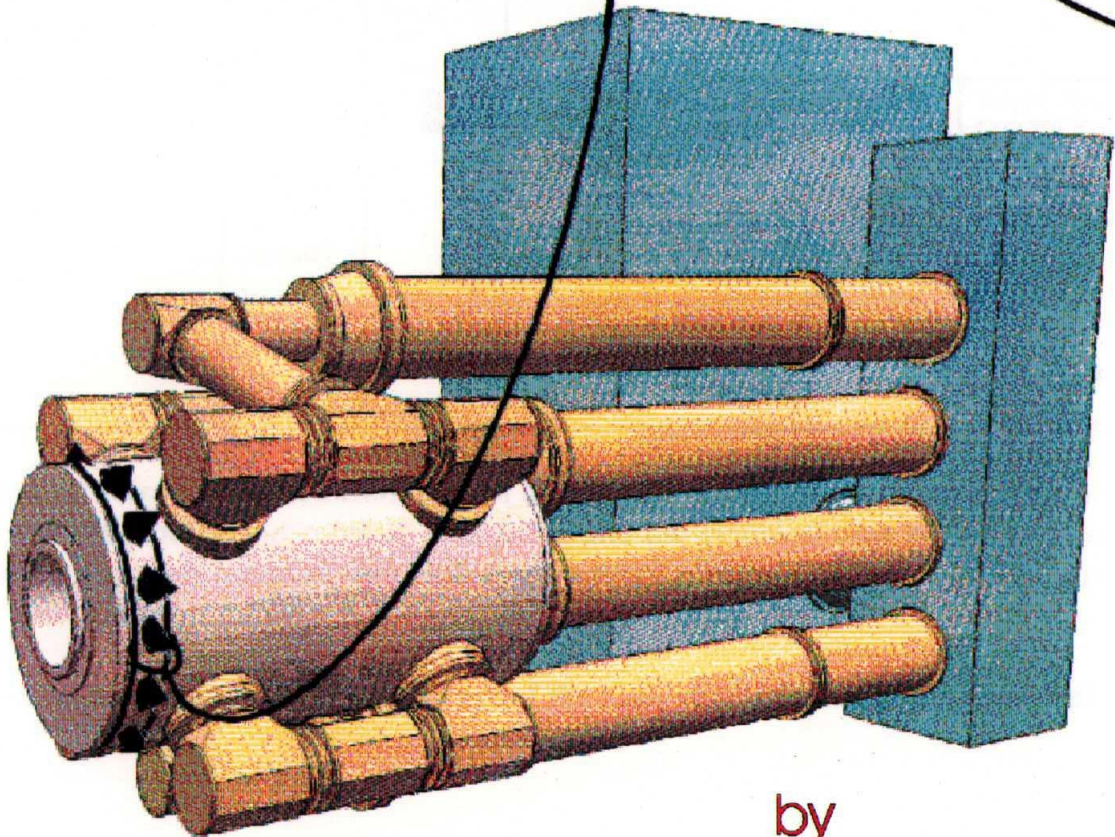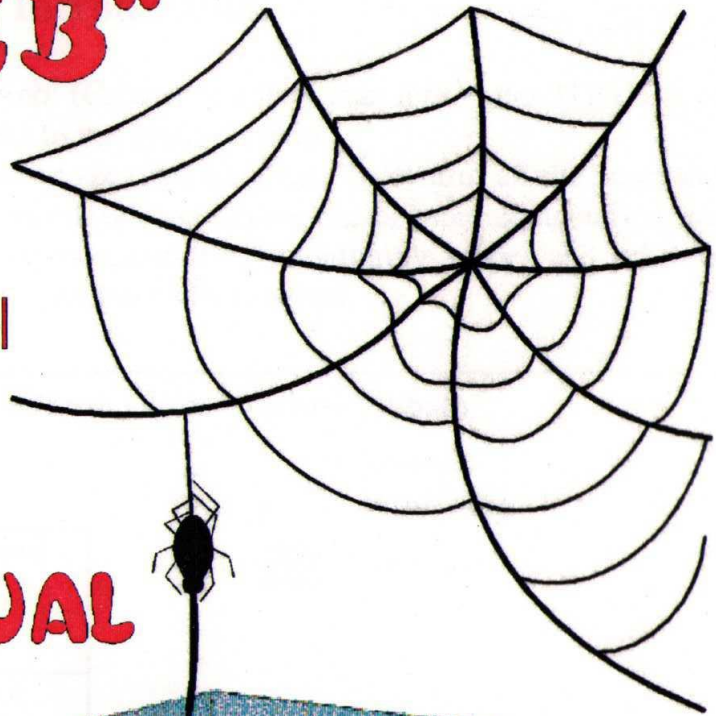# "COBWEB"

Titania Control Software

USER MANUAL

by
E. Divall

Introduction:

The control system is called 'Cobweb' (Cobweb is a fairy that looks after TITANIA and a cobweb is a structure that has links to the whole system).
The Titania laser system encompasses six separate areas. To control all the component parts a distributed control system was developed having one or more computers in each area. Each computer is responsible for controlling/ monitoring scopes and other I/O devices in its area. All the computers are linked by Ethernet.

Layout of Titania Laser Control System
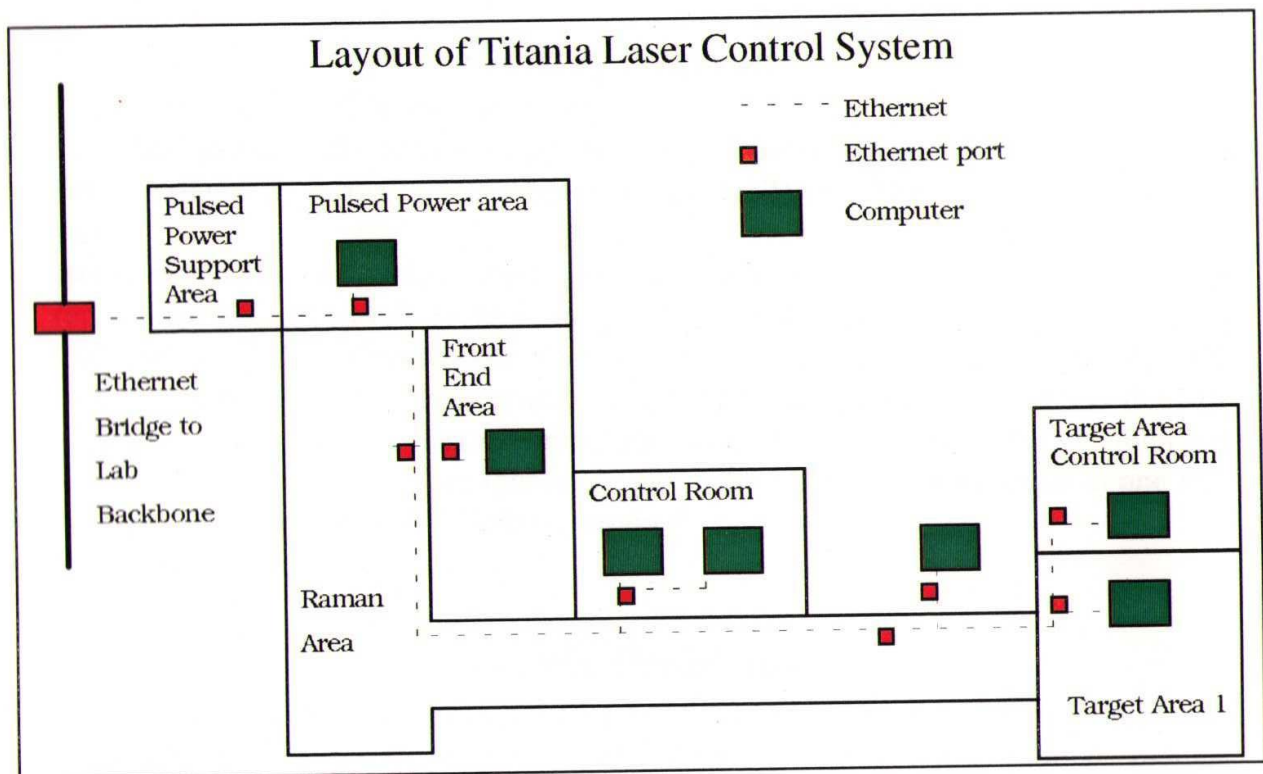
Pascal software was written from scratch to deal with the networking between machines, external diagnostics and controls, shot firing and the graphical user interface. Identical code runs on each machine, with different functions available via the menus to simplify software updates.

This user manual explains the use of the basic functions associated with this software.

System Requirements

- 386 (+) IBM PC compatible computer with:
- Mouse
- 1Mb(+) graphics card.
- Network card and appropriate packet (PKT) driver software.
- GPIB card is not necessary, but line relating to GPIB should be deleted from the 'Config.sys' file if none is present.
- Enough memory for 2MB ram drive.

Getting Started

- **Load** software into 'C:\titan1' directory.
- **Graphics card:** If the card is fairly old you will need the appropriate VBE (VESA BIOS Extension) software - if none exists use UNIVBE. This can be found on the web.
- **Network Card:** Not strictly necessary for stand alone applications, but must be recompiled with Network features disabled. Need a packet driver, currently using 'NE2000.com' from Crynwr-soft. This must be initialised by typing '2000NE 0x62 Int# BA', where int# is the interrupt number of the network card and BA is the base address. (0x signifies a hexadecimal number). '0x62' is the software interrupt number, N.B. lower values are ignored to allow 2 (or more) network cards in one PC.
- **Set-up GPIB** card using IBCONF as required.
- **Create** ram drive.

Possible Problems

- *Crashes out as soon as starts initialising graphics.* NE2000 driver not installed.
- *Scrollbox doesn't scroll properly and pull-down menus leave rubbish behind.* Granularity is set on the wrong value. See the software manager or re run with the additional parameter 'GR#' there '#' is either 4 or 64.
- *Wrong ID letter displayed / will not arm devices on shot.* Most likely cause is that network card has been changed so computer no longer knows which area it is in. Rerun software with the additional parameter 'ID#' there '#' is the ID letter or see the software manager. i.e. to rerun the multiplexer PC type 'TTNTMAIN IDM'. 'ID#' bit must be in capital letters.

- *Crashes when click on menu:* Incorrect ram drive specification or no ramdrive. Create ram drive or rerun software with the additional parameter 'RD#' where '#' is the letter of the ram drive.

The Basics:
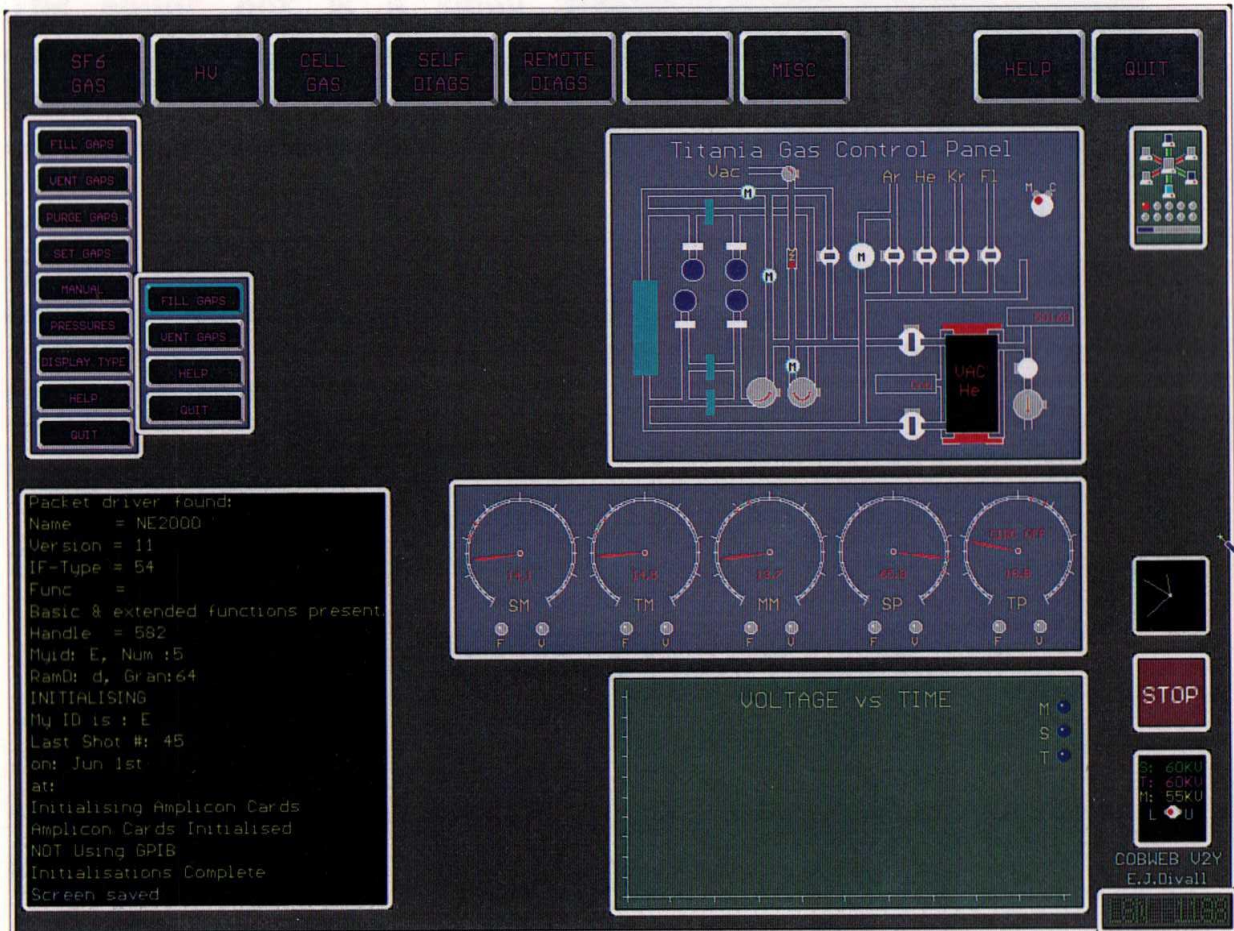
Typical screen shot:

Menu buttons (top row) are pressed to reveal flip down menus of available functions. The 'SF6 GAS' menu is shown flipped down on the image above. Some functions need a password- see 'Duty Operator' for this.

Icons (right hand column): Network and HV icons give quick view of which computers are present and what the current firing status is. 'SF$_6$', 'GP' and 'VvT' can be maximised to give more detail of laser condition.

Scrollbox (bottom left): All messages are shown in here.

Last Shot Number: The small box in the bottom right corner displays the last shot number of the laser and is automatically updated after each shot. All data is saved with reference to this number.

The Editor.

The editor box is a small control panel allowing Boolean and numerical variables to be altered.

Editor box: In SF$_6$ vent mode.

The editor box appears when ever pressures, charge times, voltage settings etc. are to be altered, i.e. selecting 'MANUAL' - 'VENT' will bring up the box shown above. (NB. All data settings are currently held on the pulse power computer and values can only be altered when this PC is running.)

Using the editor:

Boolean: Shown as square button:-

: Crossed: Selected, True or Turned on

: Blank: Not selected, False or Turned off.

Toggle between the two positions by either pressing the corresponding F# or clicking on the button.

Numbers:- In the same way as Booleans are edited, clicking on or pressing the corresponding F# activates the variable changing its colour from yellow to white. The value may then be altered by either clicking on the slider or typing in a new value. If the new value entered is out of range then the old value will be retained.

Other Buttons:

      OK: In most menus this exits the editor saving the new values, however in 'MANUAL FILL/VENT' menus it activates the selected valve for chosen time.

      CANCEL: Exits the editor losing all new values.

:   Dragging this button around the screen, enables the whole editor to be dragged and repositioned.

EXAMPLES:

- *How do I fill the mini-Marx for 2.8 seconds using the mouse?*

From the 'SF$_6$' menu select 'MANUAL' followed by 'FILL' the editor will then appear. Select mini-Marx by clicking in the 3rd box down, then set the fill time to 2800ms by clicking on fill time and using the slider to adjust the value. (As shown above.) Click on 'OK' to fill.

- *How do I set Sprites' firing voltage to 0V so that only Titania is fired using only the keyboard.*

Select 'SET VOLTAGES' from the HV menu ('F2' followed by 'F1'). Then select Sprite firing voltage ('F?') and type in the new value ('0'). Press enter followed by 'O' for OK, exit and save.

SF$_6$ Menu

Access to control of SF$_6$ filling and venting for Sprite, Titania and the Mini Marx.

The SF$_6$ pressures can be displayed in two formats. Firstly as a bar graph showing the five gaps. The graph is graduated showing high and low cut off points for each pressure setting (i.e. they are relative to their own set points and not one another). If the gap is 'SET' (see 'SET GAPS command) and the pressure is outside these cut off points the bar is coloured red, within half a bar either way it is green, otherwise it is displayed in orange. However if the gap is not 'SET' the bar is drawn in blue. Secondly this information can be displayed on dials, which have the same colour coding, but have the advantage of displaying the full pressure range.
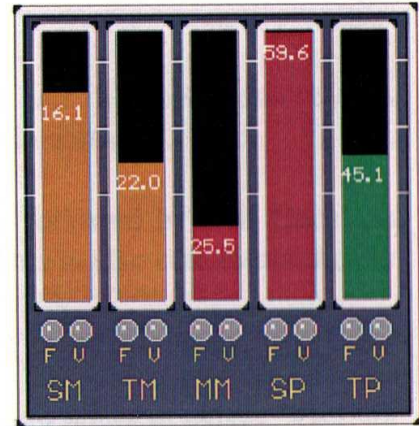
SF$_6$ Bar graph display

SF$_6$ Dial graph display
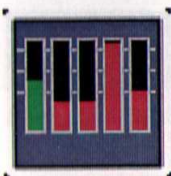
These readouts are available in large and small sizes as well as a minimised icon. The two bigger displays also show the actual pressure digitally and have small LED's which light to indicate when the vent and fill valves are open. Finally, the display has a blue background while displaying 'upto date' pressures, as shown above. After ten seconds this will change to green if no new pressures are received.

SF$_6$ icon

DISPLAY TYPE: Cycles through the different sizes and styles of SF$_6$ display as mentioned above.

SF6 MENU (left menu buttons):
FILL GAPS
VENT GAPS
PURGE GAPS
SET GAPS
MANUAL
PRESSURES
DISPLAY TYPE
HELP
QUIT

SF6 MENU

FILL GAPS: Commands the pulse power area PC to pressurise (fill) the 'SET' SF$_6$ gaps to their pre-set pressures for the current operating voltages. Fill procedure stops when either the gaps reach operating pressures or 'Q' or 'STOP' is pressed on the Pulse Power area PC. If 0 psi is read on one of the input channels then the computer will attempt to reinitialise the Amplicon cards before proceeding with the fill.

VENT GAPS: Vents high pressure gaps and fills low pressure ones for a pre-set time- this is only changeable in software.

PURGE GAPS: Performs a 'Vent Gaps' followed by 'Fill Gaps' on 'SET' gaps to flush through some SF6. This is also run automatically after a shot..

SET GAPS: when a fill or vent command is issued, it will only relate to valves 'SET' in this section, unselected valves are shown as a blue reading. When firing the computer automatically selects the correct gaps for the shot, and returns the old values afterwards.

PRESSURES (SM) (menu buttons):
SPRITE MARX
TITANIA MARX
MINI MARX
SPRITE PFL
TITANIA PFL
HELP
QUIT

PRESSURES (SM)

MANUAL:(Sub-menu)

FILL or **VENT**: Fill and vent both use the editor to allow a gap and fill/vent time to be selected. Pressing the 'OK' button causes the selected to valve to be opened for the given time. Software checks stop the valve being opened for longer than the preset time.

MANUAL (SM) (menu buttons):
FILL GAPS
VENT GAPS
HELP
QUIT

MANUAL (SM)

PRESSURES:(Sub-menu)

The optimal SF$_6$ operating pressure varies slightly for each firing voltage, this submenu activates the editor to change any of the operating pressures. The numbers in the left-hand column related to the firing voltage from 55-85KV, whist the right hand column shows the pressure in psi absolute, for that voltage. If a firing voltage between 1 and 54psi is chosen then the 'used defined' pressure (UDKV) is used, otherwise the pressure is interpolated from 55-85KV range.

EXAMPLES:

- *We have one leaky gap which we wish to set at operating pressure prior to each shot.* This could be done either by selecting the gap in 'MANUAL FILL/VENT' and opening/shutting valve until pressure is reached, or by selecting just the leaky gap and pressing fill gaps.

- *Titania PFL occasionally self-breaks at 75KV and we wish to increase the operating pressure by 2psi.* Enter the 'PRESSURES' submenu and select 'TITANIA PFL' button. The editor will appear, click on the 75KV setting and enter the new value. Press 'OK' to save and use the new value.

HV MENU

Access to the Titania, Sprite and mini-Marx pulsed power settings.

SET VOLTAGES: This option allows the setting of the key pulse power variables, namely the 3 firing voltages (although the mini-Marx is pre-set to 30KV) and the trigger laser timings. The program expects voltages between 0 and 85KV. Zero volts signifies that that particular Marx is not to be charged - (the program will not attempt to charge Titania or Sprite if the mini-Marx is not being used). A value between 1 and 54 is outside the usual operating range and is a called a user defined (UD) voltage setting, UD pressures and timings are used at these settings.

HV MENU

CHARGE TIMES:(Sub-menu)

As with the set pressures option for the SF_6, this option allows the charge times for each firing voltage to be entered. The computer uses these to decide the relative start times for charging each of the Marxs, so they all reach full charge together. If the time is too short the voltage graph will start to overwrite itself at the right of the trace, but will not effect the firing of the laser. Times should be kept as accurate as possible to avoid leaving one of the Marx's sitting at volts while the other finishes charging.

TIME LPXS: a test routine to check that computer - Stanford box-trigger laser-scope and back to computer connections are up and running and sets the trigger box at the correct timings. The computer automatically runs this procedure before each shot.

LPX's ON / OFF: - Turns the triggers on or off to the trigger lasers from the Stanford boxes. This is done simply by turning the SRS box on to its 1Hz internal trigger for the ON state and back to it external trigger for the off state. Hence the trigger lasers are NOT fired at their correct timing relative to the oscillator 8Hz.

EXAMPLES:

- *We are performing gain measurements on Sprite and wish fire Sprite at a range of Voltages from 30 to 60KV.*

Initially set the firing voltage of Titania to 0 volts so that it is not fired - This is set via the 'SET VOLTAGES' menu. Then adjust the Sprite voltage to the required value in the range 30 to 60. If it is below 55KV then the Sprite PFL and Marx SF_6 pressures will not be automatically calculated, and will need to be entered in the 'PRESSURES' under the user defined (UDKV) heading. After each shot it will be necessary to check the timing of the ASE relative to the pulse and adjust the pulse back to the centre of the gain by making the Sprite trigger laser either earlier or later.

CELL GAS

View Pressures and Control Gas in Laser Cells.

The panel shown below gives a simplified image of the valve positions and pressures in either of the laser cells. In normal mode the 'Control panel' on the left is not shown and it is possible to toggle between Titania and Sprite by clicking in the upper left corner of the 'Sprite Gas Control Panel'.

CTS UPDATE: Sets the computer to update the panel every 10 seconds. If the data is up to date the panel has a blue background, otherwise it changes to green.

CTS UPDATE

SPRITE

TITANIA

HELP

QUIT

REFILL LASER

ARGON FILL

MANUAL

HELP

QUIT

SPRITE and **TITANIA** buttons both bring up the sub menu:-

REFILL LASER: Pumps out laser cell and refills with current KrF mixture.

ARGON FILL: Pumps out laser and fills with Argon.

MANUAL : Activates the 'Control Panel' shown above on the left.

CONTROL PANEL : Gives manual type access to various valves and pumps on each of the two gas cells. Click on valves and pumps to select, they will then be shown in purple. The small rectangle on each device will be coloured green if it is being activated by the computer.

MODES:

Mouse Control: What ever is clicked on is activated for the length of time of the click.
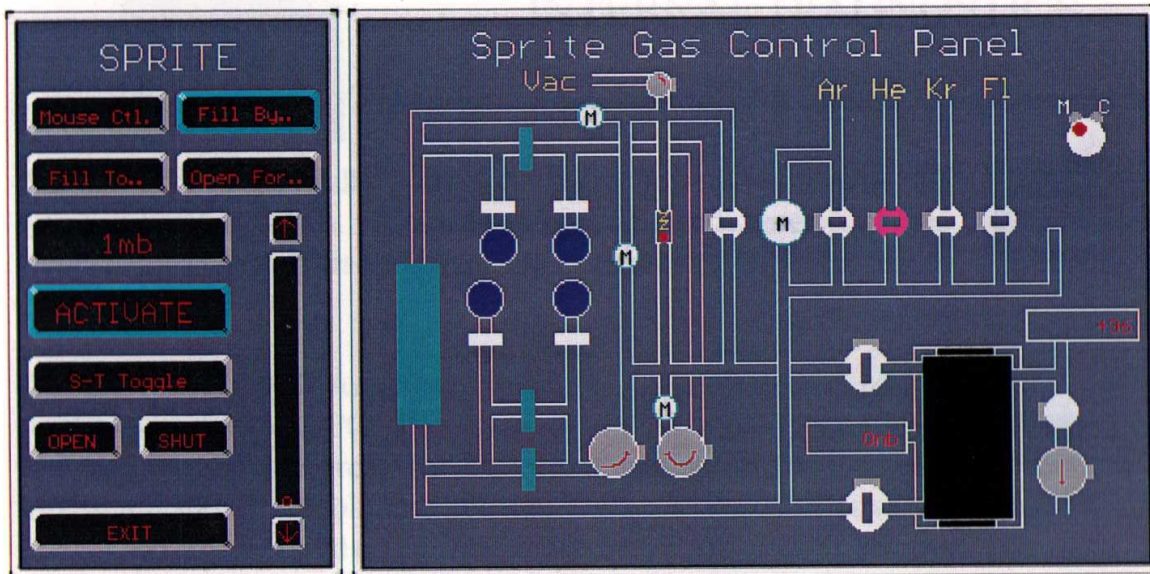**Fill by:** Once device selected pressing ACTIVATE opens chosen valve until pressure has risen by specified amount.
Fill to: Once device selected pressing ACTIVATE opens it until pressure reaches specified value.
Open for: Once device selected pressing ACTIVATE opens it for specified time.
OPEN & **SHUT** permanently activate or deactivate chosen device.

Gas Cell Control Panel

Example: *Pressing Activate on the above diagram will open the Sprite Helium valve until the pressure has risen by 1mb.*

INTERNAL DIAGNOSTICS

Diagnostic checks mainly for internal Amplicon cards.

'RE-INIT.': Occasionally, firing the pulse power can disable the Amplicon (I/O) cards. Running this command resets all the command registers. This unfortunately causes a trigger to be sent to the SRSbox.

DIG I/O: displays all Amplicon digital channels (including relays) available on the local PC. The status of each is shown by an LED which is illuminated green for high logic and is off for low. The LED's are shown in columns of eight with a short descriptive name underneath each LED. The direction of data flow is shown at the top of each column: I/P: input or O/P: output. All LED's on an Output channel can be clicked on to toggle the output state. If cards are added, removed or channel names changed this must be altered in the software.

ADC I/O - similar to 'DIG I/O' but displays all analogue I/O channels available on that PC. Input values show current reading as a bar graph which is coded red for negative voltages and green for positive. The actual voltage is shown under the Bar. Pressing the 'VOLTS-adc' button toggles this reading between the actual voltage ('VOLTS' in caps, assuming +/- 10V sensitivity) and raw 12bit data read in from channel ('ADC' in caps, values 0 to 4096). Output channels are recognised by up and down arrows by the bar which can be clicked on to alter the output value, it is also to possible to click on the slider. Only positive outputs in the range 0-10V are possible.

Examples:

- *We wish to turn the Sprite filter circulator on to stir up the gas.*

Enter the Dig I/O box and look for the LED with 'S FILT P' underneath, if this is illuminated then the pump is already on else click on it with the mouse and the circulator will start.

- *The ADC card is to be used as an expensive voltmeter with the probes connected to channel 3.*

Click on the 'ADC I/O' and the voltmeter bars will appear. Channel 3 will be reading your voltage on a scale +/- 10V. It will automatically update as the reading changes. (NB. The first channel is numbered ZERO).

REMOTE DIAGNOSTICS

Gives access to scopes and delay boxes connected via the GPIB interface.

A standard GPIB card has 16 available address to which 14 devices can be connected. The software is set up so Stanford boxes are connected with GPIB numbers 1 to 4, and scopes 5 to 16. (In the case on the Multiplexer room, the PC226 card emulates additional scopes 1 to 4.) For each area 30 'Input channels' are set-up which may be connected to any of the scopes. When the software is run the computer checks the GPIB for devices present. Arming, reading etc. will only apply to devices which the computer knows are available.

ARM: (Gives 'Where' Submenu).
Commands computer(s) to load current settings into all 'input channels' on the scopes in selected areas. 'ALL' obviously encompasses all areas.

LOCAL: (Gives 'Where' Submenu).
Sets all scopes in selected area(s) to local control. This means they can be operated manually.

READ SCOPES: (Gives 'Where' Submenu).
Reads traces of all 'input channels' on scopes in selected area(s) and saves them with the current shot number. This is also called on a shot. Filenames are created as follows 'T'+shot num (last 4 dig) +Area Code+Input num+'.WFM' and saved in 'TITAN/WFMS'. i.e.'T1245M4.WFM' would be input channel 4 from the Multiplexer room on shot number 1245.

'WHERE' submenu.

GPIB DEVICES:
Brings up a display showing which devices are currently connected and enables all settings to be edited - See end of section.

TRACE TO XL: Enables 'wfm' files to be saved in an Excel compatible format. Selecting this will ask for the directory and filename of the file to be converted. If successful the new file(s) name will be displayed in the Scrollbox.

USER TRIGS: Enables timing of user triggers to be set via the Editor.
User L Trig1/2 are in 8th's of seconds before the shot and are only accurate to +/- 2 seconds.
User M Trig1/2 is adjustable in milliseconds between 16 and 900ms +/- 10us before the shot.
User S Trig1/2 is adjustable in ns between the shot and 32000ns +/- .5 ns after the shot.

REINIT GPIB: Reruns the GPIB device checking routine to test whether any devices have been added/removed. Useful if scope(s) were turned off when the program was initially run.

GPIB SETTINGS

SRSBOX	SRSBOX	SRSBOX	SRSBOX
54502A	None 6	54502A	54512B
54502A	None 10	None 11	54502A
None 13	None 14	None 15	None 16
PC 0-3	PC 4-7	PC 8-11	PC 12-15

Left side buttons: 1: Used, 2: Used, 3: PFL 1, 4: PFL 2, 5: Used, 6: Used, 7: Used, 8: Used, 9: Used, 10: Used, 11: Used, 12: Used, 8: Pres J, 1: Pres J, 15: Used

Right side buttons: 16: Used, 17: Used, 18: Used, 19: Used, 20: Used, 21: Used, 22: Used, 23: Used, 24: Used, 25: Used, 26: Used, 27: Used, 28: Used, 29: Used, 30: Used

Bottom buttons: EXIT, PP2, OSC, MPX, MY, ARM, LOC, COPY

INPUT EDIT BOX

Scope input: 14

Name	Titan PI
Volts/Div	500mV
Voltage Offset	7.00V
Impedence	1M Ohm
Read Amp	Yes
Read Pos Width	No
Read Neg Width	No
Read Delay wrt	UNUSED
Read T of MxV	Yes
Read T of MnV	No
Read T of MxG	No
Read T of MnG	No
Delay	3.00S
Sec / Div	1.00S
Start Graph	13.3nS
End Graph	6.68nS
Calibration	1.00
Units	mV

OK   CANCEL

The upper, central block of 4*4 rectangles represent the 16 GPIB channels. If a device is present the rectangle is illuminated white and the device type written in black. Below these 16 devices the 4 bottom rectangles show scopes emulated on the PC226 card. The buttons down each side show the 30 'inputs channels' - moving the mouse over one of these buttons or a scope will show which 'input channel' is connected to which scope.

Changing Input data: Selecting one of the 30 input boxes (left and right hand columns) brings up the input edit box. Currently this box is only used for editing the input's name and any measurements to be made on the waveform. *i.e. The shot energy is calculated by setting the computer to read the voltage*

amplitude and multiply it by a calibration factor.

PP2, OSC, MPX: display the devices present in the Pulsed Power, Oscillator or Multiplexing areas. Computers in these areas must be on and running.

Selecting devices: Right click on a device or input to select, when selected it will be outlined in cyan. Selected devices can then be '**ARM**'ed or '**LOC**'alised using the appropriate button. Clicking the '**COPY**' button transfers the properties of the selected item to the next one clicked on.

Changing Scope Settings:

Left-clicking on a scope icon will bring up the 'scope menu' as shown below:-

BUTTONS

VERT PANEL:
Top buttons show which channel's configuration is being shown.
First box down *(250mv)* is the volts/div and the one below the Offset.
'**Z**' : Zeros the Offset:
'**x3**': Sets Offset to be 3 times the volts/div.
'**DC**': is the current channel coupling and '**ON**' is High Freq reject status.

Just below this '**inp:13**' says that this channel is connected to 'active input' number 13. It can be edited by pressing the button. If it is set to zero no input is attached and the channel will NOT be set up when the scopes are armed. The input cannot be set to a value already connected to another scope.

HORIZ PANEL:

'**PTS 2000**':Record length for scope.

'**LEFT**': Current trigger justification.

First number is Sec/div followed by Delay. As before '**Z**' zeros the delay.

When used to view old waveforms the '**< #### >**' scrolls through the waveforms displaying a 500 sample segment, and should be set back to zero before viewing 'normal' traces.

TRIG PANEL:

'**SING**': Single trigger only mode.

'**POS**': Slope of trigger. '**DC**': coupling of trigger channel.

Box shows trigger level.

'**T**' sets above settings for TTL type input on trigger channel.

Bottom buttons show the current trigger source.

SCREEN VIEW

'**LIN**': toggles whether the scope displays traces as lines or dots.

'**FRM**': toggles the frame on and off.

'**1 2 3 4**': sets the computer to draw all, 1/2, 1/3 or 1/4 of points on its trace - mainly for speed. The dial above is the brightness control!

Cursors:

When the mouse moves across the screen it disappears to reveal which ever cursor is active (if any!). Pressing the Left mouse button toggles one cursor on and off, and the right button the other. Cursor positions are displayed relative to which channel is selected in the 'VERT' panel.

'**Magnifying glass**': Top left, enlarges the scope display to double size.

SAVING / LOADING

'**S->D**':Saves current scope configuration data to disk.

'**Scp#**':Loads in new data for different scope.

'**Reload**':Reloads current data.

'**ARM**','**LOCAL**':Arms or Localises that specific scope.

'**W>D**' , '**D>W**': Loads / saves waveforms from previous shots form the disk.

'**LLW**':Loads the waveform captured on that channel on the previous shot.

LIVE SCOPE:

'**LIVE**': Toggles scope to Start or Stop displaying trace(s) from selected scope.

The bottom left of the scope screen shows '1: 1.60V ... 2: 0nV ...etc'- each relates to the current volts/division for each of the 4 possible channels. If the writing is in white then the channel is turned off, clicking on the text will turn it back on. A trace will only be displayed in LIVE mode once it has been switched on.

'**CALC**': Calculates FWHM for current data on the channel selected by the 'VERT' channel select. The cursors are set on max, min and half height points.

'**MATH**': If this is toggled on then CALC will be repeatedly recalculated for new traces.

'**SPEC**': Runs the spectrometer- only available on multiplexer machine.

SRS BOX

SRS Box Controller

The SRS Box Controller is shown to the upper left of the scope panel. N.B. It only displays delay boxes in the same room as the chosen scope.

The button '**SRS 1**' indicates the delay boxes GPIB address and can be clicked to cycle round the 4 possible boxes in that room. If a SRS Box is present then the current delay will be displayed. Left or right clicking any of the digits will cause them to be increased or decreased respectively. Clicking the channel will select the next channel's delay to be displayed.

Miscellaneous Commands Menu

This menu deals with the Network communications and basic Set-up.

Print Screen: Sends a copy of the current screen to a LaserJet Type Printer.

**Beeps On/Off:** Stops computer beeping esp. when using the network.

Spare1/2: For development purposes.

PCX SAVE: Surprisingly this saves the entire screen as the 'PCX' file of your choice. This function can also be accessed by clicking the RH mouse button on the clock.

Lock out: Enables the menus to be Locked or Unlocked to prevent unauthorised access. This function is also accessed by clicking on the HV settings icon (S:60KV, T:60KV etc).

MISC and NETWORK MENUS
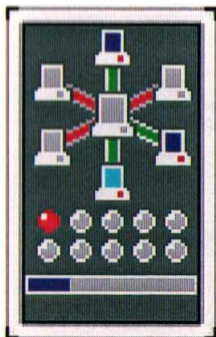
[NETWORK MENU] (sub menu)

NETWORK ICON: Uses a star shape to display which PC's are currently up and running on the network. Green lines and blue screens identify the computer as being present. A cyan screen signifies the current PC. Holding the mouse over each PC icon will identify which is which. Below this the first eight LED's show packets waiting to be read. The ninth illuminates cyan when copying files and the tenth is currently spare. The blue (or greeny blue see 'SUB DIRS?') bar shows the progress of any file copying procedure.

NETWORK ICON

VIEW PKTS: All network information received comes in the form of packets, with each computer able to store up to 8 packets for processing. This command allows waiting packets to be viewed for content and deleted if necessary, this is particularly useful if an unknown packet with a long life time is received.

COPY: Enables files to be copied between PC's on the control network. File names are entered in a similar fashion to DOS with just one difference. All names must be preceded by the ID Character of the PC. (Current ID Characters are shown in the table below.) *Therefore to copy the 'autoexec.bat' file on the control PC to the oscillator room the source file should be entered as 'CC:\AUTOEXEC.BAT' and the destination as 'OC:\'.* NB. '*'s and '?'s are allowed in the filename. Copy rate up to 10 MB/min.

BAR ON/OFF: To show the progress while copying, a blue bar moves across under the net icon. This function toggles this bar on and off to speed the copying up.

UPDATE EXE: When called from the development PC this button causes the 'TTNTMAIN.EXE' file on all PC's to be updated from the development PC.

SUB DIRS?: Selects whether sub-directory files are also to be copied when 'COPY' is pressed. Start-up condition is FALSE and is signified by a blue bar as opposed to a greeny, grey one.

MESSAGE: Send a text type message to another PC on the control network. As in the copy command the first character signifies the intended recipient.. There is one addition 'V', is a global message sent to eVeryone. *I.e.. Typing 'VThe laser is running' will cause 'The laser is running' to be displayed in the Scrollbox of each PC.*

PC's on Control System:

PC Name	Location	ID Letter	
Control PC	Control Room	C	
Archiver	Control Room		A
PP	Pulsed power area	H	
Multiplexer	Corridor by Control room	M	
Oscillator	Oscillator Room	O	
TA frame grabber	PC Target Area	T	
Development PC	Office	E	
Spare PC's	Any where	S,U	

V is the global ID for all of the above.

FIRING THE LASER

FIRE

SING TRIGGER: Sets the computer to countdown the final 2 seconds of a shot, giving the appropriate triggers. Used for timing purposes.

CTS TRIGGERS: This button continually gives 'SING TRIGGERS', until a key is pressed on the Pulsed power PC or a **'STOP TRIGGERS'** command is sent from another PC. While 'CTS TRIGGERS' is running the PP PC is unresponsive to most other commands.

8-HZ TRIG ON/OFF: Activates the 'AND' gate box watchdog to allow all triggers through. Effectively this provides 8-Hz prompt triggers to MPX and Target areas.

SPRITE ONLY: Toggles Sprite firing voltage between zero and last firing voltage.

TITANIA ONLY: As Sprite.

CHANGE SN: Changes the current shot number: Only available on the pulse power machine.

FIRE MENU

TEST SHOT	SPRITE ONLY
ARM LATE	TITANIA ONLY
HELP	SING TRIGGER
QUIT	CTS TRIGGERS
	STOP TRIGGERS
	8Hz TRIG ON
	8Hz TRIG OFF
	HELP
	QUIT

FIRE LASER: The laser is fired by turning the authorisation key and pressing the button in the Control Room.

DECREASE SN: Subtracts one from the current shot number.

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