessing screen #S51 and using the arrows to select parms 5 and 6. If parm 6 is set too high, it may slow the CPU.The A/D test mode is operational in screens of the form #S53x1 and #S53x2.
Choices for Next Step	Press CANCEL to get to the previous screen.

Chapter 5

Help Messages

Below is a description of the various Help screens and their descriptions. The system displays the problem which must be solved before exiting the screen.

1.0 Help 00

Message	AC Power Fail - System Halted *remove/restore AC power*
Description	Indicates the AC power on the DTC has failed for more than ½ second but less than several seconds.
Action	**1** Remove the AC power until the screen is dark. **2** Power on the DTC. The control displays the initial power-up screen.

2.0 Help 01

Message	Dyno Control Power Failed or Interconnection Fault *press CANCEL*
Description	Indicates the Dyn-Loc currently connected to the DTC has lost power <u>or</u> there is a disconnected or loose cable.
Action	**1** Fix the connection. **2** Press CANCEL.

3.0 Help 02

Message	(Actuator Interconn Failure *Check cable & interlocks) *press CANCEL*
Description	Indicates the actuator is improperly or not connected. This can result from a loose connector or a defective cable/connector.
Action	**1** Fix the connection. **2** Press CANCEL.

4.0 Help 03

Message	(Dyn-Loc / DTC MODE CONFLICT Mode change rejected) *press CANCEL*
Description	Indicates the following. • The DTC was put in the torque mode without powering on the Dyn-Loc. • The DTC was put in the torque mode while the Dyn-Loc was in the torque mode. • The DTC was put in the RPM mode while the Dyn-Loc was in the RPM mode. If the Dyn-Loc mode is changed to the same mode as the DTC, this is a conflict situation. The DTC may automatically change to the opposite mode, thus avoiding an error.
Action	**1** Fix the connection. **2** Press CANCEL.

5.0 Help 04

Message	(ACTUATOR STALLED, returned to 0% pos. successfully) *press CANCEL*
Description	Indicates the actuator has stalled, but has been able to return to zero position.
Action	Press CANCEL.

6.0 Help 05

Message	(ACTUATOR STALLED, unable to return to 0 position) *press CANCEL*
Description	Indicates the actuator has stalled, but has also stalled as it tried to return to zero position.
Action	Press CANCEL.

7.0 Help 06

Message	(ACTUATOR STALLED while trying to alter UL/LL setup) *press CANCEL*
Description	Indicates the actuator has stalled while the operator was adjusting the upper or lower limit of the actuator position. This is usually due to the operator running the actuator arm up against a stop.
Action	Press CANCEL.

8.0 Help 07

Message	(INSUFFICIENT STROKE, upper/ Lower limits too close) *press CANCEL*
Description	Indicates the upper and lower limits have been set too close together. The DTC gives the best results if the actuator arm moves its full arc between the stops. It is not necessary to move the full arc, but there is a minimum requirement of 12,000 counts of the optical encoder.
Action	Press CANCEL.

9.0 Help 08

Message	(SOFT OVERSPEED - RPM greater than xxxx w/DYNE OFF) *press CANCEL*
Description	Indicates the DTC is seeing a speed greater than xxxx RPM, and the Dyn-Loc is in the DYNE OFF mode. This is not allowed. If the DTC is to be used without a Dyn-Loc, a jumper must be installed. Refer to the Stand Alone section of this manual if you need additional assistance. xxxx speed is a settable parameter, #1.
Action	Press CANCEL when the speed is less than xxxx.

10.0 Help 09

Message	(HARD OVERSPEED - Press OS/US RESET on the Dyn-Loc) *press CANCEL*
Description	Indicates the Dyn-Loc connected to the DTC has tripped on OS/US (overspeed or underspeed). Refer to the Dyn-Loc User’s Manual.
Action	**1** Reset the Dyn-Loc by pressing the OS/US RESET and the Dyne Off button simultaneously. **2** Press CANCEL.

11.0 Help 10

Message	(SOFT SHUTDOWN - activated by external user contact) *press CANCEL*
Description	Indicates the soft shutdown circuit on the BASIC REMOTE sub D connector has been interrupted. This might be an N.C. contact on a DTC remote.
Action	**1** Complete the soft shutdown circuit. **2** Press CANCEL.

12.0 Help 11

Message	(EMERGENCY STOP - Press Dyn-Loc EMS RESET if connected) *press CANCEL*
Description	Indicates an emergency stop has been initiated from the front panel push buttons on the DTC or a connected Dyn-Loc or an external input such as a user contact.
Action	**1** Wait five seconds for the EMS circuitry to time out. **2** Press CANCEL.

13.0 Help 12

Message	(SAFE SHUTDOWN - activated by critical program error) *press CANCEL*
Description	Indicates there has been a fault within the DTC. If this occurs during normal operation of the DTC, contact Dyne Systems. A system restart may be necessary.
Action	Press CANCEL.

14.0 Help 13

Message	(Vacuum Control module missing - cannot change mode) *press CANCEL*
Description	When F2/VAC is pressed, the system attempts a data read/write test on the vacuum control module. This screen appears if the test fails. Either a cable is disconnected or improperly connected, there is a problem with the vacuum control module, or there is no vacuum control module installed. In this case, MAP is considered a vacuum equivalent.
Action	Press CANCEL.

15.0 Help 14

Message	(UNDERSPEED - RPM mode selected with RPM <xxxx) *press CANCEL*
Description	Indicates the DTC is seeing a speed less than xxxx RPM, and parameter #4 is a non-zero value. The DTC will be set to position mode and off. xxxx speed is a settable parameter, #4.
Action	Press CANCEL.

16.0 Help 15

Message	(ILLEGAL A/D SPAN - Span must be > zero point) *press CANCEL*
Description	When calibrating the a2d reference with a DS323 PCB installed, the difference between the span and zero must be at least 100 counts.
Action	Press CANCEL.

Chapter 6

Pin-Out List

Many of the connections are duplicated to increase reliability. Dyne Systems recommends the use of all redundant connections, if possible. The encoder requires a 15C # 22/24 shield cable. The motor requires a 4C # 18-22 shield cable. The remote requires the same cable as the encoder.

1.0 Actuator MS

1.1 Actuator Motor MS Conn

Actuator Motor PIN # ID	DTC-1 PIN #	DTC-1 Description & Connector ID	Input (I) Output (O)
I	A,F	+ Actuator Armature	O
NC	B	Interlock (pull down to Comi)	I
NC	C	Supply Common (Comi)	I/O
H	D,E	- Actuator Armature	O

1.2 Actuator Encoder Sub D

PIN # ID	DTC-1 PIN #	DTC-1 Description & Connector ID	Input (I) Output (O)
C	1,9	Supply Common	I/O
D	2,10	Supply +5 VDCi	O
A	3,11	+ Encoder Channel A	I
B	4,12	- Encoder Channel	I
E	5,13	+ Encoder Channel B	I
F	6,14	- Encoder Channel B	I
G	7,15	Interlock (pulled down to Supply Common)	I
NC	8	<not used>	I

2.0 Hard Wired Remote Conn

Remote Basic Sub D

DTC-1 PIN #	DTC-1 Description & Connector ID	Input (I) Output (O)
1,9	Supply +5 VDCi	O
2,10	Supply Commoni	I/O
3	Up Arrow Push button	I
4	Lower Limit LED Driver	O
5	Upper Limit LED Driver	O
6	Down Arrow Push button	I
7	Accepted LED Driver	O
8	Soft Shutdown (connected to I Supply +5 VDC during normal operation)	I
11	<not used>	
12	<not used>	
13	E-Stop (I supply +5=true)	I
14	Enter Push button	I
15	Soft Shutdown LED Driver	O

3.0 Control I/O to Dyn-Loc

PIN #	Description	Input (I) Output (O)
1	Torque Input: times 1 frequency	I
2	Torque Sign	I
3	Emergency Stop	I
4	Dyn-Loc ON	I
5	Dyn-Loc RPM (Torque Not)	I
6	OS/US Trip	I
7	Serial Receive Data	I
8	Clear To Send	I
9	Lock Signal	I
10	Dyn-Loc +5 VDC	I
11	Dyn-Loc Common	I/O
12	Dyn-Loc Shield	I/O
13	DIP Switch Common	I/O
14	RPM Input: times 1 frequency	I
15	DTC E-Stop	O
16	DTC +5 VDC computer supply	O
17	Output of Voltage to Frequency Converter	O
18	Mag. Pickup Conditioner/RPM Output	O
19	Request to Send	O
20	Serial Transmit Data	O
21	0-10 VDC Analog V to F Converter Input	I
22	I Supply +5 VDC	O
23	I Supply Common/Shield	I/O
24	Mag. Pickup Input (shield to 23)	I
25	Mag. Pickup Input (shield to 23)	I

4.0 DTC-1 to Actuator/DTC-1 Remote Pedestal Wiring List

4.1 DTC 1 Actuator Motor Connector

Use 4 Conductor 18 AWG.

PIN #	Cable Color	22 Pin Female MS	Description & Connector ID
A	Black	K	+ Actuator Armature
F	White	K	+ Actuator Armature
B			
C			Jumper to B
D	Green	J	- Actuator Armature
E	Red	J	- Actuator Armature

4.2 DTC-1 Actuator Encoder Connector

Use 15 Conductor 22 or 24 AWG.

PIN #	Cable Color	22 Pin Female MS	Description & Connector ID
NC	Shield	C	Supply COMi
1	Blue/Black	C	Supply COMi
9	Black/White	C	Supply COMi
2	White	D	Supply +5 VDCi
10	Red	D	Supply +5 VDCi
3	Green	A	+ Encoder Channel A
11	White/Black	A	+ Encoder Channel A
4	Orange/Black	B	- Encoder Channel A
12	Green/Black	B	- Encoder Channel A
5	Orange	E	+ Encoder Channel B
13	Black	E	+ Encoder Channel B
6	Red/White	F	- Encoder Channel B
14	Blue	F	- Encoder Channel B

PIN #	Cable Color	22 Pin Female MS	Description & Connector ID
7	Red/Black	G	Interlock (Supply Common)
15	Green/White	G	Interlock (Supply Common)
8	NC	NC	<not used>

4.3 DTC-1 Remote Connector

Use 15 Conductor 22 or 24 AWG.

PIN #	Cable Color	22 Pin Female MS	Description & Connector ID
1	White	T	Supply +5 VDCi
9	Green	T	Supply +5 VDCi
2	Orange/Black	I	Supply COMi
10	Shield	I	Supply COMi
3	Red/White	U	Up Arrow Push button
4	Orange	P	Lower Limit LED Driver
5	Red	N	Upper Limit LED Driver
6	Blue	X	Down Arrow Push button
7	White/Black	R	Accepted LED Driver
8	Black	W	Soft Shutdown
14	Green/Black	V	Enter Push button
15	Red/Black	S	Soft Shutdown LED Driver

5.0 DTC-1 RS232 Pinout from Control I/O

Control I/O to Dyn-Loc 25 Pin Female DTC End			Host Computer Connection		
			Host Computer Connection	9-Pin Female Computer End	25 Pin Female Computer End
11	shield	Shld	COMM	5	7
7	RX	Red	TX	3	2
20	TX	Green	RX	2	3
8	CTS	Black	RTS	7	4
19	RTS	White	CTS	8	5

6.0 DS301 Header X or Header P3

The following is the Pin number match up for adapting the DTC card (DS301) expansion header pinout to the DS302 Sub D. The DS307 adapter PCB on the DTC-1 Exp port changes pinout to the same as the Dyn-Loc 4.

DS301 Header X or Header P3	Signal Name	DS302 I/O Male 25 Pin Sub D	Dyn-Loc Exp port (parallel data)
1	A0	NC	
2	A1	NC	
3	RX	NC	
4	A2	NC	S7
5	TX	NC	
6	A3	NC	S6
7	CTS	NC	
8	A4	NC	S5
9	CS1	NC	S4
10	CS2	NC	S3
11	CS3	15	S0
12	CS4	16	S1
13	CS5	5	S2
14	RD	6	6
15	WR	18	18
16	D0	22	22
17	D1	10	10
18	D2	23	23
19	RTS	NC	
20	D3	11	11
21	D4	24	24
22	D5	12	12
23	D6	25	25
24	D7	13	13
25	COMMON	14	14
26	+5V	1	1,2

7.0 DS323 Optional PCB

The following table displays DS323 vacuum control and analog and digital I/O connections to DB-37 male organized by pin function and logically separated.

PIN #	Description	Special Usage
1	+5V Isolated Supply	
2	-5V Isolated Supply	
4	+15V Isolated Supply	
3	Common for Isolated Supplies	
5	-15V Isolated Supply	
17	Analog Input 1 Active	Isolated Reference
18	Analog Input 1 Common	
6	Analog Input 2 Active	Isolated FTP Feedback
7	Analog Input 2 Common	
8	+15V Isolated Supply (Same as Pin 4) for Transducer	
9	Vacuum Transducer Input	
10	Vacuum Transducer Common	
12	Digital Input 0	FTP Standby
13	Digital Input 1	FTP Cancel
16	Digital Input 2	
15	Digital Input 3	Combined Logic Mode Chart
35	Digital Common #1 for Inputs 0-3	5 – On 5 – Off
33	Digital Input 4 — see next column>>>	4 – On VAC RPM
34	Digital Input 5 — see next column>>>	4 – Off TRQ POS
37	Digital Input 6	Auto
36	Digital Input 7	On/Off
14	Digital Common #2 for Inputs 4-7	
20	Digital Output 0	
19	Digital Output 1	

PIN #	Description	Special Usage
24	Digital Output 3	
23	Digital Output 2	
27	Digital Common #1 for Outputs 0-3	Combined Logic Mode Chart
28	Digital Supply #1 for Outputs	5 – On 5 – Off
25	Digital Output 4 — see next column>>>	4 – On VAC RPM
26	Digital Output 5 — see next column>>>	4 – Off TRQ POS
29	Digital Output 6	Auto
30	Digital Output 7	On/Off
21	Digital Supply #2 for Outputs 4-7	
22	Digital Common #2 for Outputs 4-7	
11	Spare	
31	Common for D/A output	
32	D/A output of actuator position	

Chapter 7

Mainfold Vacuum or MAP Regulation Modification Board

This modification, when installed in a DTC-1 Digital Throttle Control, allows control of engine manifold vacuum or manifold absolute pressure (MAP). The modification consists of a DS313 PCB (obsolescent) or a DS323 PCB, and an 8 inch 25 wire sub-D jumper.

1.0 Theory of Operation

Since the vacuum or MAP produced in the manifold of a standard engine is related to the load on the engine, it is possible to control the amount of vacuum or MAP produced by controlling the throttle position. This requires a feedback signal from a vacuum or MAP transducer.

- MAP is proportional to load and uses an absolute type transducer.
- Vacuum is inversly proportional to load and uses a gauge transducer relative to atmospheric pressure.

1.1 Manifold Vacuum Input and Output

The manifold vacuum mod board provides a high level input of 0 to 5 VDC (or 0 to 1 VDC in special cases) for a manifold vacuum or MAP transducer signal, and +/- 15 VDC for transducer excitation. The transducer signal is fed into the V to F (voltage to frequency) converter in the DTC DS303 PCB, through the 8-inch jumper cable.

The output of the V to F converter is a signal whose frequency is proportional to manifold pressure. This signal is then brought back to the mod board through the 8-inch jumper cable, and switched in for feedback and display, in manifold vacuum or MAP mode.

1.2 Vacuum Mode

When the control is in the vacuum or MAP mode, this frequency signal is fed into the DTC's regulation circuitry in place of the torque feedback frequency signal so that vacuum or MAP can be controlled similarly to controlling engine torque. Vacuum is displayed as

0.00 to 30.00 in. of mercury relative to atmospheric. MAP is displayed as 0 to 761.2 mm of mercury absolute pressure (or higher for super charged engines).

2.0 Transducer Requirements

The DTC-1 requires a 0 to 5 VDC transducer signal with a bandwidth of 50 Hz or more. Measurement is relative to atmospheric pressure for vacuum or absolute pressure for MAP. Other voltage levels can be used, contact Dyne Systems with your proposed transducer or application requirements.

3.0 Calibration and Operation

In order to calibrate the DTC for vacuum or MAP reading, the control may be put in the vacuum or MAP mode (by pressing the F2 front panel key), and the vacuum or MAP data may then be read on the display. Alternatively the DTC may be put into the VAC or MAP override condition by pressing SETUP, 4, 0, 4, ENTER. Then VAC or MAP data will display in the position or RPM modes as well.

3.1 Calibration Display for Vacuum

1. Press Setup,4,3 to get to the VAC/MAP setup screen #S43.
2. Press 0 (VAC).
3. Press Setup, Cancel to get back to the main running screen. If the user is in the VAC mode or VAC override condition, the DTC-1 displays the actual vacuum (in inches of mercury) where torque was previously displayed.
4. Expose the transducer to the ambient air (zero vacuum).
5. Read the display. It should show 0.00, +.03. If it does not, adjust the V/F SPAN pot on DS303 PCB (not the "ZERO" pot as might be expected) for a 0.00 reading. It is best to turn the span pot counterclockwise until a non-zero reading is seen and then clockwise just enough to get the reading to zero.
6. Expose the transducer to a vacuum of 25 inches of mercury (or higher). If the display does not indicate the known value of vacuum, adjust it by turning the V/F ZERO pot on DS303 PCB (not the "SPAN" pot as may be expected).
7. Repeat until the span and zero adjustment require no change.

3.2 Operation for Vacuum

During operation, the Dyn-Loc (if used) must be in the RPM or SPEED mode. The DTC can be in the POSITION or TORQUE modes (the Dyn-Loc should be locked before the DTC is switched from POSITION to any other mode).

1. Switch the DTC-1 to the VACUUM mode by pressing the F2 or VAC key. If this method is used, the control will switch to vacuum mode with a setpoint, which is the same as vacuum data at that instant (a bumpless transfer into the vacuum mode).
2. Change the vacuum setpoints by either keying in the new setpoint and pressing ENTER or using the arrow keys. The default value of 30.00 is displayed in the lower right corner of the display (instead of 0 as in all other modes). This is to insure that if the ENTER key is mistakenly pressed before a value is entered, the throttle will go to zero position while attempting to obtain 30.00 inches Hg.
3. Put the control into the POSITION mode to ensure a zero transient.
4. Put the control into the next desired mode.

3.3 Calibration Display for MAP

1. Press Setup,4,3 to get to the VAC/MAP setup screen #S43.
2. Press 1 (VAC).
3. Press Setup, Cancel to get back to the main running screen. If the user is in the MAP mode or MAP override condition, the DTC-1 displays the actual MAP (in mm of mercury) where torque was previously displayed.
4. Expose the transducer to the ambient air.
5. Obtain a known accurate current barometer reading and convert to mm Hg.
6. Read the display. It should show ~761.2. If it does not, adjust the V/F SPAN pot on DS303 to match your barometer reading (as converted to mm Hg).
7. Expose the transducer and a calibrated MAP sensor to as perfect a vacuum as you can get. If the display does not indicate the same as the calibrated MAP sensor, adjust the display by turning the V/F ZERO pot on DS303 PCB.
8. Repeat until the span and zero adjustment require no change.

3.4 Operation for MAP

During operation, the Dyn-Loc (if used) must be in the RPM or SPEED mode. The DTC can be in the POSITION or TORQUE modes (the Dyn-Loc should be locked before the DTC is switched from POSITION to any other mode).

1. Switch the DTC-1 to the MAP mode by pressing the F2 or VAC key. If this method is used, the control will switch to MAP mode with a setpoint, which is the same as MAP data at that instant (a bumpless transfer into the MAP mode).
2. Change the MAP setpoints by either keying in the new setpoint and pressing ENTER or using the arrow keys. The default value of 0 is displayed in the lower right corner of the display. This is to insure that if the ENTER key is mistakenly pressed before a value is entered, the throttle will go to zero position while attempting to obtain 0 mm Hg.
3. Put the control into the POSITION mode to ensure a zero transient.
4. Put the control into the next desired mode.

4.0 Tuning

The manifold vacuum or MAP loop tuning parameters used are the torque parameters in Parameter Set 15.

4.1 Changing the Manifold Vacuum or MAP Loop Tuning Parameters

1. Access the Closed Loop Parameter screen #S51. The screen should displays what parameter set the control is presently in (this should be noted so that this screen can be returned to).
2. Access parameter set 15 is by pressing the F2 key to jump to the next larger parameter set or the F3 key to jump to the next smaller parameter set. Do this until arriving at parameter set 15. The only parameters of concern for manifold vacuum mode or MAP are 1,3,4,7 & 10 for version 2.XX & parms 20-28 for version 3.31 and up. Parameters 17, 18, 19, and 29 may also be used if the firmware version is V3.73 or higher. Since it is possible to use parameter set 15 in any mode, you should also set up remaining ones.
3. Change to the parameter set the control was using when the closed loop parameter screen was first entered. It is this parameter set that the control will use in Position, RPM, and Torque modes. The control will only look in parameter set 15 for parameter values in the vacuum or MAP modes, unless you intentionally make it ACTIVE.

Chapter 8

Drawings and Schematics

1.0 Drawings and Schematics

Description	Drawing Number	# Pages	Revision Date
Typical Actuator Mounting	2 01 019 00	1	06-13-1995
Actuator Mountin	2 01 019 01	1	06-13-1995
Stand-alone Cable	1 11 008 00	1	10-08-1997
Battery Backed Power Supplies	DS304S	1	07-23-1988
Battery Backed Power Supplies	DS304BS	1	01-01-1992
Throttle Back Panel PCB	DS303A	2	01-01-1989
Throttle Back Panel PCB	DS303B	2	10-02-1990
Throttle Back Panel PCB	DS303C	2	10-13-1994
Basic Remote Station	3 01 015 01	1	11-21-1989
Basic Remote Schematic	1 01 022 01	1	02-21-1995
Actuator Mounting Assembly	3 01 035 00	1	12-03-1992
Keyboard Interface	1 10 007 00	1	03-15-1993
Vacuum and Analog and Digital I/O	2 10 006 06	1	09-23-1998
Serial I/O Schematic	2 10 013 00	1	04-09-1992
Serial I/O Schematic	2 10 014 00	1	04-09-1992

2.0 Drawings Not in the Current Manual

Description	Drawing Number	# Pages	Revision Date
Interconnection DWG	3 01 017 00	1	01-03-1989
CPU PCB Schematic	2 10 011 01	1	02-22-1995

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