T.E.C. Technology Ltd.

Unit B22
Holly Farm Business Park
Honiley
Warwickshire
CV8 1NP

Tel: (01926) 484063

Fax: (01926) 484059

22/01/03

Dave Thomson

TRAK2000 TRAILER STEERING SYSTEM

GENERAL OPERATION HANDBOOK

(For OEM Users)

Please read carefully all sections of this handbook, paying particular attention to safety aspects, before attempting to Install, Commission, Operate or Service the system.

Please ensure that all personnel operating or working on machinery to which this system is fitted are fully conversant with the system and necessary safety precautions.

This document is intended for OEM users, and should be used as a basis for inclusions in the Machine Handbook.

INDEX

1.0 DESCRIPTION

Please read carefully all sections of this handbook, paying particular attention to safety aspects, before attempting to Install, Commission, Operate or Service the system.

Please ensure that all personnel operating or working on machinery to which this system is fitted are fully conversant with the system and necessary safety precautions.

The TRAK2000 Trailer Steering Controller is designed for operation in conjunction with a purpose designed Proportional Hydraulic System supplied by System 910 Hydraulics Ltd.

The primary function of the TRAK2000 Trailer Steering System is to ensure that the trailer wheels follow the line of the tractor wheels during a turn to minimise crop damage. Additionally the system can be used in either 'Manual' or 'Automatic' modes to assist in maintaining the line of the trailer wheels when working on a hillside. It should be noted however that in 'Automatic' mode this can only provide compensation for trailer wheel slip, not tractor slip, as the control system cannot distinguish between the tractor slipping or turning.

The Electronic System comprises a tractor cab mounted Control Unit, two Angle Position Transducers and an optional pre-made Hydraulic Manifold wiring harness. It incorporates many features which enhance Safety, Reliability, Ease of Installation/Commissioning, Simplicity of Operation and make the system very User Friendly.

* The unit, being housed in a single sealed enclosure which incorporates both the Operator Controls and Control Electronics, sites the system in the tractor cab away from the hostile environment of the Sprayer, and minimises installed wiring.

* The Angle Position Transducers are well sealed, high reliability units, proven over many years on similar applications.

* TRAK2000 is fitted with a Fused, Reverse Polarity Protected Supply, features a fully rated Latching Emergency Stop, and can only be Turned On initially when in 'Manual' mode.

* Normal operation is simply controlled by three robust sealed toggle switches, which enable selection of :-

    a) Manual/Automatic operation.

    b) Steer Left/Right in 'Manual' mode.

    c) Tracking/Hillside in 'Automatic' mode.

* All Configuration and Calibration adjustments necessary during Commissioning and Operation are easily made from the tractor cab mounted unit using only four pushbuttons. These enable selection of :-

    a) Steered Axle or Drawbar variants.

    b) Open/Closed centre or Load Sensing Hydraulics.

    c) Spray Dependency (either continuous Tracking, or automatic reversion to Straight Ahead/Manual Steering when Spraying On).

    d) Straight Ahead Calibration of Angle Transducers

    e) Tracking Calibration.

    f) Hillside Calibration.

    g) Deadband Width to minimise Hydraulic Loading due to continual small steering corrections.

    h) Delayed Response Time to headland turn, thus reducing tracking errors at onset of turn.

* The settings for the above are retained when the system is powered down, requiring to be set once only for a particular Tractor/Trailer combination. They can be quickly and easily reset for a new tractor if required, using only the four pushbuttons provided.

2.0 INSTALLATION.

This handbook is intended for OEM customers, as a basis for inclusions in the Machine Handbook. It provides a general guide to the TRAK2000 Trailer Steering system. but is not specific to any application, i.e. Manufacturer. Model or Axle/Drawbar variants.

It is recommended that before incorporating this system into a new model or variant of machine, that T.E.C. Technology Ltd., be contacted to discuss the particuiar requirements of the application.

Care should be taken with the siting of the Control Unit to ensure that it can in no way affect the safety of the operator or machine. In particular the Control Unit should not obstruct the tractor drivers view, and it should not be possible for cables to become trapped or in any other way affect the safe operation of the tractor/trailer.

An overall 'External Connections' circuit diagram (5218/A4) is included in appendix 8.3. This shows all external connection options.

2.1 Angle Transducers.

These are provided as part of the system, and are intended to provide electrical feedback as to the 'Tractor to Drawbar' and either 'Drawbar to Trailer' or 'Wheels to Trailer' angles, depending on trailer type.

Ideally the Transducers should be mounted in an inverted position. Although sealed, this prevents moisture from being trapped against the seal.

The mechanical linkage required is not supplied as this is application specific.

The Transducers are fitted with a shaft, having an M6 tapped thread for the attachment of a ball coupling. This shaft is secured by a set screw into the main shaft, which enables the length and hence angular deflection to be set.

The Transducers should be mounted so that in the straight ahead position the shaft is central, and at maximum deflection it travels approximately +/-45 degrees about centre. Care should be taken to ensure the transducers/linkage can not be damaged by overtravel.

The centre vertical main shaft of the units have a centre punch mark offset to the side of the set screw. This marks the orientation of the shaft, and should be on the same side of the body as the cable entry gland. The units are supplied with the correct orientation, but this can be a useful check if the linkage has been dismantled.

The electrical connections to the Transducers are made with a colour coded three core cable. Two types of Transducer are currently in use, the colour codes for which are :-

Brown	or	Red ...	Supply
Blue	or	Blue ...	Wiper (voltage feedback)
Green/Yellow	or	Green ...	Supply

The orientation of the two supply wires is application specific, depending on the mechanical orientation of the Transducer. The units cannot be damaged by the reversal of the supply wires, however the system will only function correctly with one orientation. Please consult T.E.C. Technology Ltd., when using the system on a new application.

Once established on a new model/variant, Transducer linkage lengths/deflections, wiring connections and hydraulic valve/cylinder functions should always be maintained.

3.0 COMMISSIONING.

Please read carefully and ensure that you are fully conversant with the notes on Safety in Section 5.0 of this handbook.

Please read in conjunction with Panel drawings in Appendix.

When commissioning the system the following configuration settings need to be made in addition to the calibration settings described in Section 4.1.

The system can be configured for steered Drawbar or steered Axle operation and in addition when used with the appropriate hydraulic manifold assembly for open centre. closed centre or pressure compensated hydraulics.

To enter CONFIGURATION mode the unit must be initially turned OFF. Depress both the Left Arrow and Right Arrow cursor panel buttons (PB2 and PB3) simultaneously and maintain whilst turning the system ON with the '+[1]' panel button. Depression of PB2 and PB3 must be maintained until LED8 illuminates.

LED0 and LED1 indicate the status of the hydraulic setting. This can be changed using the '+[1]' and '-' panel buttons. Once set as required the Left Arrow panel button exits to RUN mode, the Right Arrow panel button enables selection of Axle/Drawbar trailer type.

LED2 and LED3 indicate the status of the Axle/Drawbar trailer type setting. This can be changed using the '+[1]' and '-' panel buttons. Once set as required the Right Arrow panel button exits to RUN mode, the Left Arrow panel button enables selection of the hydraulic setting.

Note that when the system is first turned on and 'AUTO' mode is selected the hydraulic actuator may immediately move to full travel, either extended or retracted, as the system has not been calibrated or due to wiring/hydraulic inversions.

3.1 Initial Checks in 'MANUAL' mode

Initially check in 'MANUAL' mode for the correct operation of the manual steering feature.

In the case of a drawbar steered machine, moving the Manual steering switch to the left should result in the drawbar/trailer pivot point moving towards the RHS of the tractor.

In the case of an axle steered machine, moving the Manual steering switch to the left should result in the trailer wheels moving towards the RHS of the tractor.

3.2 'Alignment Calibration' of Angle Transducers

Calibrate the two Angle Transducers for the 'Straight Ahead' condition, as described in 4.1 CALIBRATION MODE.

3.3 Phasing of Angle 2

Having carried out the Straight Ahead calibration, check that the drawbar or wheels return to the Straight Ahead position when returning from Auto mode to Manual mode. If the actuator moves directly to full travel then the supply connections to the 'Angle 2' Transducer are reversed. If this is so then the system must be turned off, the wiring corrected, and the procedure repeated from 3.1

3.4 Phasing of Angle 1

Next check operation in 'AUTO' mode. Correct operation will not be possible until the system has been calibrated as described in 4.1 CALIBRATION MODE. However if the actuator moves directly to full travel, then the supply connections to the 'Angle 1' Transducer are reversed. If this is so then the system must be turned off, the wiring corrected, and the procedure repeated from 3.1

4.0 OPERATION.

Please read in conjunction with Panel drawings in Appendix.

This section refers to the operation of the system previously commissioned as described in Section 4.0.

On units that are not hard wired to the 12V Supply, indication of reverse polarity supply will be indicated by the Power LED (LED 15) showing RED whenever the Emergency Stop is released and power is present.

The unit can only be turned on when the Emergency Stop button is released and Manual mode is selected (SW1). It is then turned on by depressing the '+ [1]' panel button (PB1). The 'ON' condition will be indicated by the Power LED (LED 15) showing GREEN.

The unit will power up indicating that Spray Dependency can be set (LED14) and displaying the unit configuration:-

Trailer type - Axle (LED3)
Trailer type - Drawbar (LED2)
Hydraulic type - Closed centre (LED1)
Hydraulic type - Open centre (LED0)

The trailer can now be steered Manually (SW2).

On selection of Automatic mode (SW1) steering will be Automatic in either Tracking or Hillside mode as set by SW3 and modified by Spray Dependency if selected.

Spray Dependency is turned on by the '+[1]' panel button and off by the '-' panel button. Spray dependency status being indicated by LED7 and Spray status by LED6.

When in Tracking mode with Spray Dependency selected the unit will only track when NOT spraying. When spraying is turned ON the steering will centre and Manual mode will be restored following a short delay. This condition is indicated by the flashing of LED17.

When in Hillside mode with Spray Dependency selected the unit will only make Hillside steering corrections when spraying is ON. When spraying is turned OFF tracking mode will be enabled. This condition is indicated by the flashing of LED17.

On re-selection of Manual mode the steering will be centred and following a short delay Manual steering restored.

The calibration and performance of the steering system can be modified to suit different tractor/trailer combinations and operating conditions.

4.1 Calibration Mode

LED's 13 to 9 indicate which parameter is being adjusted as follows:-

LED13 - Tracking
LED12 - Hillside
LED11 - Deadband
LED10 - Delay
LED 9 - Angle Sensor 'straight ahead' calibration

To enter CALIBRATION mode depress both Left Arrow and Right Arrow cursor panel buttons (PB2 and PB3) simultaneously until the Set Spray Dependency (LED14) extinguishes and LED13 illuminates, release PB2 and PB3 and wait until all LED's 0 to 7 extinguish.

Select the parameter to be adjusted by using the Left Arrow and Right Arrow cursor panel buttons.

Exit from the CALIBRATION mode can be made by using the Left Arrow and Right Arrow cursor panel buttons either to the left or right until CALIBRATION mode LED's are extinguished and RUN mode reinstated.

LED13 - Tracking

With the unit set to Auto/Tracking the degree of Tracking steering during a turn can be set using the '+[1]' and '-' panel buttons.

LED 9 - Angle Sensor 'straight ahead' calibration

Angle Sensor 'straight ahead' calibration would normally only be set during commissioning. However it may be necessary to update these values in the event of the use of a different towing tractor or if the sensors/linkages have been changed.

To store the straight ahead position, select Manual, steer the trailer to the straight ahead position and ensure that the tractor/trailer combination are aligned straight ahead. Simultaneously depress the '+[1]' and '-' panel buttons until LED 9 extinguishes. Release both panel buttons. The unit will at this point revert to RUN mode.

LED12 - Hillside

With the unit set to Auto/Hillside the degree of Hillside steering can be set using the '+[1]' and '-' panel buttons.

LED11 - Deadband

Centre deadband can be introduced to minimise steering operations resulting from small deviations to prevent unnecessary heating of the hydraulic system. It can also assist in maintaining tracking at the start and end of a headland turn.

The degree of centre deadband can be set to one of eight levels (0 to 7) as indicated by bargraph display of LED's 0 to 7.

Deadband is increased by depressing '+[1]' panel button, the current level being indicated by the bargraph.

Deadband is decreased by depressing '-' panel button, the current level being indicated by the bargraph.

LED10 - Delay

Delay can be introduced to assist in maintaining tracking at the start and end of a headland turn.

The degree of delay can be set to one of eight levels (0 to 7) as indicated by bargraph display of LED's 0 to 7.

Delay is increased by depressing '+[1]' panel button, the current level being indicated by the bargraph.

Delay is decreased by depressing '-' panel button, the current level being indicated by the bargraph.

LED 9 - Angle Sensor 'straight ahead' calibration

Angle Sensor 'straight ahead' calibration would normally only be set during commissioning. However it may be necessary to update these values in the event of the use of a different towing tractor or if the sensors/linkages have been changed.

To store the straight ahead position, select Manual, steer the trailer to the straight ahead position and ensure that the tractor/trailer combination are aligned straight ahead. Simultaneously depress the '+[1]' and '-' panel buttons until LED 9 extinguishes. Release both panel buttons. The unit will at this point revert to RUN mode.

5.0 SAFETY.

Safety considerations fall into three areas. those relating to the trailer when travelling on public roads, those relating to the use of the system, and safety of personnel working on or near those parts of the machine actuated by this system.

When the trailer is towed on public roads the drawbar/wheels should be centred and locked by independent mechanical means. The controller should be set to the manual steering mode and the electrical and hydraulic supplies removed from the system.

When the system is in use on a Drawbar Steered machine. extreme caution should be exercised when the spray booms are folded. Some machines have marginal stability in this condition, and excessive Drawbar deflection when the machine is not on level ground can result in the trailer turning over.

As with all Electro-Hydraulic systems, work should only be carried out on the system with both the electrical and hydraulic power sources disconnected. Operators must be made aware of the potential hazards associated with the actuated components, and ensure that no personnel approach them whilst the system is active.

Note also that when the electronic steering is active, particularly the first time a new installation is powered-up, faults or incorrect settings can cause the Drawbar/Wheels to traverse to full travel position, or to hunt about a fixed position.

6.0 FAULT FINDING.

Please read in conjunction with panel drawings in appendix.

The following is a list of the most probable causes of malfunctions with newly installed systems.

Will not turn on - LED 15 not illuminated :-

Firstly ensure that the twist release Emergency Stop button is released, and that 'Manual ' mode is selected by Switch SW1.

If SW1 and the Emergency Stop button are correct, then the problem most likely is as a result of no 12Vdc supply reaching the unit.

The unit has no user serviceable fuses, those fitted automatically reset following a short delay after removal of the excess current.

Will not turn on - LED 15 illuminated RED :-

This is due to the supply polarity being reversed. LED 15 is illuminated RED <u>whenever</u> a reverse polarity supply is connected, and GREEN only when a correct supply is connected <u>AND</u> the unit is switched on.

Manual Steering Inoperative :-

* No Hydraulic supply.
* Steering valves not connected.
* Manual mode not selected or time-out not expired.

Hydraulic Steering Ram Fully Extends or Retracts:

* Linkage to Angle Position Transducer Missing/Broken/Loose.
* Wiring to Angle Position Transducer incorrect.
* Reversed Angle Position Transducer Polarity
* Reversed Angle Position Transducer Shaft.
* Reversed Steer Left/Right Steering Valve Coils.

No Tracking Mode :-

* Automatic Mode not selected.
* Spray Dependency 'ON' and Spraying Signal at +12 Volts.

Instability or Insensitivity :-

* Backlash in Angle Position Transducer Linkage.
* Sticking or faulty Hydraulic Steering Valve.

Incorrect Centring :-

* System not Calibrated.
* See Hydraulic Steering Ram Fully Extends or Retracts
* See Instability or Insensitivity.

Incorrect Tracking/Hillside Operation :-

* Automatic Mode not selected.
* Booms not deployed. (Machines with Boom interlock only)
* Spray Dependency setting status incorrect.
* System not Calibrated.
* Backlash in Angle Position Transducer Linkage.
* No Hydraulic supply - check 'Manual' operation.
* Linkage to Angle Position Transducer Missing/Broken.
* Wiring to Angle Position Transducer incorrect.
* Reversed Angle Position Transducer Polarity
* Reversed Angle Position Transducer Shaft.
* Reversed Steer Left/Right Steering Valve Coils.
* Sticking or faulty Hydraulic Steering Valve.
* Steering valves not connected.

7.0 CE MARKING.

The Controller is CE Marked, for sale and operation within the European Economic Community Countries, having been designed/constructed/tested to comply with all relevant standards. It should be noted however that the units supplied are strictly components, having no intrinsic function until incorporated into a machine. The machine into which it is incorporated must therefore not be put into service until it has been certified by it's manufacturer as conforming with the EC Machinery Directive.

Unauthorised modifications are prohibited for reasons of safety.

The Electronic Control System is designed and supplied by :-

T.E.C. Technology Ltd,.
Unit B22.
Holly Farm Business Park.
Honiley.
Warwickshire.
CV8 1NP
England

Telephone : (44) (0)1926 484063
Fax : (44) (0)1926 484059

The Hydraulic System with which the Electronic Control System has been designed to operate is designed and supplied by :-

System 910 Hydraulics Ltd,.
7 The Old Granary.
Boxgrove.
Chichester.
West Sussex.
PO18 OES

Telephone : (44) (0)1243 539789
Fax : (44) (0)1243 530307

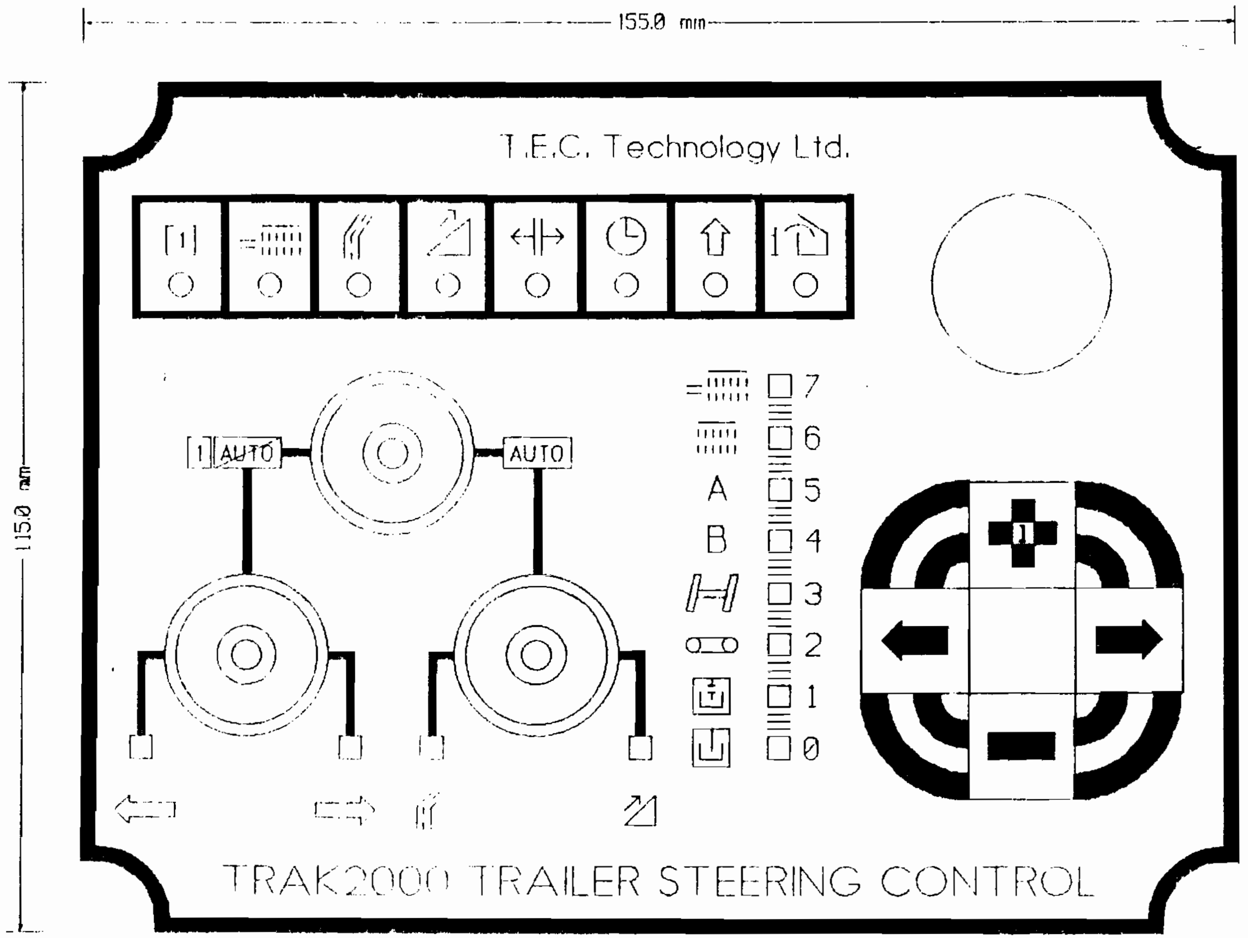
8.0 APPENDIX.

8.1 Drg. 5166/A4 - Front Panel GA.

8.2 Drg. 5175/A4 - Front Panel Control Functions

8.3 Drg. 5218/A4 - General External Connection Diagram

ECAD DETAILS - 5166_02.FCD
LAYER 01 - OUTLINE
LAYER 02 - DIMENSIONS



T.E.C. Technology Ltd

Iss.5	Iss.4	Iss.3	Iss.2	Iss.1	Drawn	Check
			17/03/11	11/01/11		
Drn	Drn	Drn	Drn DJT	Project TRAK 2000		
Alt	Alt	Alt	Alt 9342	Title PANEL GA - ECAD		

Projection Do Not Scale

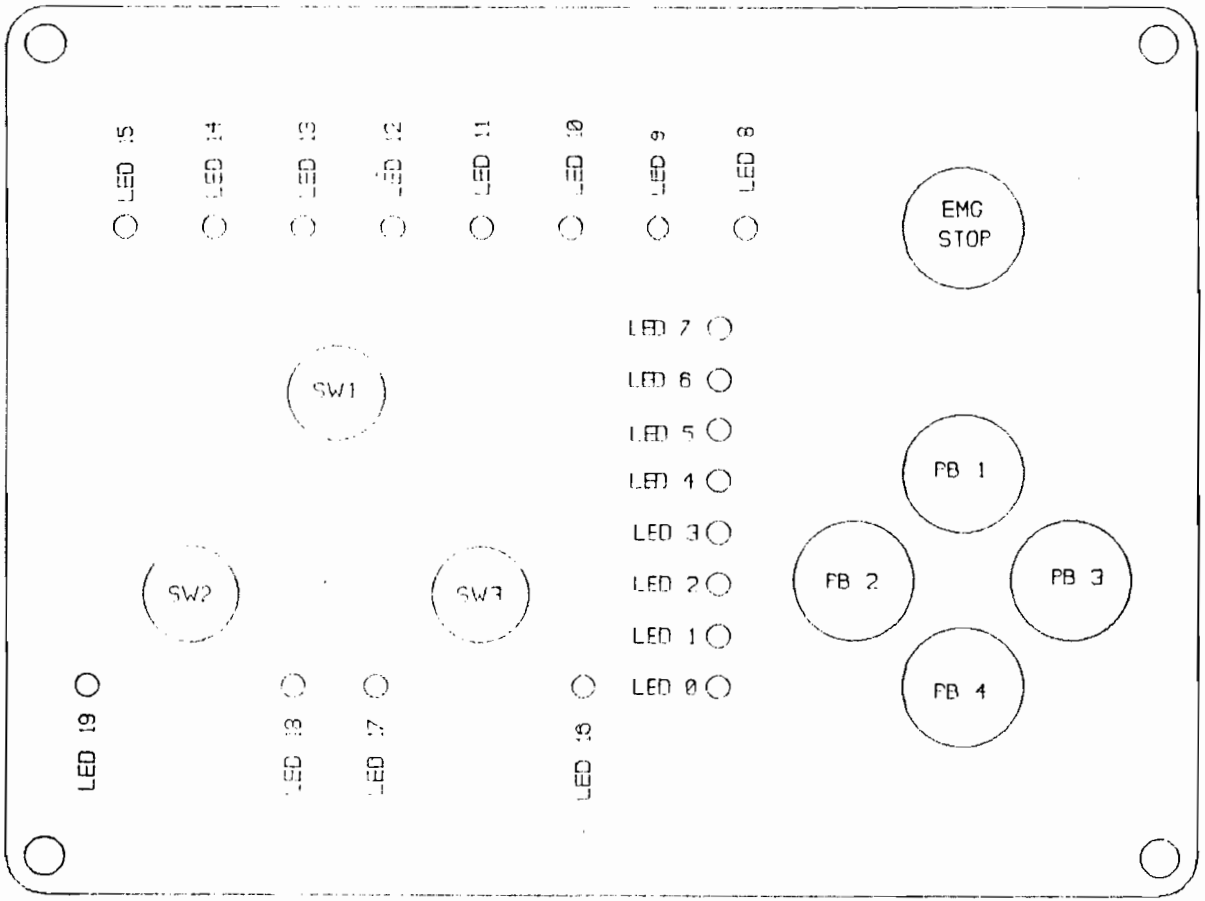
Client TE C

Filename 1049

Drawing No. 5166/A4

Sheet of

ECAD DETAILS 5175_01.PCD
LAYER 01 - ALL

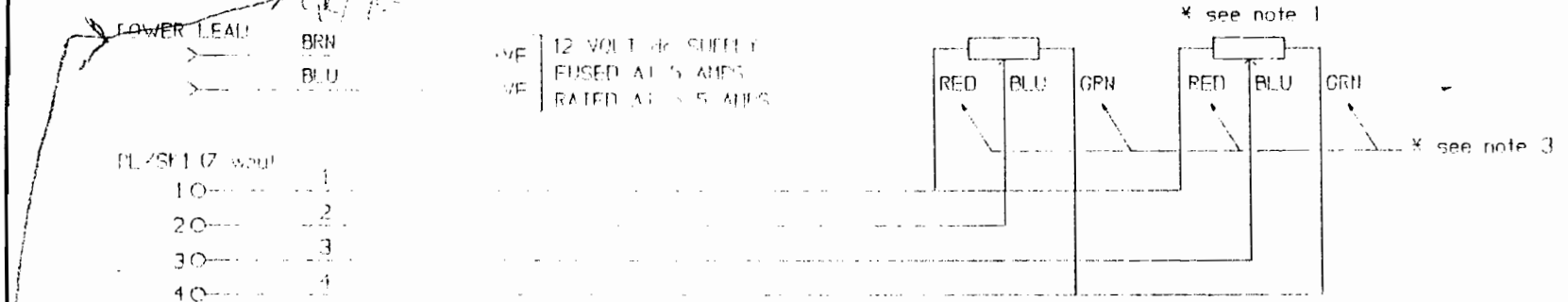


SW1	MANUAL/AUTO SELECTION
SW2	MANUAL STEER LEFT/RIGHT
SW3	TRACK/HILLSIDE SELECTION
PB1	POWER ON - INCREMENT
PB2	LEFT - MODE/PARAMETER SELECT
PB3	RIGHT - MODE/PARAMETER SELECT
PB4	DECREMENT
LED0	0 OR OPEN CENTRE HYDRAULICS
LED1	1 OR CLOSED CENTRE HYDRAULICS
LED2	2 OR DRAWBAR TRAILER
LED3	3 OR AXLE TRAILER
LED4	4 OR B (NOT USED)
LED5	5 OR A (NOT USED)
LED6	6 OR SPRAYING
LED7	7 OR SPRAY DEPENDENCY SELECTED
LED8	STORED INFO - SELECTED AT POWER-UP ONLY
LED9	CALIBRATE TRANSDUCERS STRAIGHT AHEAD
LED10	SET DELAY (0 TO 7)
LED11	SET DEADBAND (0 TO 7)
LED12	SET HILLSIDE
LED13	SET TRACKING
LED14	SET SPRAY DEPENDENCY
LED15	POWER ON
LED16	HILLSIDE SELECTED
LED17	TRACKING SELECTED - FLASH IF DUE TO SPRAY DEPENDENCY + SPRAYING
LED18	STEER RIGHT PROPORTIONAL VALVE
LED19	STEER LEFT PROPORTIONAL VALVE

T.E.C. Technology Ltd	Iss.5	Iss.4	Iss.3	Iss.2	Iss.1 19/04/97	Drawn SJO	Check	Projection Do Not Scale	THIS DESIGN AND DRAWING IS THE PROPERTY OF T.E.C. TECHNOLOGY LTD IT MUST NOT BE COPIED, IN PART OR WHOLE, WITHOUT PRIOR WRITTEN AUTHORISATION
	Drn	Drn	Drn	Drn.	Project TRAK 2000			Client TEC	
	Alt	Alt	Alt	Alt	Title F/P COMPONENT FUNCTIONS - ECAD			Filename 10x47	Drawing No. 5175/A4 Sheet of

TRAK2000
CONTROLLER

ECAD - 5218_01ECD



PL/SK1 (7 way)

1 O— 1
2 O— 2
3 O— 3
4 O— 4
5 O— 5 — NC
6 O— 6 — AUX I/P - CUSTOMER SPECIFIC OPTION
7 O— GRN — +12 VOLTS WHEN SPRAYING (* see note 2)

PL/SK2 (6 way)

1 O— 1 — +12 VOLTS WHEN SPRAYING (* see note 2)
2 O— 2
3 O— 3 — OPEN/CLOSED CENTRE SOLENOID
4 O— 4
5 O— 5 — LEFT PROP STEERING SOLENOID
6 O— 6 — RIGHT PROP STEERING SOLENOID

* see note 4

SPRAY LEAD (OPTION)
(* see note 2)
BRN — +12 VOLTS WHEN SPRAYING (* see note 2)

NOTES

1. FUNCTION DEPENDENT ON TRAILER TYPE - AXLE OR DRAWBAR STEERED
2. THE SPRAYING I/P CAN BE CONNECTED VIA PL/SK 1 OR 2, OR VIA OPTIONAL SPRAY LEAD
3. RED AND GREEN ANGLE TRANSDUCER CONNECTIONS ARE APPLICATION SPECIFIC, NOT NECESSARILY AS SHOWN
4. IN MANUAL MODE, MOVING SWITCH TO THE LEFT SHOULD RESULT IN THE FOLLOWING :- DRAWBAR TYPE - DRAWBAR REAR PIVOT MOVES TOWARDS RHS OF TRACTOR
   AXLE TYPE - TRAILER WHEELS STEER TOWARDS RHS OF TRACTOR

T.E.C. Technology Ltd	Iss.5	Iss.4	Iss.3	Iss.2	Iss.1 06/11	Drawn DJ	Check	Projection Do Not Scale
	Drn	Drn	Drn	Drn	Project TRAK2000			Client TEC
	Alt	Alt	Alt	Alt	Title GENERAL EXTERNAL CONNECTION DIAGRAM			Filename 1049

Drawing No. 5218 | Sheet 1 of 1

T.E.C. Technology Ltd.

Unit B22
Holly Farm Business Park
Honiley
Warwickshire
CV8 1NP

Tel: (01926) 484063

Fax: (01926) 484059

TRAK2000 TRAILER STEERING SYSTEM

GENERAL OPERATION HANDBOOK

(For OEM Users)

Please read carefully all sections of this handbook, paying particular attention to safety aspects, before attempting to Install, Commission, Operate or Service the system.

Please ensure that all personnel operating or working on machinery to which this system is fitted are fully conversant with the system and necessary safety precautions.

This document is intended for OEM users, and should be used as a basis for inclusions in the Machine Handbook.

INDEX

1.0 DESCRIPTION

Please read carefully all sections of this handbook, paying particular attention to safety aspects, before attempting to Install, Commission, Operate or Service the system.

Please ensure that all personnel operating or working on machinery to which this system is fitted are fully conversant with the system and necessary safety precautions.

The TRAK2000 Trailer Steering Controller is designed for operation in conjunction with a purpose designed Proportional Hydraulic System supplied by System 910 Hydraulics Ltd.

The primary function of the TRAK2000 Trailer Steering System is to ensure that the trailer wheels follow the line of the tractor wheels during a turn to minimise crop damage. Additionally the system can be used in either 'Manual' or 'Automatic' modes to assist in maintaining the line of the trailer wheels when working on a hillside. It should be noted however that in 'Automatic' mode this can only provide compensation for trailer wheel slip, not tractor slip, as the control system cannot distinguish between the tractor slipping or turning.

The Electronic System comprises a tractor cab mounted Control Unit, two Angle Position Transducers and an optional pre-made Hydraulic Manifold wiring harness. It incorporates many features which enhance Safety, Reliability, Ease of Installation/Commissioning, Simplicity of Operation and make the system very User Friendly.

* The unit, being housed in a single sealed enclosure which incorporates both the Operator Controls and Control Electronics, sites the system in the tractor cab away from the hostile environment of the Sprayer, and minimises installed wiring.

* The Angle Position Transducers are well sealed, high reliability units, proven over many years on similar applications.

* TRAK2000 is fitted with a Fused, Reverse Polarity Protected Supply, features a fully rated Latching Emergency Stop, and can only be Turned On initially when in 'Manual' mode.

* Normal operation is simply controlled by three robust sealed toggle switches, which enable selection of :-

    a) Manual/Automatic operation.

    b) Steer Left/Right in 'Manual' mode.

    c) Tracking/Hillside in 'Automatic' mode.

* All Configuration and Calibration adjustments necessary during Commissioning and Operation are easily made from the tractor cab mounted unit using only four pushbuttons. These enable selection of :-

    a) Steered Axle or Drawbar variants.

    b) Open/Closed centre or Load Sensing Hydraulics.

    c) Spray Dependency (either continuous Tracking, or automatic reversion to Straight Ahead/Manual Steering when Spraying On).

    d) Straight Ahead Calibration of Angle Transducers

    e) Tracking Calibration.

    f) Hillside Calibration.

    g) Deadband Width to minimise Hydraulic Loading due to continual small steering corrections.

    h) Delayed Response Time to headland turn, thus reducing tracking errors at onset of turn.

* The settings for the above are retained when the system is powered down, requiring to be set once only for a particular Tractor/Trailer combination. They can be quickly and easily reset for a new tractor if required, using only the four pushbuttons provided.

2.0 INSTALLATION.

This handbook is intended for OEM customers, as a basis for inclusions in the Machine Handbook. It provides a general guide to the TRAK2000 Trailer Steering system, but is not specific to any application, i.e. Manufacturer, Model or Axle/Drawbar variants.

It is recommended that before incorporating this system into a new model or variant of machine, that T.E.C. Technology Ltd., be contacted to discuss the particular requirements of the application.

Care should be taken with the siting of the Control Unit to ensure that it can in no way affect the safety of the operator or machine. In particular the Control Unit should not obstruct the tractor drivers view, and it should not be possible for cables to become trapped or in any other way affect the safe operation of the tractor/trailer.

An overall 'External Connections' circuit diagram (5218/A4) is included in appendix 8.3. This shows all external connection options.

2.1 Angle Transducers.

These are provided as part of the system, and are intended to provide electrical feedback as to the 'Tractor to Drawbar' and either 'Drawbar to Trailer' or 'Wheels to Trailer' angles, depending on trailer type.

Ideally the Transducers should be mounted in an inverted position. Although sealed, this prevents moisture from being trapped against the seal.

The mechanical linkage required is not supplied as this is application specific.

The Transducers are fitted with a shaft, having an M6 tapped thread for the attachment of a ball coupling. This shaft is secured by a set screw into the main shaft, which enables the length and hence angular deflection to be set.

The Transducers should be mounted so that in the straight ahead position the shaft is central, and at maximum deflection it travels approximately +/-45 degrees about centre. Care should be taken to ensure the transducers/linkage can not be damaged by overtravel.

The centre vertical main shaft of the units have a centre punch mark offset to the side of the set screw. This marks the orientation of the shaft, and should be on the same side of the body as the cable entry gland. The units are supplied with the correct orientation, but this can be a useful check if the linkage has been dismantled.

The electrical connections to the Transducers are made with a colour coded three core cable. Two types of Transducer are currently in use, the colour codes for which are :-

Brown	or	Red	... Supply
Blue	or	Blue	... Wiper (voltage feedback)
Green/Yellow	or	Green	... Supply

The orientation of the two supply wires is application specific, depending on the mechanical orientation of the Transducer. The units cannot be damaged by the reversal of the supply wires, however the system will only function correctly with one orientation. Please consult T.E.C. Technology Ltd., when using the system on a new application.

Once established on a new model/variant, Transducer linkage lengths/deflections. wiring connections and hydraulic valve/cylinder functions should always be maintained.

3.0 COMMISSIONING.

Please read carefully and ensure that you are fully conversant with the notes on Safety in Section 5.0 of this handbook.

Please read in conjunction with Panel drawings in Appendix.

When commissioning the system the following configuration settings need to be made in addition to the calibration settings described in Section 4.1.

The system can be configured for steered Drawbar or steered Axle operation and in addition when used with the appropriate hydraulic manifold assembly for open centre, closed centre or pressure compensated hydraulics.

To enter CONFIGURATION mode the unit must be initially turned OFF. Depress both the Left Arrow and Right Arrow cursor panel buttons (PB2 and PB3) simultaneously and maintain whilst turning the system ON with the '+[1]' panel button. Depression of PB2 and PB3 must be maintained until LED8 illuminates.

LED0 and LED1 indicate the status of the hydraulic setting. This can be changed using the '+[1]' and '-' panel buttons. Once set as required the Left Arrow panel button exits to RUN mode, the Right Arrow panel button enables selection of Axle/Drawbar trailer type.

LED2 and LED3 indicate the status of the Axle/Drawbar trailer type setting. This can be changed using the '+[1]' and '-' panel buttons. Once set as required the Right Arrow panel button exits to RUN mode, the Left Arrow panel button enables selection of the hydraulic setting.

Note that when the system is first turned on and 'AUTO' mode is selected the hydraulic actuator may immediately move to full travel, either extended or retracted, as the system has not been calibrated or due to wiring/hydraulic inversions.

3.1 Initial Checks in 'MANUAL' mode

Initially check in 'MANUAL' mode for the correct operation of the manual steering feature.

In the case of a drawbar steered machine, moving the Manual steering switch to the left should result in the drawbar/trailer pivot point moving towards the RHS of the tractor.

In the case of an axle steered machine, moving the Manual steering switch to the left should result in the trailer wheels moving towards the RHS of the tractor.

3.2 'Alignment Calibration' of Angle Transducers

Calibrate the two Angle Transducers for the 'Straight Ahead' condition, as described in 4.1 CALIBRATION MODE.

3.3 Phasing of Angle 2

Having carried out the Straight Ahead calibration, check that the drawbar or wheels return to the Straight Ahead position when returning from Auto mode to Manual mode. If the actuator moves directly to full travel then the supply connections to the 'Angle 2' Transducer are reversed. If this is so then the system must be turned off, the wiring corrected, and the procedure repeated from 3.1

3.4 Phasing of Angle 1

Next check operation in 'AUTO' mode. Correct operation will not be possible until the system has been calibrated as described in 4.1 CALIBRATION MODE. However if the actuator moves directly to full travel, then the supply connections to the 'Angle 1' Transducer are reversed. If this is so then the system must be turned off, the wiring corrected, and the procedure repeated from 3.1

4.0 OPERATION.

Please read in conjunction with Panel drawings in Appendix.

This section refers to the operation of the system previously commissioned as described in Section 4.0.

On units that are not hard wired to the 12V Supply, indication of reverse polarity supply will be indicated by the Power LED (LED 15) showing RED whenever the Emergency Stop is released and power is present.

The unit can only be turned on when the Emergency Stop button is released and Manual mode is selected (SW1). It is then turned on by depressing the '+ [1]' panel button (PB1). The 'ON' condition will be indicated by the Power LED (LED 15) showing GREEN.

The unit will power up indicating that Spray Dependency can be set (LED14) and displaying the unit configuration:-

Trailer type - Axle (LED3)
Trailer type - Drawbar (LED2)
Hydraulic type - Closed centre (LED1)
Hydraulic type - Open centre (LED0)

The trailer can now be steered Manually (SW2).

On selection of Automatic mode (SW1) steering will be Automatic in either Tracking or Hillside mode as set by SW3 and modified by Spray Dependency if selected.

Spray Dependency is turned on by the '+[1]' panel button and off by the '-' panel button. Spray dependency status being indicated by LED7 and Spray status by LED6.

When in Tracking mode with Spray Dependency selected the unit will only track when NOT spraying. When spraying is turned ON the steering will centre and Manual mode will be restored following a short delay. This condition is indicated by the flashing of LED17.

When in Hillside mode with Spray Dependency selected the unit will only make Hillside steering corrections when spraying is ON. When spraying is turned OFF tracking mode will be enabled. This condition is indicated by the flashing of LED17.

On re-selection of Manual mode the steering will be centred and following a short delay Manual steering restored.

The calibration and performance of the steering system can be modified to suit different tractor/trailer combinations and operating conditions.

4.1 Calibration Mode

LED's 13 to 9 indicate which parameter is being adjusted as follows:-

LED13 - Tracking
LED12 - Hillside
LED11 - Deadband
LED10 - Delay
LED 9 - Angle Sensor 'straight ahead' calibration

To enter CALIBRATION mode depress both Left Arrow and Right Arrow cursor panel buttons (PB2 and PB3) simultaneously until the Set Spray Dependency (LED14) extinguishes and LED13 illuminates, release PB2 and PB3 and wait until all LED's 0 to 7 extinguish.

Select the parameter to be adjusted by using the Left Arrow and Right Arrow cursor panel buttons.

Exit from the CALIBRATION mode can be made by using the Left Arrow and Right Arrow cursor panel buttons either to the left or right until CALIBRATION mode LED's are extinguished and RUN mode reinstated.

LED13 - Tracking

With the unit set to Auto/Tracking the degree of Tracking steering during a turn can be set using the '+[1]' and '-' panel buttons.

LED12 - Hillside

With the unit set to Auto/Hillside the degree of Hillside steering can be set using the '+[1]' and '-' panel buttons.

LED11 - Deadband

Centre deadband can be introduced to minimise steering operations resulting from small deviations to prevent unnecessary heating of the hydraulic system. It can also assist in maintaining tracking at the start and end of a headland turn.

The degree of centre deadband can be set to one of eight levels (0 to 7) as indicated by bargraph display of LED's 0 to 7.

Deadband is increased by depressing '+[1]' panel button, the current level being indicated by the bargraph.

Deadband is decreased by depressing '-' panel button, the current level being indicated by the bargraph.

LED10 - Delay

Delay can be introduced to assist in maintaining tracking at the start and end of a headland turn.

The degree of delay can be set to one of eight levels (0 to 7) as indicated by bargraph display of LED's 0 to 7.

Delay is increased by depressing '+[1]' panel button, the current level being indicated by the bargraph.

Delay is decreased by depressing '-' panel button, the current level being indicated by the bargraph.

LED 9 - Angle Sensor 'straight ahead' calibration

Angle Sensor 'straight ahead' calibration would normally only be set during commissioning. However it may be necessary to update these values in the event of the use of a different towing tractor or if the sensors/linkages have been changed.

To store the straight ahead position, select Manual, steer the trailer to the straight ahead position and ensure that the tractor/trailer combination are aligned straight ahead. Simultaneously depress the '+[1]' and '-' panel buttons until LED 9 extinguishes. Release both panel buttons. The unit will at this point revert to RUN mode.

5.0 SAFETY.

Safety considerations fall into three areas. those relating to the trailer when travelling on public roads. those relating to the use of the system, and safety of personnel working on or near those parts of the machine actuated by this system.

When the trailer is towed on public roads the drawbar/wheels should be centred and locked by independent mechanical means! The controller should be set to the manual steering mode and the electrical and hydraulic supplies removed from the system.

When the system is in use on a Drawbar Steered machine. extreme caution should be exercised when the spray booms are folded. Some machines have marginal stability in this condition, and excessive Drawbar deflection when the machine is not on level ground can result in the trailer turning over.

As with all Electro-Hydraulic systems, work should only be carried out on the system with both the electrical and hydraulic power sources disconnected. Operators must be made aware of the potential hazards associated with the actuated components, and ensure that no personnel approach them whilst the system is active.

Note also that when the electronic steering is active, particularly the first time a new installation is powered-up, faults or incorrect settings can cause the Drawbar/Wheels to traverse to full travel position. or to hunt·about a fixed position.

6.0 FAULT FINDING.

Please read in conjunction with panel drawings in appendix.

The following is a list of the most probable causes of malfunctions with newly installed systems.

Will not turn on - LED 15 not illuminated :-

Firstly ensure that the twist release Emergency Stop button is released, and that 'Manual ' mode is selected by Switch SW1.

If SW1 and the Emergency Stop button are correct, then the problem most likely is as a result of no 12Vdc supply reaching the unit.

The unit has no user serviceable fuses, those fitted automatically reset following a short delay after removal of the excess current.

Will not turn on - LED 15 illuminated RED :-

This is due to the supply polarity being reversed. LED 15 is illuminated RED <u>whenever</u> a reverse polarity supply is connected, and GREEN only when a correct supply is connected <u>AND</u> the unit is switched on.

Manual Steering Inoperative :-

* No Hydraulic supply.
* Steering valves not connected.
* Manual mode not selected or time-out not expired.

Hydraulic Steering Ram Fully Extends or Retracts:

* Linkage to Angle Position Transducer Missing/Broken/Loose.
* Wiring to Angle Position Transducer incorrect.
* Reversed Angle Position Transducer Polarity
* Reversed Angle Position Transducer Shaft.
* Reversed Steer Left/Right Steering Valve Coils.

No Tracking Mode :-

* Automatic Mode not selected.
* Spray Dependency 'ON' and Spraying Signal at +12 Volts.

Instability or Insensitivity :-

* Backlash in Angle Position Transducer Linkage.
* Sticking or faulty Hydraulic Steering Valve.

Incorrect Centring :-

* System not Calibrated.
* See Hydraulic Steering Ram Fully Extends or Retracts
* See Instability or Insensitivity.

Incorrect Tracking/Hillside Operation :-

* Automatic Mode not selected.
* Booms not deployed. (Machines with Boom interlock only)
* Spray Dependency setting status incorrect.
* System not Calibrated.
* Backlash in Angle Position Transducer Linkage.
* No Hydraulic supply - check 'Manual' operation.
* Linkage to Angle Position Transducer Missing/Broken.
* Wiring to Angle Position Transducer incorrect.
* Reversed Angle Position Transducer Polarity
* Reversed Angle Position Transducer Shaft.
* Reversed Steer Left/Right Steering Valve Coils.
* Sticking or faulty Hydraulic Steering Valve.
* Steering valves not connected.

7.0 CE MARKING.

The Controller is CE Marked, for sale and operation within the European Economic Community Countries, having been designed/constructed/tested to comply with all relevant standards. It should be noted however that the units supplied are strictly components, having no intrinsic function until incorporated into a machine. The machine into which it is incorporated must therefore not be put into service until it has been certified by it's manufacturer as conforming with the EC Machinery Directive.

Unauthorised modifications are prohibited for reasons of safety.

The Electronic Control System is designed and supplied by :-

T.E.C. Technology Ltd,.
Unit B22.
Holly Farm Business Park.
Honiley.
Warwickshire.
CV8 1NP
England

Telephone : (44) (0)1926 484063
Fax : (44) (0)1926 484059

The Hydraulic System with which the Electronic Control System has been designed to operate is designed and supplied by :-

System 910 Hydraulics Ltd,.
7 The Old Granary.
Boxgrove.
Chichester.
West Sussex.
PO18 OES

Telephone : (44) (0)1243 539789
Fax : (44) (0)1243 530307

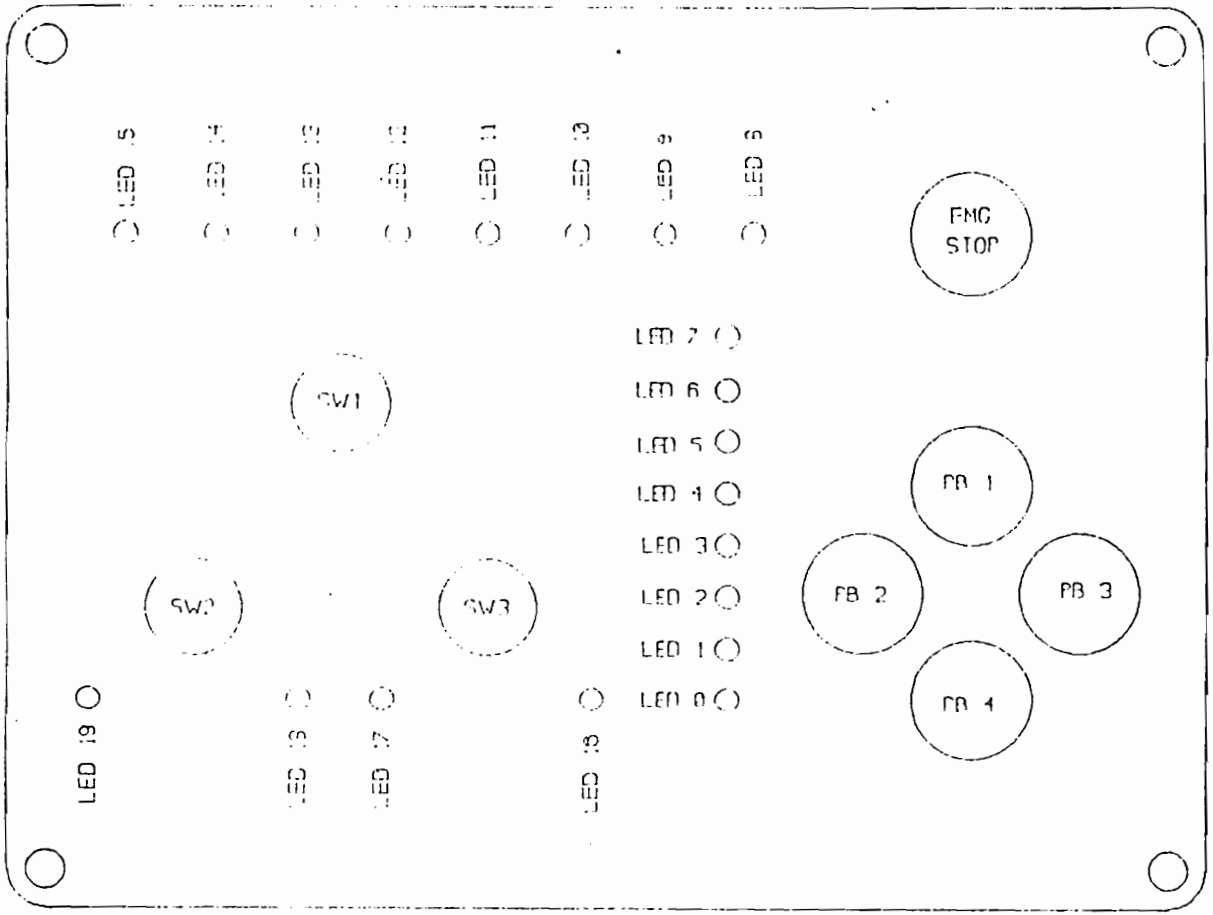
8.0 APPENDIX.

8.1 Drg. 5166/A4 - Front Panel GA.

8.2 Drg. 5175/A4 - Front Panel Control Functions

8.3 Drg. 5218/A4 - General External Connection Diagram

ECAD DETAILS 5175_01FCD
LAYER 01 - ALL



SW1	MANUAL/AUTO SELECTION
SW2	MANUAL STEER LEFT/RIGHT
SW3	TRACK/HILLSIDE SELECTION
PB1	POWER ON - INCREMENT
PB2	LEFT - MODE/PARAMETER SELECT
PB3	RIGHT - MODE/PARAMETER SELECT
PB4	DECREMENT
LED0	0 OR OPEN CENTRE HYDRAULICS
LED1	1 OR CLOSED CENTRE HYDRAULICS
LED2	2 OR DRAWBAR TRAILER
LED3	3 OR AXLE TRAILER
LED4	4 OR B (NOT USED)
LED5	5 OR A (NOT USED)
LED6	6 OR SPRAYING
LED7	7 OR SPRAY DEPENDENCY SELECTED
LED8	STORED INFO - SELECTED AT POWER-UP ONLY
LED9	CALIBRATE TRANSDUCERS STRAIGHT AHEAD
LED10	SET DELAY (0 TO 7)
LED11	SET DEADBAND (0 TO 7)
LED12	SET HILLSIDE
LED13	SET TRACKING
LED14	SET SPRAY DEPENDENCY
LED15	POWER ON
LED16	HILLSIDE SELECTED
LED17	TRACKING SELECTED - FLASH IF DUE TO SPRAY DEPENDENCY + SPRAYING
LED18	STEER RIGHT PROPORTIONAL VALVE
LED19	STEER LEFT PROPORTIONAL VALVE

T.E.C. Technology Ltd

Iss.5	Iss.4	Iss.3	Iss.2	Iss.1 9/6/93	Drawn SJC	Check
Dcn	Dcn	Dcn	Dcn	Project TRAK 2000		
Alt	Alt	Alt	Alt	Title F/P COMPONENT FUNCTIONS - ECAD		

Projection Do Not Scale

Client TEC

Filename terry

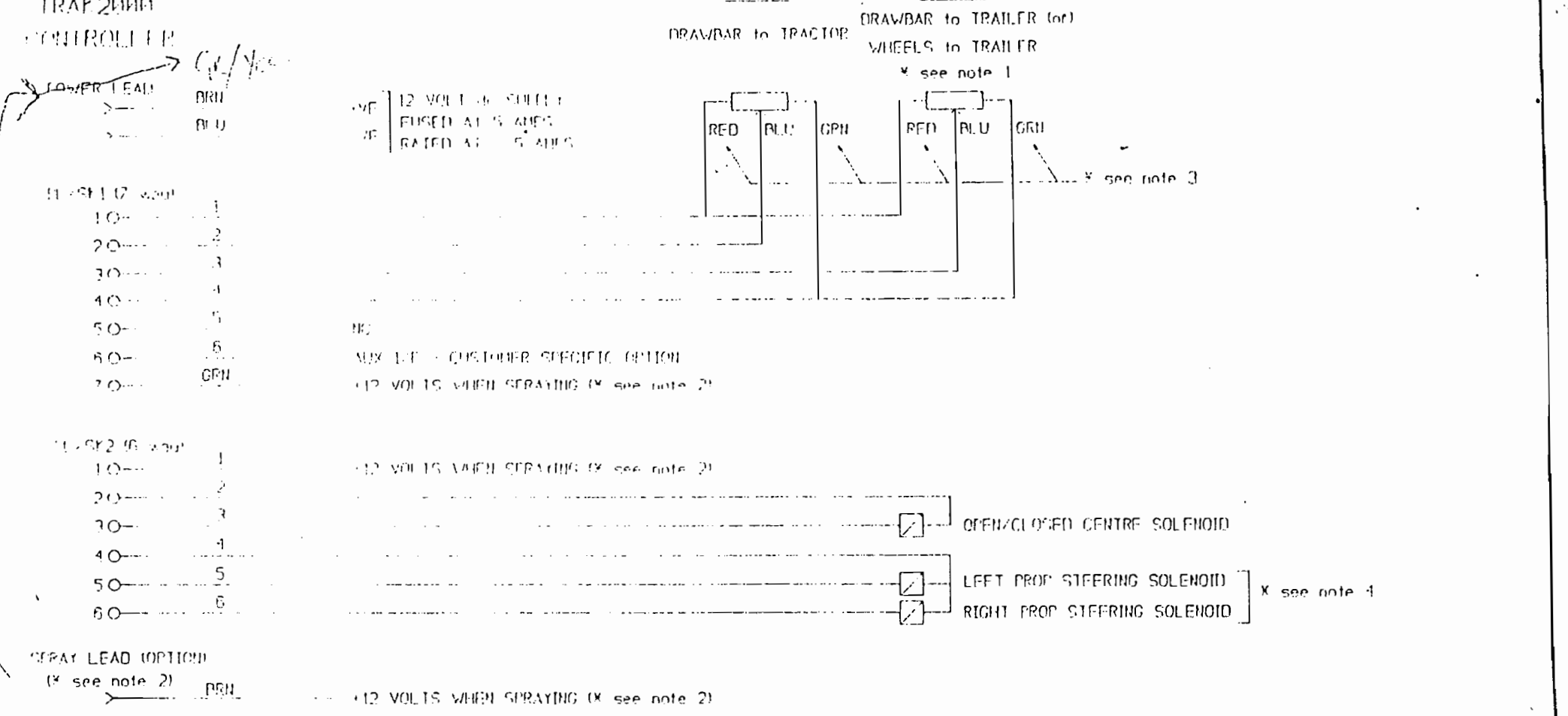
Drawing No. 5175/A4

Sheet of

TRAK2000

CONTROLLER

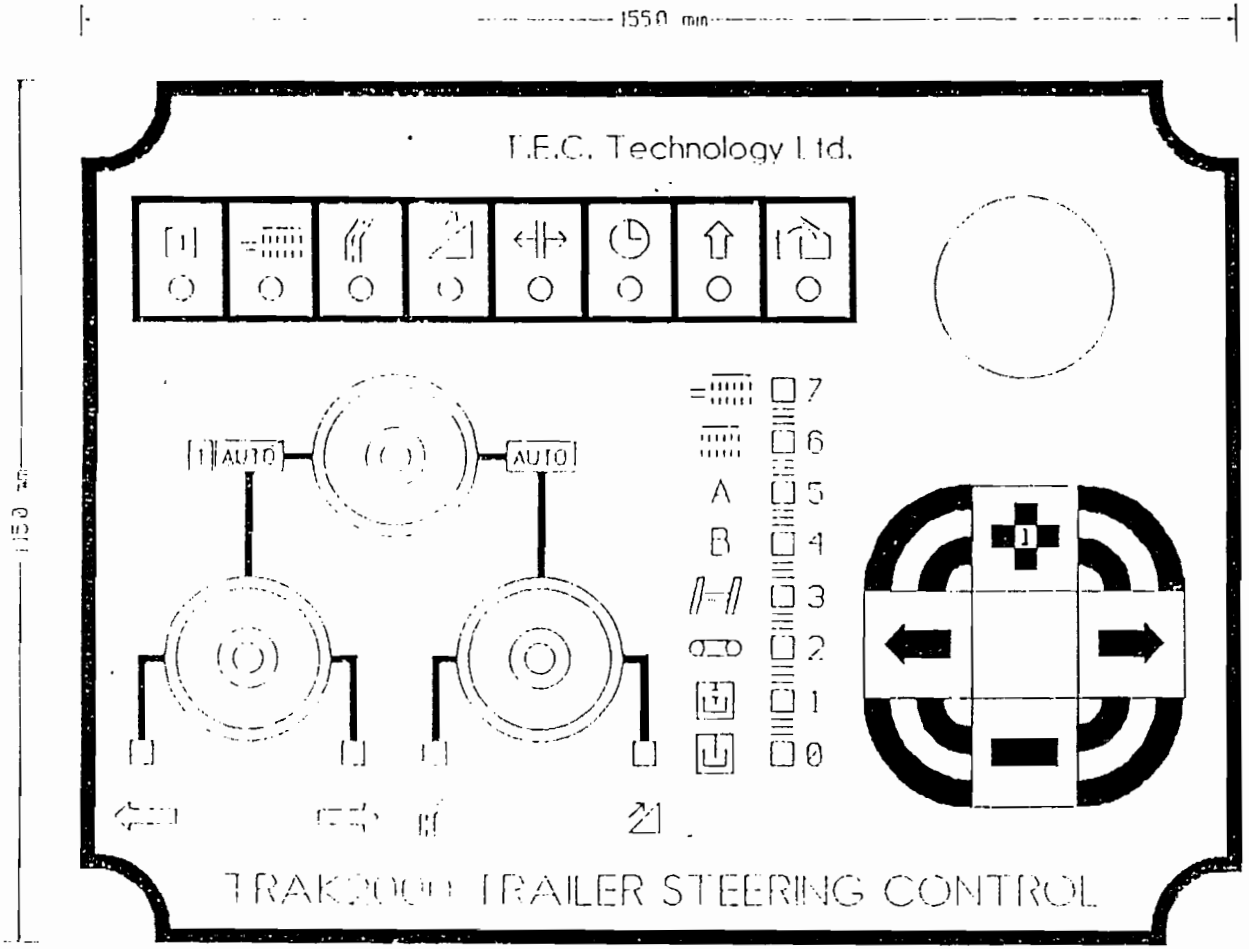
ECAD - 5218_01ECD



NOTES

1. FUNCTION DEPENDENT ON TRAILER TYPE - AXLE OR DRAWBAR STEERED
2. THE SPRAYING I/P CAN BE CONNECTED VIA PLUG 1 OR 2, OR VIA OPTIONAL SPRAY LEAD
3. RED AND GREEN ANGLE TRANSDUCER CONNECTIONS ARE APPLICATION SPECIFIC, NOT NECESSARILY AS SHOWN
4. IF MANUAL PROP MOVING SWITCH TO THE LEFT SHOULD RESULT IN THE FOLLOWING :- DRAWBAR TYPE - DRAWBAR REAR PIVOT MOVES TOWARDS RHS OF TRACTOR
   AXLE TYPE - TRAILER WHEELS STEER TOWARDS RHS OF TRACTOR

T.E.C. Technology Ltd	Iss.5	Iss.4	Iss.3	Iss.2	Iss.1	Drawn SP	Check	Projection Do Not Scale	THIS DESIGN AND DRAWING IS THE PROPERTY OF T.E.C. TECHNOLOGY LTD IT MUST NOT BE COPIED, IN PART OR WHOLE, WITHOUT PRIOR WRITTEN AUTHORISATION
	Dcn	Dcn	Dcn	Dcn	Project TRAK2000			Client TEC	
	Alt	Alt	Alt	Alt	Title GENERAL EXTERNAL CONNECTION DIAGRAM			Filename (none)	Drawing No. 5218 Sheet 1 of 1



ECAD DETAILS - 5166_02.ECD
LAYER 01 - OUTLINE
LAYER 02 - DIMENSIONS

T.E.C. Technology Ltd	Iss.5 / Iss.4 / Iss.3 / Iss.2 / Iss.1	Drawn	Check	Projection Do Not Scale	THIS DESIGN AND DRAWING IS THE PROPERTY OF T.E.C. TECHNOLOGY LTD IT MUST NOT BE COPIED, IN PART OR WHOLE, WITHOUT PRIOR WRITTEN AUTHORISATION		
	Drn / Drn / Drn / Drn	Project TRAK 2000		Client TEC			
	Alt / Alt / Alt / Alt	Title PANEL SA - ECAD		Filename 5166	Drawing No. 5166/A4	Sheet of	