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INSTRDCTIONS FOR TBR BLBCTRONIC
T L SCOPING CONTROL TSTBM (TCS)

LINKBELT D6

DMR ELECTRONICS INC.
HIBBING, MN 55746

September 29, 1993

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REPLACEMENT PARTS LIST

<u>DESCRIPTION</u>	<u>PART NUMBER</u>
- Fuses (F1-F8)	GNA 3A/125V
- Fuses (F9)	GNA 10A/125V
- BOOM TELESCOPE MODE A lamp (YELLOW)	F2 06CY6 -12v/4 OP
- BOOM TELESCOPE MODE A lens (YELLOW)	LCF470W-CYF
- BOOM TELESCOPE MODE B lamp (ORANGE)	F206CO6-12V/40P
- BOOM TELESCOPE MODE B lens (ORANGE)	LCF470W-COF
- TELESCOPE KICKOUT ENABLED lamp (GREEN)	F206CG6-12V/40P
- TELESCOPE KICKOUT ENABLED lens (GREEN)	LCF470W-CGF
- TELESCOPE KICKOUT DISABLED lamp (RED)	F206CR7-12V/40P
- TELESCOPE KICKOUT DISABLED lens (RED)	LCF470F-CRP
- STATUS OPERATIONAL lamp (GREEN)	F206CG6-12V/40P
- STATUS OPERATIONAL lens (GREEN)	LCF470W-CGF
- FAULT DETECTED lamp (RED)	F2 06CR6 -12V/4 OP
- FAULT DETECTED lens (RED)	LCF4 70Yf- CRF
- Waterproof Holders (For lamps above)	MFS4 T OB -WT

CALIBRATION INSTRUCTIONS

- o : Calibration is done after the unit is installed and should not have to be repeated unless the boom reel potentiometers are replaced or readjusted.

Tool needed: Large phillips screwdriver

1. Remove the (4) screws holding the front cover of the ETCS unit with a phillips screwdriver.
2. If unit is working properly, the following conditions will be observed when viewing the diagnostic indicator lamps on the top of the ETCS unit (+12 VDC power must be on -- place the ignition switch in the "RDN" position):
 - A) "TELESCOPE KICKOUT DISABLED" lamp is on.
 - B) "TELESCOPE KICKOUT ENABLED" lamp is off.
 - C) "STATUS OPERATIONAL" lamp is on.
 - D) "FAULT DETECTED" or "FAILURE INDICATION" lamp is off and not flashing.
3. Set the Boom Telescope mode to mode B.
4. Locate the toggle switch on the lower left side of the top printed circuit board.
5. Retract the tip, mid-inner, and mid-outer booms completely.
6. Move the calibration switch into the "CALIBRATE HOME" position for two seconds. The toggle switch is a spring loaded to the center ("OFF") position and will return to center when released.
7. Extend the tip, mid-inner, and mid-outer booms completely. (NOTE: If the boom will not extend out completely with the foot pedal, use the Extend Override switches to extend it fully.)

CALIBRATION INSTRUCTIONS (con't)

8. Move the calibration switch into the 'CALIBRATE EXTEND' position for two seconds. The toggle switch is spring loaded to the center ('OFF') position and will return to center when released.
9. Replace the ETCS front cover and tighten the (4) screws to complete the calibration procedure.

TROUBLESHOOTING INSTRUCTIONS

Tools needed:

Large phillips screwdriver
Ohm meter
Voltage meter

1. If unit is working properly, the following conditions will be observed when viewing the diagnostic indicator lamps on the top of the ETCS unit (+12 V_{DC} power must be on -- place the ignition switch in the 'RUN' position):
 - A) "TELESCOPE KICKOUT DISABLED' lamp is on.
 - B) "TELESCOPE KICKOUT ENABLED' lamp is on.
 - C) "STATUS OPERATIONAL' lamp is on.
 - D) "FAULT DETECTED' or 'FAILURE INDICATION' lamp is off and not flashing.
2. If the 'FAULT DETECTED' or 'FAILURE INDICATION' lamp is flashing or on, go to step 3. Otherwise go to step 6.
3. Check the Failure Indication Table given on the next page, and write down the code that is flashing.
4. Keep the ignition switch off for the remainder of the tests unless otherwise stated.
5. Turn to the page (referenced in the table) corresponding to the fault that you wrote down.
6. Remove the (4) screws holding the front cover of the ETCS unit with a phillips screwdriver.
7. If the 'STATUS OPERATIONAL' lamp is off check fuse F9 on the top left of the control board.
8. If a failure is found in the ETCS other than the fuses or lamps return box to the manufacturer for repair.

¥'AZz•'DRB ZzzDICx 'IOX BZ>Zziz CODBs

The format for the fault codes is a long pause (5 seconds) followed by the applicable fault code(s) in succession.

X = Long Flash (2 seconds)
O = Short Flash (.5 seconds)
Time between flashes is 1 second

failure Tndicatipn Ti le

- XO = Inner mid boom length reel potentiometer or connecting cable failure. (page 5)
- XOO = Outer mid boom length reel potentiometer or connecting cable failure. (page 11)
- XXO = Foot control pedal or connecting cable failure. (page 17)
- KKOO = Low vehicle battery supply voltage (below 8.5 Vpc) (page 23)
- K&XO = Inner mid boom control valve or connecting cable failure. (page 25)
- XZXOO = Outer mid boom control valve or connecting cable failure. (page 27)
- KKXXO = ETCS control circuitry failure. **(page 29)**
- CONTINDODSLY BLINKING = RCL ETCS control box kickout command signal sent to the ETCS control box. (page 31)
- CONTINDODSLY LIT** = ETCS microprocessor failure.

NOTE: 1) The blink codes XXO, XXOO, XXXO, KXXOO, XXXXO will put the crane in the manual mode and turn the "Status Operational" light off.

Failure Indication Instructions

FLASH CODE: XO

DESCRIPTION: Failure of inner mid boom length reel
potentiometer or connecting cable failure.

A. Check for Short/Open in Potentiometer or Connecting Cables

1. Disconnect the 10-pin J2 (reel/boom mode) connector MS/3106F-18-1S from the ETCS unit.
2. With an ohm meter, measure the resistance between terminals A and B on the J2 connector. Write down this value.
3. Repeat step 2 for terminals B and C on the J2 connector. Write down this value.
4. Sum the two resistance readings from steps 2 and 3:

The total should be between 4750 and 5250 ohms. If it is, then check for shorts to ground (step B). If either measurement is infinity, then there is a probable open in the circuit. Continue checking the system at step C.

If the total ohm meter reading is not within 4750 and 5250 ohms and not infinity, then continue checking the system at step D.

Pa11oze Zzzd1cab1ozt Zos€zuc€1oaa

FLASH CODE: JO

DESCRIPTION: Failure of the inner mid boom length reel ,
potentiometer or connecting cable failure.

B. Check for Short to Ground in Potentiometer or connecting
tables

1. Disconnect the 10-pin J2 (reel/boom mode) connector MS/3106F-18-1S from tAe ETCS unit.
2. With an ohm meter, measure the resistance between terminal A on the J2 connector and the vehicle ground.
3. Repeat step 2 twice replacing terminal A first with terminal B and then with terminal C, both on the J2 connector.

With readings of infinity for all of
the above readings, then assume no
intermittent shorts. Continue check
at step C.

If one or more readings are not
infinity, then locate and repair the
short(s) to ground in the wire con-
nected to terminal A (Red wire), B
(Violet wire), or C (Blue wire) that
did not have an infinite impedance
to ground.

Failure Indication Instructions

FLASH CODE: XO

DESCRIPTION: Failure of inner mid boom length reel
potentiometer or connecting cable failure.

C. Check for Open in Potentiometer or Connecting Cables

1. Disconnect the 10-pin J2 (reel/boom mode) connector MS/3106F-18-1S from the ETCS unit.
2. With an ohm meter, measure the resistance between terminals A and B on the J2 connector.
3. Repeat step 2 twice first for terminals A and C and then for terminals B and C, both on the J2 connector.

• With readings of infinity for two of the three above tests, locate and repair open in the wire connecting to terminal A (Red wire), B (Violet wire), or C (Blue wire) in which the test failed. (For example: measuring infinity between terminals A and B and between terminals B and C then there is an open in the Violet wire connected to terminal B).

• If readings are infinity for one or more tests, and no opens were found in the wiring, then replace the potentiometer for the inner mid boom position reel.

No readings of infinity then continue check at step D.

Failure Indication Instructions

FLASH CODE: XO

DESCRIPTION: Failure of inner mid boom length reel potentiometer or connecting cable failure.

D. Check fog Short p round in the ETCS Dnit

1. Disconnect the 10-pin J2 (reel/boom mode) connector MS/3106F-18-1S from the ETCS unit.
2. Remove the (4) screws holding the front cover of the ETCS unit with a phillips screwdriver.
3. With an ohm meter, measure the resistance between terminal A in the J2 bulkhead connector on the ETCS unit and vehicle ground. Write down this value.
4. Repeat step 3 twice replacing terminal A first with terminal B and then with terminal C, both in the J2 connector on the ETCS unit. Write down these values.

Readings of:
infinity between terminals A and D,
100k ohm to infinity between terminals
B and D,
250 ohm to infinity between terminals
C and D.
Then assume no intermittent shorts in
the ETCS unit. Continue check at
step E.

If readings are out of above range,
then locate and repair short in the
system between the two terminals that
were out of range. Continue checking
the system at step F.

Failure Indication instructions

FLASH CODE: XO

DESCRIPTION: Failure of inner mid boom length reel potentiometer or connecting cable failure. *

E. Check for Short in Potentiometer or Connecting Cables.

1. Disconnect the 10-pin J2 (reel/boom mode) connector MS/3106F-18-1S from the ETcs unit.
2. With an ohmmeter, measure the resistance between terminals A and B on the J2 connector. Write down this value.
3. Repeat step 2 between terminals B and C on the J2 connector. Write down this value.
4. Repeat step 2 between terminals A and C on the J2 connector. Write down this value.
5. Sum the resistances measured in steps 2 and 3:

The total should be between 4750 and 5250 ohms. Step 4 should also have a resistance between 4750 and 5250 ohms. If both measurements above are in range, then continue checking system at step F.

If the step 2 reading is less than 2 ohms, then check for and repair short in wires between terminals A (Red wire) and B (Violet wire).

If the step 3 reading is less than 2 ohms, then check for and repair short in wires between terminals B (Violet wire) and C (Blue wire).

If the step 4 measurement is out of range, then check for and repair the short in wires between terminals A (Red wire) and C (Blue wire).

(Continued on next page.)

Failure Indication Instructions

FLASH CODE: XO

DESCRIPTION: Failure of ioner mid boom lengthA reel
potentiometer or connecting cable failure.

E. Check for Short in Potentiometer or Connecting tables

(Continued from last page).

If no short is found, but one or more
measurements are out of range, then
replace the inner mid potentiometer.

Failure Indication Instructions

FLASH CODE: JO

DESCRIPTION: Failure of inner mid boom length reel potentiometer or connecting cable failure.

F. Check for Short or Open in the ETCS Unit

1. Disconnect the 10-pin J2 (reel/boom mode) connector MS/3106F-18-1S from the ETCS unit.
2. Remove the (4) screws holding the top cover of the ETCS unit with a phillips screwdriver.
3. Look for obvious shorts or opens in the inner boom reel wires.

Repair wires or connector if any obvious shorts or opens are noticed:

4. With an ohm meter, measure the resistance between terminals A and B in the J2 connector on the ETCS unit. Write down this value.
5. Move and wiggle wires for the inner boom reel inside the ETCS unit and watch reading.
6. Repeat steps 4 and 5 twice for terminals A and C and then for terminals B and C, both in the J2 connector on the ETCS unit. Write down these values.

Constant readings of:
12k to 14k ohm between terminals A and B
100k ohm to infinity between terminals A and C,
100k ohm to infinity between terminals B and C.
Repair is complete.

If readings are intermittent when the wires are moved or out of the above ranges. Then repair internal wiring or replace bulkhead connector.
Repair is complete

Pailura indication Instructions

rz SH COOM: x00

DESCRIPTION: Failure of outer mid boom length reel
potentiometer or connect gcable failure.

A. Check for Short/Open {n Potentiome\$qr or \$onnecttlg
Cables

1. Disconnect tbe 10-pin J2 (reel/boom mode) connector MS/3106F-18-1S from the ETCS unit.
2. With an ohmmeter, measure the resistance between terminals A and F on the J2 connector. Write down this value.
3. Repeat step 2 for terminals C and F on the J2 connector. Write down this value.
4. Sum tAe two resistance readings from steps 2 and 3:

The total should be between 4750 and 5250 ohms. If it is, then check for sborts to ground (step B).

If either measurement is infinity, then there is a probable open in the circuit. Continue checking the system at step C.

If the total ohm meter reading is not within 4750 and 5250 ohms and not infinity, then continue checking the system at step D.

Failure Indication Instructions

FLASH CODE: XOO

DESCRIPTION: Failure of the outer mid boom length reel potentiometer or connecting cable failure.

B. Check for Short to Ground in Potentiometer or Connecting Cables

1. Disconnect the 10-pin J2 (reel/boom mode) connector MS/3106F-18-1S from the ETCS unit.
2. With an ohm meter, measure the resistance between terminal A on the J2 connector and the vehicle ground.
3. Repeat step 2 twice replacing terminal A first with terminal F and then with terminal C, both on the J2 connector.

Readings of infinity for all of the above readings, then assume no intermittent shorts. Continue check at step C.

If one or more readings are not infinity, then locate and repair the short(s) to ground in the wire connected to terminals A (Red wire), F (Green wire), or C (Blue wire) that did not have an infinite impedance to ground.

Failure Identification Instruction

FLASH CODE: TOO

DESCRIPTION: failure of outer mid boom length reel
potentiometer or connecting cable failure.

C. Check for Open in Potentiometer or Connecting Cables

1. Disconnect the 10-pin J2 (reel/boom mode) connector MS/3106F-18-1S from the ETCS unit.
2. With an ohmmeter, measure the resistance between terminals A and F on the J2 connector.
3. Repeat step 2 twice first for terminals A and C and then for terminals F and C, both on the J2 connector.

With readings of infinity for two of the three above tests, locate and repair open in the wire connecting to terminals A (Red wire), F (Green wire), or C (Blue wire) in which the test failed. (For example: measuring infinity between terminals A and F and between terminals F and C, then there is an open in the Green wire connected to terminals F).

If readings are infinity for one or more of the tests above and no opens were found in the wiring then replace the potentiometer for the outer mid boom position reel.

If no readings of infinity are found, then continue check at step D.

Failure Indication Instructions

FLASH CODE: **TOO**

DESCRIPTION: Failure of outer mid boom length reel potentiometer or connecting cable failure.

D. Check for „Short to ground in the ETCS Pnit

1. Disconnect the 10-pin J2 (reel/boom mode) connector MS/3106F-18-iS from the ETCS unit.
2. Remove the (4) screws holding the front cover of the ETCS unit with a phillips screwdriver.
3. With an ohm meter, measure the resistance between terminal A in the J2 bulkhead connector on the ETCS unit and vehicle ground. **Write down** this value.
4. Repeat step 3 twice replacing terminal A first with terminal F and then with terminal C, both in the J2 connector on the **ETCS** unit. write down these values.

Readings of:
infinity between terminals A and D,
100k ohm to infinity between terminals
F and D,
250 ohm to infinity between terminals
C and D.
Then assume no intermittent shorts in
the ETCE unit. Continue check at
step E.

If readings are out of above range,
then locate and repair short in the
system between the two terminals that
were out of range. Continue checking
the system at step F.

Failure Indication Instructions

FLASH CODE: XOO

DESCRIPTION: Failure of outer mid boom length reel potentiometer or connecting cable failure.

E. Check for Short in Potentiometer or **Connecting** Cables

1. Disconnect the 10-pin J2 (reel/boom mode) connector MS/3106F-18-1S from the **RTCS** unit.
2. With an ohm meter, measure the resistance between terminals A and F on the J2 connector. Write down this value.
3. Repeat step 2 between terminals F and C on the J2 connector. Write down this value.
4. Repeat step 2 between terminals A and C on the J2 connector. Write down this value.
5. Sum the resistances measured in steps 2 and 3.

The total should be between **4750** and **5250** ohms. Step 4 should also have a resistance between **4750** and **5250** ohms. If both measurements above are in range, then continue checking system at step F.

If the step 2 reading is less than 2 ohms, then check for and repair short in wires between terminals A (Red wire) and F (Green wire).

If the step 3 reading is less than 2 ohms, then check for and repair short in wires between terminals F (Green wire) and C (Blue wire).

If the step 4 measurement is out of range, then check for and repair short in wires between terminals A (Red wire) and C (Blue wire).

(Continued on next page.)

Failure Indication Instructions

FLASH CODE: TOO

DESCRIPTION: Failure of outer mid boom length reel
potentiometer or connecting cable failure.

E. Check for Short in Potentiometer or Connecting Cables

(Continued from last page).

If no short is found, but one or more
measurements are out of range, then
replace the inner mid potentiometer.

Failure Indication Instructions

FLASH CODE: X00

DESCRIPTION: Failure of outer mid boom length reel potentiometer or connecting cable failure.

F. Check for Short or Open in the ETCS Unit

1. Disconnect the 10-pin J2 (reel/boom mode) connector MS/3106F-18-1S from the ETCS unit.
2. Remove the (4) screws holding the top cover of the ETCS unit with a phillips screwdriver.
3. Look for obvious shorts or opens in the outer boom reel wires.

Repair wires or connector if any obvious shorts or opens are noticed.

4. With an ohm meter, measure the resistance between terminals A and F in the J2 connector on the ETCS unit. Write down this value.
5. Move and wiggle wires for the outer boom reel inside the ETCS unit and watch reading.
6. Repeat steps 4 and 5 twice for terminals A and C and then for terminals F and C, both in the J2 connector on the ETCS unit. Write down these values.

Constant readings of:
12k to 14k ohms between terminals A and F,
100k ohm to infinity between terminals A and C,
100k ohm to infinity between terminals F and C.
Repair is complete.

If readings are intermittent when the wires are moved or out of the above ranges. Then repair internal wiring or replace bulkhead connector.
Repair is complete.

Pnilure Iodiccti<ro lomtructions

FLASH CODE: CEO

DESCRIPTION: Failure of foot control pedal or coonecting
cable failure

A. Check for Short or open in Foot Control Pedal or
Connecting Cables

1. Disconnect the 7-pin J1 (Extend/Retract Pedal) connector MS/3106F-16S-1S from the ETCS unit.
2. With an ohm meter, measure the resistaoce between terminals A and B on the J1 connector. Write down thia value.
3. Repeat step 2 for terminals B and C on the J1 connector. Write down tthis value.
4. Sum the two resistance readioga from steps 2 and 3:

The total should be between **475 and 525 ohms**. If it is, then check for shorts to ground (step B).

If either measurement is infinity, then there is a probable open in the circuit. Continue checking the system at step C.

If the total ohm meter reading is not **within 475** and 525 ohms and not infinity, then continue checking the system at step D.

Failure Indication Instructions

FLASH CODE: CEO

DESCRIPTION: Failure of foot control pedal or connecting cable failure.

B. Check for Short to Ground to Foot Control Pedal or Connecting Cables

1. Disconnect the 7-pin J1 (Extend/Retract Pedal) connector MS/3i06F-16S-1S from the ETCS unit.
2. With an ohm meter, measure the resistance between terminal A and terminal D (ground) on the J1 connector.
3. Repeat step 2 twice replacing terminal A first with terminal B and then with terminal C, both on the J1 connector.

Readings of infinity for all of the above readings, then assume an intermittent short. Continue check at step C.

If one or more readings are not infinity, then locate and repair the short(s) to ground in the wire connected to terminals A, B, C that did not have an infinite impedance to ground.

Failure Indication Instructions

FLASH CODE: EKO

DESCRIPTION: Failure of foot control pedal or connecting cable failure.

C. Check for Open in Foot Control medal or Connecting tables

1. Disconnect the 7-pin J1 (Extend/Retract Pedal) connector MS/3106F-16S-1S from the ETCS unit.
2. With an ohm meter, measure the resistance between terminals A and B on the J1 connector.
3. Repeat step 2 twice firBt for terminals A and C and then for terminals B and C, both on the J1 connector.

With readings of infinity for two of three above tests, then locate and repair open in the wire connecting to terminals A, B, C, in which the test test failed. (For example: measuring infinity between terminals A and B and between terminals B and C, then there ia an open in the wire connected to terminal B).

If readings are infinity for one or more tests, and no opens were found in the **wiring**, then replace the foot control pedal.

If no readinga of infinity are measured, then continue check at step D.

Failure Indication Instructions

FLASH CODE: TO

DESCRIPTION: Pailure of foot control pedal or connecting cable failure.

D. Check for Short to Ground in the ETCS Qp}g

1. Disconnect the 7-pin J1 (Extend/Retract Pedal) connector MS/3106F-16S-1S from the ETCS unit.
2. Remove the (4) screws holding the front cover of the RTCS unit with a phillipa screwdriver.
3. With an obm meter, measure the resistance between terminal A in the J1 bulkhead connector on the ETCS unit and vehicle ground. Write down this value.
4. Repeat step 3 twice replacing terminal A first with terminal B and then with terminal C, both in the J1 connector on the ETCS unit. write down the 6e values.

Readings of:
infinity between teminals A and D,
100k ohm to infinity between terminals B and D,
45 ohm to infinity between terminals C and D.
Then assume no intermittent shorta in the ETCS unit continue check at step E.

If readings are out of above range, then locate and repair short in the system between the two terminals that were out of range. Continue checking tAe eyetem at step F.

Failure Indication Instructions

FLASH CODE: XXO

DESCRIPTION: Failure of foot control pedal or connecting cable failure .

E. Check for Short in Foot Control Pedal or Connecting Cables

1. Disconnect the 7-pin J1 (Extend/Retract Pedal) connector MS/3106F-16S-1S from tAe ETCS unit.
2. With an ohm meter, measure the resistance between terminals A and B on tAe J1 connector. Write down this value.
3. Repeat step 2 between terminals B and C on the J1 connector. Write down this value.
4. Repeat step 2 between terminals A and C on the J1 connector. Write down this value.
5. Sum the resistances measured in steps 2 and 3.

The total should be between 475 and 525 ohms. Step 3 should also have a resistance between 475 and **525** ohms. If both measurements above are in range, then continue checking system at step F.

If the step 2 reading is less than 2 ohms, then check for and repair short in wires between terminals A and B.

If the step 3 reading is less than 2 ohms, then check for and repair short in wires between terminals B and C.

If the step 4 measurement is out of range, then repair short in wires between terminals A and C.

If no short is found, but one or more measurements are out of range, then replace the inner mid potentiometer.

Failure Indication Instructions

FLASH CODE: ISO

DESCRIPTION. Failure of foot control pedal or connecting cable failure.

F. Check for Short or Open in the ITES Unit

1. Disconnect the 7-pin J1 (Extend/Retract Pedal) connector MS/3106F-16S-1S from tAe ETCS unit.
2. Remove tbe (4) screws holding the top cover of the ETCS unit with a phillips screwdriver.
3. Look for obvious sborts or opens in the foot control pedal wires.

Repair wires or connector if any obvious ahorts or opens are noticed.

4. With an ohm meter, measure the resistance between terminals A and B on the J1 connector. write down this v: =.
5. Move ai nigggle wires for the foot control pedal inside t-a ETCS unit and watch reading.
6. Repeat ateps 4 and 5 twice for terminals A and C and then for terminals B and C, both in the J1 connector on the ETCS unit. Write down these values.

Constant readings of:
12k to 14k ohms between terminals A and B,
100k ohm to infinity between terminals
100k ohm to infinity between terminals B and C.
Repair ia complete.

If readings are intermittent wben the wires are moved or out of the above ranges. Then repair internal wiriog or replace bulkhead connector.
Repair is complete.

Failure Indication Instructions

FLASH CODE: K00

DESCRIPTION: Low vehicle battery supply voltage - below
8.5 V_{Dc} -

A. Check Input Voltage to G+cs gnit

1. Place the ignition switch in the •RUN• position (+12 VDC power must be on).
2. Disconnect the 19-pin J3 (Power/Solenoid/Control) connector MS/3106F-22-1S from the ETCS unit.
3. Connect a volt meter between terminal A (+12 VDC* * terminal B (Ground) on the J3 connector.

If the voltage is less than 8.5 V_{Dc},
then continue checking at step E.

Otherwise, continue checking at
step B.

Failure Indication Instructions

FLASH CODE: XA00
DESCRIPTION: Low vehicle battery supply voltage - below
8.5 V_{DC}.

B. Check for Short or Open between the ETCS board and the J3 connector

1. Leave the ignition switch in the •RDN• position.
2. Reconnect the 19-pin J3 (Power/Solenoid/Control) connector MS/3106F-Z2-1S to the ETCS unit.
3. Remove the (4) screws holding the top cover of the ETCS unit with a phillips screwdriver.
4. Connect a volt meter across diode D38 on the upper right of the ETCS board.

If the voltage is less than 8.5 V_{DC}, then check fuse F9 with an ohm meter. Replace the fuse if it has infinite impedance across it. Otherwise continue at step C.

If the voltage is greater than 8.5 V_{DC}, then return the ETCS unit to the manufacturer.

Failure Indication Instructions

FLRSH CODE: XK00

DESCRIPTION: Low vehicle battery supply voltage - below
8.5 V_{Pc}.

C. Check for open in the RTCS unit

- i. Turn the ignition switch to the •Off• position (+12 V_{Pc} power must be off).
2. Disconnect the 19-pin J3 (Power/Solenoid/Control) connector MS/3106F-22-1S from the ETCS unit.
3. Remove the (4) screws holding the top cover of the ETCS unit with a phillips screwdriver.
4. With an ohm meter, measure the impedance between terminal A on the J3 connector and J3 pad 1 on the ETCS board (a large square pad at the bottom left of the board).

If the reading is between 0 and 2 ohms, then no error is found. Check for an open at step D.

Otherwise, repair the open in the wire from terminal A in the J3 connector on the ETCS unit to J3 pad 1 on the ETCS board. If no open is found replace the J3 bulkhead connector.

Failure Indication Instructions

FLASH CODE: MZ00

DESCRIPTION: Low vehicle battery supply voltage - below
8.5 VDC -

D. Check for Short in the ETCS unit

1. Turn the ignition switch to the 'Off' position (+12 VDC power must be off).
2. Disconnect the 19-pin J3 (Power/Solenoid/Control) connector MS/3106F-22-1S from the macs unit.
3. Remove the (4) screws holding the top cover of the ETCS unit with a phillips screwdriver.
4. Connect one probe of an ohm meter to terminal A on the J3 connector. Connect the other probe individually to every terminal from B to N on the J3 connector.

With readings between 0 and 2 ohms for any of the above measurements, repair the short in the ETCS unit between the wire from terminal A and the wire from the terminal that has zero impedance to terminal A in the ETCS unit.

If no short is found in the wiring, but a reading between 0 and 1 ohms is measured replace the J3 bulkhead connector.

If no readings of zero impedance are measured, then the repair is complete.

Failure Indication Instructions

FLASH CODE: ZX00

DESCRIPTION: Low vehicle battery supply voltage - below
8.5 VDC.

E. Check for Short or Open in the +12 VDC Battery or Connecting Cables

1. Leave the ignition switch in the •RDN• position.
(+12 V power must be on).
2. With a voltage meter, measure the voltage directly
across the battery

If the cruce voltage is uoder 8.5 Voc
replace the battery.

Otherwise locate and repair short or
open in the wiring from tAe battery
to the J3 coonector oo the ETCS unit.

Pxilura Tndicctioo Inctructioono

FLASH CODE: YKEO

DESCRIPTION: Failure of inner mid boom control valve or connecting cable failure.

A. Check or Short/Open iq Control Valve or Connecting Cables

1. Disconnect the 19-pin J3 (Power/Solenoid/Control) connector MS/3106F-22-1S from the ETCS unit.
2. With an ohm meter, measure the resistance between terminals F and G on the J3 connector. Write down this value.
3. Repeat step 2 for terminal B H and J on the J3 connector. Write down this value.

Readings between 6.5 and 8.5 ohms for both measurements, then check for shorts to ground at step B.

If either measurement is infinity, then there is a probable open in the circuit. Continue checking the system at step C.

Otherwise, continue checking the system at step D.

failure Indication Instructions

FLASH CODE: YEAO

DESCRIPTION: Failure of inner mid boom control valve or connecting cable failure.

B. Check for Short to Ground in Control Valve or Connecting Cables

1. Disconnect the 19-pin J3 (Power/Solenoid/Control) connector MS/3106F-22-1S from the ETCS unit.
2. With an ohm meter, measure the resistance between terminal F and terminal B (ground) on the J3 connector.
3. Repeat step 2 between terminal B and individually between each of the following terminals: G, H, and J on the J3 connector.

Readings of infinity for all four measurements, then assume no intermittent shorts. Continue check at step C.

If one or more readings are not infinity, then locate and repair the short(s) to ground in the wire(s) connected to terminals F, G, H, or J that did not have an infinite impedance to ground.

Failure Indication Instructions

FLASH CODE: ¥IAO

DESCRIPTION: Failure of inner mid boom control valve or connecting cable failure.

C. Check for Open in Control Valve or Connecting Cables

1. Disconnect the 19-pin J3 (Power/Solenoid/Control) connector MS/3106F-22-1S from the RTCS unit.
2. With an ohm meter, measure the resistance between terminals F and G, both on the J3 connector. Write down this value.
3. Repeat step 2 between terminals H and J, both on the J3 connector. Write down this value.

If readings are infinity for either of the two tests, then locate and repair open in the wires connecting to terminals F or G (if infinity was measured in step 2) or terminals H and J (if infinity was measured in step 3).

If readings of infinity were measured, but no opens were found, then directly test the impedances of the inner control valves. If infinity is measured for either test, then replace or return to the manufacturer the corresponding control valve.

If no readings of infinity are measured, then continue check at step D.

Failure Indication Instructions

FLASH CODE: EEXO

DESCRIPTION: Failure of ioner mid boom control valve or
connecting cable failure.

D. Check for Short to Ground in the FTCS Dqip

1. Disconnect the 19-pin J3 (Power/Solenoid/Control) connector MS/3106F-22-1S from the ETCS unit.
2. Remove the (4) screws holding the front cover of the ETCS unit with a phillips screwdriver.
3. With an ohm meter, measure the resistance between terminal F and terminal B (ground), both in the J3 bulkhead connector on the ETCS uolt.
4. Repeat step 3 between terminal B (ground) and individually between each of the following terminals: G, H, and J in the J3 connector, on the ETCS unit.

If readings from 0 to 2 ohms are measured for step 3 or 4, then check for and repair short(s) to ground in the internal wiring between the ETCS board and the J3 bulkhead connector.

If readings are out of above range, then the problem has not been found. Continue checking at step E.

Failure Indication Instructions

FLASH CODE: XXXO

DESCRIPTION: Failure of inner mid boom control valve or
connecting cable failure.

E. Check for Short in Control Valve or Connecting Cables

1. Disconnect the 19-pin J3 (Power/Solenoid/Control) connector MS/3106F-22-15 from the ETCS unit.
2. With an ohm meter, measure the resistance between terminal B F and G on the J3 connector. Write down this value.
3. Repeat step 2 between all of the following pairs of terminals on the J3 connector: F and H, F and J, G and H, G and J, H and J. Write down these values.

If readings from 0 to 2 ohms are measured between one or more pair of terminals above, then repair the short(s) in the wires connected to those terminals on the J3 connector.

If the readings are from 0 to 2 ohms, but no short is found in the wiring. Then directly test the impedances of both inner control valves. If infinity is measured for either test, then replace or return to the manufacturer the corresponding control valve.

If readings are out of above range, then the problem has not been found. Continue checking at step F.

Failure Indication Instructions

FLASH CODE: TO

DESCRIPTION: Failure of inner mid boom control valve or ,
connecting cable failure.

F. Check for short or Open in the ETCS Dnit

(Continued from tbe last page)

If readings are intermittent when the wires are moved. Then repair internal wiring between the ETCS board and the J3 bulkhead conoector. Repair is complete.

If tbe readings are from 0 to 2 ohms. but no short is found in the wiriñg. Then directly test the impedance on the board. If infinity is measured for either test, then returnboard to the manufacturer.

Otherwise the repairs are complete.

Failure Indication Instructions

FLASH CODE: EKEO

DESCRIPTION: Failure of inner mid boom control valve or connecting cable failure.

F. Check for Short or Open in the ETCS Unit

1. Disconnect the 19-pin J0 (Power/Solenoid/Control) connector MS/3106F-22-1S from the ETCS unit.
2. Remove the (4) screws holding the top cover of the ETCS unit with a phillips screwdriver.
3. Look for obvious shorts or opens in the inner boom control valve inside the ETCS unit.
4. Measure the impedance of the fuses F1 thru F4.

Repair wires or connector if any obvious shorts or opens are noticed. Also replace any fuses with infinite impedance.

5. With an ohm meter, measure the resistance between terminals F and G in the J3 connector, on the ETCS unit. Write down this value.
6. Move and wiggle wires for the inner boom control valve inside the ETCS unit and watch reading.
7. Repeat steps 5 and 6 between terminals H and J in the J3 connector, on the ETCS unit. Write down these values.

If readings from 0 to 2 ohms are measured for steps 5 or 7, then check for and repair short in the internal wiring between the ETCS board and the J3 bulkhead connector.

(Continued on the next page)

Failure of Outer Midboom Control Valve or
Connecting Cable Failure

FLASH CODE: ZXZ00

DESCRIPTION: Failure of outer midboom control valve or
connecting cable failure.

A. Check for Short/Open in Control Valve or Connecting
Cables

1. Disconnect the 19-pin J3 (Power/Solenoid/Control) connector MS/3106F-22-1S from the RTCS unit.
2. With an ohm meter, measure the resistance between terminals K and L on the J3 connector. Write down this value.
3. Repeat step 2 for terminals M and N on the J3 connector. Write down this value.

Readings between 6.5 and 8.5 ohms for both measurements, then check for shorts to ground (step B).

If either measurement is infinity, then there is a probable open in the circuit. Continue checking the system at step C.

Otherwise, continue checking the system at step D.

Failure Indication Instructions

FLASH CODE: XEX00

DESCRIPTION: Failure of outer mid boom control valve or connecting cable failure.

B. Check for Short to Ground in Control Valve or Connecting Cables

1. Disconnect the 19-pin J3 (Power/Solenoid/Control) connector MS/3106F-22-1S from the ETCS unit.
2. With an ohm meter, measure the resistance between terminal K and terminal B (ground) on the J3 connector.
3. Repeat step 2 between terminal B and individually between each of the following terminals: L, M, and N on the J3 connector.

Readings of infinity for all four measurements, then assume an intermittent short. Continue check at step C.

If one or more readings are not infinity, then locate and repair the short(s) to ground in the wire(s) connected to terminals K, L, M, or N that did not have an infinite impedance to ground.

Failure Indication Instructions

FLASH CODE: YXKOO

DESCRIPTION: Failure of outer mid boom control valve or connecting cable failure.

C. Check for Open in Control Valve or Connecting Cables

1. Disconnect the 19-pin J3 (Power/Solenoid/Control) connector MS/3106F-22-1S from the ETCS unit.
2. With an ohm meter, measure the resistance between terminals K and L, both on the J3 connector. **Write** down this value.
3. Repeat step 2 between terminals M and N, both on the J3 connector. Write down this value.

If readings are infinity for either of the two tests, then locate and repair open in the wires connecting to terminals K or L (if infinity was measured in step 2) or terminals M and N (if infinity was measured in step 3).

If readings of infinity were measured, but no opens were found, then directly test the impedances of the outer control valves. If infinity is measured for either test, then replace or return to the manufacturer the corresponding control valve.

If no readings of infinity are measured, then continue check at step D.

Failure Indication Instructions

FLASH CODE: ¥¥K00

DESCRIPTION: Failure of outer midboom control valve or ,
connecting cable failure.

D. Check for Short to Ground in the ETCS Unit

1. Disconnect the 19-pin J3 (Power/Solenoid/Control) connector MS/3106F-22-1S from the ETCS unit.
2. Remove the (4) screws holding the front cover of the ETCS unit with a Phillips screwdriver.
3. With an ohm meter, measure the resistance between terminal K and terminal B (ground), both in the J3 bulkhead connector on the ETCS unit.
4. Repeat step 3 between terminal B (ground) and individually between each of the following terminals: L, M, and N in the J3 connector, on the ETCS unit.

If readings from 0 to 2 ohms are measured for steps 3 or 4, then check for and repair short(s) to ground in the internal wiring between the ETCS board and the J3 bulkhead connector.

If readings are out of above range, then the problem has not been found.

- . Continue checking at step E.

Failure Indication Instructions

FLASH CODE: ZYKOO

DESCRIPTION: Failure of outer mid boom control valve or connecting cable failure.

E. Check for Short in Control Valve or Connecting cables

1. Disconnect the 19-pin J3 (Power/Solenoid/Control) connector MS/3106F-82-1S from the ETCS unit.
2. With an ohm meter, measure the resistance between terminals K and L on the J3 connector. Write down this value.
3. Repeat step 2 between all of the following pairs of terminals on the J3 connector: K and W, K and N, L and M, L and N, M and N. Write down these values.

If readings from 0 to 2 ohms are measured between one or more pair of terminals above, then repair the short(s) in the wires connected to those terminals on the J3 connector.

If the readings are from 0 to 2 ohms, but no short is found in the wiring. Then directly test the impedances of both outer control valves. If infinity is measured for either test, then replace or return to the manufacturer the corresponding control valve.

If readings are out of above range, then the problem has not been found. Continue checking at step F.

Failure Indication Instructions

FLASH CODE: ¥¥XOO

DESCRIPTION: Failure of outer mid boom control valve or connecting cable failure.

F. Check for Short or Cpen,,in the ETCS Dnit

1. Disconnect the 19-pin J3 (Power/Solenoid/Control) connector MS/3106F-22-1S from the ETCS unit.
2. Remove the (4) screws holding the top cover of the ETCS unit with a phillips screwdriver.
3. Look for obvious ahorts or opens in the outer boom control valve inside the ETCSunit.
4. Measure the impedance of the fuses F1 thru P4.

Repair wires or connector if any obvious shorts or opens are noticed. Also replace any fuses with infinite impedance.

5. With an ohm meter, measure the resistance between terminals K and L in the J3 connector, on the ETCS unit. Write down this value.
6. Move and wiggle wires for the outer boom control valve inside **the ETCS unit and** watch reading.
7. Repeat steps S and 6 between terminals M and N in the J3 connector, on the **ETCS** unit. Urite down these values.

If readings from 0 to 2 ohms are measured for steps 5 or 7, then check for and repair short in the interoal wiring between the **ETCS** board and the J3 bulkhead connector.

(Continued on the next page)

Failure Indication Instructions

FLASH CODE: ZKK00

DESCRIPTION: Failure of outer midboom control valve or
connecting cable failure.

F. Check for Short pr Open in the ETCS Pnit

(Continued from the last page)

If readings are intermittent when the wires are moved. Then repair internal wiring between the ETCS board and the J3 bulkhead connector. Repair is complete.

If the readings are from 0 to 2 ohms, but no short is found in the wiring. Then directly test the impedance on the board. If infinity is measured for either test, then return board to the manufacturer.

Otherwise the repairs are complete.

Failure Indication Instructions

FLASH CODE: XXXY0

DESCRIPTION: Failure of the ETCS control circuitry.

C. Check for Shorts or Opens in the ETCS Unit

1. Turn the ignition switch to the •Off• position (+12 V_{PC} power must be off).
3. Disconnect the 19-pin J3 (Power/Solenoid/Control) connector M5/3106F-22-1S from the ETCS unit.
3. Remove the (4) screws holding the top cover of the ETCS unit with a phillips screwdriver.
4. Look for obvious shorts or opens inside the ETCS unit.

Repair wires or connector if any
obvious shorts or opens are noticed.
Otherwise, return ETCS unit to the
manufacturer.