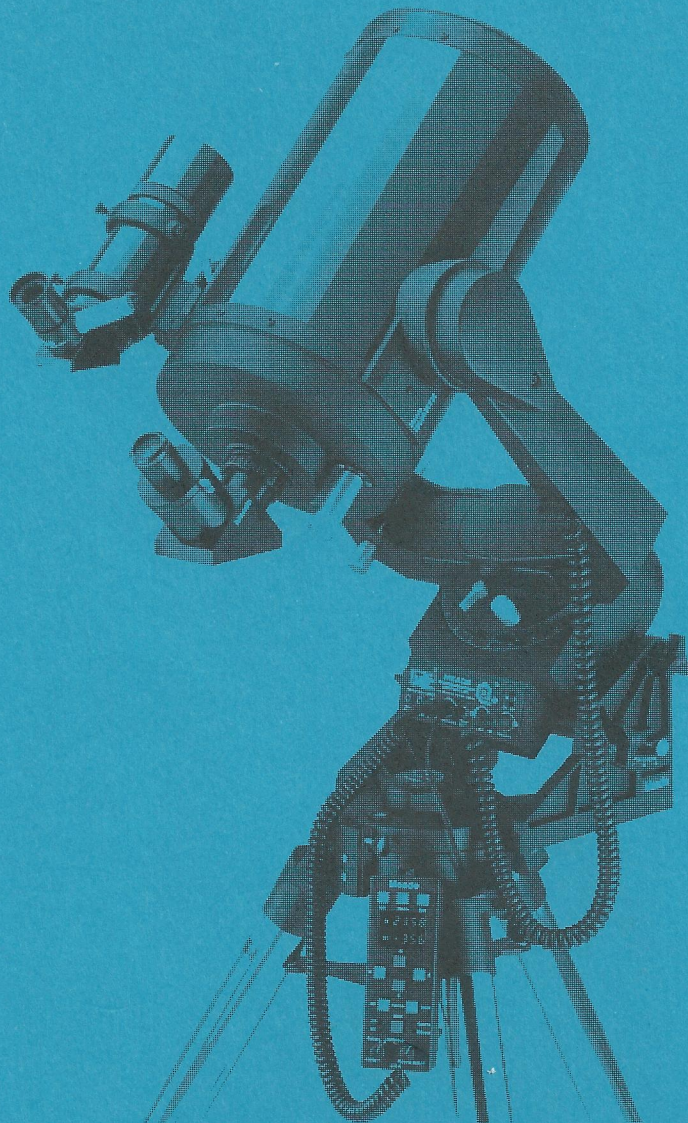


# Supplementary Instructions

## Smart Drive™

All Meade Premier Series 8" and 10"  
Schmidt-Cassegrain Telescopes  
with Quartz Electronic Drive System



**Meade Instruments Corporation**

1675 Toronto Way, Costa Mesa, Ca 92626\* (714) 556-2291

## Contents

|                                                         |   |
|---------------------------------------------------------|---|
| A. Introduction . . . . .                               | 4 |
| 1. New Features Included with the Smart Drive . . . . . | 4 |
| 2. What is Smart Drive . . . . .                        | 4 |
| B. Operation . . . . .                                  | 5 |
| 1. Accessing Smart Drive Functions . . . . .            | 5 |
| 2. Permanent Periodic Error Correction (PPEC) . . . . . | 5 |
| a. PPEC Worm Model . . . . .                            | 6 |
| 1) Building the Worm Model . . . . .                    | 7 |
| 2) Erasing the Worm Model . . . . .                     | 7 |
| 3) Using the Customer Worm Model . . . . .              | 7 |
| 4) Updating the Worm Model . . . . .                    | 8 |
| 3. Electric Focuser Switch . . . . .                    | 8 |
| 4. Declination Drift . . . . .                          | 9 |
| 5. Declination Motor Directions . . . . .               | 9 |

## A. Introduction

Congratulations on your purchase of the Meade **Premier** telescope equipped with **Smart Drive™**! This telescope is the latest in a long line of Meade Schmidt-Cassegrain telescope models, and as such, represents the absolute pinnacle in state-of-the-art telescope design for the serious amateur. The introduction of **Smart Drive** adds a new dimension to telescope drive precision - allowing drive accuracy previously hard to achieve in even the finest professional instruments.

This supplementary instruction manual covers topics unique to **Smart Drive** and refers to terms and telescope procedures covered in the Premier Series Telescope Manual. **Please refer to the standard Premier Series Telescope Manual for complete detailed information regarding set-up and operation of the telescope.**

### 1. New Features Included with the Smart Drive:

- Permanent Periodic Error Correction (PPEC)
- Declination Drift Correction
- Reversible Directions for Declination Correction Buttons
- Two Speed Electric Focus
- Electric Focus Lock-Out
- Internal Beeper (for input feedback and timer functions)
- Improved Backlash Compensation (for 8X East corrections)

### 2. What is Smart Drive?

The purpose of a clock drive on any telescope, is to accurately track an astronomical object - keeping it precisely in the center of the field of view. Since the motion of a star is perfectly smooth and consistent, the telescope clock drive should, ideally, also be perfectly smooth and consistent. In attempting to achieve this ideal, telescope makers have gone to great measures to procure the most precise gears and worms. But no matter how accurate the gear and worm, there are always manufacturing tolerances, and these lead to minute, repeatable speed variations in the tracking speed of the telescope - called periodic error.

By far the largest contributor to periodic error is the worm itself. Errors as small as 1/1000" can lead to errors as large as 30 arcsec in the tracking of the telescope, and these errors will repeat every time the worm makes a complete revolution. For astrophotography work, this is the major reason that a long-exposure photo must be "guided"; this much error will ruin a photograph. While even a telescope with zero periodic error (if one existed) would still require "guiding" during a long astrophoto (due to atmospheric turbulence), eliminating as much periodic error as possible greatly increases the odds for a good photograph.

The **Smart Drive** makes a quantum leap forward in the elimination of periodic error. It is "taught" the periodic error due to the worm, so that the microprocessor can make the necessary speed corrections - usually before the errors are even seen. **Smart Drive** is "taught" by "guiding" on a star, as if you were taking an astrophotograph. This is done by tracking on a star and keeping it centered in the field-of-view by using the correction buttons on the ECC hand controller. By monitoring the button pushes, the **Smart Drive** builds, and permanently remembers, a model of the periodic error. This model is then used to vary the frequency to the motor to eliminate the worm periodic error.

## B. Operation

### 1. Accessing Smart Drive Functions

All **Smart Drive** features are accessed by the ECC hand controller buttons, with audible feedback for each step. While not necessary for any **Smart Drive** feature, the optional Digital Readout System will provide additional feedback and information for some steps, if installed.

There are two basic categories of **Smart Drive** functions. The **Control-Focus** functions are used to turn on and off the electric focuser, and to train and use the worm model feature of the PPEC. The **Control-Dec** functions are used for the Declination drift feature, and to reverse the Declination motor direction buttons.

Note: *Entering a Control mode is only the first step of activating a **Smart Drive** function.* When a Control mode is entered (described below), the ECC buttons are actually being redefined to perform tasks different than what they normally do. Think of the **Control-Focus** and **Control-Dec** as the shift key on a typewriter or function key on a scientific calculator. Once pressed, the next button press will determine the **Smart Drive** function being activated.

To enter the **Control-Focus** mode, hold both Focus buttons ( $\infty$  & Near) down at the same time for approximately two seconds. (If you have an electric focuser, it will not move when both buttons are pushed at the same time.) **Smart Drive** will respond with two quick beeps, indicating that it is in the **Control-Focus** mode and ready for the next part of the command.

To enter the **Control-Dec** mode, hold both Declination buttons (N and S) down at the same time for approximately two seconds. (If you have a Declination Motor System, it will not move when both buttons are pushed at the same time.) **Smart Drive** will respond with three quick beeps, indicating that it is in the **Control-Dec** mode and ready for the next part of the command.

| Smart Drive Control Mode     | Buttons Pushed (2-Sec.)       | Audible Response | DRS Display |
|------------------------------|-------------------------------|------------------|-------------|
| <b>Control-Focus (CTL-F)</b> | Both Focus ( $\infty$ & Near) | 2 Quick Beeps    | No Change   |
| <b>Control-Dec (CTL-D)</b>   | Both Dec (N & S)              | 3 Quick Beeps    | No Change   |

Remember, once a Control mode is entered, it must be followed by a **Smart Drive** command. These commands are described in detail, below.

### 2. Permanent Periodic Error Correction (PPEC)

As described in the Introduction, the main feature of **Smart Drive** is to correct for periodic error due to the worm. In order for **Smart Drive** to do this, it can be "taught" a model of the worm, which it then uses to determine the corrections necessary for play back.

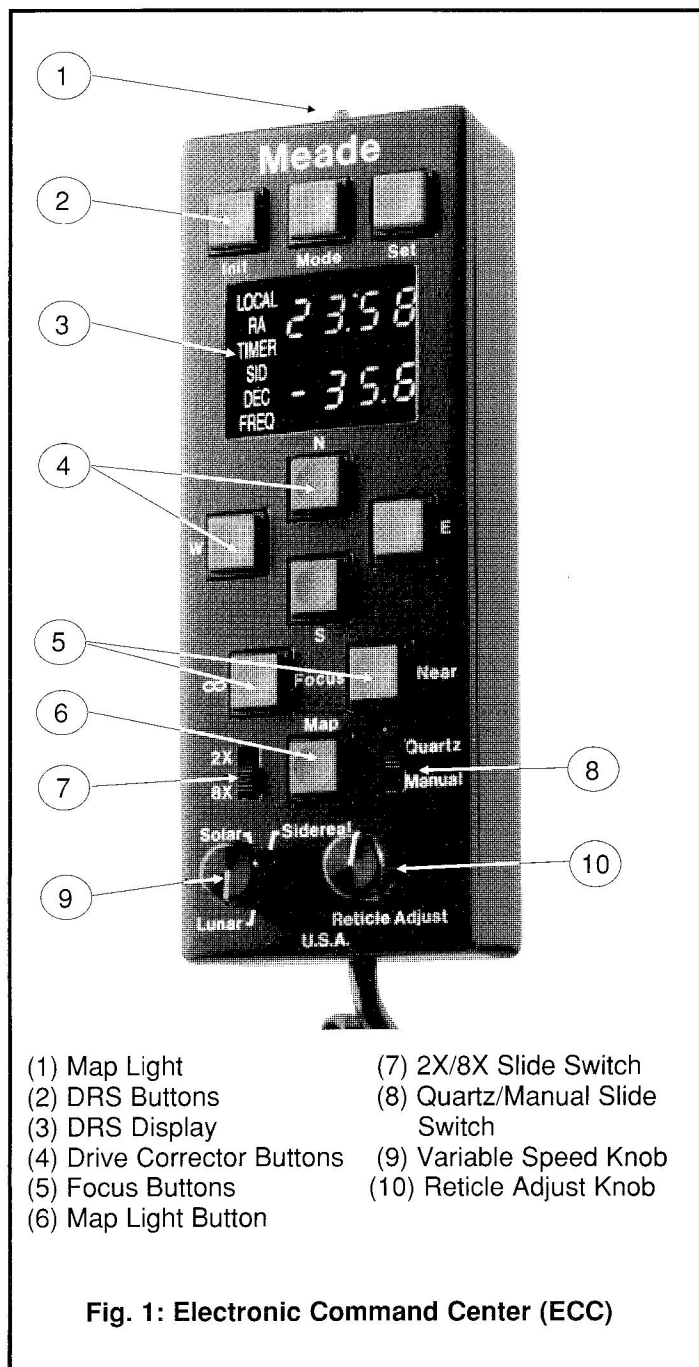
**Smart Drive** will only compensate for periodic error in the Quartz Mode (or if no ECC is present)- when the slide switch (#8, Fig. 1) is in the Quartz position. When in the Manual Mode, the telescope will drive at the uncompensated rate determined by the Variable Speed Knob (#9, Fig. 1).

Before **Smart Drive** can correctly play back the worm model, it first needs to know the angular position of the worm. The worm has a magnetic index pulse which sends a signal to the **Smart Drive** every time it reaches the zero position. *When the telescope is first turned on, **Smart Drive** will not begin to compensate for periodic error until it receives this index signal* - the telescope will drive at the normal sidereal rate. When the worm index pulse is received, **Smart Drive** will give 1 quick beep, and automatically begin to compensate (if in the Quartz mode). Note: it may take as long as eight minutes before this index pulse is received - depending on its position when the telescope was turned off.

### a. PPEC Worm Model

The general procedure for building the worm model is to first enter the "train" mode (described below), and then guide on star as if you were taking an astrophotograph. The more accurately you guide on the star, the better the worm model will be.

Guiding on a star requires an Illuminated Reticle Eyepiece (an eyepiece that has a crosshair) and a barlow lens to increase the magnification. After polar aligning the telescope (see the Premier Series Instruction Manual, pages 40-42), center a star (near the Celestial Equator) on the crosshair of the eyepiece. Then, using the Drive Corrector Buttons (#4, Fig.1), keep the star exactly centered on the crosshair of the eyepiece. As you push the Drive Corrector Buttons, **Smart Drive** will monitor the "E" and "W" buttons to build the worm model. When the model is complete, **Smart Drive** will give three long beeps, indicating that the model is built.



## 1) Building the Worm Model

To build the worm model, follow the following steps:

- 1) Polar Align the telescope as per the Premier Series Instruction Manual.
- 2) Position a star in the center of the field of view of the eyepiece. (Using a crosshair eyepiece helps.) Use as much magnification as possible. The star should be near the Celestial Equator, having a Declination as near 0 as possible.
- 3) Practice guiding on the star, keeping it exactly centered on the crosshairs by pushing the ECC Drive Corrector Buttons. Note: Make sure the slide switch (#7, Fig. 1) is in the 2X position.
- 4) Press **CTL-F** until **Smart Drive** gives 2 quick beeps, and release the two focus buttons. You are now in the Control Focus Command mode.
- 5) Press the "W" button. This puts **Smart Drive** into the "teach" mode, and **Smart Drive** gives 3 long beeps. If a DRS is installed, all displays will show zeros.

At this point, the **Smart Drive** is waiting for a worm index pulse. This may take as long as eight minutes. During this time, keep the star centered on the crosshairs.

When the worm index pulse is reached, **Smart Drive** will give 1 quick beep. As you guide on the star, **Smart Drive** will give 1 quick beep every 10 seconds to let you know it is in the "train" mode. If a DRS is installed, the top display will show the worm angle increment (0 to 239) and the bottom display will show the actual number of motor pulses during that worm angle increment.

When the worm model is complete, **Smart Drive** will give 3 long beeps and automatically begin to compensate for periodic error and other telescope functions are resumed.

Note: During the training cycle, all other telescope functions are suspended. If any button is pushed (other than the 4 Drive Corrector Buttons) **Smart Drive** will abort the training session, erase what it has done, and give 4 long beeps signifying the end of the train session.

The worm model is permanently remembered by **Smart Drive**, even when power is removed from the telescope.

## 2) Erasing the Worm Model

If the worm model needs to be erased, do the following:

- 1) Press CTL-F
- 2) Press "E"

**Smart Drive** will respond with 4 long beeps and resume normal telescope functions.

#### 4) Updating the Worm Model

**Smart Drive** has the ability to modify the worm model. If you build the model several times, it will average the model - thereby creating a model that is more accurate. Follow steps 1-4 on page 7 for building a worm model. Then:

5) Press "N". This puts **Smart Drive** into the "update" mode, and **Smart Drive** gives 2 long beeps. If a DRS is installed, all displays will show zeros.

### 3. Electric Focuser Switch

If you have an Electric Focuser installed, there are times when it is advisable to disable it. During a guided astrophoto is a good example - you don't want to accidentally hit the focus button while guiding.

To disable the Electric Focuser buttons:

- 1) Press CTL-F
- 2) Press "Near"

To enable the Electric Focuser buttons:

- 1) Press CTL-F
- 2) Press  $\infty$

#### Two Speed Electric Focus

The Electric Focus buttons now function at two speeds. The 2X/8X slide switch (#7, Fig. 1) is used to change between the high speed (8x position) and slow speed (2X position).

The following table summarizes the above Control Focus commands.

| Control Focus Commands   |                                    |                  |                                |
|--------------------------|------------------------------------|------------------|--------------------------------|
| Smart Drive Feature      | Buttons Pushed                     | Audible Response | DRS Display                    |
| Build Worm Model         | CTL-F ( $\infty$ & Near)           | 2 Quick Beeps    | No Change                      |
|                          | "W"                                | 3 Long Beeps     | 00:00<br>00:00                 |
|                          | When worm index pulse is received: |                  | Worm Angle #<br># Motor Pulses |
|                          | Either Focus                       | 4 Long Beeps     | Returns to Entry Pt.           |
| Erase Worm Model         | CTL-F ( $\infty$ & Near)           | 2 Quick Beeps    | No Change                      |
|                          | "E"                                | 4 Long Beeps     | No Change                      |
| Update Worm Model        | CTL-F ( $\infty$ & Near)           | 2 Quick Beeps    | No Change                      |
|                          | "N"                                | 2 Long Beeps     | 00:00<br>00:00                 |
|                          | When worm index pulse is received: |                  | Worm Angle #<br># Motor Pulses |
|                          | Either Focus                       | 4 Long Beeps     | Returns to Entry Pt.           |
| Electric Focuser Disable | CTL-F ( $\infty$ & Near)           | 2 Quick Beeps    | No Change                      |
|                          | "Near"                             | 1 Quick Beep     | No Change                      |
| Electric Focuser Enable  | CTL-F ( $\infty$ & Near)           | 2 Quick Beeps    | No Change                      |
|                          | " $\infty$ "                       | 1 Quick Beep     | No Change                      |

## 4. Declination Drift

**Smart Drive** has the ability to playback a Declination drift. This is helpful when guiding an astrophotograph when the telescope is not perfectly polar aligned, or when trying to track a Comet or asteroid. Follow these steps to train a Declination drift:

- 1) Position the object on the crosshairs of the eyepiece. Use as much magnification as possible.
- 2) Press CTL-D. **Smart Drive** will give 3 quick beeps.
- 3) Press "S". **Smart Drive** will give 2 quick beeps, and the DRS display will show all zeros, if installed.
- 4) Guide on the object. The longer you guide on the object, the more accurate the Declination drift playback will be. As you guide on the object, the upper DRS display will show the number of "S" time period corrections and the lower display will show the number of "N" time period corrections.
- 5) Press either Focus button to end the Declination Drift train mode.

The Declination drift playback will be the most accurate when the training is done with very short, frequent corrections. If the corrections are long and infrequent, the playback will be the same.

To stop the Declination drift playback, follow the above steps without doing any guiding - basically retraining a 0 drift rate.

Note: The Declination drift is averaged to give a smooth playback. When guiding in Declination, if both "N" and "S" buttons are pushed, the resulting playback will be in one direction only, at an averaged speed.

## 5) Declination Motor Directions

When the telescope is first powered up, the "N" Declination button will move the telescope North, and the "S" Declination button will move the telescope South. It is often desirable to reverse these actions, especially during the guiding of an astrophotograph, where the 4 directional buttons will move the telescope in consistent directions. To reverse the Declination Motor direction, follow these steps:

- 1) Press CTL-D
- 2) Press "N"

The CTL-D + "N" is a toggle command and will toggle the Declination motor directions back and forth.

The following table summarizes the Control Dec commands.

| Control Dec Commands                            |                                     |                  |                                        |
|-------------------------------------------------|-------------------------------------|------------------|----------------------------------------|
| Smart Drive Feature                             | Buttons Pushed                      | Audible Response | DRS Display                            |
| Declination Drift Train                         | CTL-D ("N" & "S")                   | 3 Quick Beeps    | No Change                              |
|                                                 | "S"                                 | 2 Quick Beeps    | 00:00<br>00:00                         |
|                                                 | As Declination Corrections are Made |                  | # "S" Corrections<br># "N" Corrections |
|                                                 | To Exit                             | Either Focus     | 1 Quick Beep<br>Returns to Entry Pt.   |
| Reverse Dec. Directions<br>(Toggles Directions) | CTL-D ("N" & "S")                   | 3 Quick Beeps    | No Change                              |
|                                                 | "N"                                 | 1 Quick Beep     | No Change                              |