WAVETEK

USER'S HANDBOOK

Model 1362/S/MT
VXIbus Card DMM

User's Handbook

For

The Model 1362/S/MT
VXIbus Card DMM

850255

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WAVETEK

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Wavetek Ltd
CERTIFICATE
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For any assistance contact your nearest Wavetek Sales and Service Center.
Addresses can be found at the back of this handbook.

Due to our policy of continuously updating our products, this handbook may contain minor differences in specification, components and circuit design to the instrument actually supplied. Amendment sheets precisely matched to your instrument serial number are available on request.

Wavetek Corporation
Standard Warranty Policy

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April 1, 1994

Wavetek Corporation reserves the right to amend specifications without notice.

1362 Users Handbook - Contents

SAFETY ISSUES

READ THIS ENTIRE SECTION THOROUGHLY BEFORE ATTEMPTING TO INSTALL, OPERATE OR SERVICE THE MODEL 1362/S/MT VXIbus CARD DMM

General Safety Summary

This instrument has been designed and tested in accordance with the British and European standard publication EN61010:1993/ A2:1995, and has been supplied in a safe condition.

This manual contains information and warnings that must be observed to keep the instrument in a safe condition and ensure safe operation. Operation or service in conditions or in a manner other than specified could compromise safety. For the correct and safe use of this instrument, operating and service personnel must follow generally accepted safety procedures, in addition to the safety precautions specified.

To avoid injury or fire hazard, **do not** switch on the instrument if it is damaged or suspected to be faulty. **Do not** use the instrument in damp, wet, condensing, dusty, or explosive gas environments.

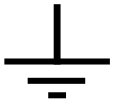
Whenever it is likely that safety protection has been impaired, make the instrument inoperative and secure it against any inintended operation. Inform qualified maintenance or repair personnel. Safety protection is likely to be impaired if, for example, the instrument shows visible damage, or fails to operate normally.

WARNING **THIS INSTRUMENT CAN DELIVER A LETHAL ELECTRIC SHOCK. NEVER TOUCH ANY LEAD OR TERMINAL UNLESS YOU ARE ABSOLUTELY CERTAIN THAT NO DANGEROUS VOLTAGE IS PRESENT.**

Explanation of safety-related symbols and terms

DANGER **electric shock risk**
The product is marked with this symbol to indicate that hazardous voltages (>30 VDC or AC peak) may be present.

CAUTION **refer to documentation**
The product is marked with this symbol when the user must refer to the instruction manual.



Earth (Ground) terminal
Functional Earth (Ground) only - must not be used as a Protective Earth.

Warnings and Cautions

WARNING **WARNING STATEMENTS IDENTIFY CONDITIONS OR PRACTICES THAT COULD RESULT IN INJURY OR DEATH.**

CAUTION **CAUTION STATEMENTS IDENTIFY CONDITIONS OR PRACTICES THAT COULD RESULT IN DAMAGE TO THIS OR OTHER PROPERTY.**

Protective Earth (Ground)

The instrument **must** be operated with a permanent Protective Earth/Ground connection to the VXIbus mainframe's power supply.

WARNING **ANY INTERRUPTION OF THE PROTECTIVE GROUND CONDUCTOR TO THE VXI MAINFRAME IS LIKELY TO MAKE THE MAINFRAME AND ALL MODULES DANGEROUS TO USE.**

To avoid electric shock hazard, make signal connections to the instrument after making the protective ground connection. Remove signal connections before removing the protective ground connection, i.e. **the power cable must be connected whenever signal leads are connected**.

Installation Category I:

Measurement and/or guard terminals are designed for connection at Installation (Overvoltage) Category I. To avoid electric shock or fire hazard, the instrument terminals must not be directly connected to the AC line power supply, or to any other voltage or current source that may (even temporarily) exceed the instrument's peak ratings.

WARNING **TO AVOID INJURY OR DEATH, DO NOT CONNECT OR DISCONNECT SIGNAL LEADS WHILE THEY ARE CONNECTED TO A HAZARDOUS VOLTAGE OR CURRENT SOURCE.**

MAKE SURE THAT SIGNAL LEADS ARE IN A SAFE CONDITION BEFORE YOU HANDLE THEM ANY WAY.

THE INSTRUMENT MUST BE POWERED WHEN ANY SIGNAL IS PRESENT AT ITS INPUT TERMINALS.

continued overleaf

Do Not Operate Without Covers

To avoid electric shock or fire hazard, **do not** operate the instrument with its covers removed. The covers protect users from live parts, and unless otherwise stated, must only be removed by qualified service personnel for maintenance and repair purposes.

WARNING

REMOVING THE COVERS MAY EXPOSE VOLTAGES IN EXCESS OF 1.5KV PEAK (MORE UNDER FAULT CONDITIONS).

Safe Operating Conditions

Only operate the instrument within the manufacturer's specified operating conditions. Specification examples that must be considered include:

ambient temperature
ambient humidity
power supply voltage & frequency
maximum terminal voltages or currents
altitude
ambient pollution level (Pollution Degree 2)
exposure to shock and vibration

To avoid electric shock or fire hazard, **do not** apply to or subject the instrument to any condition that is outside specified range. See Section 7 of this manual for detailed instrument specifications and operating conditions.

CAUTION

CONSIDER DIRECT SUNLIGHT, RADIATORS AND OTHER HEAT SOURCES WHEN ASSESSING AMBIENT TEMPERATURE.

CAUTION

BEFORE CONNECTING THE INSTRUMENT TO THE SUPPLY, MAKE SURE THAT THE REAR PANEL AC SUPPLY VOLTAGE CONNECTOR IS SET TO THE CORRECT VOLTAGE AND THAT THE CORRECT FUSES ARE FITTED.

Maintenance and Repair

Observe all applicable local and/or national safety regulations and rules while performing any work. First disconnect the instrument from all signal sources, then from the AC line supply before removing any cover. Any adjustment, parts replacement, maintenance or repair should be carried out only by the manufacturer's authorized technical personnel.

WARNING

FOR PROTECTION AGAINST INJURY AND FIRE HAZARD, USE ONLY MANUFACTURER SUPPLIED PARTS THAT ARE RELEVANT TO SAFETY. PERFORM SAFETY TESTS AFTER REPLACING ANY PART THAT IS RELEVANT TO SAFETY.

Moving and Cleaning

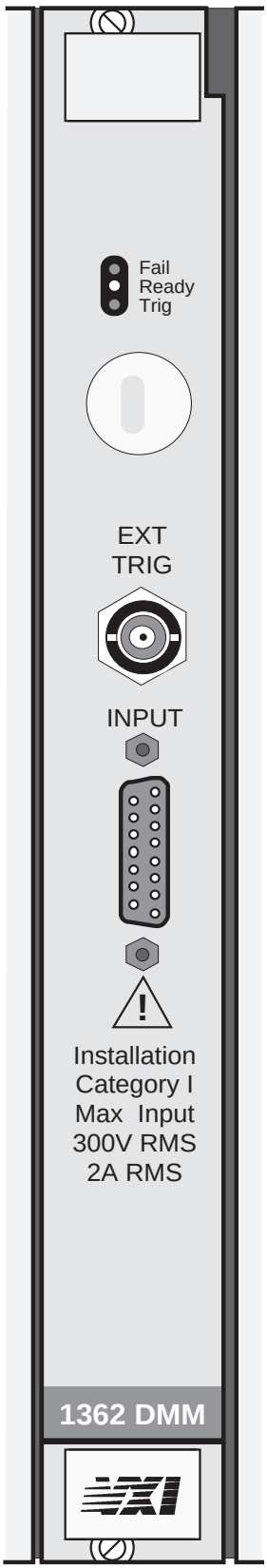
First disconnect the instrument from all signal sources, then disconnect the VXI mainframe from the AC line supply before moving or cleaning.Use only a damp, lint-free cloth to clean fascia and case parts.

Observe any additional safety instructions or warnings given in this manual.

SECTION 1
INTRODUCTION

SECTION 1 THE 1362 VXIbus DIGITAL MULTIMETER

Designed specifically for system operation, the 1362 is a high-performance, fully compatible VXIbus card DMM.
This Handbook covers 3 instruments, 1362, 1362S and 1362MT. Unless specified, it reflects all instruments.



Standard and Optional Measurement Facilities

With or without options, the 1362 native language conforms to IEEE Standard Codes, Formats, Protocols and Common Commands (ANSI/IEEE STD 488.2 - 1987) although it uses the VXI bus as the hardware message transport system.

1362 Series Basic Configuration

When purchased without options, the 1362 is a high quality DC/AC Voltmeter and Ohmmeter.

The basic configuration offers the following measurement capabilities:

- DC Voltage in five ranges from 100nV to 300V.
- AC Voltage in five ranges from 1μV to 300V.
- Resistance in six ranges from 100μΩ to 20MΩ.
- Selectable 4.5 to full 6.5 digits resolution.
- Fully IEEE-488.2 programmable, subject to the requirements of the VXI bus message transport system.
- External trigger with trigger delay.
- Autocal: covers-on programmable external calibration.

1362 Series Options

To extend its functional range, the instrument can be expanded by adding purchasable options, providing further measurement capability:

30 DC and AC Current option:
- One range of DC Current from 1μA to 2A.
- One range of AC Current from 10μA to 2A RMS.

40 Ratio Option:
- Two identical front input channels, A and B.
- Math in the form of (A - B); or (A ÷ B); or deviation: (A - B) / B

1362S Configuration

In addition to the features of the 1362, the 1362S can interpret Standard Commands for Programmable Instruments (SCPI Rev 1991). The Native language can be accessed from SCPI if necessary.

This instrument also utilizes the VXI backplane trigger bus. The Synchronous and Asynchronous protocols adhere to the VXI revision 1.3 specifications.

1362MT Configuration

This includes all the features of the 1362, but in addition the 1362MT can interpret Control Interface Intermediate Language (CIIL - Standard 2806763 - rev C), in full compatibility with 'MATE' applications.

In this configuration the native language (IEEE 488.2 Command Syntax) is retained as an alternative.

Transfer from CIIL to Native is directly programmable as a CIIL command, and conversely from Native to CIIL as a Native command.

Safety Default State and Function Configurations

When the instrument power is switched on, all functions are forced into a safety default state. Once a function is configured to a required state it remains in that state, regardless of subsequent configurations in other functions, until either the state is changed or the instrument power is switched off.

Calibration

Autocal

The 1362 is an 'Autocal' instrument, providing full external calibration of all ranges and functions via the VXIbus, so that it is not necessary to remove any covers. Calibration commands can be programmed in SCPI and native language, but not in CIIL.

Periodically, the DMM should be electronically calibrated against external inputs from traceable standards. The difference between the DMM's reading and the value of the external calibration source is used to derive calibration constants, which are stored by the instrument in non-volatile memory. The 1362 assumes that nominal values are used, unless informed of deviations from nominal by user-commands via the VXI bus.

Subsequently, when in normal use, the DMM calculates and applies a correction from the most-recently stored external calibration constants for the parameters of the measurement in progress. Thus each reading taken by the DMM receives an individual correction derived from the latest calibration.

Calibration Security

Accidental or unauthorized use of calibration facilities is prevented by a screwdriver-operated switch in a hole on the front panel. In addition, an enabling command must be used in order to enter calibration mode. For Native language this is `'CAL ON'` *(Section 5, page 5-29)*; and for SCPI language in the 1362S, it is `'CALibration SECure'` *(Section 4, page 4-13)*.

Calibration Routines

The Routine Autocal procedures are given in Section 8 of this handbook.

Message Readout

Generally, the offered selections reflect the availability of facilities, incompatible combinations being excluded. Nevertheless, the 1362 outputs information to the user such as unsuitable attempts at configuration, test failures and some other conditions which would need to be reported to an authorized service center.

Programming

Data can be input via the VXI bus to set up measurements with facilities for:

- selecting a suitable range for measurement of an expected value;
- introducing user-defined trigger delays;
- setting the number of readings-per-block to be taken when in BLOCK mode;
- recalling a number of readings (sub-block) from a stored block;
- setting non-nominal targets for requested calibrations;
- performing a nominated individual test from the range of tests activated in sequence during a 'Self Test'.

Operation within the parameters of each function or facility is programmed by selection from the available codes.

Full details are given in Sections 4, 5 and 6.

Self Test

Standard codes are used to activate the instrument's internal Self Test sequence. These can be found in Sections 4 to 6.

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SECTION 2
INSTALLATION

SECTION 2 INSTALLATION

Logical Address Switch Configuration

The Logical Address Switch is an 8-way DIL switch, accessible via a hole in the top cover (RHS).

Refer to Fig. 2.1
The switch contacts are labelled from 1 to 8, corresponding to the eight bits of the logical address value (**8 ≡ MSB**; **1 ≡ LSB**). One side of the switch bank is labelled **OPEN**; this represents address bits at **logic-1**. Setting a switch to the **CLOSED** position sets its address bit to **logic-Ø**.

The address can be set to any value between 1 and 255 (address Ø is reserved for the resource manager). However, as the 1362 fully supports Dynamic Configuration as defined in *Section F of the VXI specification*, address **255** should be selected **only** if the Resource Manager also supports Dynamic Configuration.

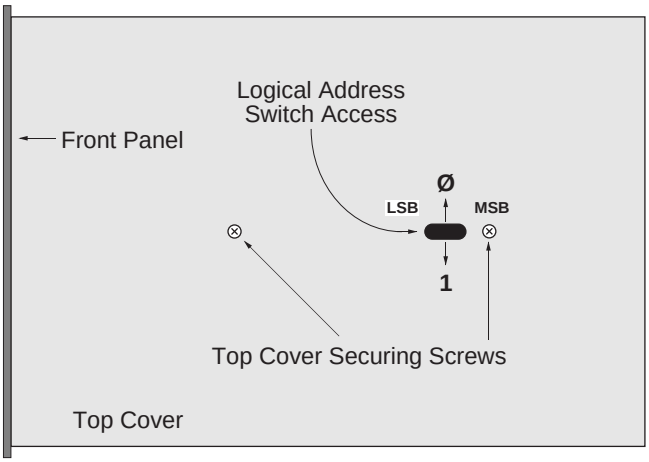


Fig. 2.1 Logical Address Switch - Access

Interrupt Acknowledge Daisy Chain

As the 1362 has VXIbus **Interrupter** capability, care must be taken to ensure that the **Interrupt Acknowledge** daisy chain is correctly configured. This is usually implemented using DIP switches or links in the subrack.

For the actual method to be used, consult the subrack manufacturer's Handbook.

Fitting the 1362 into the Subrack

The 1362 is a standard Size **C**, VMEbus **Functional Module**, with **Interrupter** capability. It can be fitted to the **Subrack** by turning it to its vertical position with its **Board** to the left, and sliding it into any **Slot** (not Slot Ø).

Ejectors are located at top and bottom of the front panel. When removing the module, these operate levers to ease the P1 and P2 connectors out of the **Backplane**. When fitting, the module should be gently pressed in to engage the connectors into the backplane, and when fully home, the ejectors will be set at right angles to the surface of the front panel.

Two captive screws, outboard of the ejectors, secure the module to the subrack.

Removal from the Subrack

Two captive screws, outboard of the ejectors, are unscrewed to release the module from the subrack.

Ejectors are located at top and bottom of the front panel. These are forced gently outwards (top - up; bottom - down) to operate levers which ease the P1 and P2 connectors out of the **Backplane**. The module can then be pulled to slide it out of the slot.

E-M Interference:

Noisy or intense electric, magnetic or electromagnetic fields in the vicinity of the calibration set-up can disturb the measurement circuit.

Some typical sources are:

- Proximity of large electric fields
- Fluorescent lighting
- Inadequate screening, filtering or grounding of power lines
- Transients from local switching
- Induction and radiation fields of local E-M transmitters
- Excessive common mode voltages between source and load

The disturbances may be magnified by the user's hand capacitance. Electrical interference has greatest effect in high impedance circuits. Separation of leads and creation of loops in the circuit can intensify the disturbances.

50Hz/60Hz/400Hz Line Frequency Configuration

Line Frequency Programming

To obtain optimum performance from the A-D converter it is necessary to adapt its configuration to the line frequency in use. The adaptation is performed by remote programming.

The 1362 has been calibrated to your local line frequency. The syntax used to reset or query the line frequency depends on the model type.

Associated SCPI Commands

The following syntax are associated with line setting and query *(Refer to Section 4; page 4-32).*

`SENse:LFRequency` <numeric_value>

Example, 50Hz, 60Hz or 400Hz

`SENse:LFRequency?` Queries the current line setting.

`CALibration:SLFRequency?` Saves the current line frequency setting to non-volatile memory. This setting is subsequently used as the power up default.

Associated Native Commands

The following syntax are associated with line setting and query *(Refer to Section 5; page 5-32).*

`LINE` <Nrf> Selects the line frequency.

`LINE?` Recalls the line frequency to which the instrument is currently adapted.

`STLN?` Saves the current line frequency setting to non volatile memory. This setting is subsequently used as the power up default.

Further information about the programming syntax is detailed in Sections 4 and 5.

No Associated CIIL Command

There are no implemented CIIL commands associated with line setting and query. Line frequency configuration must be set in Native Language.
(Implemented CIIL commands are given in Section 6.)

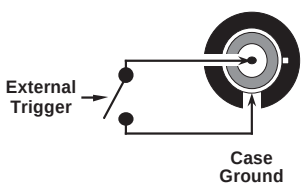
Front Panel Connections

Two connectors are fitted on the front panel: a co-axial BNC external trigger input plug; above a 15-way D-type plug which carries the analog inputs.

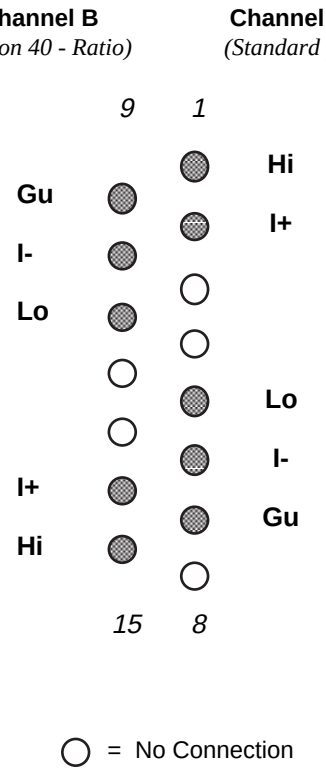
The pin connections to these plugs are given below.

N.B. It is advisable to ensure that the trigger source applied to the EXT TRIG input is adequately debounced, to avoid multiple triggering.

J301 External Trigger - Connection and Operation



J351 Analog Input Plug - Pin Layout and Configuration
(Viewed from the front)



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SECTION 3
1362 VXI LOW LEVEL INTERFACE

SECTION 3 1362 VXI LOW LEVEL INTERFACE

VXI Registers

This sub-section summarizes the VXI registers used by the 1362 as viewed from a VXI Slot Zero to the DMM.
For further information consult the *VXI Specification Issue 1.2*, or *VMEbus Specification revision C*.

$3F_{16}$	**DEVICE DEPENDENT REGISTERS**
$Ø6_{16}$	Offset Register
$Ø4_{16}$	Status/Control Register
$Ø2_{16}$	Device Type
$ØØ_{16}$	ID/Logical Address Register

ID/Logical Address Register (Read)

Bit No	15 - 14	13 - 12	11 - Ø
	Device Class	Address Space	Manufacturer ID

The 1362 DMM is a message-based device so the **Device Class** bits take the value of **10** (binary).

The address space of the DMM is A16 only and thus the **Address Space** bits take the binary value of **11**.

The **Manufacture ID** for Wavetek is $\mathbf{FFE_{16}}$.

Thus the **contents of this register** is always $\mathbf{BFFE_{16}}$.

ID/Logical Address Register (Write)

This is defined by the optional Dynamic Configuration Protocol and is written into the Resource Manager.

Device Type (Read)

Bit No	15 - 12	11 - Ø
	Required Memory	Model Code

As the DMM is A16, there is no Required Memory, so these bits are allowed to float high.

The Model code is the identifier for the DMM this has been chosen to be 552_{16} (1362 dec).

Thus the contents of this register will always be $F552_{16}$.

Status/Control Register (Read)

(indicates Low-Active)*

Bit No	15	14	13 - 4	3	2	1 - Ø
	A24/A32 Active	MODID*	Device Dependent	Ready	Passed	Device Dependent

The A24/A32 Active and the Device Dependent bits are not used by the DMM and are allowed to float high.

The MODID* is an inverted reflection of the P2 MODID line. This is used to indicate that the board has been selected.

The Ready bit indicates that the DMM is ready to accept its full set of operational commands.

The Passed bit is set to zero to indicate that the DMM is either executing or has failed its power-up / reset sequence. A one indicated the DMM has passed it's selftest.

Status/Control Register (Write)

Bit No	15	14 - 2	1	Ø
	A24/A32 Enable	Device Dependent	Sysfail Inhibit	Reset

As the DMM is A16 only, the A24/A32 Enable bit is always ignored.

The Device Dependent bits are ignored.

The Sysfail Inhibit is used by the controller to disable the DMM from driving the SYSFAIL line. It also forces the DMM into a 'safe' state when the Reset bit is also one.

A one in the Reset bit forces the DMM into the Reset state.

Offset Register (Read)

The Dynamic Configuration Protocol defines additional use of the offset register.

Device Dependent Registers

This area is further expanded by the Message Based class. *See overleaf.*

Message Based Specifics

The VXI specification allocates further registers for message based devices in the Device Dependent area shown above. This gives:

$3F_{16}$	**DEVICE DEPENDENT REGISTERS**
$1F_{16}$	Reserved
14_{16}	A32 Pointer
$1Ø_{16}$	A24 Pointers
$ØE_{16}$	Data Low
$ØC_{16}$	Data High
$ØA_{16}$	Response/Data Extended
$Ø8_{16}$	Protocol/Signal Register
$ØØ_{16}$	CONFIGURATION REGISTERS

The Configuration Registers are described earlier on *pages 3-2 and 3-3*.

Protocol/Signal Register (Read)

(indicates Low-Active)*

Bit No	15	14	13	12	11	1Ø	9 - 4	3 - Ø
	CMDR*	Signal Reg*	Master	Interrupter	FHS*	Shared Mem*	RESERVED	Device Dependent

In the above, the DMM is not a commander, has no signal register, is not a bus master, does not support Fast Hand Shake and does not use shared memory. Thus all of these bits float to one. The RESERVED and Device Dependent bits are not used and also float to one.

It is however an interrupter, and this is indicated by the Interrupted bit being one. Thus the entire register is always read by VXI as $FFFF_{16}$.

Protocol/Signal Register (Write)

The signal Register in the DMM is not implemented.

Response/Data Extended Register (Read)

Bit No	15	14	13	12	11	1Ø	9	8	7	6 - Ø
	Ø	RESERVED	DOR	DIR	Err*	Read Ready	Write Ready	FHS Active*	Locked*	Device Dependent

In this register the RESERVED, FHS Active*, Locked* and Device Dependent bits are not used and float high.

The Err* bit is used to indicate that there is an error in the word serial protocol and is manipulated by the DMM software.

DOR (Data Out Ready) is set to Logic-1 to indicate that the DMM is ready to output data to its commander

DIR (Data In Ready) is set to Logic-1 to indicate that the DMM is ready to receive data from its commander.

The Read Ready and Write Ready are handshakes associated with data transfer between the VXI bus and the DMM and are manipulated by the DMM software.

Response/Data Extended Register (Write)

The Data Extended Register is not implemented on the DMM.

Data High Register.

This is not implemented by the DMM.

Data Low Register (Read/Write)

This register is used for all data communication between the VXI bus and the DMM. The VXI writes data for the DMM into this location, and the DMM puts data into this location to be read by the DMM's commander.

It is a bi-directional 16-bit register.

A24 Pointer and A32 Pointer Registers

These registers are not implemented by the DMM.

VXI to DMM Communications Cycle

This sub-section outlines the sequence of events that may take place between the DMM and its VXI commander. The main low level communication is the VXI Word Serial Protocol, which is a simple handshake system. For example: the DMM indicates with a flag that it is ready to receive, the VXI writes a word and sets a flag indicating that data is available. The DMM reads this word and clears the flag. To get data out of the DMM, the commander asks for a byte using the above sequence. It then waits for the DMM to set a flag indicating that the DMM has placed a word in the output register. When this flag goes true, the commander will read the data. This will then clear the flag indicating that the data has been read and that the cycle may repeat.

In addition to this simple system, there is an interrupt protocol which can be used to modify the above cycle.

Word Serial Protocol

The following describes more fully the (low level) communication sequence between the DMM's commander and the DMM. It is assumed that all power on sequences have been completed and the DMM is in a quiescent state waiting to receive a command. (Power on and Selftest will be dealt with later).

('Commander' is name given to the device which is controlling the DMM, whether it is a 'Slot Zero', a computer or another instrument.)

There are three main interactions:- data from the commander to the DMM, data from the DMM to the commander and the DMM-generated interrupt cycle.

Data From Commander To DMM

1. The commander waits for the DMM to set the 'Write Ready' bit true in the VXI Response register. This indicates the DMM is ready for data.
2. The commander can then write a word of data into the Data Low register of the DMM. The write action will automatically set the DMM's Write Ready bit to false. It will also generate an internal interrupt to inform the DMM that data has arrived.
3. The DMM can then read this word of data from the Data low register. It is then up to the DMM to parse the word, in order to determine which VXI word serial command the high order byte contains. The parser acts on this command. If the lower byte of the word contains data, it is transferred to the high-level command parser.
4. When the word of data has been dealt with, then the DMM can again set the Write Ready bit true to indicate that it is ready for a further exchange.

Data From DMM to Commander

1. The commander can obtain a word of data from the DMM only by requesting it. This request comes in the form of the word serial protocol 'Byte Request' command. The commander must send the Byte Request command as a word of data, using the above sequence, before a response can be given.
2. On receiving the Byte Request command, the DMM takes a word of data from the output buffer and places it in the Data Low register. This action sets the 'Read Ready' bit in the DMM's VXI Response register automatically.
3. If the DMM has been set to interrupt the commander at this stage it will do so: refer to 'The Interrupt Cycle'.
4. Either in response to the interrupt, or by polling, the commander will discover that the DMM Read Ready bit has been set true. It can then read the word of data from the DMM's Data Low register. The commander's act of the reading this word clears the Read Ready bit automatically.
5. This completes the transfer of data from the DMM. To obtain another word of data the commander must send the Byte Request command again.

Byte Transfer Protocol

This is a mechanism for the transfer of data between a device and its commander. Data is passed using the Word Serial Protocol 'Byte Available' and 'Byte Request' commands, regulated by the DOR and DIR bits of the Response register.

1. When a device is ready to accept incoming data it sets the DIR bit to Logic-1.

2. The commander can then send a data byte via the Byte Available command.

3. When a device has data available in its internal store, and is ready to process a Byte Request command, it sets the DOR bit to Logic-1.

4. The commander can then send a Byte Request command.

5. On receipt of the Byte Request command, the device responds by placing the output data in its Data Low register.

Note that incoming word serial protocol Trigger commands are also held off until the DIR bit has been set to Logic-1.

The Interrupt Cycle

The VXI specification permits two types of interrupt cycle, 'Response' or 'Event'. The two types are mutually exclusive, and must be selected by the controller before they become active.

1. The commander can use several word serial commands to select ‘when’, ‘how’, and ‘with what’ the DMM will interrupt.

‘**When**’
could be implemented as a result of any of the Read Ready, Write Ready or Err* bits going true.

'**How**'
is selected from the VME Interrupt levels (IRQ1* to IRQ7*).

‘**With What**’
can be either a Response Interrupt or an Event Interrupt.

2. When the condition for the DMM to interrupt the Commander occurs, the DMM will initiate the Interrupt cycle. For example: it could be immediately after the DMM has placed a word of data in the Data Low register, for the Commander to read.

3. In the case of a Response Interrupt, the commander must respond with the VME Interrupt Acknowledge cycle. The DMM will return a vector consisting of the logical address (on the low byte) and the upper half of the Response register (on the high byte).

4. In the case of an Event Interrupt, the DMM will place the contents of the Event register in the high byte of the vector instead of the upper half of the Response register.

Word Serial Protocol Commands

The VXI specification defines a series of commands that are used to configure, and communicate with, a device. These are all low level single word commands sent, and responses received, via VXI word serial protocol.
The following is the subset of commands implemented by the DMM:

(**Note**: The Code values and responses given apply only to the 1362 DMM and can vary for other devices)

Abort Normal Operation

The *Abort Normal Operation* command is used to cause the DMM to cease normal operation. On receipt of the command the DMM returns to default configuration, aborting all operations. The DMM will then be in a generally inactive state and will be ready to accept commands.

The syntax of the *Abort Normal Operation* command is defined in the following table.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	0	0	1	0	0	0	1	1	1	1	1	1	1	1

When the abort operation has completed (the DMM is in the aborted state), response data is placed in the Data Low register in the following format:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0

Assign Interrupter Line

The *Assign Interrupter Line* is used to assign a VMEbus IRQ line to the DMM. The syntax of this command is defined in the following table.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	0	1	0	1	0	1	0	X	Int_ID			X	Line		

- X: Don't care. The value written to this bit has no effect.
- Int_ID: This is a unique identifier of the particular Interrupter being assigned. It has a range of 1 to 7. As the DMM has only one interrupter, this should always take the value 1.
- Line: This is the VMEbus IRQ line number. A value of zero (0_{16}) indicates that the Interrupter is to be disconnected.

When the assignment operation has completed, response data is placed in the Data Low register in the following format:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status				1	1	1	1	1	1	1	1	1	1	1	0

- Status: This field indicates the execution state of the command. It may have the following values:
  - F_{16}: The command successfully completed.
  - 7_{16}: Command failed - The Interrupter referenced in the Int_ID field is unknown to this device.

Asynchronous Mode Control

The *Asynchronous Mode Control* command is used by a commander to direct the path of events and responses. The syntax of this command is defined in the following table.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	0	1	0	1	0	0	0	X				Resp. En*	Event En*	Resp. Mode	Event Mode

- X: Don't care. The value written to this bit has no effect.
- Resp. En*: A zero (0) enables generation of responses. A one (1) disables generation of responses.
- Event En*: A zero (0) enables generation of events. A one (1) disables generation of events.
- Resp. Mode: A one (1) indicates that responses should be sent as signals. A zero (0) indicates that responses should be sent as interrupts.
- Event Mode: A one (1) indicates that events should be sent as signals. A zero (0) indicates that events should be sent as interrupts.

The result data is placed in the Data Low register in the following format. The result is a confirmation/denial of the command.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status				1	1	1	1	1	1	1	1	Resp. En*	Event En*	Resp. Mode	Event Mode

- Status: This field indicates the execution state of the command. It may have the following values:
  - F_{16}: The command successfully completed.
  - 7_{16}: Command failed - A requested option is not supported.
- Resp. En*: A zero (0) indicates that generation of responses is enabled. A one (1) indicates that generation of responses is disabled.
- Event En*: A zero (0) indicates that generation of events is enabled. A one (1) indicates that generation of events is disabled.
- Resp. Mode: A one (1) indicates that responses are being sent as signals. A zero (0) indicates that responses are being sent as interrupts.
- Event Mode: A one (1) indicates that events are being sent as signals. A zero (0) indicates that events are being sent as interrupts.

Since the DMM is not a VMEbus MASTER, Responses and Events can only be sent as Interrupts.

Begin Normal Operation

The *Begin Normal Operation* command notifies the DMM that it can begin normal operation. The *Top_Level* field of the *Begin Normal Operation* command is provided to inform a device whether or not it is a top level Commander. The syntax of this command is defined in the following table.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	1	1	1	1	0	Top Level	1	1	1	1	1	1	1	1

- Top Level: A one (1) in this field indicates that the device is a top level Commander. A zero (0) indicates that it is a Servant to another device.

  As the DMM is not a commander this bit should always take the value zero.

When the begin operation has completed, response data is placed in the Data Low register in the following format:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status				State				Logical Address							

- Status: This field indicates the execution state of the command. It may have the following values:
  - F_{16}: The Begin Normal Command has been successfully executed. The value FE_{16} is reported in the Logical Address field.
  - 4_{16} The DMM could not successfully initialize itself. The value FE_{16} is reported in the Logical Address field.
  - 3_{16} The DMM is not able to be a top level Commander. The value FE_{16} is reported in the Logical Address field.
  - 1_{16} An undefined error was caused. The value FE_{16} is reported in the Logical Address field.
- State: This field indicates the state of the DMM. It may have the following values:
  - F_{16}: The DMM is in the NORMAL OPERATION sub-state.
  - 3_{16} The DMM is in the CONFIGURE sub-state.
- Logical Address: This field contains the Logical Address corresponding to the status field values.

Byte Available

The *Byte Available* command is used by a Commander to send a byte of data to the DMM. The END field signifies that this is the last byte of the message. The syntax of this command is defined in the following table.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	0	1	1	1	1	0	END	Datum							

Byte Request

The *Byte Request* command is used by a Commander to read a byte of data from the DMM. The syntax of this command is defined in the following table.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1

The result data is placed in the Data Low register in the following format. The END field is used to indicate the last byte of the message.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	1	1	1	1	1	END	Datum							

Clear

The *Clear* command is used by a Commander to cause the DMM to clear the VXIbus interface and any pending operations. Any initiated operations in the DMM are undisturbed. The syntax of this command is defined in the following table.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Control Event

The *Control Event* command is used by a Commander to selectively enable the generation of events by the DMM. A one (1) in the enable field enables the generation of the specific event. A zero (0) in the enable field disables the generation of the specific event. The syntax of this command is defined in the following table.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	0	1	0	1	1	1	1	Enable	Event						

- Event: These bits (6-0) are the identifying bits (14-8) of the event being enabled/disabled.

The following Events are supported:

Request True: This event is sent by the DMM when it requires service from its Commander. The syntax of this event is defined in the following table.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	1	1	1	1	0	1	Sender's Logical Address							

Request False: This event is sent by the DMM when it no longer requires service from its Commander. The syntax of this event is defined in the following table.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	1	1	1	1	0	0	Sender's Logical Address							

Device Response

The device returns the following data in the Data Low register:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status				1	1	1	1	1	1	1	1	1	1	1	0

- Status: This field indicates the execution state of the command. It may have the following values:
  - F_{16}: The command successfully completed.
  - 7_{16}: Command failed - The event referenced is not generated by this device.

Control Response

The *Control Response* command is used enable response interrupts on certain response register bit transitions. The syntax of this command is defined in the following table.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	0	0	0	1	1	1	1	X	B14*	DOR*	DIR*	Err*	RR*	WR*	FHS*

The bits have the following meanings:

- X: Don't care. The value written to this bit has no effect.
- B14*: A zero enables a signal/interrupt on a 0-1 transition of bit 14 of the Response register. A one disables this capability. Since bit 14 of the Response register is reserved (always one), the value of this bit will be ignored by the DMM.
- DOR*: A zero enables an interrupt on a 0-1 transition of the *DOR* bit. A one disables this capability.
- DIR*: A zero enables an interrupt on a 0-1 transition of the *DIR* bit. A one disables this capability.
- Err*: A zero enables an interrupt on a 1-0 transition of the *Err* bit. A one disables this capability.
- RR*: A zero enables an interrupt on a 0-1 transition of the *Read Ready* bit. A one disables this capability.
- WR*: A zero enables an interrupt on a 0-1 transition of the *Write Ready* bit. A one disables this capability.
- FHS*: A zero enables an interrupt on a 0-1 transition of the *FHS Active* bit. A one disables this capability.

The result data is placed in the Data Low register in the following format. The result is a confirmation/denial of the command.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status				1	1	1	1	1	B14*	DOR*	DIR*	Err*	RR*	WR*	FHS*

The bits have the following meanings:

- Status: This field indicates the execution state of the command. It may have the following values:
  - F_{16}: The command successfully completed.
  - 7_{16}: Command failed - an unsupported bit transition was requested.
- B14*: A zero indicates that interrupt generation on transitions of bit 14 of the Response register is enabled. A one indicates that this capability is disabled. This bit will always be set to one (1).
- DOR*: A zero indicates that interrupt generation on 0-1 transitions of the *DOR* bit is enabled. A one indicates that this capability is disabled.
- DIR*: A zero indicates that interrupt generation on 0-1 transitions of the *DIR* bit is enabled. A one indicates that this capability is disabled.
- Err*: A zero indicates that interrupt generation on 1-0 transitions of the *Err* bit is enabled. A one indicates that this capability is disabled.
- RR*: A zero indicates that interrupt generation on 0-1 transitions of the *Read Ready* bit is enabled. A one indicates that this capability is disabled.
- WR*: A zero indicates that interrupt generation on 0-1 transitions of the *Write Ready* bit is enabled. A one indicates that this capability is disabled.
- FHS*: A zero indicates that interrupt generation on 1-0 transitions of the *FHS Active* bit is enabled. A one indicates that this capability is disabled. As the DMM does not implement FHS, a one (1) will always be returned in this position.

End Normal Operation

The *End Normal Operation* command is used to cause the DMM to cease normal operation in an orderly manner. The 'ended' state is defined as follows: Pending interrupts are unasserted; no new interrupts may be asserted; the DMM is in a generally inactive state and is ready to accept commands.

The syntax of the *End Normal Operation* command is defined in the following table.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	0	0	1	0	0	1	1	1	1	1	1	1	1	1

When the 'ending' operation has completed, response data is placed in the Data Low register in the following format:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status				State				Logical Address							

- Status: This field indicates the execution state of the command. It may have the following values:
  - F_{16}: The End Normal Command has been successfully executed. The value FE_{16} is reported in the Logical Address field.
  - 7_{16} The DMM was already in the CONFIGURE sub-state. The value FE_{16} is reported in the Logical Address field.
  - 5_{16} The DMM was not able to end its operation in a consistent manner. The value FE_{16} is reported in the Logical Address field.
  - 3_{16} An undefined error was caused. The value FE_{16} is reported in the Logical Address field.
- State: This field indicates the state of the DMM. It may have the following values:
  - F_{16} The DMM is in the CONFIGURE sub-state.
  - 3_{16}: The DMM is in the NORMAL OPERATION sub-state.
- Logical Address: This field contains the Logical Address corresponding to the status field values.

Read Interrupter Line

The *Read Interrupter Line* command is used to determine which VMEbus IRQ line is connected. The syntax of this command is defined in the following table.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	0	0	0	1	1	0	1	X					Int_ID		

- X: Don't care. The value written to this bit has no effect.
- Int_ID: This is a unique identifier of the particular Interrupter being queried. It has a range of 1 to 7. As the DMM has only one interrupter, this should always take the value 1.

The VMEbus IRQ line number is placed in the Data Low register with the following format:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status				1	1	1	1	1	1	1	1	1	Line		

- Status: This field indicates the execution state of the command. It may have the following values:
  - F_{16}: The command successfully completed.
  - 7_{16}: Command failed - The Interrupter referenced in the Int_ID field is unknown to this device.
- Line: This is the VMEbus line number currently assigned. A value of zero (0_{16}) indicates that the Interrupter is disconnected.

Read Interrupters

The *Read Interrupters* command is used to determine the number of Interrupters within the DMM. The syntax of this command is defined in the following table.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	0	0	1	0	1	0	1	1	1	1	1	1	1	1

The number of Interrupters is placed in the Data Low register with the following format:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	1	1	1	1	1	1	1	1	1	1	1	Int_no		

- Int_no: The number of Interrupters within the DMM. As the DMM has only one interrupter, this will always take the value 1.

Read Protocol

The *Read Protocol* command is used by a Commander to find out what protocols, in addition to the Word Serial protocol, that the DMM supports. The syntax of this command is defined in the following table.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1

The protocol support word is placed in the Data Low register with the following format:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	1	1	1	1	1	1	0	0	1	0	I4*	0	1	1

- I4*: A zero (0) in this position indicates that this device supports the VXIbus 488.2 Instrument protocol. The 1362MT will report a one (1) in this position.

Read Protocol Error

The *Read Protocol Error* command is used by a Commander to tell the DMM to report its most-recent error code. When the error code has been reported by the DMM, the *Err** bit is reset before Read Ready is asserted on the error code output. The syntax of this command is defined in the following table.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	0	0	1	1	0	1	1	1	1	1	1	1	1	1

The error codes are placed in the Data Low register with the following format:

- No error:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

- Multiple Queries: The DMM was requested to overwrite previous unread response data.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1

- Unsupported Command: The DMM has received a command that it does not implement.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0

- DIR Violation: The DMM has received a command that violates the DIR handshake.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1

- DOR Violation: The DMM has received a command that violates the DOR handshake.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0

Read STB

The *Read STB* command is used by a Commander to read the status word from the DMM. The syntax of this command is defined in the following table.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1

The error codes are placed in the Data Low register with the following format:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	1	1	1	1	1	1	Status Byte							

Trigger

The *Trigger* command is used by a Commander to cause the DMM to trigger.
The syntax of this command is defined in the following table.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1

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SECTION 4
1362S SCPI LANGUAGE

SECTION 4 1362S SCPI LANGUAGE

SCPI Programming Language

Introduction

The 1362S will power-up default in SCPI language but has the ability to switch to Native (IEEE-488.2) language. Both languages obey IEEE-488.2 command syntax.

As the instrument operates on the VXI bus, it is not in direct contact with the outside world and cannot conform fully to the IEEE 488.1 Hardware model. For example, in the IEEE 488.1 model, a separate (SRQ) line is provided for the instrument to request service from the controller.

A separate line for requesting service is not provided on the VXI bus, and to provide a similar facility, the VXI 'request true' syntax has to be programmed in software; thus a hardware difference imposes a departure from the standard programming model.

IEEE 488.2 defines sets of Mandatory Common Commands and Optional Common Commands along with a method of Standard Status Reporting. The 1362S implementation of SCPI language conforms with all IEEE-488.2 Mandatory Commands but not all Optional Commands. It conforms with the SCPI-approved Status Reporting method.

Note: Commands in SCPI language, prefaced by an asterisk (eg: ∗TRG), are IEEE-488.1 standard-defined 'Common' commands.

VXI WSC and Effects

The VXI Word Serial 'clear' Message will force the following instrument states:

- the input buffer and output queue are cleared;
- parser is reset to the beginning of a message;
- any device-dependent message interlocks are cleared.

This command will not:

- change any settings or stored data within the instrument except as listed above;
- interrupt analog input;
- interrupt or affect any functions of the device;
- change the status byte.

∗RST and Effects

The effects of the ∗RST command are described later on page 5-39.

Reset

A complete instrument reset is accomplished by the two reset commands in sequence. In other circumstances they may be used individually:

WS clear Message exchange initialization;
∗RST Device initialization.

Message Exchange

IEEE 488.2 Model

The IEEE 488.2 Standard document illustrates its Message Exchange Control Interface model at the detail level required by the device designer. Much of the information at this level of interpretation (such as the details of the internal signal paths etc.) is transparent to the application programmer. However, because each of the types of errors flagged in the Event Status Register are related to a particular stage in the process, a simplified 1362 interface model can provide helpful background. This is shown in Fig. 4.1, together with brief descriptions of the actions of its functional blocks.

1362S STATUS Subsystem

Input/Output Control transfers messages from the 1362 output queue to the system bus; and conversely from the bus to either the input buffer, or other predetermined destinations within the device interface. It receives the Status Byte from the status reporting system, as well as the state of the Request Service bit which it imposes on bit 6 of the Status Byte response. Bit 6 reflects the 'Request Service state *true*' condition of the interface.

Incoming Commands and Queries

The **Input Buffer** is a first in - first out queue, which has a maximum capacity of 128 bytes (characters). Each incoming character in the I/O Control generates an interrupt to the instrument processor which places it in the Input Buffer for examination by the Parser. The characters are removed from the buffer and translated with appropriate levels of syntax checking. If the rate of programming is too fast for the Parser or Execution Control, the buffer will progressively fill up. When the buffer is full, the VXI Commander is informed by DIR being false. *Refer to Section 3*.

The **Parser** checks each incoming character and its message context for correct Standard-defined generic syntax, and correct device-defined syntax. Offending syntax is reported as a **Command Error**, by setting true bit 5 (CME) of the Standard-defined Event Status register (refer to the sub-section 'Retrieval of Device Status Information').

Execution Control receives successfully parsed messages, and assesses whether they can be executed, given the currently-programmed state of the 1362 functions and facilities. If a message is not viable (eg the calibration trigger: CALL? when calibration is not enabled); then an Execution Error is reported, by setting true bit 4 (EXE) of the Standard-defined Event Status register. Viable messages are executed in order, altering the 1362 functions, facilities etc. Execution does not 'overlap' commands; instead, the 1362 Execution Control processes all commands 'Sequentially' (ie. waits for actions resulting from the previous command to complete before executing the next).

1362 Functions and Facilities

The 1362 Functions and Facilities block contains all the device-specific functions and features of the 1362, accepting Executable Message Elements from Execution Control and performing the associated operations. It responds to any of the elements which are valid Query Requests (both IEEE 488.2 Common Query Commands and 1362 Device-specific Commands) by sending any required Response Data to the Response Formatter (after carrying out the assigned internal operations).

Device-dependent errors are detected in this block. Bit 3 (DDE) of the Standard-defined Event Status register is set true when an internal operating fault is detected, for instance during a self test. Each reportable error has a listed number, which is appended to an associated queue as the error occurs.

Trigger Control

Two types of message are used to trigger the 1362 A-D into taking a measurement:

A Word Serial 'trigger'
∗**TRG** (IEEE 488.2-defined)

In the 1362 either message is passed through the Input Buffer, receiving the same treatment as a program message unit, being parsed and executed as normal.

Outgoing Responses

The **Response Formatter** derives its information from Response Data (being supplied by the Functions and Facilities block) and valid Query Requests. From these it builds Response Message Elements, which are placed as a Response Message into the Output Queue.

The **Output Queue** acts as a store for outgoing messages until they are read over the system bus by the application program. For as long as the output queue holds one or more bytes, it reports the fact by setting true bit 4 (Message Available - MAV) of the Status Byte register. Bit 4 is set false when the output queue is empty (refer to the sub-section 'Retrieval of Device Status Information'). The 'DOR' bit set performs the same action. *Refer to Section 3*.

'Query Error'

This is an indication that the controller is following an inappropriate message exchange protocol, resulting in the *Interrupted*, *Unterminated* or *Deadlocked* condition:

Refer to 'Bit 2' on *page 4-8*.

The Standard document defines the 1362's response, part of which is to set *true* bit 2 (QYE) of the Standard-defined Event Status register.

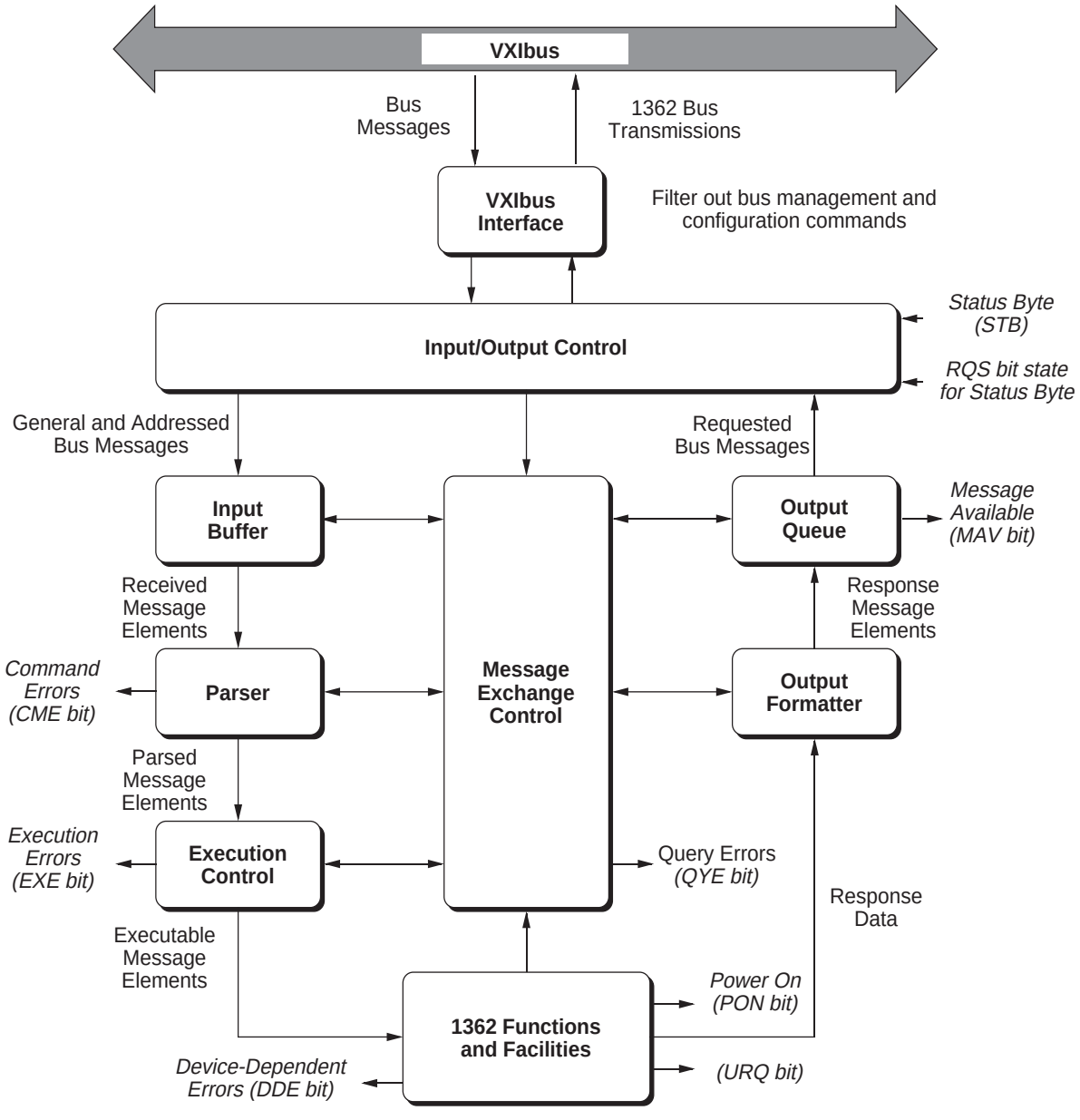


Fig. 4.1 1362 Message Exchange Model

Request Service (RQS)

Reasons for Requesting Service

There are two main reasons for the application program to request service from the controller:

- When the 1362 message exchange interface discovers a system programming error;
- When the 1362 is programmed to report significant events by RQS.

The significant events vary between types of devices; thus there is a class of events which are known as 'Device-Specific'. These are determined by the device designer.

IEEE 488.2 Model

The application programmer can enable or disable the event(s) which are required to originate an RQS at particular stages of the application program. The IEEE 488.2 model incorporates a flexible extended status reporting structure in which the requirements of the device designer and application programmer are both met.

This structure is described in the next sub-section, dealing with 'Retrieval of Device Status Information'.

Retrieval of Device Status Information

Introduction

For any remotely-operated system, the provision of up-to-date information about the performance of the system is of major importance. This is particularly so in the case of systems which operate under automatic control, as the controller requires the necessary information feedback to enable it to progress the programmed task, and any break in the continuity of the process can have serious results.

When developing an application program, the programmer needs to test and revise it, knowing its effects. Confidence that the program elements are couched in the correct grammar and syntax (and that the program commands and queries are thus being accepted and acted upon), helps to reduce the number of iterations needed to confirm and develop the viability of the whole program. So any assistance which can be given in closing the information loop must benefit both program compilation and subsequent use.

***Note**: The registers use binary weighting - the numbers in the boxes are bit numbers, not weighted values*

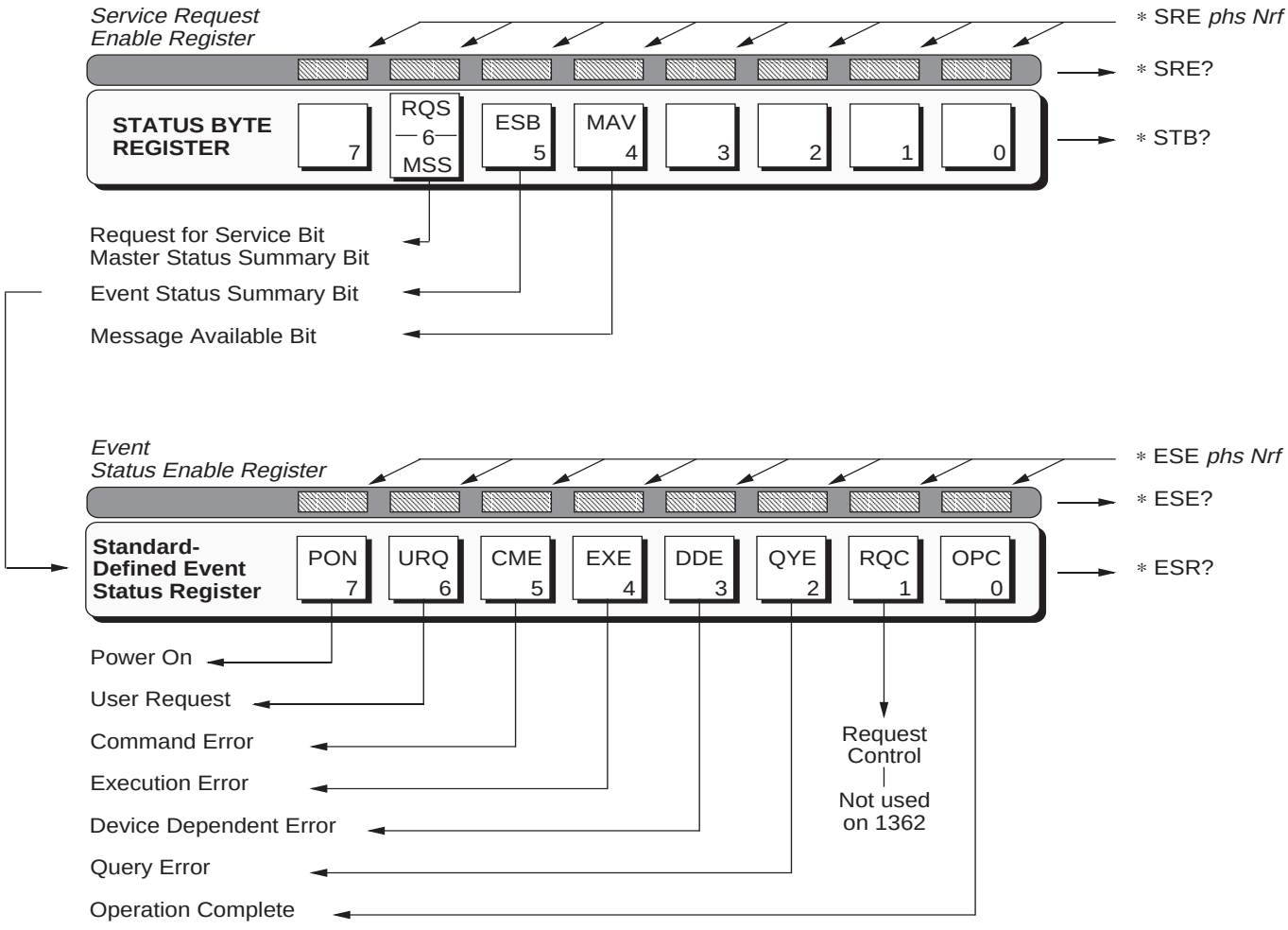


Fig. 4.2 1362 Status Reporting Structure

Standard-Defined Features

Types of Status Information Available

Two main categories of information are provided for the controller:

Status Summary Information

Certain standard events are flagged in the 8-bit latched 'Event Status Register' (ESR), read-accessible to the controller. The user's application program can also access its associated enabling register, to program the events which will be eligible to activate the 'ESB' summary bit in the Status Byte.

Status Byte Register

Contained within the 'Status Byte Register', the 'Status Byte' (STB) consists of three flag bits which direct the controller's attention to the type of event which has occurred. One is the ESB bit mentioned above, the other two (MAV and MSS) are described in detail later.

Access via the Application Program

The application designer has access to two enable registers (one for each main register - Fig. 4.2). The application program can enable or disable any individual bit in these registers.

Each bit in the event status register remains in *false* condition unless its assigned event occurs, when its condition changes to *true*. If an event is to be reported, the application program sets its corresponding enable bit *true*, using the number *Nrf* (defined as a decimal numeric from 0 to 255 in any common format). Then when the enabled event occurs and changes the enabled bit from *false* to *true*, the ESB summary bit in the Status Byte is also set true. If the ESB bit is also enabled, then the 1362 will generate a request true event on the VXI bus.

Thus the application programmer can decide which assigned events will generate an event, by enabling their event bits and then enabling the ESB bit in the Status Byte. The application program can read the Status Byte, and be directed to the Event Register to discover which event was responsible for originating the request.

All registers can be read by suitable commands, as an ASCII decimal numeric, which when expressed in binary, represents the bit pattern in the register. This form is also used to set the enabling registers to the required bit-patterns. The detail for each register is expanded in the following paragraphs, and in the command descriptions.

1362 Status Reporting - Detail

IEEE 488.2 Model

This incorporates the two aspects of the IEEE 488.1 model into an extended structure with more definite rules. These rules invoke the use of standard 'Common' messages and provide for device-dependent messages. A feature of the structure is the use of 'Event' registers, each with its own enabling register as shown in Fig. 4.2.

1362 Model Structure

The IEEE 488.2 Standard provides for an extensive hierarchical structure with the Status Byte at the apex, defining its bits 4, 5 and 6 and their use as summaries of a *Standard*-defined event structure which must be included, if the device is to claim conformance with the Standard. The 1362 employs these bits as defined in the Standard.

Bits 0, 1, 2 and 3 and 7 are made available to the device designer, but are not used in the 1362.

It must be recognized by the application programmer that whenever the controller reads the Status Byte, it can only receive summaries of types of events, and further query messages are necessary to dig deeper into the detailed information relating to the events themselves. Thus a further byte is used to expand on the summary at bit 5 of the Status Byte.

Status Byte Register

In this structure the Status Byte is held in the 'Status Byte Register'; the bits being allocated as follows:

Bits 0 (DIO1), **1** (DIO2), **2** (DIO3) and **3** (DIO4) are not used in the 1362 status byte. They are always *false.*

Bit 4 (DIO5) IEEE 488.2-defined Message Available Bit (MAV)

The MAV bit helps to synchronize information exchange with the controller. It is *true* when the 1362 message exchange interface is ready to accept a request from the controller to start outputting bytes from the Output Queue; or *false* when the Output Queue is empty.

The common command ∗CLS can clear the Output Queue, and the MAV bit 4 of the Status Byte Register; providing it is sent immediately following a 'Program Message Terminator'.

Bit 5 (DIO6) IEEE 488.2-defined Standard Event Summary Bit (ESB)

Summarizes the state of the 'Event Status byte', held in the 'Event Status register' (ESR), whose bits represent IEEE 488.2-defined conditions in the device. The ESB bit is *true* when the byte in the ESR contains one or more enabled bits which are *true*; or *false* when all the enabled bits in the byte are *false*. The byte, the Event Status Register and its enabling register are defined by the IEEE 488.1 Standard; they are described later.

Bit 6 (DIO7) is the Master Status Summary Message (MSS bit), and is set *true* if one of the bits 0 to 4 or bit 5 is *true* (bits 0 to 3 and bit 7 are always *false* in the 1362).

Bit 7 (DIO8) is not used in the 1362 status byte. It is always *false*.

Reading the Status Byte Register

∗STB?

Either the common query: ∗STB?, or the VXI word serial 'read STB' command *(Section 3)*, reads the binary number in the Status Byte register. The response is in the form of a decimal number which is the sum of the binary weighted values in the enabled bits of the register. In the 1362, the binary-weighted values of bits 1, 2, 3 and 7 are always zero.

Service Request Enable Register

The SRE register is a means for the application program to select, by enabling individual Status Byte summary bits, those types of events which are to cause the 1362 to originate an RQS. It contains a user-modifiable image of the Status Byte, whereby each *true* bit acts to enable its corresponding bit in the Status Byte.

Bit Selector: ∗SRE *phs Nrf*

The program command: ∗SRE *phs Nrf* performs the selection, where *Nrf* is a decimal numeric, which when decoded into binary produces the required bit-pattern in the enabling byte.

For example:

If an RQS is required only when a Standard-defined event occurs and when a message is available in the output queue, then *Nrf* should be set to 48. The binary decode is 00110000 so bit 4 or bit 5, when *true*, will generate an RQS; but even when bit 0 or bit 6 is *true*, no RQS will result. The 1362 always sets the Status Byte bits 1, 2, 3 and 7 *false*, so they can never originate an RQS whether enabled or not.

Reading the Service Request Enable Register

The common query: ∗SRE? reads the binary number in the SRE register. The response is in the form of a decimal number which is the sum of the binary-weighted values in the register. The binary-weighted values of bits 1, 2, 3 and 7 are always zero.

VXIbus Implementation

An RQS is implemented as a 'request true' event on the VXIbus. Refer to *Section 3*.

IEEE 488.2-defined Event Status Register

The 'Event Status Register' holds the Event Status Byte, consisting of event bits, each of which directs attention to particular information. All bits are 'sticky'; ie. once *true*, cannot return to *false* until the register is cleared. This occurs automatically when it is read by the query: ∗ESR?. The common command ∗CLS clears the Event Status Register and associated error queues, but not the Event Status Enable Register. The bits are named in mnemonic form as follows:

Bit 0 Operation Complete (OPC)

This bit is *true* only if ∗OPC has been programmed *and* all selected pending operations are complete. As the 1362 operates in serial mode, its usefulness is limited to registering the completion of long operations, such as self-test.

Bit 1 Request Control (RQC)

This bit would be *true* if the device were able to assume the role of controller, *and* is requesting that control be transferred to it from the current controller. This capability is not available in the 1362, so bit 1 is always *false*.

Bit 2 Query Error (QYE)

QYE *true* indicates that the controller is following an inappropriate message exchange protocol, resulting in the following situations:

- ***Interrupted Condition.*** When the 1362 has not finished outputting its **Response Message** to a **Program Query**, and is interrupted by a new **Program Message**.
- ***Unterminated Condition.*** When the controller attempts to read a **Response Message** from the 1362 without having first sent the complete **Query Message** (including the **Program Message Terminator**) to the instrument.
- ***Deadlocked Condition.*** When the input and output buffers are filled, with the parser and the execution control blocked.

Bit 3 Device Dependent Error (DDE)

DDE is set *true* when an internal operating fault is detected, for instance during a self test. Each reportable error has been given a listed number, which is appended to an associated queue as the error occurs. The queue is read destructively as a First In Last Out stack, using the query command DDQ? to obtain a code number. The DDE bit is not a summary of the contents of the queue, but is set or confirmed *true* concurrent with each error as it occurs; and once cleared by ∗ESR? will remain *false* until another error occurs. The query DDQ? can be used to read all the errors in the queue until it is empty, when the code number zero will be returned.
The common command ∗CLS clears the queue.

Bit 4 Execution Error (EXE)
An execution error is generated if the received command cannot be executed, owing to the device state or the command parameter being out of bounds.

Bit 5 Command Error (CME)
CME occurs when a received bus command does not satisfy the IEEE 488.2 generic syntax or the device command syntax programmed into the instrument interface's parser, and so is not recognized as a valid command.

Bit 6 User Request (URQ)
This bit is set *true* when, in block measurement mode, the number of measurements programmed for the block measurement have been completed.

Bit 7 1362 Power Supply On (PON)
This bit is not required in the VXI subsystem.

Standard Event Status Enable Register

The ESE register is a means for the application program to select, from the positions of the bits in the standard-defined Event Status Byte, those events which when *true* will set the ESB bit *true* in the Status Byte. It contains a user-modifiable image of the standard Event Status Byte, whereby each *true* bit acts to enable its corresponding bit in the standard Event Status Byte.

Bit Selector: ∗ESE *phs Nrf*
The program command: ∗ESE *phs Nrf* performs the selection, where *Nrf* is a decimal numeric, which when decoded into binary, produces the required bit-pattern in the enabling byte.

For example:

If the ESB bit is required to be set *true* only when an execution or device-dependent error occurs, then *Nrf* should be set to 24. The binary decode is 00011000 so bit 3 or bit 4, when *true*, will set the ESB bit *true*; but when bits 0-2, or 5-7 are *true*, the ESB bit will remain *false*.

Reading the Standard Event Enable Register
The common query: ∗ESE? reads the binary number in the ESE register. The response is in the form of a decimal number which is the sum of the binary-weighted values in the register.

SCPI Additional Status Reporting

In addition to IEEE 488.2 status reporting the 1362S implements the Operation and Questionable Status register with associated condition, event and enable commands. The extra status deals with current operation of the instrument and the quality of any measurements taken.

The structure of these two registers are detailed in Fig. 4.3 overleaf. The registers are detailed in the `STATus` subsystem on *page 4-33* of this handbook.

SCPI Syntax and Styles

Where possible the syntax and styles used in this section follow those defined by the SCPI consortium. The commands on the following pages are broken into three columns; the KEYWORD, the PARAMETER FORM, and any NOTES.

The KEYWORD column provides the name of the command. The actual command consists of one or more keywords since SCPI commands are based on a hierarchical structure, also known as the tree system.

Square brackets ([ ]) are used to enclose a keyword that is optional when programming the command: that is, the instrument 1362 will process the command to have the same effect whether the option node is omitted by the programmer or not.

Letter case in tables is used to differentiate between the accepted shortform (upper case) and the long form (upper and lower case).

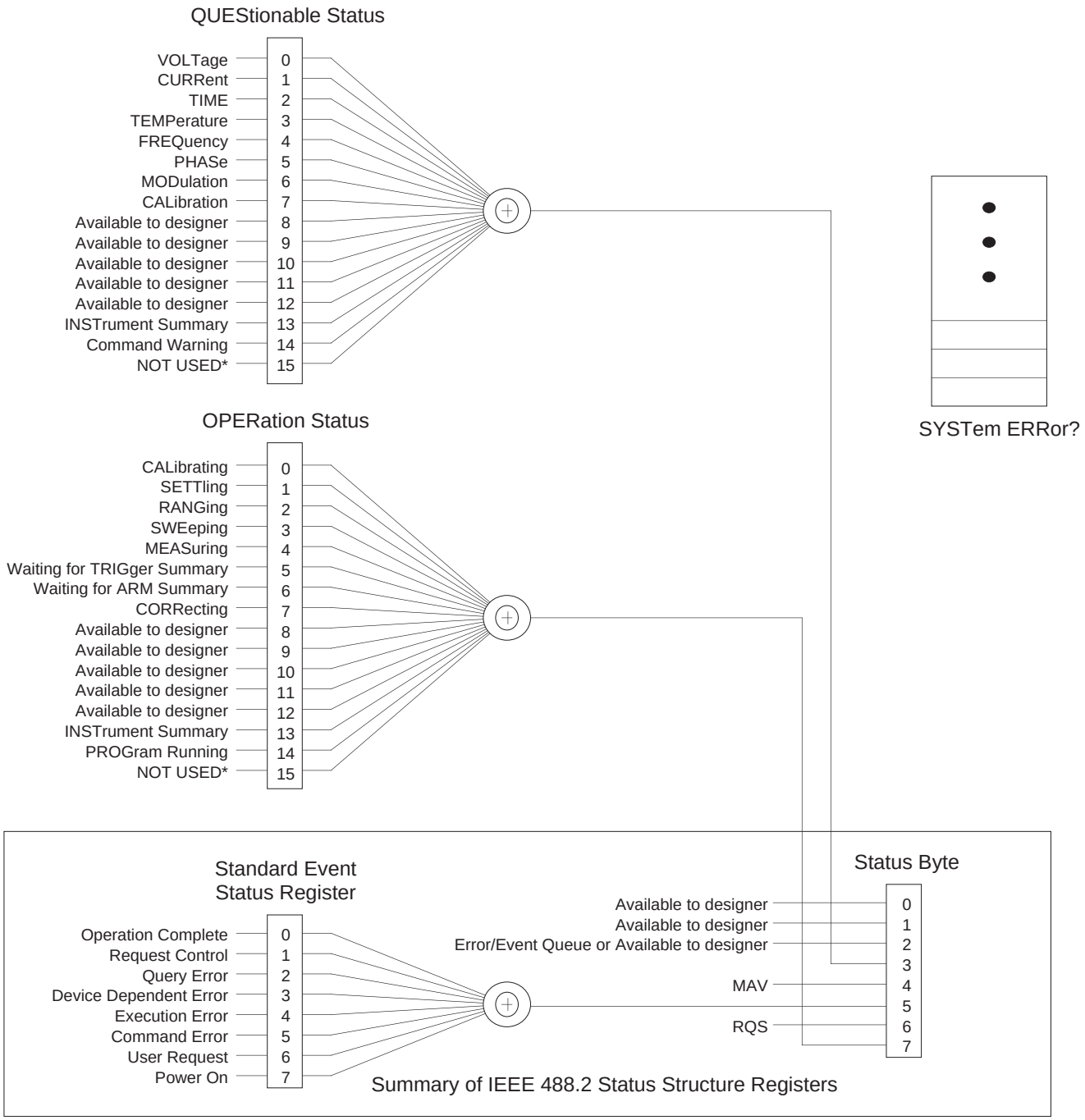
The PARAMETER FORM column indicates the number and order of parameter in a command and their legal value. Parameter types are distinguished by enclosing the type in angle brackets (< >). If parameter form is enclosed by square brackets ([ ]) these are then optional. The vertical bar (|) can be read as "or" and is used to separate alternative parameter options.

Queries

All commands unless otherwise noted have an addition query form. (for example `INPut:COUPling?`)

Native Language

The 1362S SCPI command capabilities are an extension to the existing language now known as 'Native'. Native and SCPI are both resident on the 1362S. Native was maintained to support those existing customers who may wish to retain their current programs. The 1362S defaults to SCPI on power on. The commands associated with switching to Native language can be found on *page 4-36*.



* The use of Bit 15 is not allowed since some controllers may have difficulty reading a 16 bit unsigned integer. The value of this bit shall always be 0.

Fig. 4.3 1362 SCPI Status Reporting Structure

1362S SCPI Language - Commands and Syntax

The command subsystems are placed in alphabetical order.

ABORt

The ABORt command returns the DMM to the IDLE state. Any measurements that are in progress will be completed before the DMM goes into the IDLE state. See page 4-38, Fig. 4.4.

This command does not affect the settings of the trigger system and any subsequent INITiate will cause the DMM to return to the wait-for-trigger state as selected by the TRIGger:SOURce command. Refer to the TRIGger subsystem, page 4-38.

Syntax	ABORt	(Event, No query)
Related Commands	INITiate, TRIGger	
Query Format	No Query.	
Errors	No errors associated with this command.	
*RST Condition	There is no associated *RST condition. However, after the *RST the DMM is put in the IDLE state.	

Native Equivalents There are no native equivalent commands.

CALibration Subsystem

This subsystem is used to calibrate the ranges and functions of the DMM. This will correct for any system errors due to drift or ageing effects.

Before any calibration can take place, two security levels must be set. First, there is a switch on the DMM itself that must be set to CAL ENABLE. Having done this, the command `CALibration:SECure ON` must be sent.

Syntax	`CALibration`		
	`:HIGH?`	[<numeric_value>]	(manufacturer's extension)
	`:LOW?`	[<numeric_value>]	(manufacturer's extension)
	`:SECure`	<Boolean>	(manufacturer's extension)
	`:SLFRequency?`		(manufacturer's extension)

Related Commands — There are no directly related commands, however commands to configure the DMM such as `CONFigure`, `SENSe` etc. are used in conjunction with CALibration.
See also Routine Calibration Procedure; section 8 of this handbook.

`CALibration:HIGH?` [<numeric_value>]
`CALibration:LOW?` [<numeric_value>]

These commands are used to perform a calibration operation. In the case of `:HIGH?`, this will be at the full range value. In the case of `:LOW?` this will be at zero for DC and Ohms, or at 1% of range for AC. The DMM will measure the input signal as a reference. From this measurement, correction factors are calculated and stored in the non-volatile memory. These correction factors will then be applied to all subsequent readings.

If the calibration operation is a success then the command returns a `0`. If the command fails for any reason, then a `1` is returned and an error message is put in the error queue.

Note that to use this command the calibration switch must be set to CAL ENABLE and the command `CALibration:STATe ON` must have been sent.

The optional parameter <numeric_value> gives the actual value of the reference being applied to the input terminals if this is not the nominal value.

Errors — An error - `110,'Calibration switch disabled'` will be generated if either the calibration switch is not set to enable and the `CAL:SECure ON` command has not been received.

Errors - `222,'Data out of range'` will be generated if the <numeric_value> is out of range or the measured value is out of range compared to the <numeric_value>

If the input is not connected, or the instrument is in DC coupled AC, or `TRIG:SOURce IMM` is not selected, then the error `120,'Calibration operation invalid'` will be reported.

If the calibration fails for any other reason, then the message `122,'Calibration operation failed'` will be reported.

∗RST — There is no associated ∗RST condition.

Notes — Both `CALibration:SECure ON` and the hardware calibration switch found on the front panel have to be enabled before calibration can take place. Four measurements are taken for every Calibration trigger. See Section 5-31 CVAL? command.

CALibration:SECure <Boolean>

This command is used to enable the calibration mode. Before this command can be accepted, the calibration switch on the DMM must be set to CAL ENABLE. The accepted value for <Boolean> is OFF|0|1|ON.

Errors	An error will be generated if CAL:SEC ON is received and the calibration switch is not set to CAL ENABLE.
Query	CALibration:SECure? This queries the current setting of the secure mode. It returns either 0 for disabled, or 1 for enabled.
*RST	CALibration:SECure OFF.

CALibration:SLFRequency?

This query command is used to store the current setting of the ADC conversion line frequency into the non-volatile calibration stores. This value will then become the default value at power on and *RST.

The line frequency is set using the SENSe:LFRequency command (page 4-32).

Note that to use this command the calibration switch must be set to CAL ENABLE and the command CALibration:STATe ON must have been sent.

Errors	An error of 110,'Calibration switch disabled' shall be generated if either the calibration switch is not set to enable and the CAL:SECure ON command has not been received.
Query	This command is a query only and will return 0 if the value is successfully stored, or 1 if the operation failed.
*RST	Last value set with an CAL:SLFR? command.

Native Equivalents	CALibration:SECure	≡ CAL ON/OFF
	CALibration:HIGH <...>	≡ CALH?
	CALibration:LOW <...>	≡ CALL?
	CALibration:SLFRequency?	≡ STLN?

CONFigure

The CONFigure command subsystem is used to configure the DMM. It prepares the DMM to take a measurement but does not cause a trigger.

Syntax **CONFigure<function> <parameters>[,<source_list>]**

Subsystem: CONFigure

Function:

:CURRent	
[:DC]	<parameters>[,<source_list>]
:AC	<parameters>[,<source_list>]
:FRESistance	<parameters>[,<source_list>]
:RESistance	<parameters>[,<source_list>]
:VOLTage	
[:DC]	<parameters>[,<source_list>]
:AC	<parameters>[,<source_list>]

Parameters: [<expected_value>[,<resolution>]]

Source List: [,[(@1)]|(@2)|(@1,2)|(@1:2)]

Related Commands FETCh?, INITiate, INPut, MEASure?, READ? CONFigure?

Note INPut:STATe <Boolean> should be ON before measurement takes place.
See page 4-24 for further information on the INPut command.
The <source list> will remain in the same state after a function change.

Description As shown by the syntax, the command:

CONFigure<function> <parameters>[,<source_list>]

is a compound command. The <function> selects which function the DMM measures. This may be voltage, current or resistance. Each function has associated parameters that are used to select the range and resolution of subsequent measurements. There is then an optional <source_list> which selects which channel the measurement is made on.

Note In the event of an error within the command, as much as possible of the command up to the error shall be implemented. For example, if:

```
CONF:VOLT   1,1E-6,(@2)
```

is received on a single channel DMM, then the 1 volt DC 6.5 digit range would be selected, but the second channel selection would generate an error.

`CONFigure:CURRent[:DC]` [<expected_value>[,<resolution>]]
`CONFigure:CURRent:AC` [<expected_value>[,<resolution>]]

Either command selects the current measuring function. The default is for DC current, AC can be selected with the additional parameter. AC current with a DC component can be selected with the command:

`INPut:COUPling AC|DC`.

See the `INPut` Subsystem page 4-24.

The <expected_value> is used to select the range of the function, however the DMM has only one range: 1 Amp. Thus all values will be accepted including the commands:

`MAXimum, MINimum, AUTO, AUTO ON, AUTO OFF & DEFault`

The optional <resolution> parameter is used to select the measurement resolution. There are three modes - 4.5, 5.5 and 6.5 digits. However, 6.5 digit resolution is not allowed in AC or DC coupled AC. The tables on the left below show the modes selected by numeric values of `<resolution>`, those on the right show the modes selected by `<resolution>` commands:
However, 6.5 digit resolution is not allowed in AC or DC coupled AC.

DC Current
Numeric Values Used to Select Required Resolutions

Function	Range	Required Digits 6.5	5.5	4.5
CURR:DC	1A	<1E-6> (1.000000A)	<1E-5> (1.00000A)	<1E-4> (1.0000A)

DC Current
Resolutions Selected by Command

Function	<resolution>	selected
CURR[:DC]	MAXimum	6.5 digit
	MINimum	4.5 digit
	AUTO	6.5 digit
	AUTO ON	6.5 digit
	AUTO OFF	Resolution as last set
	DEFault	6.5 digit

AC Current
Numeric Values Used to Select Required Resolutions

Function	Range	Required Digits 5.5	4.5
CURR:AC	1A	<1E-5> (1.00000A)	<1E-4> (1.0000A)

AC Current
Resolutions Selected by Command

Function	<resolution>	selected
CURR:AC	MAXimum	5.5 digit
	MINimum	4.5 digit
	AUTO	5.5 digit
	AUTO ON	5.5 digit
	AUTO OFF	Resolution as last set
	DEFault	5.5 digit

Errors — Current is an option and if the option is not fitted any `CURRent` command will generate the error - `241, 'Hardware missing'`.

Query — See `CONFigure?` command page 4-21.

∗RST — `CONF:CURR:DC 1, 1E-5` (Note that this function is inactive.)

CONFigure:FRESistance [<expected_value>[,<resolution>]]
CONFigure:RESistance [<expected_value>[,<resolution>]]

These two commands are used to select the resistance measuring function. RESistance selects two wire measurements, while FRESistance selects four wire measurements.

The <expected_value> is used to select the range of the resistance measurement. The table shows that <expected_value> affects the range selected.

<expected_value>	Range
0 to 199.9999	100 Ohm
200 to 1999.999	1 kOhm
2000 to 19999.99	10 kOhm
20000 to 199999.9	100 kOhm
200000 to 1999999	1 MOhm
>2000000	10 MOhm
MINimum	100 Ohm
MAXimum	10 MOhm
DEFault no parameter	Autorange
AUTO ON	Select Autorange
AUTO OFF	Deselect Autorange

In the table above, DEFault, AUTO and no <expected_value> selects autoranging. In this mode the DMM will select the most appropriate range to measure the signal on the input. Any other <expected_value> will de-select the autorange feature. The AUTO OFF command will leave the DMM in the last active range.

The optional <resolution> parameter is used to select the measurement resolution. There are three modes - 4.5, 5.5 and 6.5 digits. The table on the left below shows the modes selected by numeric values of `<resolution>`, that on the right shows the modes selected by `<resolution>` commands:

Resistance (2- and 4-Wire)
Numeric Values Used to Select Required Resolutions

Function	Range	Required Digits 6.5	5.5	4.5
RES/FRES	100Ω	<1E-4> (100.0000Ω)	<1E-3> (100.000Ω)	<1E-2> (100.00Ω)
	1kΩ	<1E-6> (1.000000kΩ)	<1E-5> (1.00000kΩ)	<1E-4> (1.00000kΩ)
	10kΩ	<1E-5> (10.00000kΩ)	<1E-4> (10.0000kΩ)	<1E-3> (10.000kΩ)
	100kΩ	<1E-4> (100.0000kΩ)	<1E-3> (100.000kΩ)	<1E-2> (100.00kΩ)
	1MΩ	<1E-6> (1.000000MΩ)	<1E-5> (1.00000MΩ)	<1E-4> (1.0000MΩ)
	10MΩ	<1E-5> (10.00000MΩ)	<1E-4> (10.0000MΩ)	<1E-3> (10.000MΩ)

Resistance (2- and 4-Wire)
Resolutions Selected by Command

Function	<resolution>	selected
RES/FRES	MAXimum	6.5 digit
	MINimum	4.5 digit
	AUTO	6.5 digit
	AUTO ON	6.5 digit
	AUTO OFF	Resolution as last set
	DEFault	6.5 digit

Errors — None

Query — See `CONFigure?` command page 4-21.

∗RST — `CONF:FRES: 1E7, 1E2` (Note that this function is inactive.)
`CONF:RES: 1E7, 1E2` (Note that this function is inactive.)

CONFigure:VOLTage[:DC] [<expected_value>[,<resolution>]]
CONFigure:VOLTage:AC [<expected_value>[,<resolution>]]

Either command selects the voltage measuring function. The default is DC voltage, AC can be selected with the additional parameter. AC voltage with a DC component can be selected with the command `INPut:COUPling AC|DC`.
See `INPut` Subsystem page 4-24.

The <expected_value> is used to select the range of the voltage measurement. The table shows how <expected_value> affects the range selected.

<expected_value>	Range
`0 to .1999999`	100 mV
`0.2 to 1.999999`	1 V
`2.0 to 19.99999`	10 V
`20.0 to 199.9999`	100 V
`>200`	300 V
`MINimum`	100 mV
`MAXimum`	300 V
`DEFault`	
no parameter	Autorange
`AUTO ON`	Select Autorange
`AUTO OFF`	Deselect Autorange

In the above table, `DEFault, AUTO` and no <expected_value> selects autoranging. In this mode the DMM will select the most appropriate range to measure the signal on the input. Any other <expected_value> will de-select the autorange feature. The `AUTO OFF` command will leave the DMM in the last active range.

The optional <resolution> parameter is used to select the measurement resolution. There are three modes - 4.5, 5.5 and 6.5 digit. However, 6.5 digit resolution is not allowed in AC or DC coupled AC. The tables on the left below show the modes selected by numeric values of `<resolution>`, those on the right show the modes selected by `<resolution>` commands:

DC Voltage
Numeric Values Used to Select Required Resolutions

Function	Range	Required Digits 6.5	5.5	4.5
VOLT:[DC]	100mV	<1E-4> (100.0000mV)	<1E-3> (100.000mV)	<1E-2> (100.00mV)
	1V	<1E-6> (1.000000V	<1E-5> (1.00000V)	<1E-4> (1.00000V)
	10V	<1E-5> (10.00000V)	<1E-4> (10.0000V)	<1E-3> (10.000V)
	100V	<1E-4> (100.0000V)	<1E-3> (100.000V)	<1E-2> (100.00V)
	300V	<1E-3> (300.000V)	<1E-2> (300.00V)	<1E-1> (300.0V)

DC Voltage
Resolutions Selected by Command

Function	<resolution>	selected
VOLT[:DC]	MAXimum	6.5 digit
	MINimum	4.5 digit
	AUTO	6.5 digit
	AUTO ON	6.5 digit
	AUTO OFF	Resolution as last set
	DEFault	6.5 digit

AC Voltage
Numeric Values Used to Select Required Resolutions

Function	Range	Required Digits 5.5	4.5
VOLT:AC	100mV	<1E-3> (100.000mV)	<1E-2> (100.00mV)
	1V	<1E-5> (1.00000V)	<1E-4> (1.00000V)
	10V	<1E-4> (10.0000V)	<1E-3> (10.000V)
	100V	<1E-3> (100.000V)	<1E-2> (100.00V)
	300V	<1E-2> (300.00V)	<1E-1> (300.0V)

AC Voltage
Resolutions Selected by Command

Function	<resolution>	selected
VOLT:AC	MAXimum	5.5 digit
	MINimum	4.5 digit
	AUTO	5.5 digit
	AUTO ON	5.5 digit
	AUTO OFF	Resolution as last set
	DEFault	5.5 digit

Errors — An error of `-241,'Data questionable'` will be generated if greater than 6.5 digit resolution is selected. (or >5.5 for AC).

Query — See `CONFigure?` command page 4-21.

*RST — `CONF:VOLT:DC 300,1E-3`. This function is active.

<source_list> `[(@1)]|(@2)|(@1,2)|(@1:2)`

All the above commands (VOLT, CURR, RES and FRES) may have an additional parameter specifying which of the input channels to measure. If the DMM has option 40 (Ratio) fitted then this parameter may be used to select the different inputs.

In the above list, '1' selects the main channel and is the default, '2' selects the additional ratio channel. The parameters (@1,2) and (@1:2) will cause both channels to be measured sequentially when a trigger occurs. Note because of user configuration there is no guarantee of timing between the two measurements.

Query	Note that when a measurement is taken in the (@1,2) or (@1:2) mode, then the RATIO between the two channels is returned. It is not possible to access the partial measurements. Channels are not changed by a function change.
Errors	An execution error of - 241, 'Hardware missing' is generated if @2 is selected when the option is not fitted.
*RST	The reset condition is channel 1, (see INPut command).

Native Equivalents	DCV, DCI, ACV, ACI,
Note	Measuement inputs are isolated from the front connector on power up. INPut:STATe<Boolean> should be ON before valid measurement can take place.
	See page 4-24 for further information on the INPut command.

CONFigure?

This queries the current configuration of the DMM. Note that it returns the present setting of the DMM - not what was last set with a CONF command.

Syntax `CONFigure?` (Query Only)

Related Commands `CONFigure, MEASure?, SENSe`

CONFigure? This single command is used to query the current settings of the DMM, It returns a string in the form of :

"<function> <range>, <resolution>,<source_list>"

The possible combinations of the string are :

<function>	<range>	<resolution>	<source_list>
CURR CURR:AC	 1	1E-6 1E-5 1E-4	(@1) (@2) (@1,2)
 RES FRES	1E2 1E3 1E4 1E5 1E6 1E7	<range>/1E-6 <range>/1E-5 <range>/1E-4	 (@1) (@2) (@1,2)
 VOLT VOLT:AC	1E-1 1E0 1E1 1E2 3E2	<range>/1E-6 <range>/1E-5 <range>/1E-4	 (@1) (@2) (@1,2)

If AUTO, DEF, MIN or MAX was selected for <range> or <resolution> then the CONF? string will contain the current setting that the DMM has selected.

Note that in the above the <resolution> depends on the range currently selected. Thus if the current active selection is 10 volt , 5.5 digits, then the returned string would be :

```
VOLT:DC 1E1,1E-4,(@1)
```

In the case of the 300V range, then the resolution is returned as 1E-1, 1E-2 or 1E-3.

∗RST Query only, no associated ∗RST condition.

Native Equivalents *LRN

FETCh?

This query command retrieves the last set of measurements taken and places them in the output queue. The returned data will be either a single reading if 'block' mode is not selected, or the several readings if 'block' mode is selected.

Syntax `FETCh?` (Query only)

Related Commands `CONFigure, INITiate, READ?`

Qualifiers Note that the SCPI definition allows <function> and <parameter> qualifiers, but as the DMM only stores the readings for the current setting, these commands are not implemented.

Query The returned data is formatted in the following character positions:

4.5 digit	1	2	3	4	5	6	7	8	9	10	11	12	
	s	n	x	x	x	n	n	E	s	n	n	t	
5.5 digit	1	2	3	4	5	6	7	8	9	10	11	12	13
	s	n	x	x	x	n	n	n	E	s	n	n	t
6.5 digit	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	s	n	x	x	x	n	n	n	n	E	s	n	n	t

Where
- `s` = the sign + or -
- `n` = ASCII digit 0 to 9
- `x` = either an n or a decimal point
- `E` = ASCII character identifying the exponent
- `t` = a terminator or separator- either ; or , or <lf> (linefeed character)

The measurement overload condition is reported as `200.000E+33t`

Multiple readings are returned with each value separated by a comma and the last reading terminated with the linefeed character.

Errors If no measurement has been taken or the instrument has been reconfigured, then no result is returned and the error `-230,'Data corrupt or stale'` is stored in the error queue. This will be as a result of `*RST`, a `CONF`, `SENSe` etc command or after an `INIT` command has been sent.

`*RST` Condition As this is a query command then there is no associated `*RST` condition. However note that `*RST` puts the DMM into the idle state and thus a `FETCh?` command would cause an error if no `INIT` had been received.

Native Equivalents RDG? BRCL?

INITiate

This command removes the DMM from the idle state and into the wait for trigger state. When the trigger occurs the subsequent readings are stored within the DMM. These can then be accessed by the FETCh? command. Any readings already in memory will be overwritten.

Syntax INITiate[:IMMediate] (Event, No query)

Related Commands ABORt, CONFigure, FETCh?, READ?, TRIGger

INITiate[:IMMediate]

This puts the DMM into the wait for trigger state. The DMM will then wait for the appropriate trigger to occur before taking a measurement. If the trigger state is set to TRIG:SOUR IMM then the DMM will take a reading immediately, without waiting for any other event.

Any other trigger state set by the TRIG:SOUR command will cause the DMM to wait until that event occurred before taking a reading.

The ABORt command can be used to remove the DMM from the wait for trigger state.

Once the pending trigger conditions have been met, and all the readings have been taken, then the DMM will return to the idle state and another INIT command is required before further triggers are executed. The FETCh? command can be used to access these readings.

The READ? command executes an INITiate command implicitly and the MEASure? command executes a READ? command implicitly. Thus both commands will put the DMM into the wait for trigger state. Note that if TRIGger:SOURce IMMediate is in operation then these two commands will implicitly cause a trigger. Once the trigger has occured, then the measurement will be placed in the output queue. Note that for external triggers, it will not be possible to communicate with the DMM until the trigger has occured. See *Appendix A* to this section for further details.

Query Format INIT is an event and cannot be queried.

Errors An error of - 213,'Init ignored' will be generated if the DMM is not in the idle state when this command is received.

∗RST Condition There is no associated ∗RST condition, but note that the ∗RST places the DMM in the idle state.

Native Equivalents No direct equivalent, but is related to X?, *TRG

INPut

Controls the connection of the input terminals to the signal to be measured. The command is also used to configure the remote guard and the state of the input filter.

Syntax:

Subsytem	INPut	
Alternatives/Parameters	:COUPling	AC|DC
	:FILTer	
	[:LPASs]	
	[:STATe]	<Boolean>
	:GUARd	LOW|FLOat
	[:STATe]	<Boolean>
	:ZERO?	(Manufacturer's extension)
Related commands	CONFigure, MEASure?, SENSe	

INPut:COUPling AC|DC

This command is used to cause the DMM to measure the DC component of an AC voltage signal. It is valid only when in AC voltage measurement, thus a CONF or SENSe command must have already selected the AC function.

If the command is received with the AC parameter, then the DMM will only measure the AC component. However sending the DC parameter will enable the DMM to measure the DC and the AC components of the signal.

Errors — If the DMM is not in AC, then the error - 221,'Settings conflict' is generated.

Query — INPut:COUPling?
This will return either the string "AC" or "DC". If the DMM is in the Ohms function, then this query will return "DC".

*RST — INPut:COUPling AC - but inactive (See CONF:VOLT AC)

INPut:FILTer[:LPASs][:STATe] <Boolean>

This sub-system configures the state of the input filter of the DMM. As the DMM has effectively only a low pass filter, the other SCPI defined parameters are not implemented.

Note that both :LPASs and :STATe are optional. If the value of <Boolean> is 0 or OFF, then the filter is deselected. If <Boolean> is 1 or ON then the filter is selected.

Errors — No associated errors.

Query — INPut:FILTer[:LPASs][:STATe]?
This will return the string '0' if the filter is inactive or '1' if the filter is active.

*RST — INPut:FILTer:LPASs:STATe 0 (Low-pass Input Filter in OFF state)

`INPut:GUARd LOW|FLOat`

This command sets the connection of the internal guard shield :

Option	Guard Connection
`LOW`	Internally connected to signal common
`FLOat`	connected to front panel guard terminal

Errors — No associated errors

Query — `INPut:GUARd?`
This queries the setting of the guard shield. Will return either `"LOW"` for internally connected, or `"FLO"` for connected to guard terminal.

∗RST — `INPut:GUARd LOW`

`INPut[:STATe] <Boolean>`

This command controls whether the input terminals are connected to the measurement signal. If <Boolean> is `0` or `OFF` then the DMM is isolated from the external signal source. If <Boolean> is `1` or `ON`, then the DMM input is connected to the external signal source.

Errors — No directly associated errors; however, it is not possible to take measurements if the input is not connected to the signal. Thus a command such as `MEAS?` and `INIT:IMM` can generate errors as a result of the setting of `INPut:[STATe]`

Query — `INPut[:STATe]?`
Returns either `'0'` if the input is disconnected or `'1'` if the input is connected.

∗RST — `INPut:[STATe] 0`
Note that this is different to that mandated by SCPI, but it is our policy to disconnect all instruments from the signal lines. This isolation will improve safety and prevent internal damage due to inadvertently large inputs at power-on.

`INPut:ZERO?`

This command will cause the DMM to measure the current input value and subtract this from all subsequent readings for the setting (i.e. function and range etc.)

Errors — An execution error is generated if the measured value is outside the range of the input zero correction range. The error `100,'Input not connected'` is reported if this command is received and the input is disconnected

Query — `INPut:ZERO?`
This command returns `1` for a fail, `0` for a successful input zero.

∗RST — All input zero corrections are unaffected by ∗RST.

Native Equivalents

`INPut:COUPling AC|DC`	≡	ACV ACCP DCCP
`INPut:FILter`	≡	FILT0/FILT1 in DCV etc.
`INPut:[STATe]`	≡	INPUT OFF, CH_A etc.
`INPut:ZERO`	≡	ZERO?

MEASure?

This command configures the DMM, takes a measurement and then outputs the reading to the output queue. This is equivalent to sending a CONF command followed by a READ? command.

Syntax **MEASure <function>?<parameters>[,<source_list>]**

Subsystem MEASure

Function:

:CURRent	
[:DC]?	<parameters>[,<source_list>]
:AC?	<parameters>[,<source_list>]
:FRESistance?	<parameters>[,<source_list>]
:RESistance?	<parameters>[,<source_list>]
:VOLTage	
[:DC]?	<parameters>[,<source_list>]
:AC?	<parameters>[,<source_list>]

Parameters: [<expected_value>[,<resolution>]]

Source List: [,[(@1)]|(@2)|(@1,2)|(@1:2)]

Related Commands READ?, INPut, CONFigure

Note INPut:STATe <Boolean> should be ON before measurement takes place. See page 4-24 for further information on the INPut command.

As the MEASure? and CONFigure commands have the same structure — please refer to this for a full description of CURRent, RESistance etc. For the format of the data returned see the FETCh? command.

For the operation of MEAS? with the various trigger modes see *Appendix A* to this section.

The MEASure command also allows for a <presentation layer>. This has not been implemented on the 1362.

Errors If the input is not connected, then error 100,'Input not connected' is reported.

If the DMM is in TRIGger:SOURce BUS, then the error -214, Trigger deadlock is reported.

OUTPut

This command is used to select the response mode of the DMM to a TTL trigger.

Syntax `OUTPut:TTLTrg<n>:PROTocol SYNChronous|ASYNchronous`
Where `n` = `0` through `7`, referring to the eight backplane lines.

Related Commands `TRIGger:SOURce:TTLTrg`

`OUTPut:TTLTrg<n>:PROTocol SYNChronous|ASYNchronous`

This command is used to select the trigger protocol for the backplane TTL lines. The `SYNChronous` mode configures the eight TTL lines as individual trigger inputs. That is, a measurement can be triggered from any one of the lines if the line is selected and `INITiated`.

In the `ASYNchronous` mode, the eight lines are treated as four input/output pairs - 0/1, 2/3, 4/5, 6/7.

In this configuration the trigger is received on the lower number (i.e. `TTLT0/2/4/6`) and the measurement complete signal is output on the higher number (i.e. `TTLT1/3/5/7`).

The `ASYN` command will select the pair of the currently active TTLT line.
E.g. if `TTLT5` is selected `ASYN` would select pair 4/5.

Refer to VXI Specifications revision 1.3 for further information on triggering protocols.

Query Format `OUTPut:TTLTrg<n>:PROTocol?`
This query will return `'SYNC'` or `'ASYN'` depending on which is currently selected.

Errors No associated errors with this command.

∗`RST` Condition `SYNChronous` mode all TTLTrg lines deselected.

Native Equivalents None.

READ?

This command places the DMM in a 'wait for trigger' state and then returns the measurement after the trigger. In effect this executes an `INITiate` and `FETCh?` command

Syntax	`READ?` (Query only)
Related Commands	`CONFigure, FETCh? INITiate`
Query	See the `FETCh?` command for a description of the data format returned.
Errors	An execution error - `100,'Input not connected'` will be generated if the DMM input has not been selected with the `INPut` command. If the DMM is in `TRIGger:SOURce BUS`, then the error - `214, 'Trigger deadlock'` is reported. For the operation of READ? with the various trigger modes see Appendix A.
∗RST Condition	Query command, no associated ∗RST state.

Native Equivalents X?

[SENSe:]

This command is used to configure the DMM to a more detailed level that the CONFigure command.
Note that :SENSe is a root level command and can be omitted. Thus only the VOLTage, FILTer etc. part of the command need be sent. This command also selects the line frequency that the measurements are taken over.

Syntax [:SENSe]

Function

```
:CURRent
  [:DC]
    :RANGe          <numeric_value>
      :AUTO         <Boolean>
    :RESolution     <numeric_value>
  :AC
    :RANGe          <numeric_value>
      :AUTO         <Boolean>
    :RESolution     <numeric_value>
:FRESistance
  :RANGe            <numeric_value>
    :AUTO           <Boolean>
  :RESolution       <numeric_value>
:RESistance
  :RANGe            <numeric_value>
    :AUTO           <Boolean>
  :RESolution       <numeric_value>
:VOLTage
  [:DC]
    :RANGe          <numeric_value>
      :AUTO         <Boolean>
    :RESolution     <numeric_value>
  :AC
    :RANGe          <numeric_value>
      :AUTO         <Boolean>
    :RESolution     <numeric_value>
:FILTer
  [:LPASs]
    [:STATe]        <Boolean>
:LFRequency         <numeric_value>   (manufacturer's extension)
```

Related Commands CONFigure, MEASure? INPut

As the six <function> defining sub-systems (see the list below) all have similar sub-levels, they will all be described together:

```
[:SENSe]
  :CURRent[:DC]
  :CURRent:AC
  :FRESistance
  :RESistance
  :VOLTage[:DC]
  :VOLTage:AC
```

Continued overleaf

`[:SENSe]:<function>:RANGe` <numeric_value>
`[:SENSe]:<function>:RANGe:AUTO` <Boolean>

These commands select the range of the specified function. The range selected for any value of <expected_value> can be found in the tables in the `CONFigure` command under the relevant <function>.

Note that these commands do **not** accept the special operators `MAXimum`, `MINimum` and `DEFault`.

The `:AUTO` parameter selects the autorange mode. In this setting, the DMM will select the most appropriate range to measure the signal. Selecting a valid `RANGe` will deselect autorange.

Query

`[SENSe:]`<function>`:RANGe? [MAXimum|MINimum]`
`[SENSe:]`<function>`:RANGe:AUTO?`

The query versions of these commands return the currently selected range. The table below gives the returned string depending on the <function>:

CURRent	RESistance	VOLTage
	1E2	1E-1
	1E3	1E0
1	1E4	1E1
	1E5	1E2
	1E6	3E2
	1E7	

If the qualifier `MINimum` or `MAXimum` is present then the following is returned:

parameter	CURRent	RESistance	VOLTage
MINimum	1	1E2	1E-1
MAXimum	1	1E7	3E2

The query for the `AUTO` parameter will return either '`0`' if autorange is deselected, or '`1`' if autorange is selected.

Errors

See the `CONFigure` command (page 4-14) for the errors associated with selecting combinations that are not available.

*RST

`[SENSe:]CURRent:DC:RANGe 1` - inactive
`[SENSe:]RESistance:RANGe 1E7` - inactive
`[SENSe:]FRESistance:RANGe 1E7` - inactive
`[SENSe:]VOLTage:DC:RANGe 300` - active

`[:SENSe]:<function>:RESolution` <numeric_value>

As with the `RESolution` sub-command in the `CONFigure` command, this selects the resolution of the measurements. Please refer to the settings as defined under the `CONFigure` command (page 4-14).

Errors — See the `CONFigure` command for the errors associated with selecting combinations that are not available.

Query — `[SENSe:]`<function>`:RESolution? [MINimum|MAXimum]`
The query form will return one of the following strings as appropriate:

<function>	**<resolution>**

`CURR|CURR:AC`	`1E-6`
	`1E-5`
	`1E-4`

`RES|FRES`	<range> / `1E-6` <range> / `1E-5` <range> / `1E-4`
`VOLT|VOLT:AC`	<range> / `1E-6` <range> / `1E-5` <range> / `1E-4`

If the qualifier `MINimum` or `MAXimum` is present then the following will be returned for each of the above functions:

<parameter>	**<resolution>**
`MINimum`	<range> / `1E-4`
`MAXimum`	<range> / `1E-6`

∗RST
```
[SENSe:]CURRent:DC:RESolution 1E-6  - inactive
[SENSe:]RESistance:RESolution 1E1   - inactive
[SENSe:]FRESistance:RESolution 1E1  - inactive
[SENSe:]VOLTage:DC:RESolution 1E-3  - active
```

`[SENSe:]FILTer[:LPASs][:STATe]` <Boolean>

This sub-system configures the state of the input filter of the DMM. As the DMM effectively only has a low pass filter, the other SCPI defined parameters are not implemented.

Note that both `:LPASs` and `:STATe` are optional. For a <Boolean> value of `0` or `OFF`, the filter is deselected. For a <Boolean> value of `1` or `ON` the filter is selected.

Errors — No associated errors

Query — `[SENSe:]`<function>`:FILTer[:LPASs:][STATe]?`
This will return the string '`0`' or '`1`' corresponding to filter inactive or filter active.

∗RST — `[SENSe:]`<function>`:FILTer:LPASs:STATe: OFF`

`[:SENSe]LFRequency` <numeric_value>

This command is a manufacturer-defined extension to the SCPI-confirmed `[:SENSe]` subsystem. It is used to set the line frequency at which the ADC converts. The table below shows the accepted numeric values (nv) and the resulting line frequency selection. Any other <numeric_value> will generate an error. The units are Hertz.

<numeric_value> (nv)	**Line Frequency selected**
0 < nv ≤ 55	50 Hz
55 < nv ≤ 100	60 Hz
100 < nv	400 Hz
MINimum	50 Hz
MAXimum	400 Hz
DEFault	60 Hz

N.B. Partial Calibration of the 1362
When carrying out a partial calibration, ensure that the programmed frequency is the same as that for the most-recent full calibration. Otherwise, small offsets may be introduced which can only be removed by a full calibration.

Errors — If the parameter is less than zero an execution error will be generated.

Query — `[SENSe:]LFRequency?`
The query form of the command returns the current setting of the line frequency. and the current setting in the calibration stores, These will be either `50`, `60` or `400` and the two values will be comma separated e.g.

```
50,60 <lf>
```

This would indicate that the tempory line frequency is 50 Hz, but the default power on setting is 60 Hz.

Note that the parameters `MAX`, `MIN` etc are not applicable in this command.

*RST — The line frequency remains unchanged as it is stored in the non-volatile store.

Native Equivalents — DCV, DCI, ACV, ACI, OHMS, FILT, LINE

STATus

This command controls the SCPI defined status reporting structures. The commands that are listed in this section are the mandatory commands that must be implemented by any SCPI instrument.

The status reporting is additional to that defined by the IEEE488.2 specification. The extra status deals with the current operation of the instrument and quality of any measurements taken.

For a diagram of the status register system please refer to the SCPI specification, section 9.2, Figure 9.1.

Syntax

```
STATus
  :OPERation
    [:EVENt]?                    (Query Only)
    :CONDition?                  (Query Only)
    :ENABle          <NRf>
    :ENABle?                     (Query Only)
  :QUEStionable
    [:EVENt]?                    (Query Only)
    :CONDition?                  (Query Only)
    :ENABle          <NRf>
    :ENABle?                     (Query Only)
  :PRESet                        (Event, No Query)
```

Related Commands No directly-related SCPI commands.

`STATus:OPERation[:EVENt]?`

This query command will return the latched settings from the operational status register. The value that is returned is a binary weighted number. Thus converting this number into a binary value will indicate which bits are set true.

The list below shows which bits of the operational register are used:

Bit	Description
0	DMM is performing a calibration
2	DMM is currently range changing
4	DMM is currently measuring
5	DMM in wait for trigger state

Note that no other bits are used by the DMM and are returned as having the value zero.

Note that this command clears any bits that are currently set. Also sending the *CLS command will clear any set bits.

Errors There are no associated errors with this command.

*RST As this is a query command then there is no associated *RST condition. However, SCPI defines that the *RST will not effect the SCPI Event registers. The operational register is cleared by one of the following:

:OPER:EVENt? *CLS power on

`STATus:OPERation:CONDition?`

This query command returns the current binary-weighted contents of the operational status register. It is similar to the `:EVENt?` query, except the condition register is non-latched or buffered and as such returns what is currently happening within the DMM.

Note that this command does not clear any of the set bits in the register. Also note that because the DMM goes 'busy' during range change and calibration, these bits will never be read true by this command.

Errors — There are no associated errors with this command.

∗RST — As this is a query command then there is no associated ∗RST condition. However, SCPI defines that ∗RST will not effect the SCPI Event registers. The operational register is cleared by one of the following:

`:OPER:EVENt?` ∗CLS power on

`STATus:OPERation:ENABle` <NRf>

This command is used to enable the summary and reporting of operational status bits. <NRf> is converted into a weighted binary number and used as the mask for the operational enable status register. If any of the enabled bits in the operational status register are true, or subsequently go true, then bit 7 of the Status Byte will be set true.

Note that the DMM only uses bits 0, 2 4 and 5 of the operational status register.

Errors — An error of - `222, 'Data out of range'` will be reported if the enable value is greater that `65535`.

Query — `STATus:OPERation:ENABle?`
This returns an <NRf1> that is the binary weighted representation of enable bits that are set.

∗RST — SCPI defines that the ∗RST will not effect the SCPI Enable registers. The operational register is cleared by one of the following:

`:OPER:EVENt?` ∗CLS power on

`STATus:QUEStionable[:EVENt]?`

This command will return the latched settings from the questionable status register, reporting information about the quality of the measurement. The value that is returned is a binary-weighted decimal number. Converting this number into a binary value will indicate which bits are set true.

The table below shows which bits of the questionable status register are used, and the meaning of the response:

Bit	Description
0	Voltage Overrange
1	Current Overrange
8	Invalid Calibration
9	Resistance Overrange

Note that no other bits are used by the DMM and these are returned as having the value zero. This command clears any bits that are currently set. Also sending the ∗CLS command will clear any set bits.

Errors — There are no associated errors with this command.

∗RST — As this is a query command then there is no associated∗RST condition. However, SCPI defines that ∗RST will not effect the SCPI Event registers. The only way to clear the questionable register is with a ∗CLS, `STATus:QUEStionable[:EVENt]?` command, or at power on.

`STATus:QUEStionable:CONDition?`

This query command returns the current binary weighted contents of the questionable status register. It is similar to the `:EVENt?` query, except the condition register is non-latched or buffered and as such returns what is currently happening within the DMM.

Note that this command does not clear any of the set bits in the register.

Errors — There are no associated errors

∗RST — As this is a query command, there is no associated ∗RST condition. However, SCPI defines that the *RST will not effect the SCPI Event registers. The only way to clear the questionable register is with a ∗CLS command or at power on.

`STATus:QUEStionable:ENABle` <NRf>

This command is used to enable the summary and reporting of questionable status bits summarized by bit 3 of the IEEE 488.2 Status Byte. The value of <NRf> is converted into a weighted binary number and used as the mask for the operational enable status register. If any of the enabled bits in the operational status register are true, or subsequently go true, then bit 3 of the Status Byte will be set.

Note that the DMM only uses bits and 0, 1, 8 and 9 of the questionable status register.

Errors — An error of - `222,'Data out of range'` will be reported if the enable value is greater that `65535`.

Query — `STATus:QUEStionable:ENABle?`
This returns an <NRf1> that is the binary weighted representation of enable bits that are set.

∗RST — SCPI defines that the ∗RST will not effect the SCPI Enable registers. The only way to clear the questionable register is with a ∗CLS command or at power on.

`STATus:PRESet`

This command sets the SCPI defined Event and Enable registers into a known state. See SCPI specification, Section II, 18.7 for details. The `STATus:PRESet` condition is all bits set to zero (disabled) Positive Transition true.

Errors — No associated errors with this command.

∗RST — No associated ∗RST condition.

SYSTem

The SYSTem command is used to query the current contents of the error queue. It can also be used to switch the DMM into a different command language interpreter, and it also reports the version of SCPI that the instrument conforms to.

Syntax			
	SYSTem		
	:ERRor?		(Query only)
	:LANGuage	NATive	(manufacturer's extension)
	:VERSion?		(Query only)

Related Commands None.

SYSTem:ERRor?

This query command returns the error currently at the top of the error queue. The format of the response is :

<NRf1>,'<description>'

<NRf1> represents the error number and <description> is a short ASCII description of the error.

If there are no errors currently in the queue then the DMM will return `0,'No error'`. If the queue overflows then the last error message added to the queue will be replaced with the message - `350,'Queue overflow'`. The queue can store 10 errors before the overflow occurs.

The error queue is a First In, First Out system, thus the oldest error is reported first.

See the section entitled 'Error Codes' for a full list of the DMM errors. All error numbers will be in the range: -32768 to +32767.

Errors There are no errors associated with this command.

SYSTem:LANGuage NATive

This command causes the DMM to switch to the native command parser. This will allow the control of the DMM with an IEEE488.2 compatible language. Refer to the 1362 VXIbus Card DMM Users Handbook for language use. Once in native mode, control can be returned to the SCPI parser by the native command 'SCPI'.

Errors There are no errors associated with this command.

Query There are no associated errors.

∗RST A ∗RST will **not** change the current parser mode, thus once this command has been issued, the only way back is by using the native command 'SCPI'.

SYSTem:VERSion?

This query command will report the version of SCPI that the instrument conforms to. The returned <NRf2> is:

`1991.0`

Errors There are no associated errors.

∗RST No associated ∗RST

TEST

This command performs an instrument selftest. It may be either one specific test or a complete run of all tests.

Syntax	TEST		
	[:ALL]?		(Query only)
	TYPE?	<numeric_value>	(Query only)

Related Commands ∗TST?

TEST[:ALL]?

This query command performs the full selftest, returning a number '0' if all tests pass, or a non-zero number if a test failed. Also, in the case of a test failure, an error code number is placed in the error queue to indicate the test which failed. Code numbers in the queue can be retrieved using the query SYSTem ERRor? (the same error code numbers are used as for the 1362 native selftest). During the selftest, once a test fails the DMM does not proceed with the testing.

Errors As described above.

∗RST There is no associated ∗RST condition. Selftest is not active.

TEST:TYPE? <numeric_value>

This query command performs the specified number test. It then returns the same data as the native 1362 TEST? command.

Errors None

Native Equivalent TEST?, *TST?. Note that this will use the current 1362 selftest structure.

TRIGger

This command controls the behaviour of the trigger system. It is used to specify where the trigger is to originate, any delays between the trigger and the measurement and how many measurements to take.

The basic principle of the SCPI trigger system is that an instrument is normally in an IDLE state, see Fig. 4.4. This is the state after a *RST, ABORt or power on. The instrument may then be initiated from the idle state by placing it into the ARM state. This is an Event Detection Layer at which the instrument will wait until the specified event has occurred.

Once the ARM event(s) have occurred then the instrument will move into the TRIGGER state. This is again an Event Detection Layer and the instrument will wait for the specified event to occur before commencing with the measurement. Once this specified number of ARM and TRIGGER states have been satisfied, then the DMM will return to the IDLE state.

The 1362 DMM does not implement the ARM layer of the trigger subsystem. Thus the DMM will proceed from the IDLE state directly to the trigger state. Other than the more drastic methods of reset or interrupting line power, there are two routes out of this state - either a Word Serial Clear command followed by the ABORt (or equivalent) command to return the DMM to IDLE state, or the specified trigger Event. In this latter case, the DMM will take a measurement before returning to the IDLE state.

If the TRIGger:COUNt command has been set to more that the default of 1, then the DMM will wait for COUNt triggers, taking a measurement for each one, before returning to the IDLE state.

Syntax	TRIGger		
	[:IMMediate]		(Event, No Query)
	:COUNt	<numeric_value>	
	:DELay	<numeric_value>	
	:AUTO	<Boolean>	
	:SOURce	BUS|EXTernal|HOLD|IMMediate|TTLTrg<n>	
		Where n = 0 to 7	
Notes	See appendix A for further information on the trigger subsystem		
Related Commands	ABORt, MEASure?, CONFigure, READ?, INITiate, FETCh?		

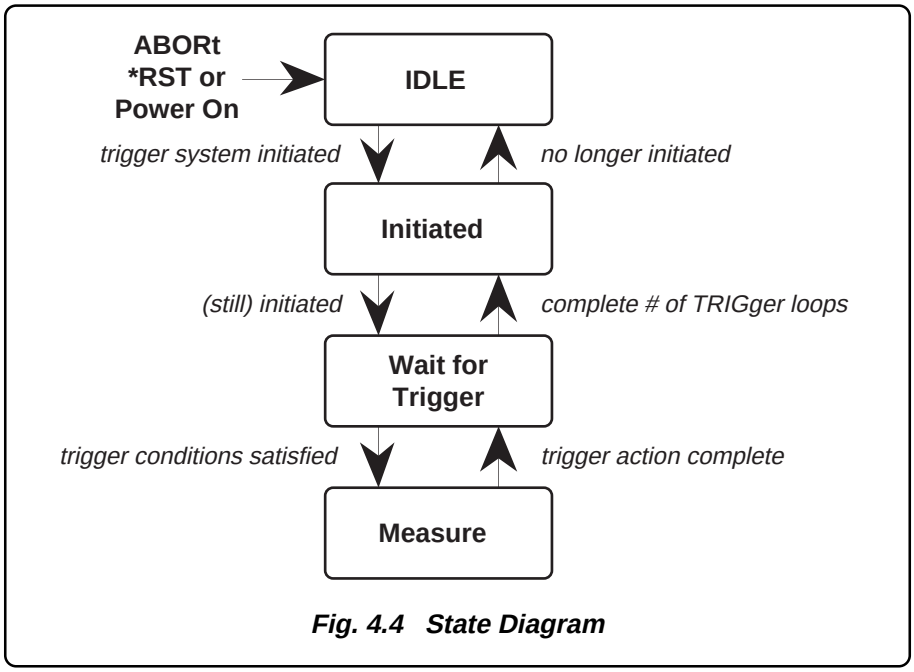


Fig. 4.4 State Diagram

`TRIGger[:IMMediate]`

If the DMM is in the Wait-for-trigger state set by the `INITiate` command, then the DMM will take a measurement. The measurements can then be recalled using the `FETCh?` command. Note that the DMM must be in either `TRIG:SOUR BUS` or `TRIG:SOUR HOLD` state for this command to trigger the DMM and not generate an error.

Errors	An error of `-211,'Trigger ignored'` will be generated if the DMM has not been initiated with an `INIT` command. (Thus from this command the error will be generated if `TRIG:SOURce IMM` is selected).
Query	This is an event and thus cannot be queried.
`*RST`	On `*RST` the DMM is placed into the Idle state.

`TRIGger:COUNt <numeric_value>`

This command configures the DMM to expect <numeric_value> triggers and to take a measurement for each trigger and store them internally. The DMM must be placed in the wait-for-trigger mode. This can be done using the `INIT` command. The subsequent readings taken can be recalled with the `FETCh?` command. Alternatively, the DMM can be placed into the wait-for-trigger state using the `READ?` command. This will then return the subsequent measurements to the output queue when they are taken.

The <numeric_value> must be in the range `1` to `1000`. If `MAXimum` is sent then the DMM will expect 1000 triggers, If `MINimum` is sent then the DMM will expect 1 trigger.

Errors	An error of `-222,'Data out of range'` is generated if <numeric_value> is outside the range `1-1000`.
Query	`TRIGger:COUNt? [MINimum|MAXimum]` This query command returns the current setting of the number of triggers expected. If `MINimum` is present '`1`' is returned, if `MAXimum` is present, then '`1000`' is returned.
`*RST`	`TRIGger:COUNt 1`

`TRIGger:DELay:AUTO` <Boolean>

This command enables or disables the use of default trigger delays. If the value of <Boolean> is '`OFF`' or '`0`' then the default delays are not used, if <Boolean> is '`ON`' or '`1`' then the defaults are used. If the default delays are deselected the delay between trigger and measurement is given by the `TRIGger:DELay` command.

The default delays are dependent on the current function, range and resolution as set in the 1362 handbook. The default value will change every time a new function or range or resolution is selected.

If a `TRIGger:DELay` <numeric_value> command is received then `TRIGger:DELay:AUTO` will be turned `OFF`.

Errors	There are no associated errors.
Query	`TRIGger:DELay:AUTO?` This returns either '`0`' or '`1`' depending if delays are respectively disabled or enabled.
`*RST`	`TRIGger:DELay:AUTO ON`

`TRIGger:DELay` <numeric_value>

This command defines the time delay between a trigger event and the measurement conversion starting. The range of <numeric_value> must be in the range `0` sec to `10` sec. (See 1362 handbook for resolutions). If a value of greater that `10` is received, the DMM will default to 10. `MINimum` will select a value of `0` sec, `MAXimum` will select `10` sec.

Once a delay is selected, then this will apply to all subsequent measurements.

Errors — An error of `-222 'Data out of range'` will be reported if the <numeric_value> is less that `0` or greater than `10` seconds.

Query — `TRIGger:DELay? [MINimum|MAXimum]`
This will return the current setting of the trigger delay. If a default delay is currently active, then this value will be returned. If `MINimum` is present, then '`0`' will be returned, if `MAXimum` is present then '`10`' will be returned.

*RST — As `TRIGger:DELay:AUTO ON` is selected, then the DMM default delays will be selected.

`TRIGger:SOURce BUS|EXTernal|HOLD|IMMediate|TTLTrg<n>` (n = `0` to 7)

This command defines the source of the measurement trigger. The following lists the possible parameter options:

Alternative Parameters:

`BUS`	This will accept Group Execute Trigger (GET), *TRG.
`EXTernal`	This selects the DMM front panel 'EXT TRIG' connector.
`HOLD`	This deselects all triggers, however the `TRIGger:IMMediate` command will override this 'HOLD' state and cause a measurement to be taken.
`IMMediate`	In this mode, an `INIT`, `READ?` or `MEAS?` command will cause a measurement to be taken.
`TTLTrg<n>` (n = `0` to 7)	This selects the backplane TTL VXI trigger system. Note that only one of these TTLTrg lines can be selected at any one time. If the `OUTPut:TTLTrg<n>:PROTocol ASYNchronous` mode is selected, then `TTLTrg1|3|5|7` will generate an error of `-221,'Settings conflict'`. Note that this command only selects the trigger mode, it does not cause a trigger.

Errors — The DMM must be in the idle mode for a `TRIGger:SOURce` command to be accepted. An execution error of `-221,'Settings conflict'` will be generated if a `TRIGger:SOURce` command is received when the DMM is already in the trigger mode.

If the DMM is in the idle state then any GET or *TRG commands will cause an execution error of `-211,'Trigger ignored'`. However any triggers on the external or TTL lines will be ignored with no error.

`MEAS?` and `READ?` will generate an error of `-214,'Trigger deadlock'` If received while in the `TRIGger:SOURce BUS` mode.

Query — `TRIGger:SOURce?`
This queries the current setting of the trigger mode. it will return one of the following:

`'BUS' 'EXT' 'HOLD' 'IMM' 'TTLTn'`

*RST — The DMM is initially placed in the idle state with `TRIG:SOUR IMM`.

Native Equivalent — BLOCK

Related Commands — `OUTPut`, `INITiate`.

APPENDIX A to SECTION 4

1362S SCPI -

- **Command Summary**
- **Error Codes and Messages**
- **∗RST (Reset) Conditions**
- **Trigger Combinations**
- **Trigger Timing Information**

SCPI Command Summary

The following is a table of Command and Query Command codes that have been implemented in the 1362S.

COMMAND FORMAT		DESCRIPTION
ABORt		Abort current trigger state and return to idle state.
CALibration	:HIGH? [<numeric_value>]	Perform full scale calibration using the <numeric_value>.
	:LOW? [<numeric_value>]	Performs zero scale calibration using the <numeric>.
	:SECure <Boolean>	Enable the calibration security.
	:SECure?	Query the current setting of the security.
	:SLFRequency?	Store current line frequency in non-volatile stores.
CONFigure<function> <parameter>[,<source_list>]		General configuration command.
<function>	:CURRent[:DC}|:AC	Selects Current; respectively DC or AC
	:FRESistance	Selects four wire Ohms.
	:RESistance	Selects two wire Ohms.
	:VOLTage[:DC]|:AC	Selects Voltage; respectively DC or AC.
<parameter>	[<expected_value[,<resolution]]	Parameters for the <function>.
<source_list>	[[,(@1)]|(@2)|(@1,2)|(@1:2)]	This selects channel (if option fitted) to be measured.
CONFigure?		This returns the current selected function, range and resolution of the DMM.
FETCh?		Returns the last set of measurements taken.
INITiate	[:IMMediate]	Places DMM in the wait for trigger state.
INPut	:COUPling AC|DC	Selects input coupling source.
	:COUPling?	Queries the state of the input coupling.
	:FILTer[:LPASs][:STATe]<Boolean>	Selects or Deselects the input filter.
	:FILTer[:LPASs][:STATe]?	Query the state of the input filter.
	GUARd LOW | FLOat	Connect the guard to signal low, or allow the guard to float.
	GUARd?	Query the status of the guard connection.
	[:STATe]<Boolean>	Selects input connection or isolation.
	[:STATe]?	Queries the state of the input connection.
	ZERO?	Performs an input zero offset correction.
MEASure	<function>?<parameters>[,<source_list>]	Configure the DMM and take a measurement and INITiates that measurement.
<function>	:CURRent[[:DC] | :AC]?	Selects Current, either DC or AC
	:FRESistance	Selects four wire Ohms.
	:RESistance	Selects two wire Ohms.
	:VOLTage[[:DC]|:AC]?	Selects voltage, either DC or AC
<parameter>	[<expected_value[,<resolution]]	Parameters for the <function>.
<source_list>	[[,(@1)]|(@2)|(@1,2)|(@1:2)]	This selects channel (if option fitted) to be measured.
OUTput	:TTLTrg0|1|2|3|4|5|6|7 :PROTocol SYNChronous |ASYNchronous	Set the VXI trigger line protocol mode.
:TTLTrg0|1|2|3|4|5|6|7 :PROTocol ?		Query the VXI lines protocol.
READ?		Places the DMM in a wait for trigger state and then returns the measurement after the trigger.
[SENSe:]	CURRent[:DC] | :AC <parameter>	Selects either DC or AC current.
	CURRent[:DC] | :AC <parameter>?	Query the setting current function setting.
	RESistance | :FRESistance <parameter>	Selects either 2 or 4 wire resistance measurement.
	RESistance | :FRESistance <parameter>?	Query the setting resistance setting.
	VOLTage[:DC]| :AC <parameter>	Selects either DC or AC Voltage.
	VOLTage[:DC]| :AC <parameter>?	Query voltage setting.
<parameter>	:RANGe<numeric_value>	Selects the value expected to be measured.
	:AUTO<Boolean>	Selects Autorange.
	:RESolution<numeric value>	Selects the resolution for the function selected.
	MAXimum	Selects the maximum resolution for the function selected.
	:MINimum	Selects the minimum resolution for the function selected.
	:AUTO ON	Explicitly setting a value for RESolution will turn Auto:Off.
	FILTer[:LPASs][:STATe] <Boolean>	Selects or deselects the input filter.
	FILTer[:LPASs][:STATe]?	Query the state of the input filter.
	LFRequency<numeric_value>	Set the integration time related to line frequency setting.
	LFRequency?	Query the line frequency setting.

SCPI Command Summary *(Contd.)*

COMMAND FORMAT		DESCRIPTION
STATus	:OPERation:CONDition?	Queries the operational condition register.
	:OPERation[:EVENt]?	Queries the operation event register.
	:OPERation:ENABle<Nrf>	Sets conditions in the operation status register.
	:OPERation:ENABle?	Queries set conditions in operation status register.
	:QUEStionable:CONDition?	Queries the questionable condition register.
	:QUEStionable:[:EVENt]?	Queries the questionable event register.
	:QUEStionable:ENABle<NRf>	Sets conditions in questionable status enable register.
	:QUEStionable:ENABle?	Queries set conditions in questionable status register.
	:PRESet	Resets the state of the STATus register.
SYSTem	:ERRor?	Query the next error in the error queue.
	LANguage NATive	Causes DMM to switch to another command interpreter.
	:VERSion?	Returns the version of SCPI to which the instrument conforms.
TEST	[:ALL]?	Performs complete selftest.
	:TYPE?<Nrf>	Performs a specific numbered test.
TRIGger	[:IMMediate]	Trigger the DMM immediately
	:COUNt <numeric_value>	Sets the number of triggers.
	:COUNt?	Query the count setting.
	:DELay<numeric_value>	Sets the time delay between the trigger and the measure.
	:AUTO<Boolean>	Selects default delay settings.
	:DELay?	Queries the current trigger delay.
	:SOURce BUS |EXTernal|HOLD |IMMediate|TTLTrg<n> (n = 0 to 7)	Specify the trigger source.
	:SOURce?	Query the trigger source setting.

Error Codes and Messages

The folowing is a table of error codes that have been implemented in the 1362S. The system errors all have negative values, the DMM specific errors have positive values.

ERROR NUMBER & MESSAGE		COMMENTS
0	No error	This message is reported when there are no more errors to report.
-100	Command error	This is generated when the DMM parser detects an error in the command string, but which cannot be specified.
-101	Invalid Character	A syntactic element contains a character which is invalid for that type.
-105	GET not allowed	A Group Execute Trigger was received within a program message.
-120	Numeric data error	An error has been detected in the numeric data string.
-200	Execution Error	This is reported when the dmm has been asked to perform a task that it cannot do, but cannot report a more specific error.
-211	Trigger ignored	Indicates that a GET or ∗TRG signal was received but ignored for either timing or dmm setting reasons.
-213	Init Ignored	An INIT was received when the dmm was already in the wait for trigger state.
-221	Settings Conflict	The dmm has received a request for an operation and cannot perform this operation as the dmm is incorrectly configured. e.g.taking a measurement.
-222	Data out of range	Indicates that the <numeric value> is outside the limit for the command it was sent, e.g. a negative time delay.
-230	Data corrupt or stale	Invalid data, e.g. a FETCh? after a ∗RST.
-241	Hardware missing	An operation was requested that could not be performed because the option (eg Current) is not fitted.
-350	Queue Overflow	This indicates that there is no more room available in the error queue.
100	Input not connected	A measurement has been attempted without connecting to the signal input.
110	Calibration switch disabled.	A calibration operation has been attempted without fully enabling the calibration security mechanism.
120	Calibration operation invalid	An invalid calibration has been attempted.
122	Calibration operation failed	This message is reported if the calibration operation was started but not completed

∗RST Condition

The following list indicates the state in which the instrument defaults following a reset (∗RST).

SUBSYSTEM	KEYWORD	DEFAULT CONDITION
ABORt		None
CALibration	:HIGH? :LOW? :SECure :SLFRequency?	None None OFF Last Stored Value
CONFigure	:CURRent :FRESistance :RESistance :VOLTage	CONF:CURR:DC 1, 1E-6, (@1) CONF:FRES 1E7, 1E2, (@1) CONF:RES 1E7, 1E2, (@1) CONF:VOLT:DC 300, 1E-3, (@1)
CONFigure?		None
FETCh?		None
INITiate	[:IMMediate]	None
INPut	:COUPling :FILTer[:LPASs][:STATe] :GUARd [:STAT] ZERO	INP:COUP:AC INP:FILT:LPAS:STAT OFF INP:GUAR:LOW INP:STAT:OFF Unaffected.
MEASure	:CURRent :FRESistance :RESistance :VOLtage	MEAS:CURR:DC 1,1E-6, (@1) MEAS:FRES 1E7, 1E2, (@1) MEAS:RES 1E7, 1E2, (@1) MEAS:VOLT:DC 300, 1E-3, (@1)
OUTput	TTLTrg0|1|2|3|4|5|6|7 :PROTocol	OUTP TTLTrg0|1|2|3|4|5|6|7:PROT SYNC
READ?		None
[SENSe:]	:CURRent :FRESistance :RESistance :VOLTage :RANGe :AUTO FILTer[:LPASs][:STATe] LFRequency	SENS:CURR:DC 1, 1E-6, (@1) SENS:FRES 1E7, 1E2, (@1) SENS:RES 1E7, 1E2, (@1) SENS:VOLT:DC 300, 1E-3, (@1) SENS:<function>:RANG:AUTO OFF SENS:FILT:LPAS:STAT OFF As last set.
STATus	:OPERation:CONDition? :OPERation[:EVENt]? :OPERation:ENABle :QUEStionable:CONDition? :QUEStionable:[:EVENt]? :QUEStionable:ENABle :PRESet	None None Unaffected None None Unaffected See SCPI Specification.
SYSTem	:ERRor? LANguage NATive :VERSion?	None SCPI Parser None
TEST	[:ALL]? :TYPE?<Nrf>	None None
TRIGger	[:IMMediate] :COUNt :DELay :AUTO :SOURce	None TRIG:COUN 1 Default values (see Section 5; p5-21) TRIG:DEL:AUTO ON TRIG:SOUR IMM

Trigger Combinations

The table below outlines how the various triggers and trigger sources interrelate.

Type\Mode	IMM	BUS	HOLD	EXT	TTL
READ? [3]	1reading taken and returned	-214, 'Trigger deadlock'	-213, 'Init ignored'	Holds bus until trigger occurs, then returns result.	Holds bus until trigger occurs, then returns result.
MEAS? [3]	1reading taken and returned	-214, 'Trigger deadlock'	-213, 'Init ignored'	Holds bus until trigger occurs, then returns result.	Holds bus until trigger occurs, then returns result.
TRIG:IMM [2]	-211, 'Trigger ignored.'	1 reading taken and stored.	1 reading taken and stored.	1 reading taken and stored.	1 reading taken and stored.
TTL	No error, trigger ignored.	No error, trigger ignored.	No error, trigger ignored.	No error, trigger ignored.	1 reading taken and stored.
EXT	No error, trigger ignored.	No error, trigger ignored.	No error, trigger ignored.	1 reading taken and stored.	No error trigger ignored.
GET	-211, 'Trigger ignored.'	1 reading taken and stored.	-211, 'Trigger ignored.'	-211, 'Trigger ignored.	-211, 'Trigger ignored.'
*TRG	-211, 'Trigger ignored.'	1 reading taken and stored.	-211, 'Trigger ignored.'	-211,'Trigger 'Trigger ignored.'	-211, 'Trigger ignored.'
INIT [1]	1 reading taken and stored.	Enables this mode	Enables this mode	Enables this mode	Enables this mode

Notes: [1] `TRIG:IMM` will give an error or `-211,Trigger ignored` if an `INIT` has not been received first.

[2] If source is `IMM`, then an `INIT` will cause a measurement to be taken, putting the dmm back to IDLE state. Thus the `TRIG:IMM` command will always generate the `-211, Trigger ignored` error.

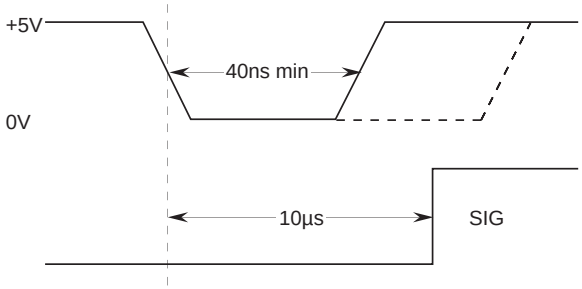
[3] If the DMM is in block mode, eg. `TRIG:COUNt 5`, then `READ?/MEAS?` will take 5 measurements in the `TRIG:SOURce IMM` mode. However, if `TRIG:SOURce EXT|TTL` is selected then 5 individual trigger pulses must be supplied before an answer is returned.

Also note that if in the `TRIG:SOURce EXT|TTLn` mode with a `READ?/MEAS?` command, it is not possible to send any further commands to the dmm as it is waiting for the triggers to arrive so it can respond with the data to the query. The only way out of this is by all of the triggers arriving or a Word Serial `Clear` command followed by `ABORt` or equivalent command to return the DMM to IDLE state.

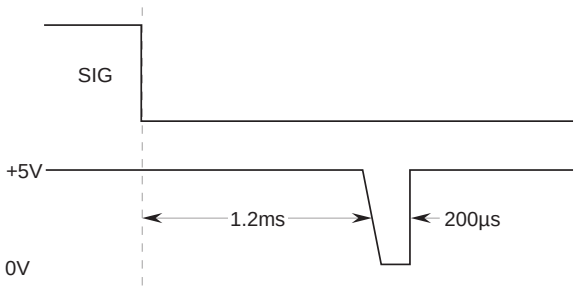
Certain trigger modes will hold the Bus as defined under SCPI version 1991.0.

Trigger Timing Information.

The following information, along with associated diagrams, detail trigger characteristics. The 1362S will respond to external trigger pulses from either front panel BNC socket or VXI backplane trigger bus. Measurement complete triggers can only be generated on the VXI backplane.



Trigger Input
(SYNCHRONOUS or ASYNCHRONOUS Mode)
(Delay set to zero)



Measurement Complete Trigger
(ASYNCHRONOUS Mode only)
(Assuming correct VXI termination)

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SECTION 5
1362 NATIVE LANGUAGE
IEEE 488.2 COMMAND SYNTAX

SECTION 5 1362 NATIVE LANGUAGE - IEEE 488.2 COMMAND SYNTAX

IEEE 488.2 Programming Language

Introduction

As the instrument has to operate on the VXI bus, it is not in direct contact with the outside world and cannot conform fully to the IEEE 488.1 Hardware model. For example, in the IEEE 488.1 model, a separate (SRQ) line is provided for the instrument to request service from the controller.

A separate line for requesting service is not provided on the VXI bus, and to provide a similar facility, the VXI 'request true' syntax has to be programmed in software; thus a hardware difference imposes a departure from the standard programming model. Apart from such external constraints, the 1362 'Native Language' conforms to the syntax rules of the IEEE 488.2 Standard programming model.

IEEE 488.2 defines sets of Mandatory Common Commands and Optional Common Commands along with a method of Standard Status Reporting. The 1362 conforms with all Mandatory Commands but not all Optional Commands, and conforms with the defined Status Reporting method.
Note: Commands prefaced by asterisk, (eg: ∗TRG) are standard-defined 'Common' commands.

VXI WSC and Effects

The VXI Word Serial 'clear' Message will force the following instrument states:

- the input buffer and output queue are cleared;
- parser is reset to the beginning of a message;
- any device-dependent message interlocks are cleared.

This command will not:

- change any settings or stored data within the instrument except as listed above;
- interrupt analog input;
- interrupt or affect any functions of the device;
- change the status byte.

∗RST and Effects

The effects of the ∗RST command are described later on page 5-39.

Reset

A complete instrument reset is accomplished by the two reset commands in sequence. In other circumstances they may be used individually:

WS clear	Message exchange initialization;
***RST**	Device initialization.

IEEE 488.2 Syntax Diagrams in this Section

The following notations decribe the syntax diagrams used in this handbook.

Notation

- Syntactic elements are connected by lines with directional symbols to indicate the flow, which generally proceeds from left to right.
- Repeatable elements have a right-to-left reverse path shown around and above them, which can also contain a separator such as a comma.
- When it is possible to bypass elements, a left-to-right path is shown around and below them.
- When there is a choice of elements, the path branches to the choices.

Hierarchy of Syntactic Elements

Messages are characterized by the presence of terminators, each of which seals the set of syntactic elements sent since the previous terminator to form a 'Program Message'.

The Program Message

Each Program Message can consist of only one syntactic element plus its terminator, or may be subdivided into many 'Program Message Units', separated by semi-colons (;) which are known as 'Program Message Unit Separators'. Thus the semi-colon cannot be used for any other purpose.

As you can see from the diagram, multiple Program Message Units can be sent if they are separated using semi-colons (shown in the repeat path). The block named 'Program Message Unit' therefore represents **either** repeats of the same unit, **or** a set of different units, **or** a mixture of both. The starting circle is a device used only for the diagram; there is no requirement to use a special character to start a message, providing the previous message was correctly terminated. It is possible to send only the terminator as a complete Program Message (as shown by the forward bypass path), but this feature has little use when programming the 1362.

Character Usage

Notice that the names of some elements are shown here in italics. This agrees with the convention used on the syntax diagrams in this handbook, which sets 'non-literal' text (names given to particular elements) in italics, whereas 'literal' text (the actual characters to be sent, such as the semi-colon in the diagram) is shown in plain-text capitals.

Upper/Lower Case Equivalence

The plain-text capitals are not demanded by the standard, and the 1362 will not differentiate between upper and lower case characters in literal program text. Either or both can be used, mixed upper and lower case if this conveys an advantage.

Numeric Representation

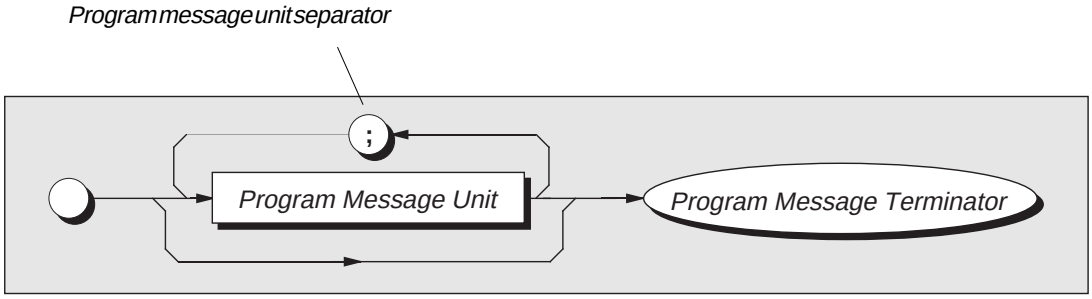
Several commands and queries used for the 1362 require transmission and reception of numbers. Decimal formats are generally used.

The IEEE 488.2 document specifies formats which ensure that a device is 'forgiving' when receiving program or query commands, but 'precise' when transmitting responses to queries.

For program data it insists that a device must accept the decimal 'Flexible Numeric Representation (*Nrf*)', which is a flexible version of three numeric representations (Nr1, Nr2 and Nr3) defined by ANSI X3.42-1975 [2]. The 1362 complies.

Decimal numeric response data from the 1362 employs either Nr1 or Nr3 format, usage depending on the particular response. In this handbook, all syntax diagrams for query messages are accompanied by a paragraph which spells out the response format. Users are left in no doubt as to the construction of the response.

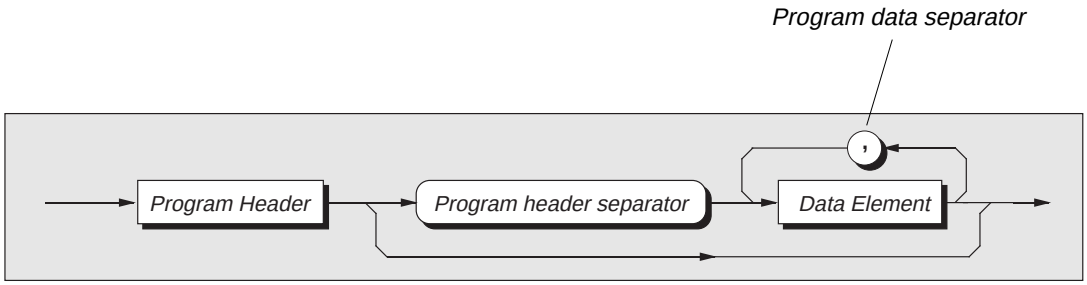
Syntax Diagram of a Simple Program Message



The Program Message Unit

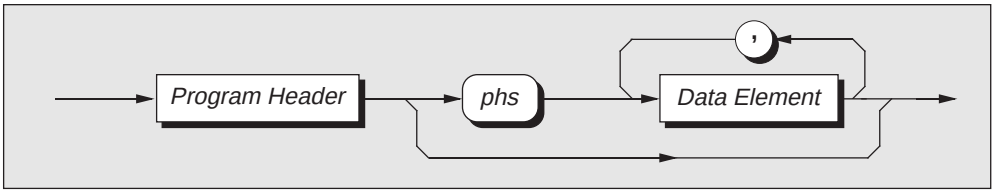
Program Message Units (PMUs) can be 'Terminal' or 'Non-terminal'. The final PMU in any Program Message is always Terminal (includes the terminator), whereas all preceding PMUs within the Program Message are obviously Non-terminal. Most of the commands in this handbook are described in the form of non-terminal message units:

Non-Terminal Program Message Unit



To save space, the name 'program header separator' is abbreviated to 'phs'.

Use of *phs*



The Command Program Header

Several versions are defined by the IEEE 488.2 Standard document. The 'Simple', 'Common' and 'Query' headers are designed into the 1362, but not 'Compound' headers.

The asterisk (Common) and question mark (Query) are defined separately by the standard document, but as they are inseparable from the command, they are shown on the 1362 syntax diagrams in the same block as the program mnemonic. For example: the command for Full Selftest (∗TST?) is shown in abbreviated format, not in full format.

Separators

Program header separator (phs)

white space.

Program data separator (pds)

a comma;
or a comma preceded by, followed by, or both preceded and followed by white space.

Program message unit separator (pmus)

a semi-colon;
or a semi-colon preceded by white space.

'White Space'

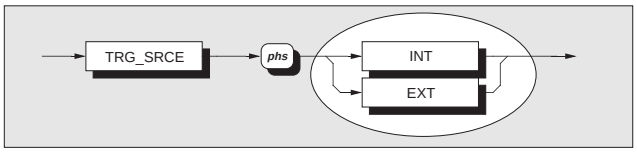
is any number of white space characters, which are:

hex	00-09, 0B-20
decimal	0-9, 11-32

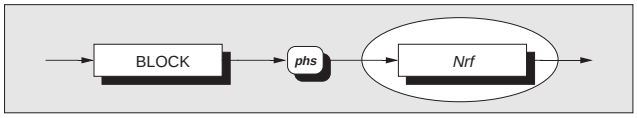
Program Data Elements

Four versions of the defined program data elements are employed. They are emphasized in the following syntax diagrams, which are examples from the list of commands available for the 1362:

Character

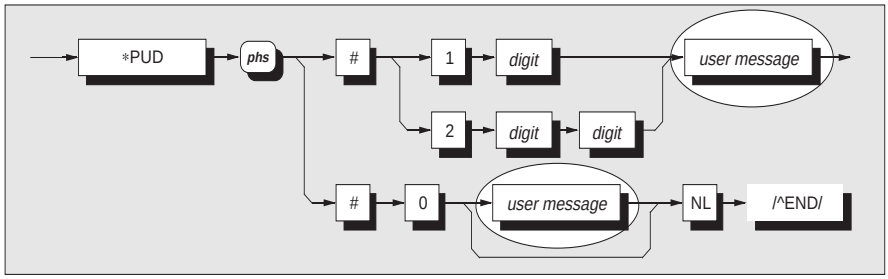


Decimal Numeric



(***Nrf*** can be expressed in any of the ways defined by the Standard document)

Arbitrary Block



Both the 'Definite' and 'Indefinite' forms of arbitrary block may be used as specified in the Standard document, and described by the Syntax diagram above. The *user message* is limited to a maximum of 63 bytes. When the indefinite form of arbitrary block program data element is used, there is no exit to further message units. The program message must be terminated to inform the instrument that the block is complete.

Message Exchange

IEEE 488.2 Model

The IEEE 488.2 Standard document illustrates its Message Exchange Control Interface model at the detail level required by the device designer. Much of the information at this level of interpretation (such as the details of the internal signal paths etc.) is transparent to the application programmer. However, because each of the types of errors flagged in the Event Status Register are related to a particular stage in the process, a simplified 1362 interface model can provide helpful background. This is illustrated in Fig. 5.1, together with brief descriptions of the actions of its functional blocks.

1362 Message Exchange Model

Input/Output Control transfers messages from the 1362 output queue to the system bus; and conversely from the bus to either the input buffer, or other predetermined destinations within the device interface. It receives the Status Byte from the status reporting system, as well as the state of the Request Service bit which it imposes on bit 6 of the Status Byte response. Bit 6 reflects the 'Request Service state *true*' condition of the interface.

Incoming Commands and Queries

The **Input Buffer** is a first in - first out queue, which has a maximum capacity of 128 bytes (characters). Each incoming character in the I/O Control generates an interrupt to the instrument processor which places it in the Input Buffer for examination by the Parser. The characters are removed from the buffer and translated with appropriate levels of syntax checking. If the rate of programming is too fast for the Parser or Execution Control, the buffer will progressively fill up. When the buffer is full, the VXI Commander is informed by DIR being false. *Refer to Section 3.*

The **Parser** checks each incoming character and its message context for correct Standard-defined generic syntax, and correct device-defined syntax. Offending syntax is reported as a **Command Error**, by setting true bit 5 (CME) of the Standard-defined Event Status register (refer to the sub-section 'Retrieval of Device Status Information').

Execution Control receives successfully parsed messages, and assesses whether they can be executed, given the currently-programmed state of the 1362 functions and facilities. If a message is not viable (eg the calibration trigger: CALL? when calibration is not enabled); then an Execution Error is reported, by setting true bit 4 (EXE) of the Standard-defined Event Status register. Viable messages are executed in order, altering the 1362 functions, facilities etc. Execution does not 'overlap' commands; instead, the 1362 Execution Control processes all commands 'Sequentially' (ie. waits for actions resulting from the previous command to complete before executing the next).

1362 Functions and Facilities

The 1362 Functions and Facilities block contains all the device-specific functions and features of the 1362, accepting Executable Message Elements from Execution Control and performing the associated operations. It responds to any of the elements which are valid Query Requests (both IEEE 488.2 Common Query Commands and 1362 Device-specific Commands) by sending any required Response Data to the Response Formatter (after carrying out the assigned internal operations).

Device-dependent errors are detected in this block. Bit 3 (DDE) of the Standard-defined Event Status register is set true when an internal operating fault is detected, for instance during a self test. Each reportable error has a listed number, which is appended to an associated queue as the error occurs.

Trigger Control

Two types of message are used to trigger the 1362 A-D into taking a measurement:

A Word Serial 'trigger'
∗**TRG** (IEEE 488.2-defined)

In the 1362 either message is passed through the Input Buffer, receiving the same treatment as a program message unit, being parsed and executed as normal.

Outgoing Responses

The **Response Formatter** derives its information from Response Data (being supplied by the Functions and Facilities block) and valid Query Requests. From these it builds Response Message Elements, which are placed as a Response Message into the Output Queue.

The **Output Queue** acts as a store for outgoing messages until they are read over the system bus by the application program. For as long as the output queue holds one or more bytes, it reports the fact by setting true bit 4 (Message Available - MAV) of the Status Byte register. Bit 4 is set false when the output queue is empty (refer to the sub-section 'Retrieval of Device Status Information'). The 'DOR' bit set performs the same action. *Refer to Section 3.*

'Query Error'

This is an indication that the controller is following an inappropriate message exchange protocol, resulting in the *Interrupted*, *Unterminated* or *Deadlocked* condition:

Refer to 'Bit 2' on *page 5-12*.

The Standard document defines the 1362's response, part of which is to set *true* bit 2 (QYE) of the Standard-defined Event Status register.

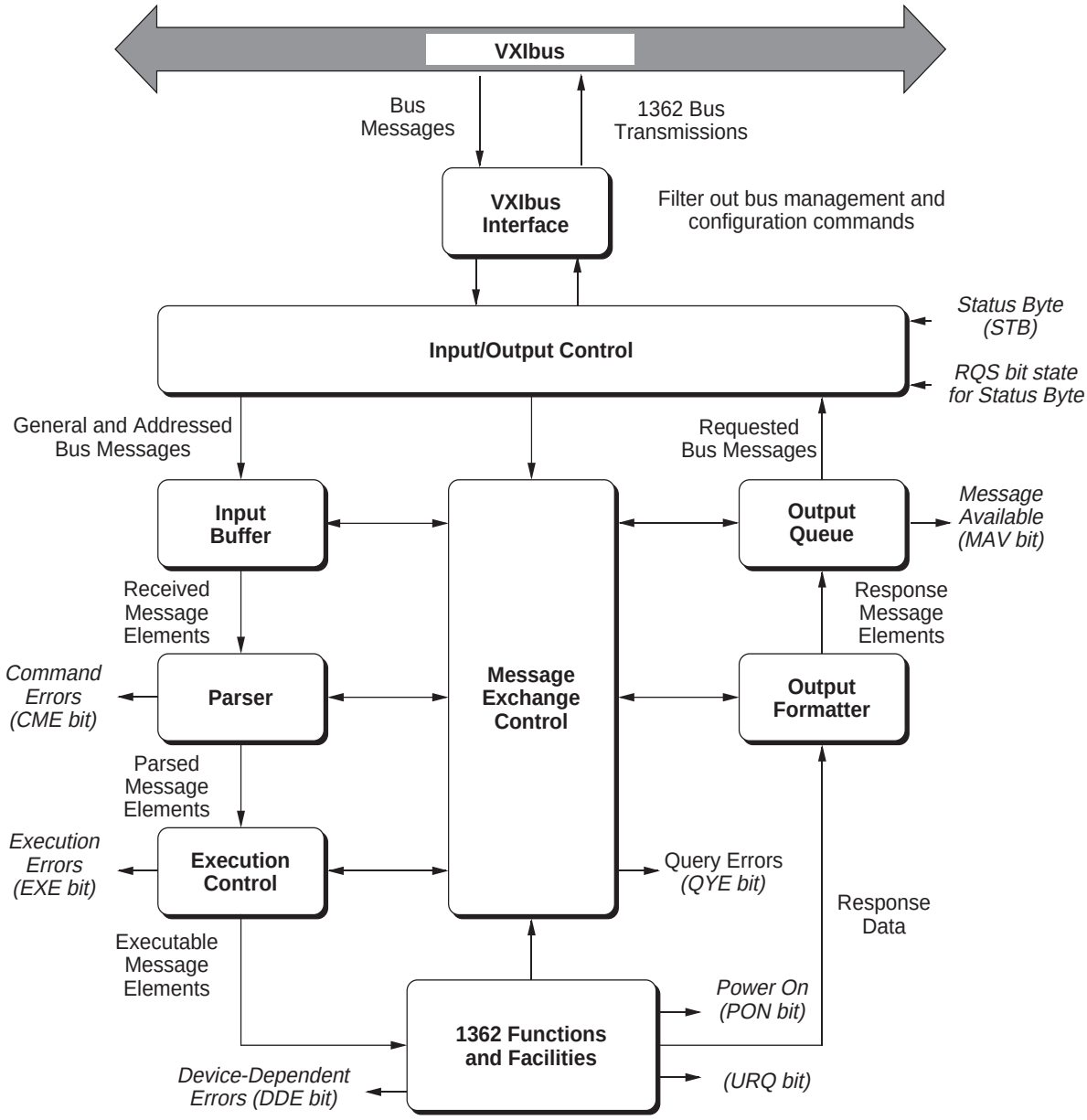


Fig. 5.1 1362 Message Exchange Model

Request Service (RQS)

Reasons for Requesting Service

There are two main reasons for the application program to request service from the controller:

- When the 1362 message exchange interface discovers a system programming error;
- When the 1362 is programmed to report significant events by RQS.

The significant events vary between types of devices; thus there is a class of events which are known as 'Device-Specific'. These are determined by the device designer.

IEEE 488.2 Model

The application programmer can enable or disable the event(s) which are required to originate an RQS at particular stages of the application program. The IEEE 488.2 model incorporates a flexible extended status reporting structure in which the requirements of the device designer and application programmer are both met.

This structure is described in the next sub-section, dealing with 'Retrieval of Device Status Information'.

Retrieval of Device Status Information

Introduction

For any remotely-operated system, the provision of up-to-date information about the performance of the system is of major importance. This is particularly so in the case of systems which operate under automatic control, as the controller requires the necessary information feedback to enable it to progress the programmed task, and any break in the continuity of the process can have serious results.

When developing an application program, the programmer needs to test and revise it, knowing its effects. Confidence that the program elements are couched in the correct grammar and syntax (and that the program commands and queries are thus being accepted and acted upon), helps to reduce the number of iterations needed to confirm and develop the viability of the whole program. So any assistance which can be given in closing the information loop must benefit both program compilation and subsequent use.

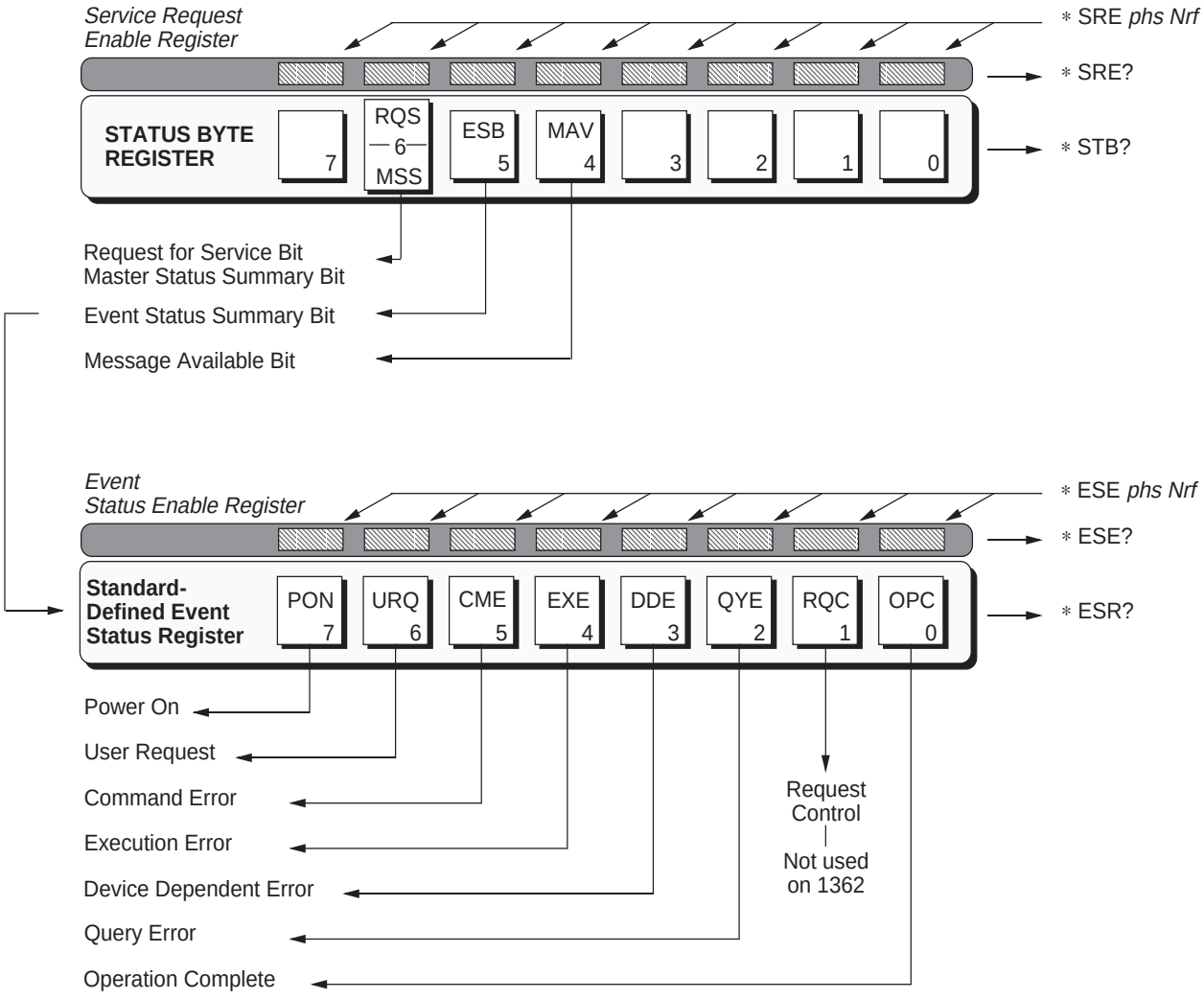


Fig. 5.2 1362 Status Reporting Structure

Standard-Defined Features

Types of Status Information Available

Two main categories of information are provided for the controller:

Status Summary Information

Certain standard events are flagged in the 8-bit latched 'Event Status Register' (ESR), read-accessible to the controller. The user's application program can also access its associated enabling register, to program the events which will be eligible to activate the 'ESB' summary bit in the Status Byte.

Status Byte Register

Contained within the 'Status Byte Register', the 'Status Byte' (STB) consists of three flag bits which direct the controller's attention to the type of event which has occurred. One is the ESB bit mentioned above, the other two (MAV and MSS) are described in detail later.

Access via the Application Program

The application designer has access to two enable registers (one for each main register - Fig. 5-2). The application program can enable or disable any individual bit in these registers.

Each bit in the event status register remains in *false* condition unless its assigned event occurs, when its condition changes to *true*. If an event is to be reported, the application program sets its corresponding enable bit *true*, using the number *Nrf* (defined as a decimal numeric from 0 to 255 in any common format). Then when the enabled event occurs and changes the enabled bit from *false* to *true*, the ESB summary bit in the Status Byte is also set true. If the ESB bit is also enabled, then the 1362 will generate a request true event on the VXI bus.

Thus the application programmer can decide which assigned events will generate an event, by enabling their event bits and then enabling the ESB bit in the Status Byte. The application program can read the Status Byte, and be directed to the Event Register to discover which event was responsible for originating the request.

All registers can be read by suitable commands, as an ASCII decimal numeric, which when expressed in binary, represents the bit pattern in the register. This form is also used to set the enabling registers to the required bit-patterns. The detail for each register is expanded in the following paragraphs, and in the command descriptions.

1362 Status Reporting - Detail

IEEE 488.2 Model

This incorporates the two aspects of the IEEE 488.1 model into an extended structure with more definite rules. These rules invoke the use of standard 'Common' messages and provide for device-dependent messages. A feature of the structure is the use of 'Event' registers, each with its own enabling register as illustrated in Fig. 5.2.

1362 Model Structure

The IEEE 488.2 Standard provides for an extensive hierarchical structure with the Status Byte at the apex, defining its bits 4, 5 and 6 and their use as summaries of a *Standard*-defined event structure which must be included, if the device is to claim conformance with the Standard. The 1362 employs these bits as defined in the Standard.

Bits 0, 1, 2 and 3 and 7 are made available to the device designer, but are not used in the 1362.

It must be recognized by the application programmer that whenever the controller reads the Status Byte, it can only receive summaries of types of events, and further query messages are necessary to dig deeper into the detailed information relating to the events themselves. Thus a further byte is used to expand on the summary at bit 5 of the Status Byte.

Status Byte Register

In this structure the Status Byte is held in the 'Status Byte Register'; the bits being allocated as follows:

Bits 0 (DIO1), **1** (DIO2), **2** (DIO3) and **3** (DIO4) are not used in the 1362 status byte. They are always *false*.

Bit 4 (DIO5) IEEE 488.2-defined Message Available Bit (MAV)

The MAV bit helps to synchronize information exchange with the controller. It is *true* when the 1362 message exchange interface is ready to accept a request from the controller to start outputting bytes from the Output Queue; or *false* when the Output Queue is empty.

The common command ∗CLS can clear the Output Queue, and the MAV bit 4 of the Status Byte Register; providing it is sent immediately following a 'Program Message Terminator'.

Bit 5 (DIO6) IEEE 488.2-defined Standard Event Summary Bit (ESB)

Summarizes the state of the 'Event Status byte', held in the 'Event Status register' (ESR), whose bits represent IEEE 488.2-defined conditions in the device. The ESB bit is *true* when the byte in the ESR contains one or more enabled bits which are *true*; or *false* when all the enabled bits in the byte are *false*. The byte, the Event Status Register and its enabling register are defined by the IEEE 488.1 Standard; they are described later.

Bit 6 (DIO7) is the Master Status Summary Message (MSS bit), and is set *true* if one of the bits 0 to 4 or bit 5 is *true* (bits 0 to 3 and bit 7 are always *false* in the 1362).

Bit 7 (DIO8) is not used in the 1362 status byte. It is always *false*.

Reading the Status Byte Register

∗STB?

Either the common query: ∗STB?, or the VXI word serial 'read STB' command *(Section 3)*, reads the binary number in the Status Byte register. The response is in the form of a decimal number which is the sum of the binary weighted values in the enabled bits of the register. In the 1362, the binary-weighted values of bits 1, 2, 3 and 7 are always zero.

Service Request Enable Register

The SRE register is a means for the application program to select, by enabling individual Status Byte summary bits, those types of events which are to cause the 1362 to originate an RQS. It contains a user-modifiable image of the Status Byte, whereby each *true* bit acts to enable its corresponding bit in the Status Byte.

Bit Selector: ∗SRE *phs Nrf*

The program command: ∗SRE *phs Nrf* performs the selection, where *Nrf* is a decimal numeric, which when decoded into binary produces the required bit-pattern in the enabling byte.

For example:

If an RQS is required only when a Standard-defined event occurs and when a message is available in the output queue, then *Nrf* should be set to 48. The binary decode is 00110000 so bit 4 or bit 5, when *true*, will generate an RQS; but even when bit 0 or bit 6 is *true*, no RQS will result. The 1362 always sets the Status Byte bits 1, 2, 3 and 7 *false*, so they can never originate an RQS whether enabled or not.

Reading the Service Request Enable Register

The common query: ∗SRE? reads the binary number in the SRE register. The response is in the form of a decimal number which is the sum of the binary-weighted values in the register. The binary-weighted values of bits 1, 2, 3 and 7 are always zero.

VXIbus Implementation

An RQS is implemented as a 'request true' event on the VXIbus. Refer to *Section 3*.

IEEE 488.2-defined Event Status Register

The 'Event Status Register' holds the Event Status Byte, consisting of event bits, each of which directs attention to particular information. All bits are 'sticky'; ie. once *true*, cannot return to *false* until the register is cleared. This occurs automatically when it is read by the query: ∗ESR?. The common command ∗CLS clears the Event Status Register and associated error queues, but not the Event Status Enable Register. The bits are named in mnemonic form as follows:

Bit 0 Operation Complete (OPC)
This bit is *true* only if ∗OPC has been programmed *and* all selected pending operations are complete. As the 1362 operates in serial mode, its usefulness is limited to registering the completion of long operations, such as self-test.

Bit 1 Request Control (RQC)
This bit would be *true* if the device were able to assume the role of controller, *and* is requesting that control be transferred to it from the current controller. This capability is not available in the 1362, so bit 1 is always *false*.

Bit 2 Query Error (QYE)
QYE *true* indicates that the controller is following an inappropriate message exchange protocol, resulting in the following situations:

- ***Interrupted Condition.*** When the 1362 has not finished outputting its **Response Message** to a **Program Query**, and is interrupted by a new **Program Message**.
- ***Unterminated Condition.*** When the controller attempts to read a **Response Message** from the 1362 without having first sent the complete **Query Message** (including the **Program Message Terminator**) to the instrument.
- ***Deadlocked Condition.*** When the input and output buffers are filled, with the parser and the execution control blocked.

Bit 3 Device Dependent Error (DDE)
DDE is set *true* when an internal operating fault is detected, for instance during a self test. Each reportable error has been given a listed number, which is appended to an associated queue as the error occurs. The queue is read destructively as a First In Last Out stack, using the query command DDQ? to obtain a code number. The DDE bit is not a summary of the contents of the queue, but is set or confirmed *true* concurrent with each error as it occurs; and once cleared by ∗ESR? will remain *false* until another error occurs. The query DDQ? can be used to read all the errors in the queue until it is empty, when the code number zero will be returned.
The common command ∗CLS clears the queue.

Bit 4 Execution Error (EXE)
An execution error is generated if the received command cannot be executed, owing to the device state or the command parameter being out of bounds.

Bit 5 Command Error (CME)
CME occurs when a received bus command does not satisfy the IEEE 488.2 generic syntax or the device command syntax programmed into the instrument interface's parser, and so is not recognized as a valid command.

Bit 6 User Request (URQ)
This bit is set *true* when, in block measurement mode, the number of measurements programmed for the block measurement have been completed.

Bit 7 1362 Power Supply On (PON)
This bit is not required in the VXI subsystem.

Standard Event Status Enable Register

The ESE register is a means for the application program to select, from the positions of the bits in the standard-defined Event Status Byte, those events which when *true* will set the ESB bit *true* in the Status Byte. It contains a user-modifiable image of the standard Event Status Byte, whereby each *true* bit acts to enable its corresponding bit in the standard Event Status Byte.

Bit Selector: ∗ESE *phs Nrf*

The program command: ∗ESE *phs Nrf* performs the selection, where *Nrf* is a decimal numeric, which when decoded into binary, produces the required bit-pattern in the enabling byte.

For example:

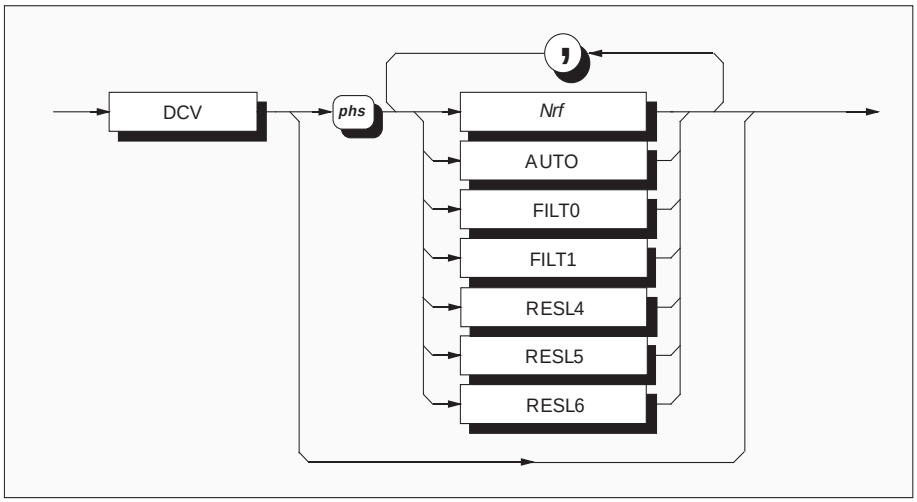
If the ESB bit is required to be set *true* only when an execution or device-dependent error occurs, then *Nrf* should be set to 24. The binary decode is 00011000 so bit 3 or bit 4, when *true*, will set the ESB bit *true*; but when bits 0-2, or 5-7 are *true*, the ESB bit will remain *false*.

Reading the Standard Event Enable Register

The common query: ∗ESE? reads the binary number in the ESE register. The response is in the form of a decimal number which is the sum of the binary-weighted values in the register.

1362 Native Language - IEEE 488.2 Command Syntax Diagrams

Select DC Voltage measurement mode, range, filter and accuracy



Nrf is a decimal numeric value used to select the range.
Thus for a modulus value of Nrf:

Ø to Ø.1999999	selects the 100mV range.
Ø.2 to 1.999999	selects the 1V range.
2.Ø to 19.99999	selects the 10V range.
2Ø to 199.9999	selects the 100V range
>2ØØ	selects the 300V range.

Excessive digits in Nrf are rounded to 6.5 digits.

AUTO selects the autorange facility.
When in AUTO, the DMM attempts to select the most appropriate range, moving up-range on overload and down-range on less than 18% of range. If there is still an overload on the 300V range, then a measurement error will be generated.

A valid Nrf deselects the AUTO mode.

Note: On exit from this function the states of the range, filter and resolution are stored.

On return to this function, these settings are recalled and used as default unless explicitly specified.

FILT1 inserts the analog filter.
The NMRR is 74dB @ 50Hz/60Hz ±0.1%.

FILTØ removes the analog filter.
The NMRR is 54dB @ 50Hz/60Hz ±0.1%.

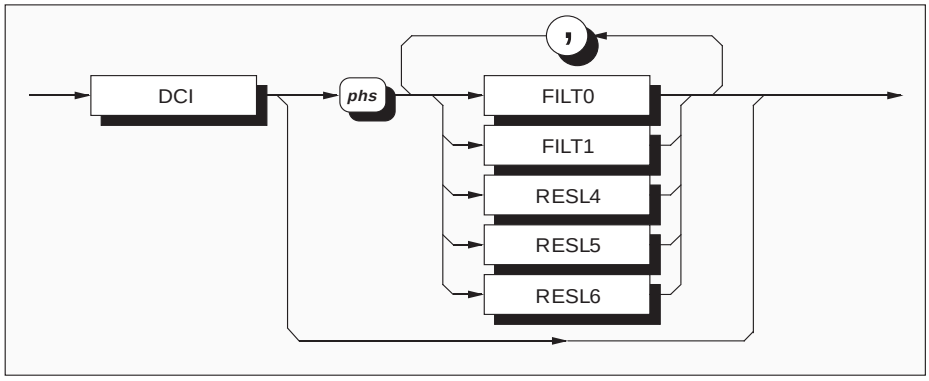
RESL4 sets resolution and A-D performance to 4.5 digits.

RESL5 sets resolution and A-D performance to 5.5 digits.

RESL6 sets resolution and A-D performance to 6.5 digits.

At **Power On** or **Reset**; the default:
DCV (**300V**) **RESL6 FILTØ**
is selected and active.

Select DC Current measurement mode, range, filter and accuracy



The 1A range is the only range available.

FILT1 inserts the analog filter.
The NMRR is 74dB @ 50Hz/60Hz ±0.1%.

FILTØ removes the analog filter.
The NMRR is 54dB @ 50Hz/60Hz ±0.1%.

RESL4 sets resolution and A-D performance to 4.5 digits.

RESL5 sets resolution and A-D performance to 5.5 digits.

RESL6 sets resolution and A-D performance to 6.5 digits.

At **Power On** or **Reset**; the default:

DCI RESL5 FILTØ

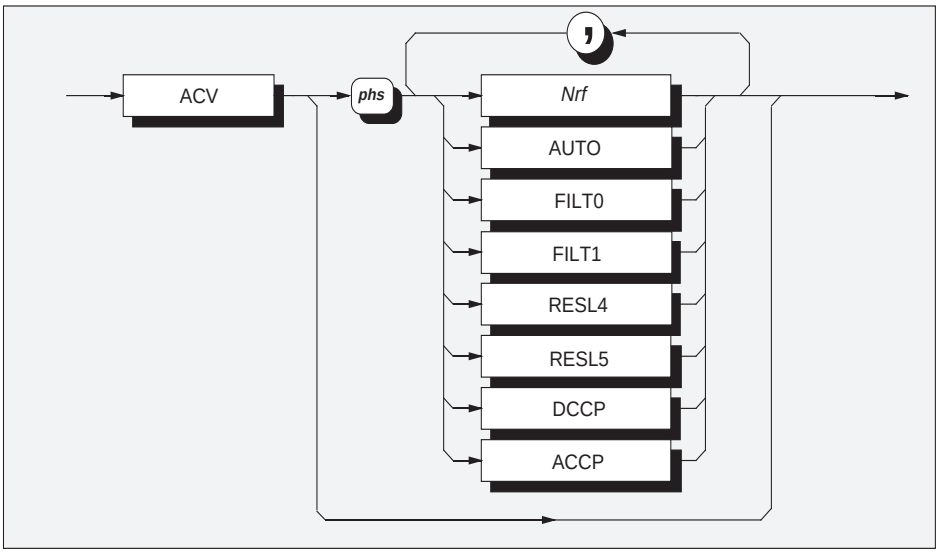
is selected but not active.

An **Execution Error** is generated if the instrument is not fitted with Option 30.

Note: On exit from this function the states of the filter and resolution are stored.

On return to this function, these settings are recalled and used as default unless explicitly specified.

Select AC Voltage measurement mode, range, filter and accuracy



Nrf is a decimal numeric value used to select the range.
Thus for a modulus value of Nrf:

Ø to Ø.199999	selects the 100mV range.
Ø.2 to 1.99999	selects the 1V range.
2.Ø to 19.9999	selects the 10V range.
2Ø to 199.999	selects the 100V range
>2ØØ	selects the 300V range.

Excessive digits in Nrf are rounded to 5.5 digits.

AUTO selects the autorange facility.
When in AUTO, the DMM attempts to select the most appropriate range, moving up-range on overload and down-range on less than 18% of range. If there is still an overload on the 300V range, then a measurement error will be generated.

A valid Nrf deselects the AUTO mode.

FILT1 inserts the analog filter.

FILTØ removes the analog filter.

RESL4 sets resolution and A-D performance to 4.5 digits.

RESL5 sets resolution and A-D performance to 5.5 digits.

DCCP DC-coupled.

ACCP AC-coupled.

Filter Combinations:
FILTØ and **ACCP**: >360Hz; AC-coupled.
FILTØ and **DCCP**: >360Hz; DC-coupled.
FILT1 and **ACCP**: >40Hz; AC-coupled.
FILT1 and **DCCP**: >10Hz; DC-coupled.

At **Power On** or **Reset**; the default:

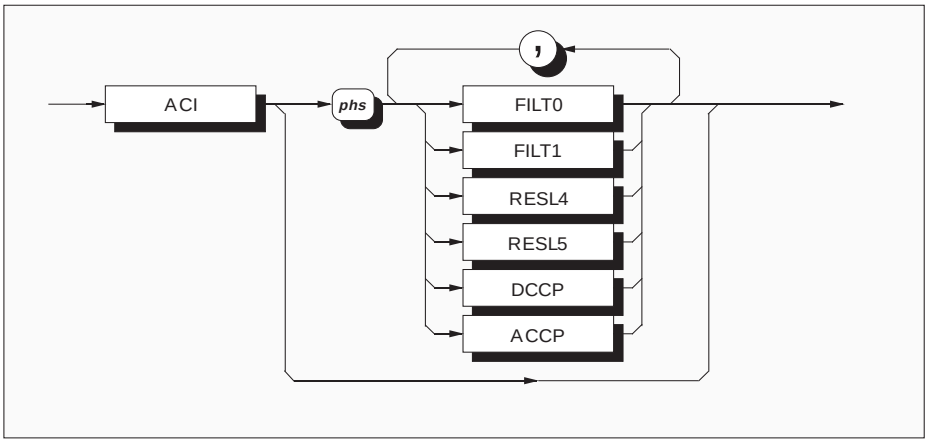
ACV (300V) RESL5 FILTØ ACCP

is selected but not active.

Note: On exit from this function the states of the range, filter, resolution and coupling are stored.

On return to this function, these settings are recalled and used as default unless explicitly specified.

Select AC Current measurement mode, range, filter and accuracy



The 1A range is the only range available.

FILT1 inserts the analog filter.

FILTØ removes the analog filter.

RESL4 sets resolution and A-D performance to 4.5 digits.

RESL5 sets resolution and A-D performance to 5.5 digits.

DCCP DC-coupled.

ACCP AC-coupled.

Filter Combinations:
FILTØ and **ACCP**: >360Hz; AC-coupled.
FILTØ and **DCCP**: >360Hz; DC-coupled.
FILT1 and **ACCP**: >40Hz; AC-coupled.
FILT1 and **DCCP**: >10Hz; DC-coupled.

At **Power On** or **Reset**; the default:

ACI RESL5 FILTØ ACCP

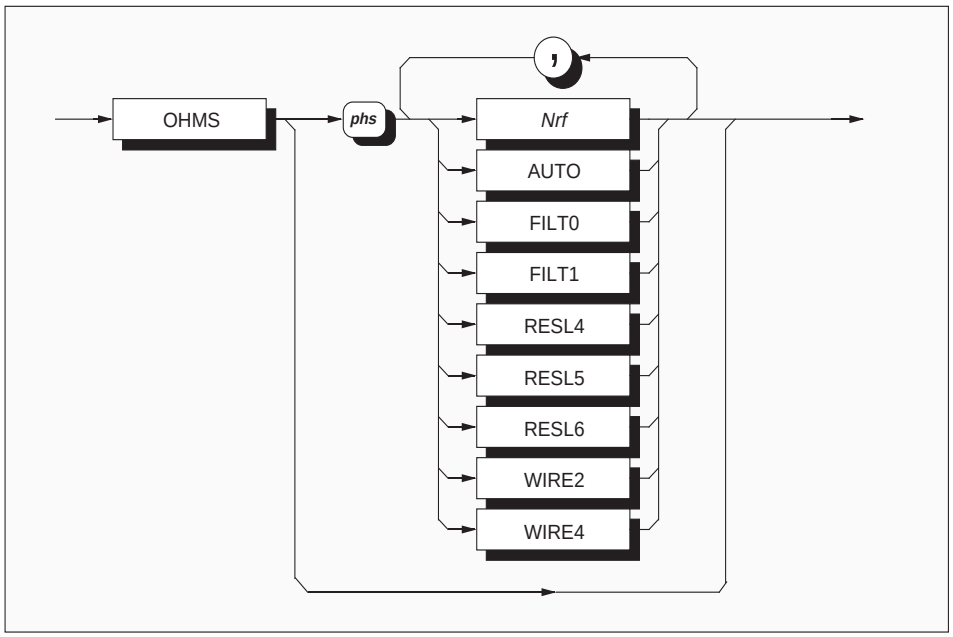
is selected but not active.

An **Execution Error** is generated if the instrument is not fitted with Option 30.

Note: On exit from this function the states of the filter, resolution and coupling are stored.

On return to this function, these settings are recalled and used as default unless explicitly specified.

Select Ohms measurement mode, range, filter and accuracy



Nrf is a decimal numeric value used to select the range. Thus for a modulus value of Nrf:

Ø to 199.9999	selects the 100Ω range.
2ØØ to 1999.999	selects the 1kΩ range.
2ØØØ to 19999.99	selects the 10kΩ range.
2ØØØØ to 199999.9	selects the 100kΩ range
2ØØØØØ to 1999999	selects the 1MΩ range
>2ØØØØØØ	selects the 10MΩ range.

Excessive digits in Nrf are rounded to 6.5 digits.

AUTO selects the autorange facility.
When in AUTO, the DMM attempts to select the most appropriate range, moving up-range on overload and down-range on less than 18% of range. If there is still an overload on the 10MΩ range, then a measurement error will be generated.

A valid Nrf deselects the AUTO mode.

FILT1 inserts the analog filter.
The NMRR is 74dB @ 50Hz/60Hz ±0.1%.

FILTØ removes the analog filter.
The NMRR is 54dB @ 50Hz/60Hz ±0.1%.

RESL4 sets resolution and A-D performance to 4.5 digits.

RESL5 sets resolution and A-D performance to 5.5 digits.

RESL6 sets resolution and A-D performance to 6.5 digits.

WIRE2 - Two-wire input connection.

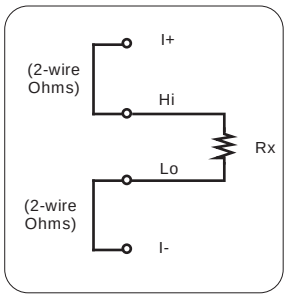
WIRE4 - Four-wire input connection.

At **Power On** or **Reset**; the default:
OHMS (10MΩ) RESL6 FILTØ WIRE4
is selected but not active.

Note: On exit from this function the states of the range, filter resolution and 2/4 wire connection are stored.

On return to this function, these settings are recalled and used as default unless explicitly specified.

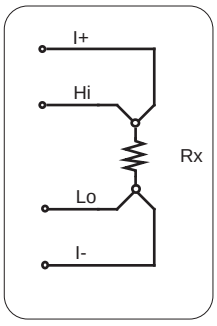
2-Wire Measurements



For the majority of applications the simple 2-wire arrangement will be adequate. However, the value displayed will include the resistance of the connecting leads.

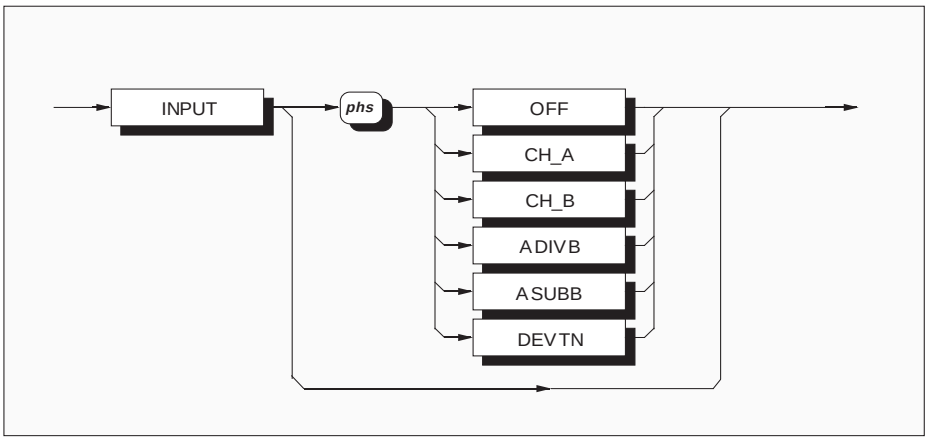
Use a twisted pair cable to reduce induced voltages, particularly where Rx is high.

4-wire Measurements



With a 4-wire connection the lead resistances have negligible effect and only the value of Rx is displayed.

Select an input port and the ratio mode



All of the above selections are mutually exclusive.

OFF disconnects all inputs.

CH_A selects Channel A inputs *(See Sect. 2 p2-3).*

Option 40 Selections:

CH_B selects Channel B inputs *(See Sect. 2 p2-3).*

ADIVB takes readings from Channel A and Channel B input alternately, then divides the Channel A reading by the Channel B reading to produce the result.

ASUBB takes readings from Channel A and Channel B input alternately, then subtracts the Channel B reading from the Channel A reading to produce the result.

DEVTN takes readings from both channels **A** and **B**. The resulting deviation data obtained from this mode is of the form:

(A - B) / B

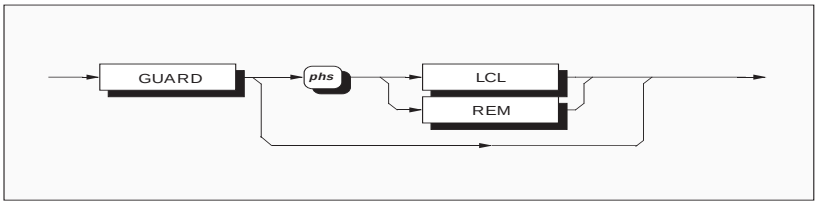
At **Power On** or **Reset**; the default:

INPUT OFF

is selected and active.

An **Execution Error** is generated if the instrument is not fitted with Option 40, together with an attempt being made to select **CH_B**, **ADIVB**, **ASUBB** or **DEVTN**.

Select Local or Remote Guard



The above selections are mutually exclusive.

LCL Internal guard tracks and shields are internally connected to Signal Common. The Guard pins of the front panel Input plug are open circuit.

REM Internal guard tracks and shields are disconnected from Signal Common, and connected to the selected channel's Guard pin on the front panel Analog Input plug (Ch A - pin 7; Ch B - pin 9).

At **Power On** or **Reset**; the default:

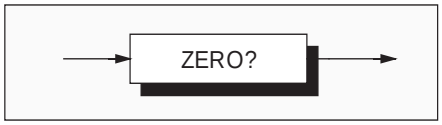
GUARD LCL

is selected and active.

Perform Input Zero

This command is used to remove the offsets at zero input. To ensure true zero input, the front panel input plug Hi and Lo pins must be shorted together. Channels A (Hi - pin 1; Low - pin 5) and B (option 40 only - Hi - pin 15; Low - pin 11) are zeroed separately, and only the selected channel is zeroed.

The corrections are held in volatile memory, but are cleared only on power down.



Response:

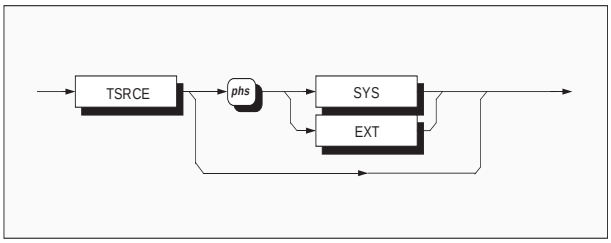
Ø t	No errors present.
1 t	Errors present.

Where: **t** = **;** or **<lf>**

If any errors are present, the relevant error codes are placed in a queue which is accessible using the request **DDQ?**.
(See ****TST?*** *on page 5-28.)*

Note: **ZERO?** is not accepted in Autorange, or in any AC function. In these cases an **Execution Error** is generated.

Select Trigger Source



This command selects either the 'System' or an external trigger to initiate a measurement.

If **SYS** is selected, then measurements can be taken using ***TRG**; **X?**; or the VXI word serial trigger command.

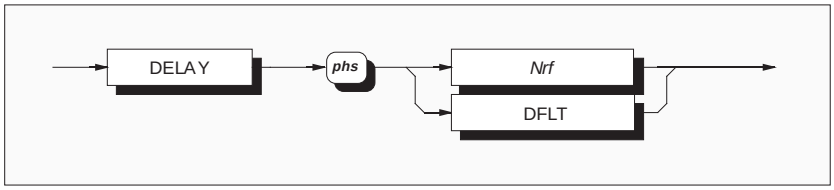
If **EXT** is selected, then measurements will be taken on receipt of suitable hardware triggers from the front panel BNC connector.

At **Power On** or **Reset**; the default:

TSRCE SYS

is selected and active.

Select a Trigger Delay



This command sets the time delay between the trigger being received and the start of the analog-to-digital conversion.

DFLT
Each measurement mode and function has its own default delay setting (fixed in firmware) which will be used if **DFLT** is selected.

Nrf
This is a decimal numeric value used to set the delay time. Its basic units are **seconds**.

The span of the Nrf delay counter is from 0 to 10s. An Nrf of greater than 10s results in a delay of 10s. For shorter delays, the resolution of the intervals between delay-time settings is dependent on the size of the memory used to store the delay-time data. This is as follows:

Delay Selection	Resolution
≤10ms	10µs
≤100ms	100µs
≤1s	1ms
≤10s	10ms

If a fast read-rate is required, then Nrf must be used and set to zero.

Once a non-default delay is set, it remains set until either a new Nrf is set or DFLT is selected, even if there is a range or function change. However, the default delay will be forced when there is an update during a measurement cycle, such as when autoranging or switching channels in Ratio mode.

At **Power On** or **Reset**; the default:

DELAY DFLT

is selected and active.

1362 Delay Default Tables

- The delays listed in the following tables are active unless a specific delay is programmed.
- Once programmed, a specific delay will be applied to all subsequent readings until either the DELAY DFLT command is received, or the instrument is returned to local control. Delays then return to their default values.

DCV, **DCI**, **ACV** & **ACI**

Funct	Filt.	Default Delay
DCV & DCI	Out In	5ms 300ms
ACV & ACI	Out In	200ms 500ms (2.5 secs if dccp selected)

Ohms

Range	Filt.	Default Delay
100Ω - 100kΩ	Out In	5ms 750ms
1MΩ	Out In	30ms 1s
10MΩ	Out In	300ms 10s

Perform a System Trigger

An **Execution Error** is generated if an input channel is not connected.

Fetch the Last Reading

Response for 4.5 digit resolution is an ***Nrf***:

1	2	3	4	5	6	7	8	9	10	11	12
s	**n**	**x**	**x**	**x**	**n**	**n**	**E**	**s**	**n**	**n**	**t**

Response for 5.5 digit resolution is an ***Nrf***:

1	2	3	4	5	6	7	8	9	10	11	12	13
s	**n**	**x**	**x**	**x**	**n**	**n**	**n**	**E**	**s**	**n**	**n**	**t**

Response for 6.5 digit resolution is an ***Nrf***:

1	2	3	4	5	6	7	8	9	10	11	12	13	14
s	**n**	**x**	**x**	**x**	**n**	**n**	**n**	**n**	**E**	**s**	**n**	**n**	**t**

Where:

s = the sign: + or **-**.
n = ASCII digit **Ø** to **9**.
x = either **n** or an ASCII decimal point.
E = ASCII character identifying the exponent.
t = **;** or **<lf>** (= line feed).

Response for Overload: **2ØØ.ØØØE+33 t**

The normal response is the most-recent measurement, which is read but not destroyed.

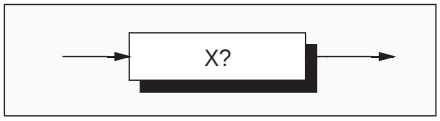
If a request is received while the DMM analog-to-digital conversion is still in progress; then that conversion is allowed to complete, and its result is given as the response.

If **RDG?** is sent when **no** trigger has been received since **Power On** or **Reset**, the following response is generated:

-2Ø.ØØØØE+36 t

Where: **t** = **;** or <**lf**>

Perform a System Trigger and output the result



Response: **2ØØ.ØØØE+33 t** Overload.

Where: **t = ;** or **<lf>** if this is a single query command or the last message in a multiple query command.

This command terminates any **BLOCK** measurement in progress.

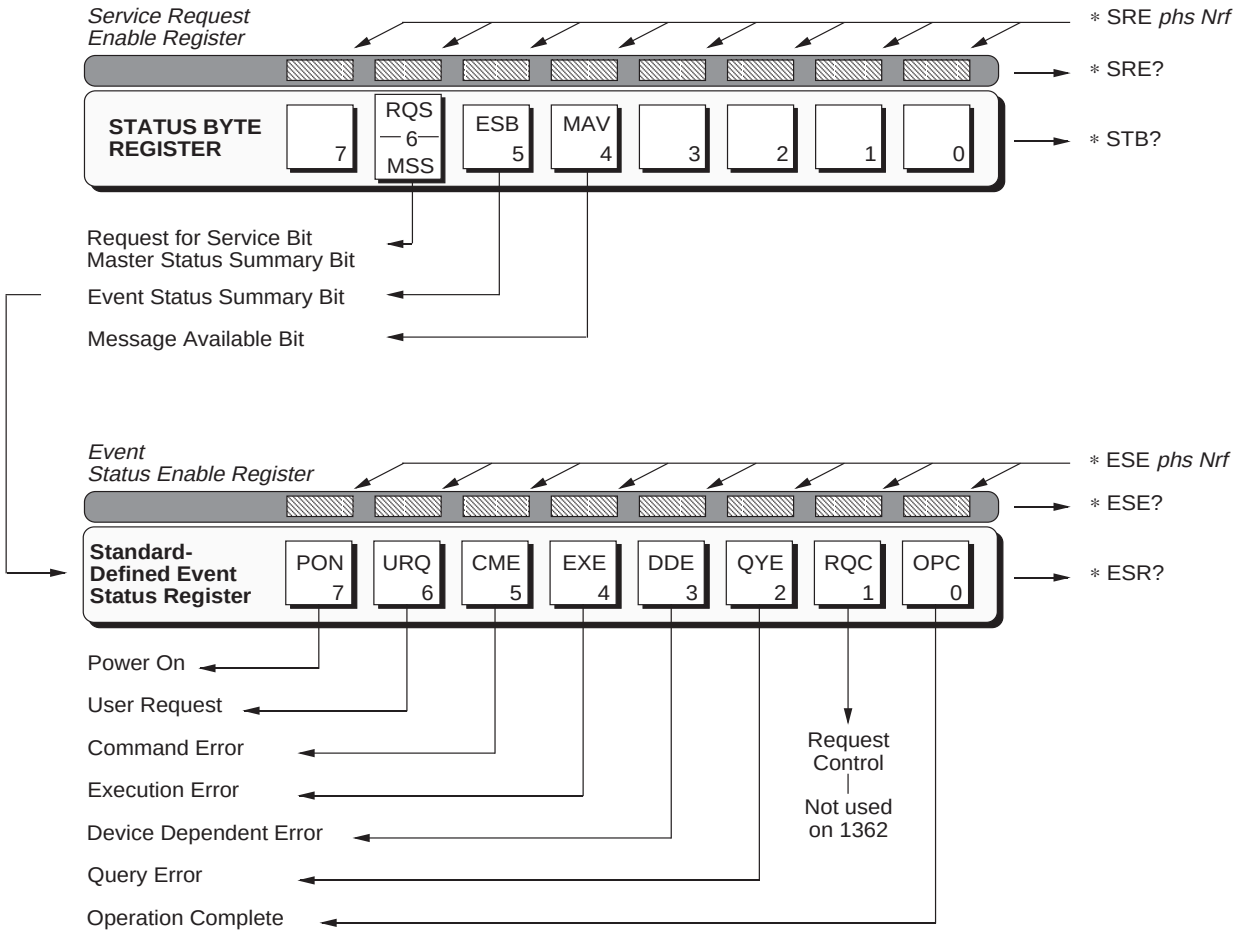
An **Execution Error** is generated if an input channel is not connected. A response is also generated:

Response with Execution Error: **2Ø.ØØØØE+36 t**

Where: **t = ;** or **<lf>**

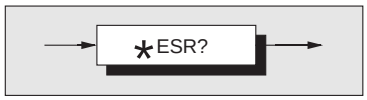
Status Reporting

Status Byte and Event Status Registers



Read Event Status Register

This event status data structure conforms to the IEEE 488.2 standard requirements for this structure.



∗ESR?
recalls the standard defined events.

Response Format:

Character position

1	2	3	4
n	n	n	nl

Where:

n = 0 to 9
nl = newline

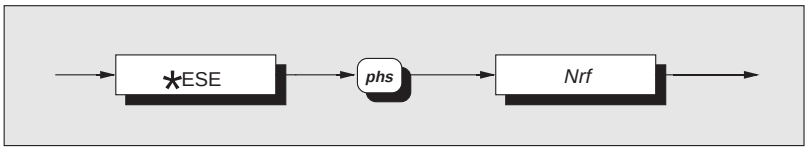
Response Decode:
The value returned, when converted to base 2 (binary), identifies the bits as described on *page 5-12*, and defined in the IEEE 488.2 standard.

Execution Errors:
None

Power On and Reset Conditions
The register is cleared.

Event Status Enable

This event status data structure conforms to the IEEE 488.2 standard requirements for this structure.



∗**ESE** enables the standard defined event bits which will generate a summary message in the status byte.

Nrf is a Decimal Numeric Data Element representing an integer decimal value equivalent to the Hex value required to enable the appropriate bits in this 8-bit register. Note that numbers **will** be rounded to an integer.

Execution Errors:
None.

Power On and Reset Conditions
Not applicable.

Recall Event Status Enable

This event status data structure conforms to the IEEE 488.2 standard requirements for this structure.

∗**ESE?** recalls the enable mask for the standard defined events.

Response Format:

Character position

1	2	3	4
n	n	n	nl

Where:

n = 0 to 9
nl = newline

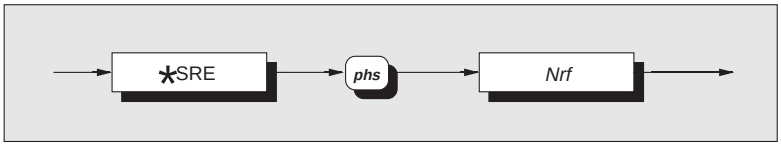
Response Decode:
The value returned, when converted to base 2 (binary), identifies the enabled bits which will generate a summary message in the service request byte, for this data structure.

Execution Errors:
None

Power On and Reset Conditions
The register is cleared.

Service Request Enable

This measurement event status data structure conforms to the IEEE 488.2 standard requirements for this structure.



***SRE** enables the standard and user-defined summary bits in the service request byte, which will generate a service request.

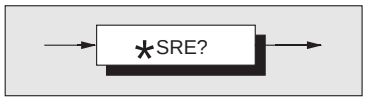
Nrf is a Decimal Numeric Data Element representing an integer decimal value equivalent to the Hex value required to enable the appropriate bits in this 8-bit register. Note that numbers **will** be rounded to an integer.

Execution Errors:
None.

Power On and Reset Conditions
Not applicable.

Recall Service Request Enable

This measurement event status data structure conforms to the IEEE 488.2 standard requirements for this structure.



***SRE?**
recalls the enable mask for the standard defined events.

Response Format:

Character position

1	2	3	4
n	n	n	nl

Where:

n = 0 to 9
nl = newline

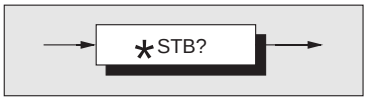
Response Decode:
The value returned, when converted to base 2 (binary), identifies the enabled bits which will generate a service request.

Execution Errors:
None.

Power On and Reset Conditions
None.

Read Service Request Register

This measurement event status data structure conforms to the IEEE 488.2 standard requirements for this structure.



∗STB?
recalls the service request register for summary bits.

Response Format:

Character position

1	2	3	4
n	n	n	nl

Where:

n = 0 to 9
nl = newline

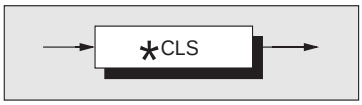
Response Decode:
The value returned, when converted to base 2 (binary), identifies the summary bits for the current status of the data structures involved. There is no method of clearing this byte directly. Its condition relies on the clearing of the overlying status data structure.

Execution Errors:
None.

Power On and Reset Conditions
Not applicable.

Clear Status

This measurement event status data structure conforms to the IEEE 488.2 standard requirements for this structure.

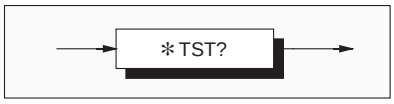


∗CLS
clears all the event registers and queues except the output queue. The output queue and MAV bit will be cleared if ∗CLS immediately follows a 'Program Message Terminator.

Execution Errors:
None.

Power On and Reset Conditions
Not applicable.

Perform Selftest



Response code:

Ø t Indicates test complete with no errors.

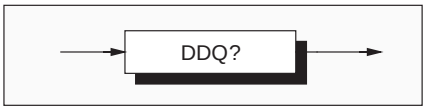
1 t Indicates test complete with errors detected.

Where:

t = ; or **<lf>** (= line feed).

In the event of an error, the DDE bit in the Event Status Register will be set. An identifying number will be placed in the associated error queue. The error number can be read using the **DDQ?** query.

Recall Device Errors



Recalls the last error from the queue of device-dependent errors.

Response:

n n n n t

Where:

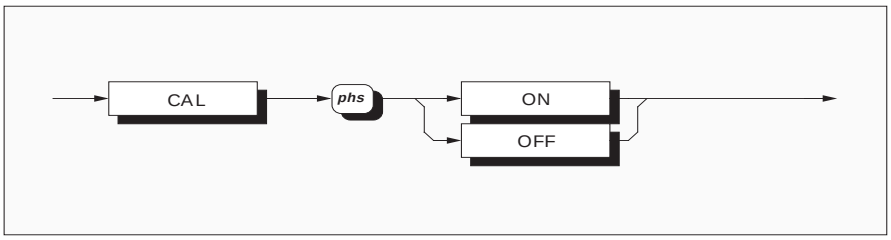
n = ASCII digit **Ø** to **9**.

t = ; or **<lf>** (= line feed).

Errors relating to the numbers returned:

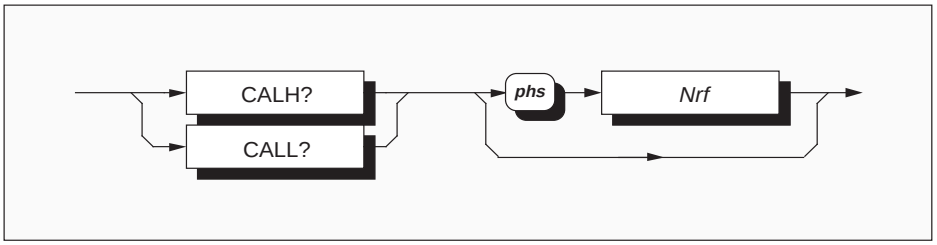
Ø	queue empty	
1ØØ	A/D transfer; bad data	
1Ø1	Internal calculation error	
1Ø2	System queue overflow	
15Ø	Calibration measurement overflow	
151	Calibration constants corrupt	
152	Illegal cal store access	
153	Invalid non-nominal calibration value	
16Ø	Illegal test number	
17Ø	Corrupt Default Line Frequency	
5ØØ	Selftest:	+10V DC
5Ø1	Selftest:	-10V DC
5Ø5	Selftest:	-10V DC filter
5Ø6	Selftest:	+10V DC filter
5Ø7	Selftest:	+10V DC filter
51Ø	Selftest:	+1V DC
515	Selftest:	+100mV DC
52Ø	Selftest:	divider check
53Ø	Selftest:	+10V AC
531	Selftest:	-10V AC
532	Selftest:	+1V AC
533	Selftest:	+100mV AC
535	Selftest:	10V zero filter
536	Selftest:	+10V filter
537	Selftest:	+10V filter
54Ø	Selftest:	1kΩ
541	Selftest:	10kΩ
542	Selftest:	100kΩ
543	Selftest:	1MΩ
55Ø	Selftest:	Current fuse
551	Selftest:	AC preamp offset
552	Selftest:	AC/DC Relay

Enable calibration mode



An **Execution Error** is generated if the external cal switch is not in the enabled position (**Up**) when this command is received.

Perform an Autocalibration



If **CALL?** is selected, then the operation will correct the **zero point** (generally the 1% point for AC) in the two-point calibration.

If **CALH?** is selected, then the operation will correct the **Full Range point** in the two-point calibration.

If ***Nrf*** is present, then the operation will use its value as the non-nominal target in the requested calibration.

Response:

Ø t	Calibration complete with no errors.
1 t	Calibration complete but with errors present.

Where: **t** = **;** or <**lf**>

Execution Errors:
Calibration can only be executed if the following conditions are met:

1. The external cal switch must be in the enable position (**Up**), **and** the calibration mode must have been turned on by sending the **CAL ON** command; before this command is received.

If either of these conditions is not fulfilled, then an execution error will be generated.

2. When an ***Nrf*** is used, it must be compatible with the setting to be calibrated.

If an Nrf is present, but it is not compatible with the setting; then an execution error will be generated.

Recall Calibration Constants

Response Code:

1	2	3	4	5	6	7	8	9	10	11	12	13	14
s	**n**	**x**	**x**	**x**	**n**	**n**	**n**	**n**	**E**	**s**	**n**	**n**	**,**
15	16	17	18	19	20	21	22	23	24	25	26	27	28
s	**n**	**x**	**x**	**x**	**n**	**n**	**n**	**n**	**E**	**s**	**n**	**n**	**,**
29	30	31	32	33	34	35	36	37	38	39	40	41	42
s	**n**	**x**	**x**	**x**	**n**	**n**	**n**	**n**	**E**	**s**	**n**	**n**	**t**

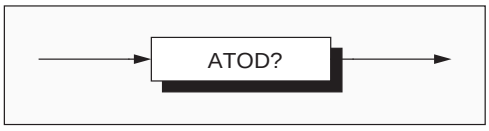
Where:

s = the sign: + or **-**.
n = ASCII digit **Ø** to **9**.
x = either **n** or an ASCII decimal point.
E = ASCII character identifying the exponent.
t = **;** or **<lf>** (= line feed).

The numbers returned relate only to the currently-selected function and range.

The first number is the positive gain factor, the second is the negative gain factor, and the third is the zero offset. For AC and Ohms functions, the negative gain factor returned is always unity.

Recall A/D Calibration Constants



Response Code:

1	2	3	4	5	6	7	8	9	10	11	12	13	14
s	**n**	**x**	**x**	**x**	**n**	**n**	**n**	**n**	**E**	**s**	**n**	**n**	**,**
15	16	17	18	19	20	21	22	23	24	25	26	27	28
s	**n**	**x**	**x**	**x**	**n**	**n**	**n**	**n**	**E**	**s**	**n**	**n**	**,**
29	30	31	32	33	34	35	36	37	38	39	40	41	42
s	**n**	**x**	**x**	**x**	**n**	**n**	**n**	**n**	**E**	**s**	**n**	**n**	**t**

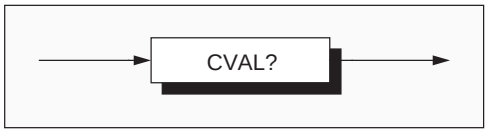
Where:

s = the sign: + or **-**.
n = ASCII digit **Ø** to **9**.
x = either **n** or an ASCII decimal point.
E = ASCII character identifying the exponent.
t = **;** or **<lf>** (= line feed).

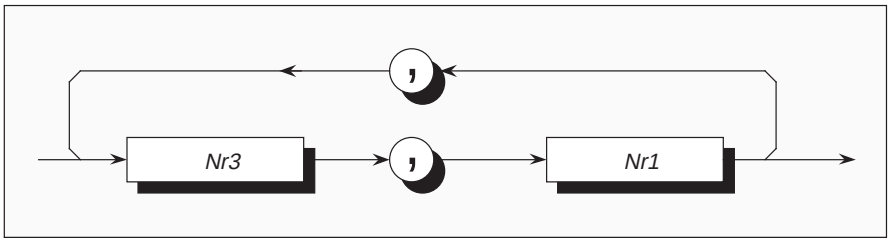
The numbers returned relate only to the currently-selected line frequency and resolution.

The first number is the positive gain factor, the second is the negative gain factor, and the third is the zero offset.

Recall Calibration Values Stored during Calibration Sequence



Response Format



Response Detail

A calibration trigger (see **CALH?** and **CALL?** earlier) can initiate several 'Calibration Operations', depending on the type of calibration being performed.

Each Calibration Operation takes four readings. It then computes their mean, which ultimately results in a correction constant (sometimes directly, and sometimes by computation with the means of other operations).

Thus a group of five values (four readings and their mean) results from every operation. Each group is placed into the calibration buffer and all five values can be recalled by a single **CVAL?** query.

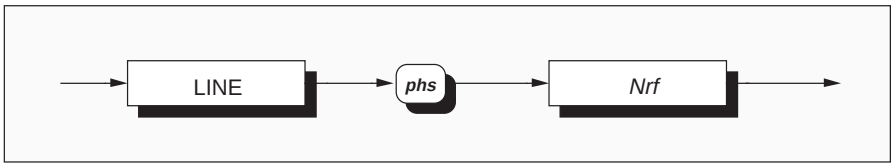
They are returned as five pairs of numbers, the first four pairs representing the reading values and the fifth pair representing their mean; all from a single calibration operation. In each pair, the first number is the value itelf *(Nr3 format)* and the second is its index number *(Nr1 format)* in the calibration buffer.

The calibration buffer has sufficient capacity for the greatest number of operations to result from a single calibration trigger.

CVAL? returns the values from the calibration buffer, starting at the highest occupied buffer location, decrementing the index number as it reads each value. When the index reaches Ø, all the values have been read. Any subsequent **CVAL?** continues to return both the value at index Ø and the index No Ø, until another calibration trigger is commanded.

The next calibration trigger will place new values in the buffer as the calibration operations proceed, starting again at register Ø.

Line Frequency Selection

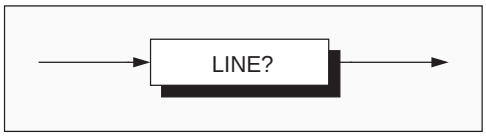


This command selects the line frequency and thus the optimum A/D configuration for this frequency. It should always be selected with care before using STLN, as it is stored as the default power up and reset configuration by that command.

The only numbers accepted by this command are: 5Ø, 6Ø, or 4ØØ.

N.B. Partial Calibration of the 1362
When carrying out a partial calibration, ensure that the programmed frequency is the same as that for the most-recent full calibration. Otherwise, small offsets may be introduced which can only be removed by a full calibration.

Read the Line Frequency Switch Setting



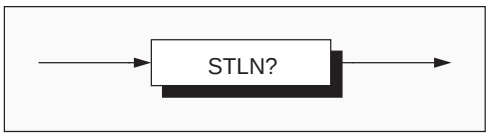
Two numbers are returned: the **first** indicates the currently-selected line frequency; the **second** is the default which is set at power on or reset, or at calibration trigger.

Response:

5Ø t 50Hz.
6Ø t 60Hz.
4ØØ t 400Hz.

Where: **t** = **;** or <**lf**>

Save Default Line Frequency



This command saves the currently-selected line frequency for use as the default frequency under Power On and Reset conditions.

Response:

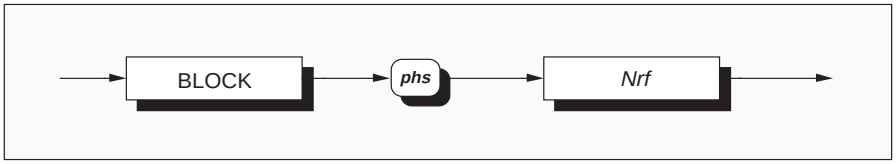
Ø t Save successful, no errors present.
1 t Errors present.

Where: **t** = **;** or <**lf**>

Execution Errors:
Errors are generated if calibration is not enabled with both the CAL switch and the CAL ON command.

If this value is corrupt, then the default becomes 60Hz.

Set the Number of Readings to be Taken in a Block



This command arms the DMM to take the next Nrf triggers and put the results into the block reading buffer. These may then be accessed by the **BRCL?** query.

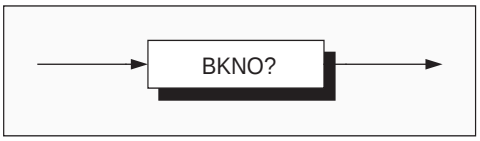
After Nrf triggers have been received, the DMM generates a URQ in the Standard Event Status Register, then resumes placing single measurements in the output queue.

The Span of Nrf is 1 to 1ØØØ.

Execution Errors:
An error is generated if Nrf is less than 1 or greater than 1ØØØ.

Note:
Receipt of the **X?** query terminates the **BLOCK** operation.

Read the Number of Readings Present in the Block Store

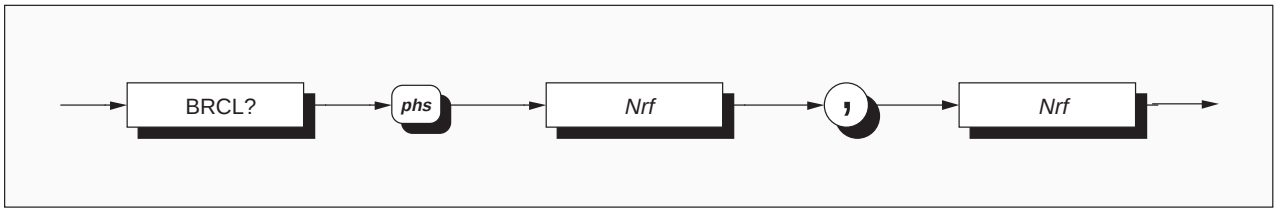


Response:

Nr1

This request also terminates the operation of the **BLOCK** command if sufficient triggers have not been received.

Recall the readings from the block store



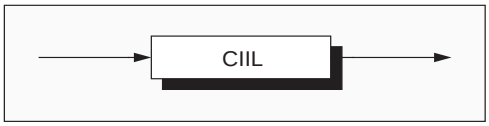
The first Nrf is the start point for readings from the buffer; the second Nrf is for the finish point.

The readings are returned in the format described for the RDG? query, successive readings being separated by a comma.

Execution Errors:
An error is generated if the start value is greater than the end value, or if the end value is greater than the number of readings in the buffer.

Note:
This query terminates the operation of the **BLOCK** command if sufficient triggers have not been received.

Return to CIIL

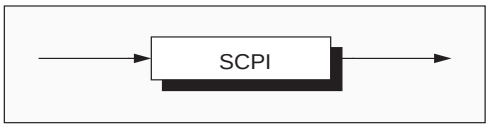


This directs the DMM to interpret CIIL commands instead of IEEE 488.2 commands. It is the complement of the CIIL command **GAL**.

Command Errors:

A command error is generated if the instrument is not a Model 1362MT.

Return to SCPI

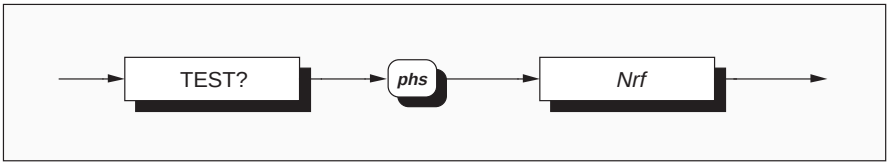


This directs the DMM to interpret SCPI commands instead of IEEE 488.2 commands. It is the complement of the SCPI command `SYSTem LANguage NATive`.

Command Errors:

A command error is generated if the instrument is not a Model 1362S.

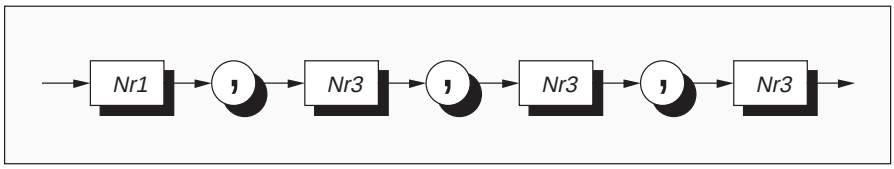
Perform an Individual Test from the Selftest List



The Nrf for this command gives the test number to be performed. The test will leave the DMM in the hardware configuration required for the test.

Note that the individual test numbers used in this command are the same as the numbers of the failed test that are reported by the DDQ? query. For group test add 100 to the test number.

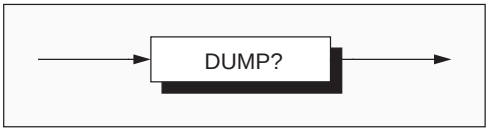
Response Code



The Nr1 in this response is either **Ø** for test pass
or **1** for test fail

The first Nr3 is the value measured by the DMM during the test.
The second Nr3 is the absolute high limit of the test.
The third Nr3 is the absolute low limit of the test.

Recall Test Measurements



This command fetches the result of a test from the test buffer and reports it only in a normalized format: 0 - 1.9999.

The buffer is organized to increment on each read until it hits the 'empty' marker when it will reset to the start. The 'empty' indicator is a large negative number -19.ØØØØØE+33. A new test will overwrite the previous values.

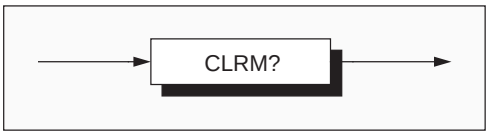
Response Code:

1	2	3	4	5	6	7	8	9	10	11	12	13	14
s	**n**	**x**	**x**	**x**	**n**	**n**	**n**	**n**	**E**	**s**	**n**	**n**	**t**

Where:

s = the sign: + or **-**.
n = ASCII digit **Ø** to **9**.
x = either **n** or an ASCII decimal point.
E = ASCII character identifying the exponent.
t = **;** or **<lf>** (= line feed).

Clear the Calibration Store (EEPROM)



IMPORTANT!

This operation clears **all** calibration memories (except serial number, default frequency and those items stored using the ***PUD** code).

Response:

Ø t Operation successful, no errors present.
1 t Errors present.

Where: **t** = **;** or <**lf**>

If any errors are present, the relevant error codes are placed in a queue which is accessible using the request **DDQ?**.

Execution Errors:
The calibration store can be cleared only if the following conditions are met:

- The external cal switch must be in the enable position (**Up**), **and** the calibration mode must have been turned on by sending the **CAL ON** command; before this command is received.

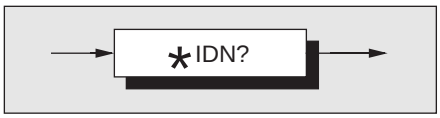
If either of these conditions is not fulfilled, then an execution error will be generated.

Mandatory IEEE 488.2 Commands

All of the commands under this heading are common commands or queries defined in the IEEE-488.2 standard.

I/D (Identification)

This command conforms to the IEEE 488.2 standard requirements.



∗IDN?
will recall the instrument's manufacturer, model number, serial number and firmware level.

Examples of Response Format:

Character Positions:

```
 1  2  3  4  5  6  7  8  9 10 11 12 13
 W  A  V  E  T  E  K  ,  1  3  6  2  ,

14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
 2  3  4  5  6  7                    ,  Ø  1  .  Ø  2 <lf>
```

```
 1  2  3  4  5  6  7  8  9 10 11 12 13 14
 W  A  V  E  T  E  K  ,  1  3  6  2  S  ,

15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33
 3  4  5  6  7  8                    ,  Ø  1  .  Ø  2 <lf>
```

```
 1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
 W  A  V  E  T  E  K  ,  1  3  6  2  M  T  ,

16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34
 4  5  6  7  8  9                    ,  Ø  1  .  Ø  2 <lf>
```

Where:
The data contained in the response consists of four comma-separated fields, the last two of which are instrument-dependent.

<lf> = Linefeed

The data element type is defined in the IEEE 488.2 standard specification.

Response Decode:
The data contained in the four fields is organized as follows:

- First field - manufacturer
- Second field - model
- Third field - serial number
- Fourth field - firmware level (will possibly vary from one instrument to another).

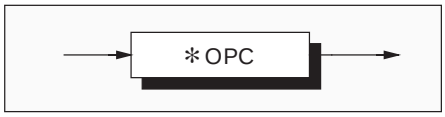
Execution Errors:
None.

Power On and Reset Conditions
Not applicable.

Mandatory IEEE 488.2 Commands (Contd.)

Operation Complete

This command conforms to the IEEE 488.2 standard requirements.



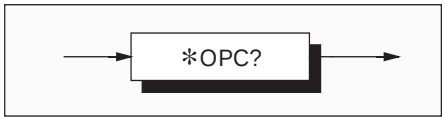
***OPC**
is a synchronization command which will generate an operation complete message in the standard Event Status Register when all pending operations are complete.

Execution Errors:
None.

Power On and Reset Conditions
Not applicable.

Operation Complete?

This command conforms to the IEEE 488.2 standard requirements.



Response Format:

Character position
1 2
n nl

Where:

n = 1
nl = newline

Response Decode:
The value returned is always 1, which is placed in the output queue when all pending operations are complete.

Reset

This command conforms to the IEEE 488.2 standard requirements.

∗RST
will reset the instrument to a defined condition, detailed in Appendix B to this section.

The reset condition is independent of past-use history of the instrument except as noted below:

∗RST does not affect the following:

- the selected address of the instrument;
- calibration data that affect specifications;
- SRQ mask conditions;
- the state of the IEEE 488 interface;
- stored math constants.

Execution Errors:
None.

Power On and Reset Conditions
Not applicable.

Wait

This command conforms to the IEEE 488.2 standard requirements.

∗WAI
prevents the instrument from executing any further commands or queries until the *No Pending Operations Flag* is set true. This is a mandatory command for IEEE-488.2 but has no relevance to this instrument as there are no parallel processes requiring Pending Operation Flags.

Execution Errors:
None.

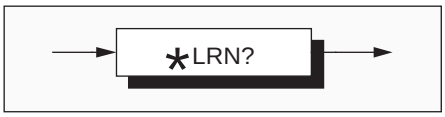
Power On and Reset Conditions
Not applicable.

Optional IEEE 488.2 Commands

From a choice of many commands, the following are included because of their relevance to the 1362.

Recall Current Instrument Settings

This command conforms to the IEEE 488.2 standard requirements.



***LRN?**
returns data about the current settings of the instrument. The response given below must be regarded as only typical, as there are many combinations of possible responses. The maximum number of characters that can be expected is 90.

Response Format:

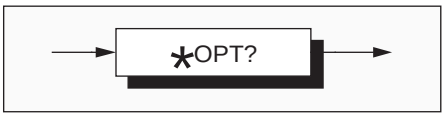
Character Positions:

```
 1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20
 O  H  M  S     1  E  +  7  ,  W  I  R  E  4  ,  F  I  L  T
21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
 Ø  ,  R  E  S  L  5  ;  I  N  P  U  T     C  H  -  A  ;  G
41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
 U  A  R  D     L  C  L  ;  T  S  R  C  E     S  Y  S  ;  D
61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
 E  L  A  Y  D  F  L  T  ;  C  A  L     O  F  F  t
```

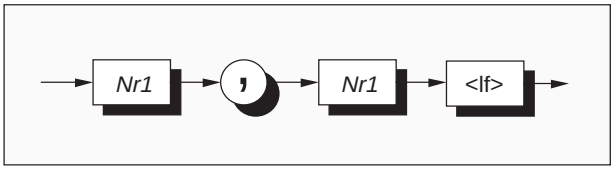
Where:

r	=	test result: Ø or 1.
s	=	the sign: + or -.
n	=	ASCII digit Ø to 9.
x	=	either n or an ASCII decimal point.
E	=	ASCII character identifying the exponent.
t	=	; or <lf> (= line feed).

Return the option numbers of the instrument options that are fitted.



Response Code



The **first Nr1** indicates the presence or absence of the Current Option: Option 30.
The value of this Nr1 can be:

Ø - No option
3Ø - Current option

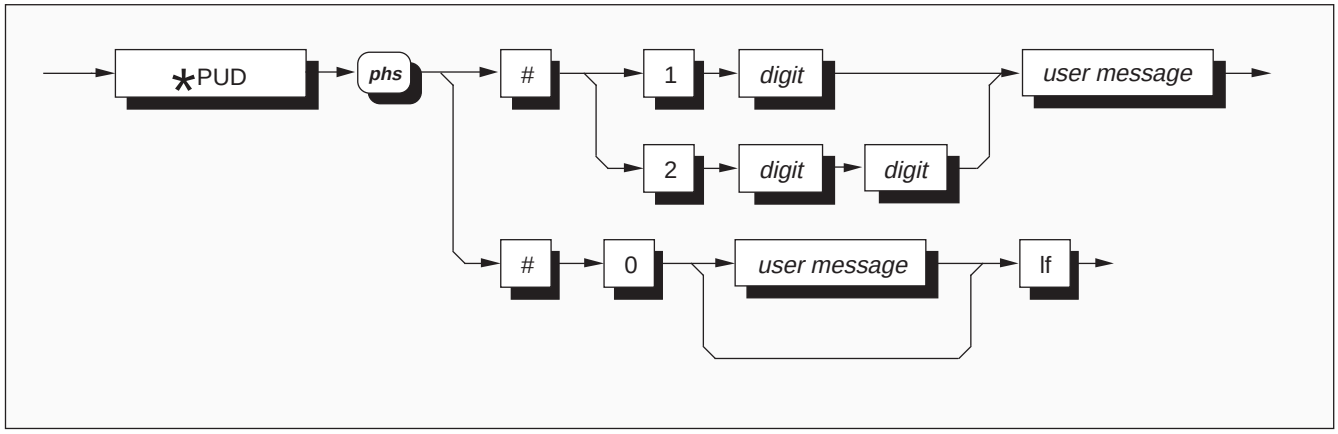
The **second Nr1** indicates the presence or absence of the Ratio Option: Option 40.
The value of this Nr1 can be:

Ø - No option
4Ø - Ratio option

Protected User Data

Entry of User Data

This command conforms to the IEEE 488.2 standard requirements.



Where:

phs	=	Program Header Separator
digit	=	one of the ASCII-coded numerals
user message	=	any message up to 63 bytes maximum

***PUD**

allows a user to enter up to 63 bytes of data into a protected area to identify or characterize the DMM. The two representations above are allowed depending on the message length and the number of 'digits' required to identify this. The instrument must be in the external calibration mode for this command to execute.

Execution Errors:

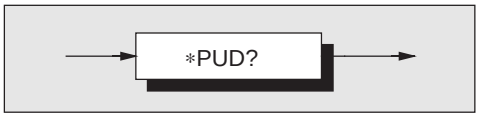
Execution errors are generated if the instrument is not in the external calibration mode.

Power On and Reset Conditions

Data area remains unchanged.

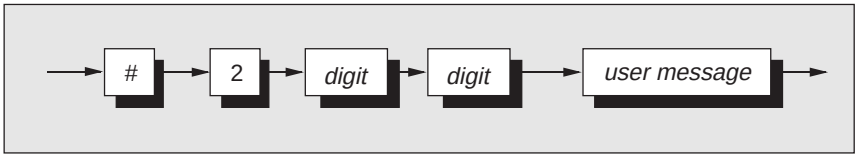
Recall of User Data

This command conforms to the IEEE 488.2 standard requirements.



∗PUD?
recalls previously entered user data:

Response Syntax:



Where:

digit	=	one of the ASCII-coded numerals
user message	=	the saved user message

Response Decode:
The previously-saved message is recalled. If no message is available, the value of the two digits is 00. The data area contains 63 bytes of data.

Execution Errors:
None.

Power On and Reset Conditions
Data area remains unchanged.

***Note**: Some controllers may need programming to accept strings of this length. Refer to appropriate manuals*

this page deliberately left blank

APPENDIX A to SECTION 5

1362 Device Settings at Power On

1362 Device Settings at Power On

Active Function:

Funct.	Range	Filter	Resol.
DCV	300V	FILTØ	RESL6

Inactive Functions:

Funct.	Range	Filter	Resol.	Other
DCI	1A	FILTØ	RESL5	
ACV	300V	FILTØ	RESL5	ACCP
ACI	1A	FILTØ	RESL5	ACCP
Ohms	10MΩ	FILTØ	RESL6	WIRE4

Analog Connections

Input	INPUT OFF
Guard	GUARD LCL

Analog Processes and Conditioning

Trigger Source	TSRCE SYS
Delay	DELAY DFLT
Input Zero	Setting retained in non-volatile memory

Calibration Processes

Calibration	Disabled
External Calibration Corrections	Applied
Line Frequency 50/60 Hz	Setting retained in non-volatile memory (or if corrupted, 60Hz)

Device Monitoring

Last Reading Value Recall	Invalid until after first trigger
Device I/D (Serial Number)	Setting retained in non-volatile memory
Options Fitted Data	As fitted
Protected User Data	Setting retained in non-volatile memory

Status Reporting Conditions

Status Byte Register	Clear
Event Status Register	Clear
Output Queue	Empty until after first query

SECTION 6
GUIDE to CIIL COMMAND LANGUAGE

SECTION 6 Guide to CIIL Command Language

‘Power On’ Default Settings

After the power has been applied, the DMM will perform its power-on configuration routine. This routine will set the DMM analogue circuits into their initial states:

DC
300V Range
Input Disconnected
No Filter
Local Guard
No Autorange
6.5 Digit

If it is not possible to set the DMM into its initial state (due to a hardware fault, for example) then the DMM will generate a **Fatal Error** and attempt to report the failure at the first opportunity. The DMM will not respond to any further commands once the fatal error has been reported.

When the DMM has finished its initialization, it is then ready to accept commands.

Control Interface Intermediate Language (CIIL)

The instrument will communicate in accordance with the **MATE** Specification Document Standard 2806763 Revision C, 21 Jun 1988.

All *references* to **CIIL** in this Section are with respect to *2806763 Rev C, 21 Jun 1988*.

Command Code Summary

The minimum op-code requirements for a sensor unit (the DMM) are :

FNC SET SRX INX FTH CLS OPN RST CNF IST STA
and the optional **GAL**

The only accepted <noun>s for this instrument are:

DCS ACS IMP

The only valid <mode-des> for this instrument are:

ACCP VOLT VRMS RESI CURR

The only used <noun-mod>s are

ACCF ACCP ACPL CURR DCPL FORW FREQ GARD
GAWD MAXT RESI TWOW TSRC VOLT VRMS

FNC <noun> <mchar> <port>

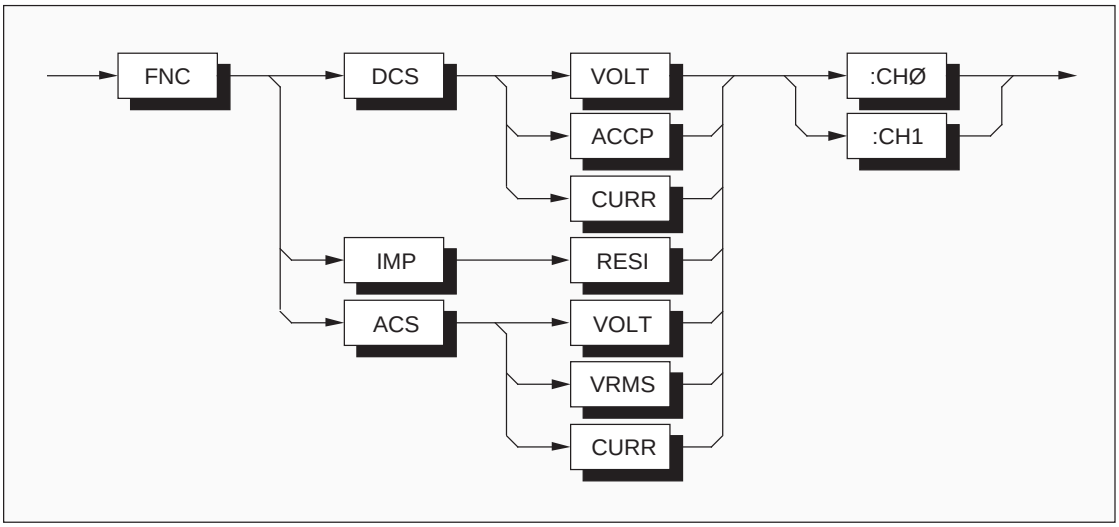
This op-code is used to set the measurement configuration of the DMM. The **FNC** op-mode must always be at the **start** of a command string and may or may not be followed by the **SET**, **SRN** or **SRX** op-code(s).

The <noun> is used to select a specific measurement quantity, ie **DCS** for DC signals, **IMP** for resistance (impedance) and **ACS** for AC signals.

The <mchar>s that may be applied to the <noun>s are shown in the syntax diagram below.

Syntax Diagram

N.B. All fields within a terminated string must be separated by an ASCII space.



Note 1: The **CURR** <mchar> is only valid if the DMM has current fitted.

Note 2: The channel **:CH1** is only valid if the DMM has ratio fitted.

Note 3: In the case of **DCS**, **ACCP** causes the AC measurement mode to be selected, enabling the DMM to measure the AC component of a DC signal.

Note 4: All **DCS** measurements will be in **6.5 digit** resolution.

All **ACS** measurements will be in **5.5 digit** resolution.

All **IMP** measurements will be in **6.5 digit** resolution.

All **DCS CURR** measurements will be in **6.5 digit** resolution.

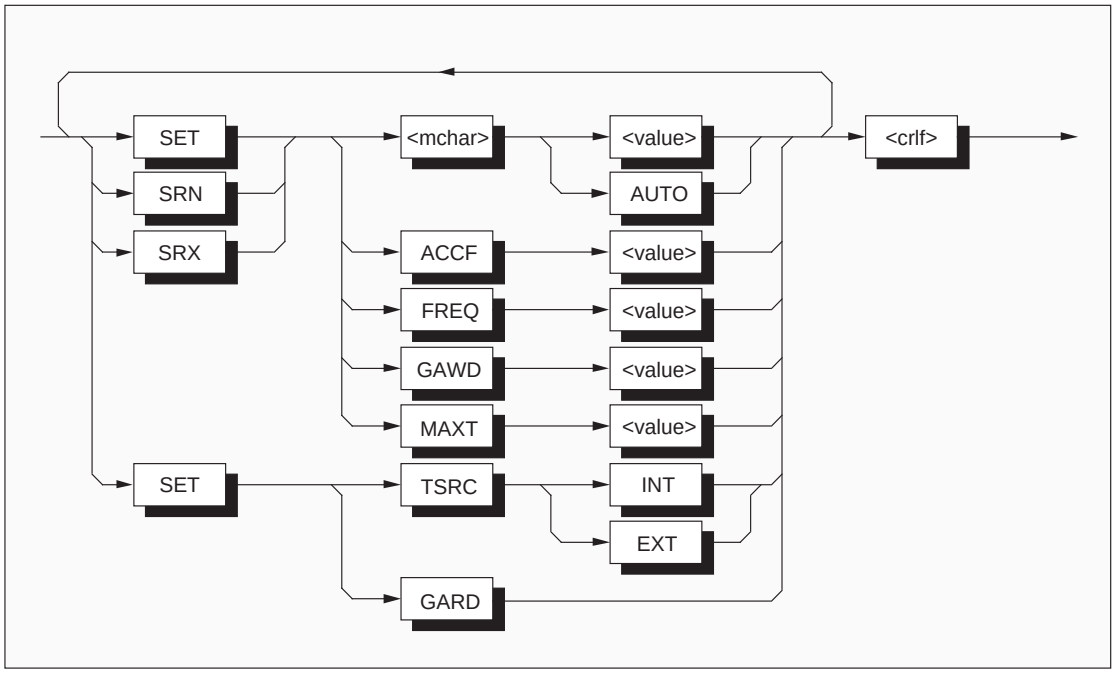
All **ACS CURR** measurements will be in **5.5 digit** resolution.

Control Interface Intermediate Language (CIIL) (Contd.)

SET, SRN and SRX Associated with DCS

Syntax Diagram

N.B. All fields within a terminated string must be separated by an ASCII space.



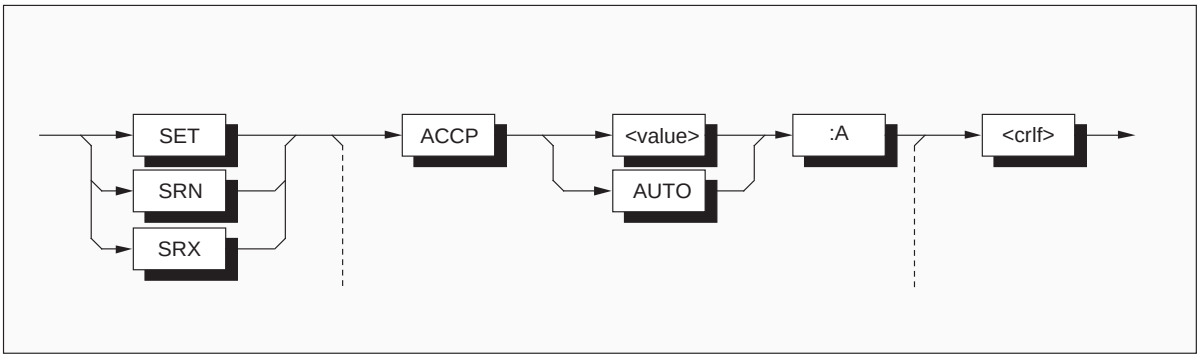
Note 1: The <mchar> must match the <mchar> in the **FNC** command, i.e. either **VOLT**, **ACCP** or **CURR**.

Note 2: If the DMM can measure current, then the **ACCP** <mchar> is modified to include an optional <unit> field, e.g. in the syntax diagram below:

The <unit> **:A** allows the measurement of the AC component of a current signal.

Syntax Diagram

N.B. All fields within a terminated string must be separated by an ASCII space.



Note 3: If **SET GARD** is present, then the DMM selects **REMOTE GUARD**.

If **SET GARD** is not present the default of **LOCAL GUARD** is selected.

Note 4: **SET TSRC EXT** allows measurement trigggers to come from the BNC connector on the front panel.

Note 5: The <value> following the <mchar> selects the range of the DMM according to the table :

Absolute <value>	DMM Range
<value> < Ø.2	100mV
Ø.2 ≤ <value> < 2.Ø	1V
2.Ø ≤ <value> < 2Ø.Ø	10V
2Ø.Ø ≤ <value> < 2ØØ.Ø	100V
2ØØ.Ø ≤ <value>	300V

Note 6: If **AUTO** follows the <mchar> instead of a <value>, then the DMM goes into the autorange mode and will select the most appropriate measurement range within its capabilities.

Note 7: The <noun-mod>s **ACCF**, **FREQ** and **GAWD** are all used to select the **analogue filter** in the DMM.

In the case of **ACCF** and **FREQ**:

If <value> **> 40 (Hz)** then the filter is **de-selected**.

If <value> ≤ **40 (Hz)** or less then the filter is **selected**.

In the case of **GAWD**:

If <value> **> 0.025** the filter is **selected**

If <value> ≤ **0.025** then the filter is **de-selected**.

Note that only positive <value>s are allowed. Negative <values>s will give an error.

Note 8: **MAXT** is used to select an external trigger window.

The <value> that follows the **MAXT** <noun-mod> must be **greater than zero** and **less than 10 Seconds**.

This <value> will then be used in checking the time between the trigger command and the external trigger actually arriving. If the external trigger does not arrive within the specified time, a timeout condition will occur and will be reported at the first opportunity.

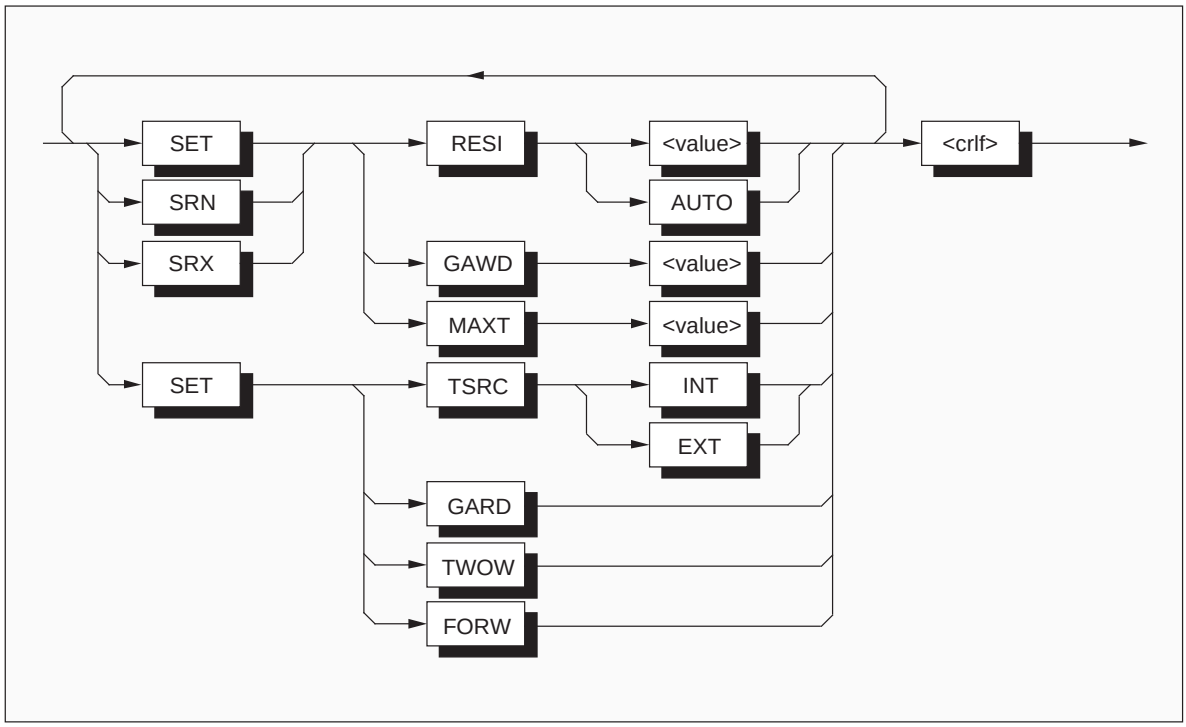
Note 9: **SET**, **SRN** and **SRX** commands may only follow on from a **FNC** command. They may not be used as an independent command string.

Control Interface Intermediate Language (CIIL) (Contd.)

SET, SRN and SRX Associated with IMP

Syntax Diagram

N.B. All fields within a terminated string must be separated by an ASCII space.



Note 1: The <value> following **RESI** selects the range of the DMM according to the table :

Absolute <value>	DMM Range
<value> < 2ØØ	0.1kΩ
2ØØ ≤ <value> < 2E3	1kΩ
2E3 ≤ <value> < 2E4	10kΩ
2E4 ≤ <value> < 2E5	100kΩ
2E5 ≤ <value> < 2E6	1MΩ
2E6 ≤ <value>	10MΩ

Note 2: If **AUTO** follows the <mchar> instead of a <value>, then the DMM goes into the autorange mode and will select the most appropriate measurement range within its capabilities.

Note 3: If **SET GARD** is present, then the DMM selects **REMOTE GUARD**.

If **SET GARD** is not present then the default of **LOCAL GUARD** is selected.

Note 4: **SET TSRC EXT** allows measurement triggers to come from the BNC connector on the front panel.

Note 5: **SET TWOW** selects the **two** wire method for measuring Ohms.

SET FORW selects the **four** wire method for measuring Ohms.

The default is **SET TWOW** if neither is specified.

Note 6: The <noun-mod> **GAWD** is used to select the analogue filter in the DMM.

If the <value> **> 0.025** the filter is **selected**

If the <value> ≤ **0.025** then the filter is **de-selected**.

Note that only positive <value>s are allowed. Negative <values>s will give an error.

Note 7: **MAXT** is used to select an external trigger window.

The <value> that follows the **MAXT** <noun-mod> must be **greater than zero** and **less than 10 Seconds**.

This <value> will then be used in checking the time between the trigger command and the external trigger actually arriving. If the external trigger does not arrive within the specified time, a timeout condition will occur and will be reported at the first opportunity.

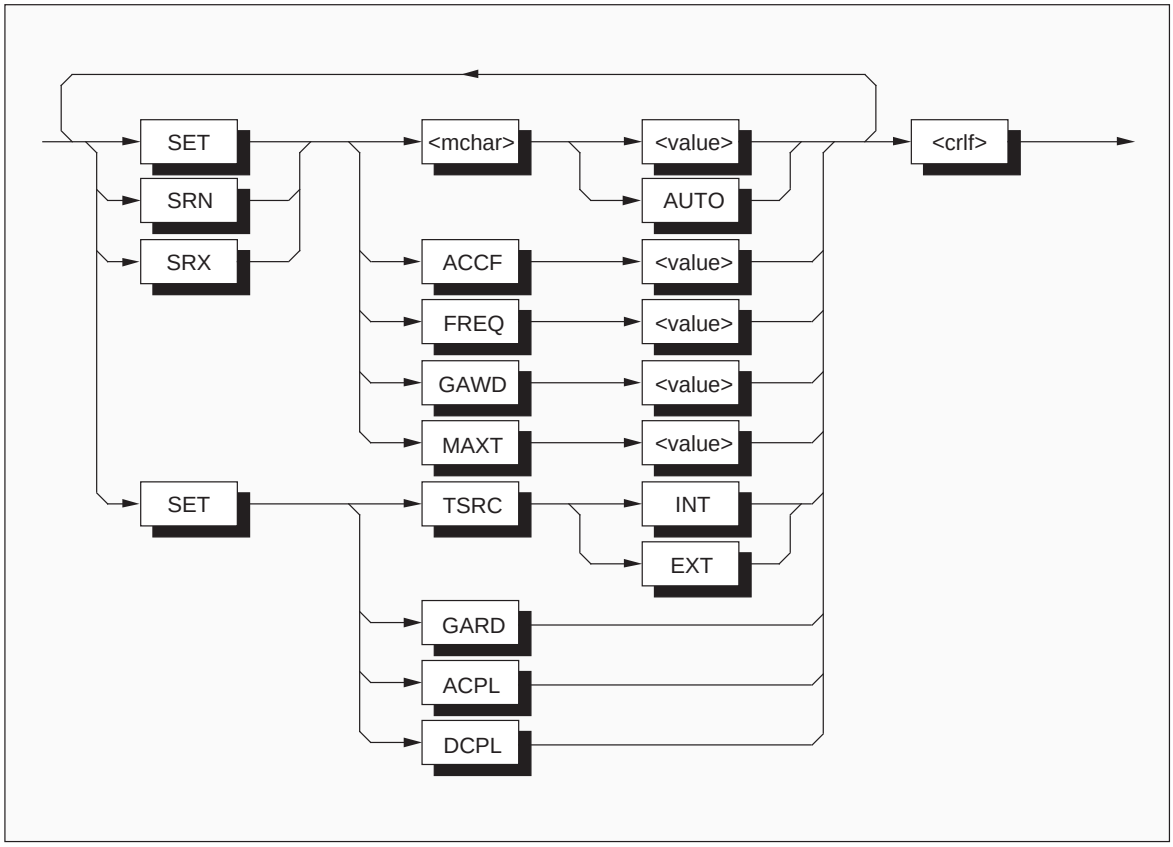
Note 8: **SET**, **SRN** and **SRX** commands may only follow on from an **FNC** command. They may not be used as an independent command string.

Control Interface Intermediate Language (CIIL) (Contd.)

SET, SRN and SRX Associated with ACS.

Syntax Diagram

N.B. All fields within a terminated string must be separated by an ASCII space.



Note 1: The <mchar> above must match the <mchar> in the FNC command, i.e. **VOLT**, **VRMS** or **CURR**

Note 2: If **SET GARD** is present, then the DMM selects **REMOTE GUARD**.
If **SET GARD** is not present then the default of **LOCAL GUARD** is selected.

Note 3: **SET TSRC EXT** allows measurement triggers to come from the BNC connector on the front panel.

Note 4: The <value> following the <mchar> selects the range of the DMM according to the table :

Absolute <value>	DMM Range
<value> < Ø.2	100mV
Ø.2 ≤ <value> < 2.Ø	1V
2.Ø ≤ <value> < 2Ø.Ø	10V
2Ø.Ø ≤ <value> < 2ØØ.Ø	100V
2ØØ.Ø ≤ <value>	300V

Note 5: If **AUTO** follows the <mchar> instead of a <value>, then the DMM goes into the autorange mode and will select the most appropriate measurement range within its capabilities.

Note 6: **SET ACPL** selects measurement of the **AC** component of the signal

SET DCPL selects measurement of the **sum** of the **AC** and **DC** components of the signal.

Note 7: The <noun-mod>s **ACCF**, **FREQ** and **GAWD** are all used to select the **analogue filter** in the DMM.

In the case of **ACCF** and **FREQ**:

If <value> **> 40 (Hz)** then the filter is **de-selected**.

If <value> ≤ **40 (Hz)** or less then the filter is **selected**.

In the case of **GAWD**:

If <value> **> 0.025** the filter is **selected**

If <value> ≤ **0.025** then the filter is **de-selected**.

Note that only positive <value>s are allowed. Negative <value>s will give an error.

Note 8: **MAXT** is used to select an external trigger window.

The <value> that follows the **MAXT** <noun-mod> must be **greater than zero** and **less than 10 Seconds**.

This <value> will then be used in checking the time between the trigger command and the external trigger actually arriving. If the external trigger does not arrive within the specified time, a timeout condition will occur and will be reported at the first opportunity.

Note 9: **SET**, **SRN** and **SRX** commands may only follow on from an **FNC** command. They may not be used as an independent command string.

Control Interface Intermediate Language (CIIL) (Contd.)

INX <mchar><crlf>

This op-code is used to trigger the DMM in **TSRC INT** mode, or arm the DMM for an external trigger if in **TSRC EXT** mode. Note that the <mchar> must match the one sent in the **FNC** command.

This command replies in accordance with *Section 5.3.2.1.1*. e.g: <sp><ascii-int><crlf>

Where the ascii-int is a value representing the timeout required before the next **FTH** is sent to the DMM.

FTH <mchar><crlf>

This op-code is used to retrieve data from the DMM. Its main use is in connection with a previous trigger command **INX**.

The <mchar> in the **FTH** op-code must match the <mchar> received in the last **FNC** op-code. Under normal conditions, where the measurement has successfully been taken, this command will cause the DMM to return:

<space><value><crlf>

In the event of a previous (unreported) error the DMM will return a suitable error string of the form described in *Rev C; Section 5.3.4* onwards.

CLS :CH0 <crlf>; OPN :CH0 <crlf>

CLS :CH1 <crlf>; OPN :CH1 <crlf>

(These two only valid if **Ratio** fitted)

These op-codes are used to connect and disconnect the DMM to the measurement bus.

In the disconnected mode (**OPN**), there is total isolation between all measurement terminals (**Hi**, **Lo**, **I+**, **I-** and **Guard**) of the DMM and the measurement bus.

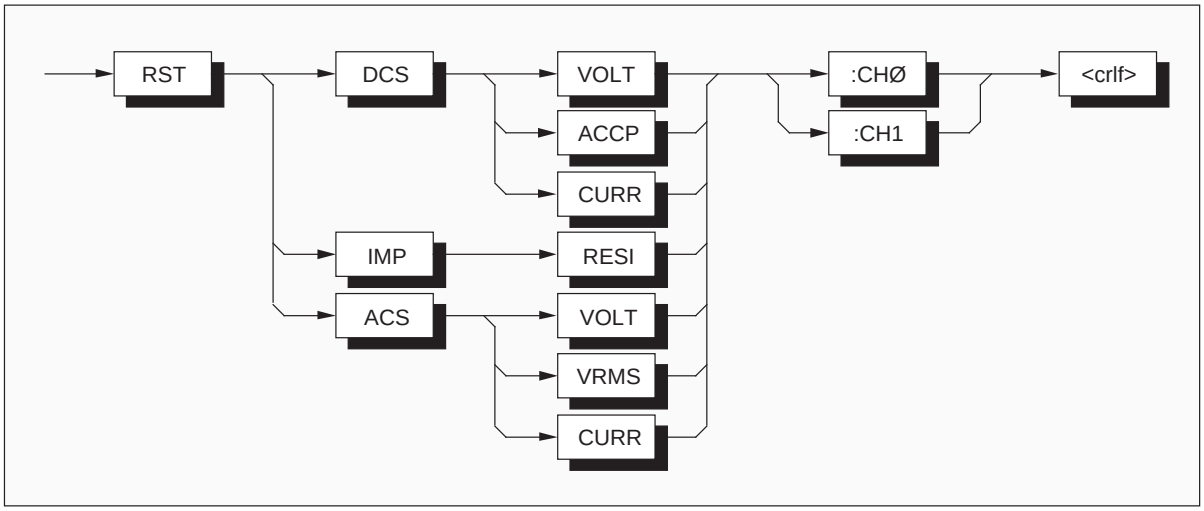
Note that it is **invalid** to attempt to trigger a measurement (using **INX**) when the DMM is disconnected (**OPN**). If this is attempted then an error will be reported at the first opportunity.

RST <noun> <mchar> <port> <crlf>

This op-code is used to reset the DMM module back into its **Power On** state. Note that the <noun>, <mchar> and <port> must match the <noun>, <mchar> and <port> that were sent in the last **FNC** command. If these do not match, then there will be no reset and an error will be reported at the first opportunity.

Syntax Diagram

N.**B**. All fields within a terminated string must be separated by an ASCII space.



Note that **CURR** is only valid if **Current** is fitted.
Note that **:CH1** is only valid if **Ratio** is fitted.

Control Interface Intermediate Language (CIIL) (Contd.)

CNF<crlf>; IST<crlf>

These two op-codes both cause the DMM to perform the **Internal Selftest** routine. Note that neither command has any modifiers.

In the case of a selftest **PASS**, the message that is returned on receipt of the next **STA** command is:

<space><crlf>

In the case of a selftest **FAIL** the message is:

F07DMM01 (DEV): <ascii string><crlf>

Where the <ascii string> is explained in the section under selftest (in the *native mode section*).

STA<crlf>

This op-code is used to find out the DMM's current operating status.

The data returned is in the format covered in *Rev C, Section 5.3.4*.

GAL<crlf>

This op-code causes the DMM to **cease** interpreting **CIIL** command codes and **accept native mode** commands instead. The op-code has no modifiers.

SECTION 7
1362 SPECIFICATIONS
and
SPECIFICATION VERIFICATION

FUNCTION	**RANGE** [1]	**FREQUENCY** (Hz)	**ACCURACY** [2] [4] ±(ppm reading + ppmFS) [3] 24hour [5] 23°C±1°C [6]	90 day Tcal±5°C [6]	1 year Tcal±5°C [6]	**TEMP. COEFF.** (ppm/°C) 10°C-40°C
DC Voltage	100.000 0mV 1.000 000V 10.000 00V 100.000 0V 300.000V		8+6 5+3 5+2 8+3 8+3	30+6 20+3 20+2 30+3 30+3	50+6 30+3 30+2 50+3 50+3	3 2 2 3 3
AC Voltage [4]	All Ranges (as DCV)	10-40 40-20k 20k-50k 50k-100k	0.3%+0.1% 0.02%+0.01% 0.07%+0.02% 0.1%+0.03%	0.4%+0.1% 0.035%+0.01% 0.1%+0.02% 0.16%+0.03%	0.4%+0.1% 0.05%+0.01% 0.12%+0.02% 0.2%+0.03%	100 50 80 150
	100mV, 1V & 10V	100k-300k 300k-1M		1.0%+0.1%(typical) 2.0%+1.0%(typical)		
Resistance	100.000 0Ω 1.000 000kΩ 10.000 00kΩ 100.000 0kΩ 1.000 000MΩ 10.000 00MΩ	1mA 1mA 100µA 10µA 4µA 400nA	15+6 10+3 10+3 15+3 30+4 100+4	35+6 30+3 30+3 40+3 80+4 200+4	50+6 40+3 40+3 60+3 150+4 300+4	4 3 3 4 4 7
DC Current	1000.000mA		100+10	200+10	300+10	30
AC Current	1000.00mA	10-40 40-3k	0.3%+0.1% 0.05%+0.03%	0.4%+0.1% 0.08%+0.03%	0.4%+0.1% 0.1%+0.03%	100 100

NOTES: [1] 100% overrange on all ranges except 300V.
[2] Specifications for maximum resolution in each function.
[3] FS = 2 x full range.
[4] Valid for signals >1%FS, < 3 x 10^7 V.Hz product.
[5] Relative to calibration standards.
[6] Tcal. is calibration temperature in range 15°C to 35°C.

FUNCTION	**DIGITS**	**READ RATE** (readings/s)			**ADDITIONAL ERRORS** (ppmR+ppmFS)
DCV, DCI & RESISTANCE	6½ 5½ 4½	5 50 1000			0+0 0+5 0+150
ACV & ACI		10Hz	40Hz	360Hz	
	5½ 4½	1/3 1/3	1 1	12 12	0+0 0+150

OTHER SPECIFICATIONS

DCV

Input Impedance:	10GΩ(0.1V to 10V ranges), 10MΩ(100V & 300V ranges)
CMRR (1kΩ unbalance):	>140dB at DC >80dB + NMRR at 1-60Hz
NMRR: filter out	>54dB at 50/60Hz±0.1%
filter in	add 20dB to above
Protection all ranges:	300V RMS
Max. Input Current:	50pA
Settling Time:	5ms filter out
(to 10ppm of step)	350ms filter in

ACV

Input Impedance:	1MΩ/100pF
CMRR (1kΩ unbalance):	>80dB at DC to 60Hz
Crest Factor:	5:1 at full range
Protection all ranges:	300V RMS
Settling Time:	
(to 0.1% of step)	
10Hz(DC coupled)	2.5s
40Hz	500ms
360Hz	200ms

RESISTANCE

Protection all ranges:	250V RMS
Settling Time:	as DCV up to 10kΩ
Max. Lead Resistance:	100Ω in any or all leads
Open circuit voltage:	15V

DC CURRENT

Protection all ranges:	2A internal fuse
Settling Time:	as DCV

AC CURRENT

Crest Factor:	5:1 at full range
Protection all ranges:	2A internal fuse
Settling Time:	as ACV

RATIO

Availability:	All functions
Protection:	As main functions
Accuracy:	±(net channel A accuracy + net channel B accuracy)

GENERAL

PEAK MODULE CURRENT:	1.4A (5V), 0.5A (±12V)
DYNAMIC MODULE CURRENT:	0.06A (5V), 0.15A (±12V)
MAINS SUPPLY FLUCTUATION:	not to exceed ±10%
MINIMUM AIRFLOW (10°C rise):	1 Liter/sec.
PRESSURE DROP:	0.05mm H_2O
OPERATING TEMPERATURE:	5°C to 40°C
STORAGE TEMPERATURE:	-40°C to +70°C
RELATIVE HUMIDITY:	up to 31°C, max RH 80%, decreasing linearly to 50% RH at 40°C
ALTITUDE:	up to 2000m
INDOOR USE:	Pollution Degree 2
DIMENSIONS: (C size)	234mm(9.2")x340mm(13.4")x30mm(1.2")
WEIGHT:	1.6kg (3.5lbs)
SAFETY:	Designed to UL1244, IEC 348, BS EN61010-1
WARRANTY:	1 year
WARM-UP:	15 minutes to full accuracy

VXIbus SPECIFICATIONS

MODULE:	C size, single slot width
DEVICE TYPE:	Message based instrument; Word serial protocol; A16 slave only
LOGICAL ADDRESS:	Manual selection 1 to 255 (Address 255 supports dynamic configuration)
INTERRUPT LEVEL:	User programmable 1 to 7

1362 Specification Verification

Introduction

The factory calibration of the 1362/S/MT ensures traceable accuracy to national standards. Its performance is quoted in the specifications at the beginning of this section, related to time since calibration.

On receipt, it is recommended that the instrument is throughly checked. This section deals with user verification of the 1362 performance to its 90-day specification, this being the most likely period to apply on receipt. Tables and calculations are provided enabling the user to verify each of the parameters listed below.

Equipment Requirements

Basic Configuration (including Option 40):
DC and AC Voltage and Resistance Calibrator of suitable accuracy.
e.g Model 4800 or 4808
(Options 10, 20, 30 & 50)

Full Analog Configuration (including Option 30):
DC and AC Voltage, DC and AC Current, and Resistance Calibrator of suitable accuracy.
e.g Model 4800 or 4808
(Options 10, 20, 30, 40 & 50)

User's Uncertainty Calculations

The accuracy and traceability of a user's standards affects the manner in which the performance of any new equipment can be verified. Users will need to evaluate the effects of the uncertainties associated with their own equipment, in conjunction with those of the instrument, therefore calculations for total tolerance limits (Validity Tolerance) are required.

The 'Validity Tolerance'

It is impossible to verify the specification of an instrument with absolute certainty, even using the original calibration equipment to make the measurements. All measurements carry a degree of uncertainty, this being quantified by the 'Traceability' of the measuring equipment to National Standards.

The measurements which follow are intended to establish that the instrument performs within its specifications, meaning it operates within the tolerance of its accumulated uncertainties. As the measurements to be taken have their own accumulated uncertainties, these must be added to those of the instrument in order to set a 'Validity Tolerance'.

The Validity Tolerance is obtained by adding together all the intervening uncertainties at the time the measurement is made. The specification sets out the worst-case allowances (relative tolerances) for the instrument's performance. For the standards equipment used, worst-case tolerances must also be assumed. Complete the Verification Report Sheet and calculate the validity tolerance limits using the formulae provided. If any range fails to verify and the instrument is to be returned, please be certain to include copies of the verification report sheets and give as much detail as possible.

Abbreviations Used

Hr 1362 upper relative accuracy tolerance limit
Lr 1362 lower relative accuracy tolerance limit
Uf Manufacturer's factory calibration standard uncertainty relative to National Standards
Um Sum of uncertainties from 1362 terminals through the user's measurement system to National Standards

Verification Report Sheet

Model 1362/S/MT Serial Number..... Calibration Interval.....

Date..... Checked by..... Company/Dept.....

Note: It is advisable to make duplicate copies of the report sheets for future use. Check at the values shown in the tables. Contact your authorized Service Centre if the instrument fails to verify and please include copies of the completed verification report sheets if the instrument is returned.

Implementation

On Receipt of Instrument

The tables in this report document provide columns to enter both the user's calculations of tolerance limits and the results of measurements made.

The relative accuracy tolerance limits (90 day Specification) are already entered in the columns. These figures include the manufacturer's factory calibration standards' uncertainties.

A relevant formula, for calculating the validity tolerances on receipt, is given on each page of tables.

After User-calibration

Once the instrument has been re-calibrated against the user's standards, the manufacturer's factory calibration uncertainties are no longer valid.

Validity tolerance limits should then be recalculated to include the user's uncertainties in place of the manufacturer's, which for convenience are entered in a separate column.

A relevant formula, for calculating the validity tolerances after user-calibration, is given on each page of tables.

Preparation

The purpose of this Verification is to check the instrument against its 90-day specification.

N.B. For 1362MT version

This Preparation must be programmed in the Native Language of the instrument (IEEE 488.2 syntax described in Section 5) as the Input Zero operation, required to ensure measurement accuracy, is not programmable in CIIL.

The verification procedures (overleaf) may be performed in the CIIL language of the instrument, noting that the DCV, DCI and Ohms functions default to 6.5-digit resolution in CIIL.

1. Ensure that the instrument is correctly mounted and operative in its subrack.
2. Turn on the instrument to be checked and allow to warm up for at least 15 minutes in the specified environment.
3. Ensure that the calibration switch is in the disable position (Down).
4. Consult the appropriate manufacturers' handbooks before connecting and operating any of their equipment.
5. Program and execute a 'Selftest' (Code ∗**TST?** for 1362 and `TEST:ALL?` or ∗`TST?` for 1362S). Should the instrument fail, contact your local authorized Service Center. If the instrument is to be returned, complete a Failure Report form, which can be found at the back of this handbook. Detach and return it with the instrument to your local service centre.
6. Use Channel A. See page 7-6 for input connections. Connect a short-circuit between Input Hi and Input Lo. Execute an 'Input Zero' (Code **ZERO?** for 1362 and `INPUT:ZERO?` for 1362S) on each of the DC Voltage ranges.
7. Use Channel A. Short together the four Inputs Hi, Lo, I+ and I-. Set to 4-wire Ohms. Execute an 'Input Zero' on each of the Ohms ranges.
8. Use Channel A. With all Channel A inputs open circuit, execute an 'Input Zero' on the 1A DC Current Range.

Procedures

WARNING **THIS INSTRUMENT CAN DELIVER A LETHAL ELECTRIC SHOCK. NEVER TOUCH ANY LEAD OR TERMINAL UNLESS YOU ARE ABSOLUTELY CERTAIN THAT NO DANGEROUS VOLTAGE IS PRESENT.**

Input Connections

With its output turned off, connect the calibrator output to the relevant input pins of Channel 'A' on the Front Panel **INPUT** connector.

Channel 'A' Input Pins

(Front Panel Input Connector)

Input	Pin
Hi	1
I+	2
Lo	5
I-	6
Gu	7

DC Voltage

1. Program the 1362 and Calibrator to DC Voltage, 6½ digits.
2. Set the 1362 to its 100mV DC range and the calibrator to +100mV output. Note the 1362 measured value.
3. Enter the measured value in the top line of Table 1 on page 7-8, under '1362 READING'.
4. Repeat (**2**) and (**3**) for the remainder of the 1362 ranges and calibrator outputs of Table 1.
5. Calculate the 'Validity Tolerance Limits' using the appropriate formula beneath Table 1 on page 7-8.
6. Check that the values in the 1362 READING column are at or within the corresponding lower and higher validity tolerance limits.

WARNING

In the following sequences, when changing connections or switching ranges, ensure that the calibrator output is switched or programmed off.

AC Voltage

1. Program the 1362 and Calibrator to AC Voltage, 5½ digits.
2. Set the 1362 to its 100mV AC range and the calibrator to 100mV AC output at 1kHz. Note the 1362 measured value.
3. Enter the measured value in the top line of Table 2 on page 7-9, under '1362 READING'.
4. Set the 1362 to its 100mV AC range and the calibrator to 100mV AC output at 30kHz. Note the 1362 measured value.
5. Enter the measured value in the second line of Table 2 under '1362 READING'.
6. Repeat (**2**) to (**5**) for the remainder of the 1362 ranges and calibrator outputs of Table 2.
7. Calculate the 'Validity Tolerance Limits' using the appropriate formula beneath Table 3 on page 7-9.
8. Check that the values in the 1362 READING column are at or within the corresponding lower and higher validity tolerance limits.

AC Voltage Linearity Checks

1. Program the 1362 and Calibrator to AC Voltage, 5½ digits.
2. Set the 1362 to its 10V AC range and the calibrator to 1V AC output at 1kHz. Note the 1362 measured value.
3. Enter the measured value in the top line of Table 3 on page 7-9, under '1362 READING'.
4. Increase the calibrator output to 10V AC output at 1kHz. Note the 1362 measured value.
5. Enter the measured value in the second line of Table 3 under '1362 READING'.
4. Increase the calibrator output to 19V AC output at 1kHz. Note the 1362 measured value.
5. Enter the measured value in the third line of Table 3 under '1362 READING'.
6. Calculate the 'Validity Tolerance Limits' using the appropriate formula beneath Table 3 on page 7-9.
7. Check that the values in the 1362 READING column are at or within the corresponding lower and higher validity tolerance limits.

Resistance

1. Program the 1362 and Calibrator to Ohms, $6^1/_2$ digits, 4-wire connection.

2. Set the 1362 to its 100Ω range and the calibrator to 100Ω nominal output.

3. Enter the calibrator resistance value in the top line of Table 4 on page 7-10, under 'Calibrator Resistance Value'. Calculate and enter δR in its column.

4. Note the 1362 measured value. Enter the value in the top line of Table 4 under '1362 READING'.

5. Repeat (**2**) to (**4**) for the remainder of the 1362 ranges and calibrator resistances of Table 4.

6. Calculate the 'Validity Tolerance Limits' using the appropriate formula beneath Table 4 on page 7-10.

7. Check that the values in the 1362 READINGS column are at or within the corresponding lower and higher validity tolerance limits.

DC Current

1. Program the 1362 and Calibrator to DC Current, $6^1/_2$ digits.

2. Set the 1362 to its 1000mA DC range and the calibrator to +1000mA output. Note the 1362 measured value.

3. Enter the measured value in the top line of Table 5 on page 7-11, under '1362 READING'.

4. Set the 1362 to its 1000mA DC range and the calibrator to -1000mA output. Note the 1362 measured value.

5. Enter the measured value in the second line of Table 5 under '1362 READING'.

6. Calculate the 'Validity Tolerance Limits' using the appropriate formula beneath Table 6 on page 7-11.

7. Check that the value in the 1362 READING column is at or within the lower and higher validity tolerance limits.

AC Current

1. Program the 1362 and Calibrator to AC Current, $5^1/_2$ digits

2. Set the 1362 to its 1000mA AC range and the calibrator to 1000mA AC output at 10kHz. Note the 1362 measured value.

3. Enter the measured value in the top line of Table 6 on page 7-11, under '1362 READING'.

4. Calculate the 'Validity Tolerance Limits' using the appropriate formula beneath Table 6.

5. Check that the value in the 1362 READING column is at or within the corresponding lower and higher validity tolerance limits.

Table 1. DC VOLTAGE Full Range Checks

1362 Range & Calibrator Output	Relative Accuracy Tolerance Limits Lower (Lr)	Higher (Hr)	Factory Cal. Std. ±Uf	User's Measurement Tolerance ±Um	Validity Tolerance Limits Lower	Higher	1362 Reading
+ 100mV	+99.9958	+100.0042	0.00045mV				
- 100mV	-100.0042	-99.9958	0.00045mV				
+ 1V	+0.999974	1.000026	0.0000035V				
- 1V	-1.000026	-0.999974	.0000035V				
+ 10V	+9.99976	+10.00024	0.000025V				
- 10V	-10.00024	-9.99976	0.000025V				
+100V	+99.9964	+100.0036	0.00045V				
-100V	-100.0036	-99.9964	0.00045V				
+199V	+198.9932	+199.0068	0.0009V				
-199V	-199.0068	-198.9932	0.0009V				

On Receipt from the manufacturer, Validity Tolerance Calculations:

Higher Limit = Hr + Um
Lower Limit = Lr - Um

Following User Calibration, Validity Tolerance Calculations:

Higher Limit = Hr - Uf + Um
Lower Limit = Lr + Uf - Um

Table 2. AC VOLTAGE Full Range Checks

1362 RANGE	Calib. FREQ	Wideband Relative Accuracy Tolerance Limits Lower(Lr)	Higher (Hr)	Factory Cal. Std. Uncert'y ±Uf	User's Measurement Uncert'y ±Um	Validity Tolerance Limits Lower	Higher	1362 READING
100mV	1kHz	99.945	100.055	0.004mV				
100mV	30kHz	99.860	100.140	0.017mV				
1V	1kHz	.99945	1.00055	0.00003V				
1V	30kHz	.99860	1.00140	0.00007V				
10V	1kHz	9.9945	10.0055	0.0003V				
10V	30kHz	9.9860	10.0140	0.0007V				
100V	1kHz	99.945	100.055	0.003V				
100V	30kHz	99.860	100.140	0.007V				
199V	1kHz	198.901	199.099	0.006V				
199V	30kHz	198.741	199.259	0.014V				

Table 3. AC VOLTAGE Linearity Checks (Performed on 10V Range)

1V	1kHz	0.9977	1.0023	0.0001V				
10V	1kHz	9.9945	10.0055	0.0003V				
19V	1kHz	18.9934	19.0066	0.0006V				

On Receipt from the manufacturer, Validity Tolerance Calculations:

Higher Limit = Hr + Um
Lower Limit = Lr - Um

Following User Calibration, Validity Tolerance Calculations:

Higher Limit = Hr - Uf + Um
Lower Limit = Lr + Uf - Um

Table 3. RESISTANCE Full Range Checks

1362 RANGE (Calibrator Nom. val.)	Calibrator Resistance Value (Vr)	δR (Vr - Nom.)	Relative Accuracy Tolerance Limits		Factory Cal. Std Uncert'y ±Uf	User's Measurement Tolerance ±Um	Validity Tolerance Limits		1362 READING
			Lower(Lr)	Higher(Hr)			Lower	Higher	
4-wire connection									
100Ω			99.9953	100.0047	0.00045				
1kΩ			0.999964	1.000036	0.0000045				
10kΩ			9.99964	10.00036	0.000045				
100kΩ			99.9954	100.0046	0.0008				
1MΩ			0.999912	1.000088	0.000012				
10MΩ			9.99792	10.00208	0.00015				

On Receipt from the manufacturer, Validity Tolerance Calculations:

Higher Limit = Hr + δR + Um
Lower Limit = Lr + δR - Um

Following User recalibration, Validity Tolerance Calculations:

Higher Limit = Hr + δR - Uf + Um
Lower Limit = Lr + δR + Uf - Um

Table 5. DC CURRENT Full Range Checks

1362 Range & Calibrator output	Relative Accuracy Tolerance Limits		Factory Cal. Std Uncert'y ±Uf	User's Measurement Tolerance ±Um	Validity Tolerance Limits		1362 READING
	Lower(Lr)	Higher(Hr)			Lower	Higher	
+1A	+0.999780	+1.000220	0.000050A				
-1A	-1.000220	-0.999780	0.000050A				

Table 6. AC CURRENT Full Range Checks

1362 Range, & Calibrator output	Calibrator FREQ	Relative Accuracy Tolerance Limits		Factory Cal. Std Uncert'y ±Uf	User's Measurement Tolerance ±Um	Validity Tolerance Limits		1362 READING
		Lower(Lr)	Higher(Hr)			Lower	Higher	
1A	1kHz	0.99860	1.00140	0.00013A				

On Receipt from the manufacturer, Validity Tolerance Calculations:

Higher Limit = Hr + Um
Lower Limit = Lr -Um

Following User recalibration, Validity Tolerance Calculations:

Higher Limit = Hr - Uf + Um
Lower Limit = Lr + Uf - Um

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SECTION 8
1362 ROUTINE CALIBRATION

SECTION 8 1362 ROUTINE CALIBRATION

NB. This calibration routine was developed for a 1362 using Native language. To calibrate using SCPI, follow this procedure but transpose the calibration commands for those detailed in Section 4; pages 4-12 & 4-13. Calibration is not programmable in CIIL.

Introduction

Read This First

To verify the instrument specification without affecting the calibration memory, please refer to Section 7 of this handbook.

For information on other forms of calibration, such as the types of repairs which must be followed by calibration, refer to your authorized service center. The instrument **must** be thoroughly checked before attempting calibration.

WARNING THIS INSTRUMENT CAN DELIVER A LETHAL ELECTRIC SHOCK. NEVER TOUCH ANY LEAD OR TERMINAL UNLESS YOU ARE ABSOLUTELY CERTAIN THAT NO DANGEROUS VOLTAGE IS PRESENT.

Equipment Requirements

Basic Configuration (including Option 40):
DC and AC Voltage and Resistance Calibrator of suitable accuracy.
e.g Model 4800 or 4808
(Options 10, 20, 30 & 50)

Full Analog Configuration (including Option 30):
DC and AC Voltage, DC and AC Current, and Resistance Calibrator of suitable accuracy.
e.g Model 4800 or 4808
(Options 10, 20, 30, 40 & 50)

Preparation

1. Ensure that the instrument is correctly mounted and operative in its subrack.
2. Turn on the instrument and allow to warm up for at least 15 minutes in the specified environment.
3. Ensure that the front panel calibration switch is in the disable position (Down).
4. Program and execute a 'Selftest' (Query ∗**TST?**). Should the instrument fail, contact your local authorized Service Center. If the instrument is to be returned, complete a Failure Report form, which can be found at the back of this handbook. Detach and return it with the instrument to your local service centre.
5. Set the calibration switch to the enable position (Up).
6. Use the **LINE Nrf** code to select the appropriate Line Frequency and Integration mode *(page 5-32)*.

Note: If a partial calibration is being attempted, use the same line frequency as for the most-recent main calibration. If the local line frequency differs from the cal frequency, ensure that common mode noise on the input signal is minimized.

7. Use the **CAL ON** code to enable calibration mode *(page 5-29)*.
8. If required, use the **STLN?** query to store the currently-selected line frequency as the Power On Default setting (the current default can be read using the **LINE?** query). *(page 5-32)*.

To disable calibration mode at any time, either send **CAL OFF** or set the front panel calibration switch to the disable position (Down) *(page 5-29)*.

Non-Nominal Calibration

The levels at which calibration is performed, given in the following procedures, are the 'nominal' points for the functions/ ranges. Nominal points need not be programmed; they are assumed by the 1362 when the commands **CALL?** and **CALH?** are sent without *Nrf*.

For users who wish to calibrate at non-nominal values, **CALL?** and **CALH?** allow the non-nominal value to be entered in '*Nrf*' form. This causes the 1362 to assume that the value represented by the *Nrf* is that which will be input.

There is a high probability that nominal resistance values will not be available; this is reflected in the 4-wire procedure at operation 7 on *page 8-4*.

An *Nrf* in the following ranges of values is valid:

With **CALL?** - any value up to +25% of full range, except for the DCV or ACV 300V range: 75V.

With **CALH?** - any value between 75% of full range and full scale.

Refer to Section 5, page 5-29.)

After Routine Calibration

Once the instrument has been re-calibrated against the user's standards, its performance can be verified against the calibration standards as detailed in Section 7.

Note: The manufacturer's factory calibration uncertainties are no longer valid after user-recalibration, so when performing the calculations in Section 7, the validity tolerance limits should be calculated to include the user's calibration uncertainties in place of the manufacturer's.

Procedures

Warning

In the following sequences, when changing connections or switching ranges, ensure that the calibrator output is switched or programmed off.

DC Voltage

Input Connections

CAUTION

Consult the appropriate manufacturers' handbooks before connecting and operating any of their equipment.

With its output turned **OFF**, connect the calibrator output to the relevant input pins of Channel 'A' on the Front Panel **INPUT** connector.

Channel 'A' Input Pins

(Front Panel Input Connector)

Input	Pin
Hi	1
I+	2
Lo	5
I-	6
Gu	7

DCV Zero and Full Range

1. Set the Calibrator to:
Output OFF, DC 10V range, Zero output, Local Guard.

2. Program the 1362 to:
DCV 1Ø,FILTØ,RESL6;GUARD LCL
(DC Voltage, 10V range, Filter Off, $6^{1}/_{2}$ digit resolution, Local Guard) *(page 5-14)*.

3. Set the Calibrator Output ON.

4. Send **CALL?** to the 1362 *(page 5-29)*.

5. Set the Calibrator output to +10.00000V.

6. Send **CALH?** to the 1362 *(page 5-29)*.

7. Set the Calibrator output to -10.00000V.

8. Send **CALH?** to the 1362 *(page 5-29)*.

9. Set the Calibrator Output OFF.

8. Repeat operations **1** to **7**, to calibrate zero and full range on the 1362 100mV, 1V and 100V ranges, and at zero and 199V on the 300V range, resetting the calibrator and 1362 at operations (1), (2), (4), (5), (6), (7) and (8) as shown in the table in the next column.

Operation	Calibrator	1362
100mV Range		
(1)	100mV Range, Zero	
(2)		**DCV Ø**
(4)		**CALL?**
(5)	+100.0000mV	
(6)		**CALH?**
(7)	-100.0000mV	
(8)		**CALH?**
1V Range		
(1)	1V Range, Zero	
(2)		**DCV 1**
(4)		**CALL?**
(5)	+1.000000V	
(6)		**CALH?**
(7)	-1.000000V	
(8)		**CALH?**
100V Range		
(1)	100V Range, Zero	
(2)		**DCV 1ØØ**
(4)		**CALL?**
(5)	+100.0000V	
(6)		**CALH?**
(7)	-100.0000V	
(8)		**CALH?**
300V Range		
(1)	100V Range, Zero	
(2)		**DCV 3ØØ**
(4)		**CALL?**
(5)	+199.0000V	
(6)		**CALH? 199**
(7)	-199.0000V	
(8)		**CALH? 199**

Resistance

Input Connections

CAUTION

Consult the appropriate manufacturers' handbooks before connecting and operating any of their equipment.

With its output turned **OFF**, connect the calibrator output to the relevant input pins of Channel 'A' on the Front Panel **INPUT** connector.

Channel 'A' Input Pins

(Front Panel Input Connector)

Input	Pin
Hi	1
I+	2
Lo	5
I-	6
Gu	7

4-Wire Zero and Full Range

1. Set the Calibrator to:
Output OFF, ZeroΩ, Remote Guard.

2. Program the 1362 to:
OHMS 1ØØ,FILTØ,RESL6,WIRE4;
GUARD LCL
(Ohms, 100Ω range, Filter Off, 6½ digit resolution, 4-wire connection,Local Guard) *(page 5-18)*.

3. Set the Calibrator Output ON. (If a four-wire zero is not available on the calibrator, disconnect the calibrator and connect a short-circuit between pins 1, 2, 5, and 6 of the 1362 input connector instead, using the shortest possible wire.)

4. Send **CALL?** to the 1362 *(page 5-29)*.

5. If a short-circuit was connected at operation (**3**), disconnect it and reconnect the calibrator leads.

6. Set the Calibrator output to 100Ω. (If nominal value is not available, see operation (**7**) regarding the use of **CALH?** ***Nrf***.

7. Send **CALH?** to the 1362 for calibration at nominal value (**CALH?** ***Nrf*** for non-nominal calibration).
(*Nrf* is the non-nominal value of the calibrator's output) *(page 5-29)*.

8. Set the Calibrator Output OFF.

9. Repeat operations **1** to **8**, to calibrate zero and full range on the 1kΩ, 10kΩ, 100kΩ, 1MΩ and 10MΩ ranges, resetting the calibrator and 1362 at operations (1), (2), (4), (6) and (7) as shown in the table in the next column (table shows settings for nominal values).

Operation	Calibrator	1362
1kΩ Range		
(1)	ZeroΩ	
(2)		**OHMS 1ØØØ**
(4)		**CALL?**
(6)	1000.000Ω	
(7)		**CALH?**
10kΩ Range		
(1)	ZeroΩ	
(2)		**OHMS 1ØØØØ**
(4)		**CALL?**
(6)	10,000.00Ω	
(7)		**CALH?**
100kΩ Range		
(1)	ZeroΩ	
(2)		**OHMS 1ØØØØØ**
(4)		**CALL?**
(6)	100,000.0Ω	
(7)		**CALH?**
1MΩ Range		
(1)	ZeroΩ	
(2)		**OHMS 1ØØØØØØ,FILT1**
(4)		**CALL?**
(6)	1,000,000Ω	
(7)		**CALH?**
10MΩ Range		
(1)	ZeroΩ	
(2)		**OHMS 1ØØØØØØØ,FILT1**
(4)		**CALL?**
(6)	10,000.00kΩ	
(7)		**CALH?**

2-Wire Zero

1. Disconnect the Calibrator. Connect a short-circuit between Channel A Hi and Lo on the front panel input connector (pins 1 and 5). Use the shortest length of wire possible.

2. Program the 1362 to:
OHMS 1ØØ,FILTØ,RESL6,WIRE2;
GUARD LCL
(Ohms, 100Ω range, Filter Off, 6½ digit resolution, 2-wire connection,Local Guard) *(page 5-18)*.

3. Send **CALL?** to the 1362 *(page 5-29)*.

4. Repeat operations (2) and (3) for the 1kΩ range (**OHMS 1ØØØ,WIRE2** only at operation (2)).

5. Repeat operations (2) and (3) for the 10kΩ range (**OHMS 1ØØØØ,WIRE2** only at operation (2)).

6. Repeat operations (2) and (3) for the 100kΩ range (**OHMS 1ØØØØØ,WIRE2** only at operation (2)).

7. Repeat operations (2) and (3) for the 1MΩ range (**OHMS 1ØØØØØØ,FILT1,WIRE2** only at operation (2)).

8. Repeat operations (2) and (3) for the 10MΩ range (**OHMS 1ØØØØØØØ,FILT1,WIRE2** only at operation (2)).

AC Voltage

Input Connections

CAUTION

Consult the appropriate manufacturers' handbooks before connecting and operating any of their equipment.

With its output turned **OFF**, connect the calibrator output to the relevant input pins of Channel 'A' on the Front Panel **INPUT** connector.

Channel 'A' Input Pins

(Front Panel Input Connector)

Input	Pin
Hi	1
I+	2
Lo	5
I-	6
Gu	7

ACV Low, and ACV Full Range

1. Set the Calibrator to:
Output OFF, AC 100mV range, 10mV RMS output at 1kHz, Local Guard.

2. Program the 1362 to:
ACV Ø,FILTØ,RESL5;GUARD LCL
(AC Voltage, 100mV range, Filter Off, 5½ digit resolution, Local Guard) *(page 5-16)*.

3. Set the Calibrator Output ON.

4. Send **CALL?** to the 1362 *(page 5-29)*.

5. Set the Calibrator output to 1kHz, 100.000mV RMS.

6. Send **CALH?** to the 1362 *(page 5-29)*.

7. Set the Calibrator Output OFF.

8. Repeat operations **1** to **7**, to calibrate zero and full range on the 1362 100mV, 1V and 100V ranges, and at zero and 199V on the 300V range, resetting the calibrator and 1362 at operations (1), (2), (4), (5) and (6) as shown in the table in the next column.

Operation	Calibrator	1362
1V Range		
(1)	1kHz, 10.0000mV RMS	
(2)		**ACV 1**
(4)		**CALL?**
(5)	1kHz, 1.00000V RMS	
(6)		**CALH?**
10V Range		
(1)	1kHz, 100.000mV RMS	
(2)		**ACV 1Ø**
(4)		**CALL?**
(5)	1kHz, 10.0000V RMS	
(6)		**CALH?**
100V Range		
(1)	1kHz, 1.00000V RMS	
(2)		**ACV 1ØØ**
(4)		**CALL?**
(5)	1kHz, 100.000V RMS	
(6)		**CALH?**
300V Range		
(1)	1kHz, 3.00000V RMS	
(2)		**ACV 3ØØ**
(4)		**CALL?**
(5)	1kHz, 199.000V RMS	
(6)		**CALH?**

DC Current (Option 30)

Input Connections

CAUTION

Consult the appropriate manufacturers' handbooks before connecting and operating any of their equipment.

With its output turned **OFF**, connect the calibrator output to the relevant input pins of Channel 'A' on the Front Panel **INPUT** connector.

Channel 'A' Input Pins

(Front Panel Input Connector)

Input	Pin
I+	2
I-	6

DCI Zero and Full Range

1. Set the Calibrator to:
   Output OFF, DC 1A range, Open Circuit output, Local Guard.
2. Program the 1362 to:
   DCI FILTØ,RESL6;GUARD LCL
   (DC Current, 1A range, Filter Off, 6½ digit resolution, Local Guard) *(page 5-15)*.
3. Set the Calibrator Output ON.
4. Send **CALL?** to the 1362 *(page 5-29)*.
5. Set the Calibrator output to +1.000000A.
6. Send **CALH?** to the 1362 *(page 5-29)*.
7. Set the Calibrator output to -1.000000A.
8. Send **CALH?** to the 1362 *(page 5-29)*.
9. Set the Calibrator Output OFF.

AC Current (Option 30)

Input Connections

CAUTION

Consult the appropriate manufacturers' handbooks before connecting and operating any of their equipment.

With its output turned **OFF**, connect the calibrator output to the relevant input pins of Channel 'A' on the Front Panel **INPUT** connector.

Channel 'A' Input Pins

(Front Panel Input Connector)

Input	Pin
I+	2
I-	6

ACI Low, and Full Range

1. Set the Calibrator to:
   Output OFF, AC 1A range, 1kHz, 100.000mA RMS output, Local Guard.
2. Program the 1362 to:
   ACI FILTØ,RESL6,ACCP;GUARD LCL
   (AC Current, 1A range, Filter Off, 5½ digit resolution, Local Guard) *(page 5-17)*.
3. Set the Calibrator Output ON.
4. Send **CALL?** to the 1362 *(page 5-29)*.
5. Set the Calibrator output to 1kHz, 1.00000A RMS.
6. Send **CALH?** to the 1362 *(page 5-29)*.
7. Set the Calibrator Output OFF.

SECTION 11 1362 Servicing Diagrams

Contents

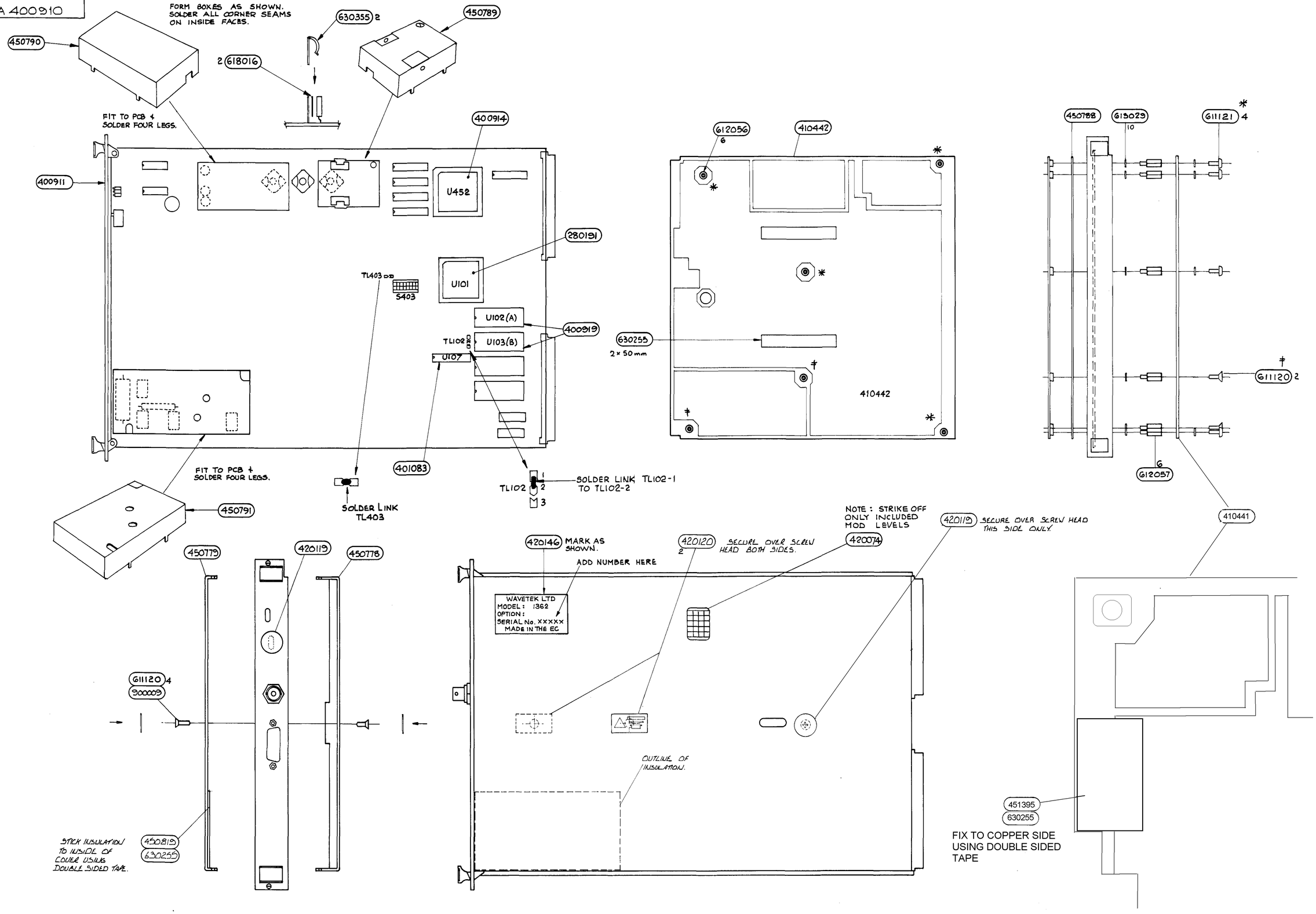
N.B. **1**. **Component Lists** appear in Section 12.
2. The pages in this section are not numbered, but the Diagrams are placed in the following order.

Assembly Description	*Layout Drawings*	*Circuit Diagrams*
1362 Finished Assembly	**DA400910 Shts 1 & 2**	**---**
1362S Finished Assembly	**DA401080 Shts 1 & 2**	**---**
1362MT Finished Assembly	**DA400952 Shts 1 & 2**	**---**
Card DMM Assembly	**Layout Drawing DA400911**	**Circuit Diagram DC400911**

Sht No.	Detail
1	Full Board Layout
2	Rear Section Detail
3	Mid Section Detail
4	Front Section Detail

Sht No.	Detail
1	Processor and Memory
2	Serial Interface
3	Digital Connections
4	Digital Subsystem & VME Interface
5	RMS Converter
6	AC Preamp
7	A to D Converter
8	DC Preamp
9	Power Supplies
10	Self-Test Subsystem
11	Floating Ohms
12	Control
13	Input and A-D Optos
14	VXI I/F Chip

DRAWING No.
DA 400910



NOTE 450779 HAS TO BE ASSEMBLED TO PCB BEFORE 450778.

ISS	CHANGES
1.0	ECO.3367 RELEASED
1.1	ECO.3400 2 OFF SCREW 611007 DELETED. 6 OFF SCREW 611120 AND 4 OFF 611121 ADDED. 6 OFF SCREW 611016 DELETED. IL. 5 OCT 89
1.2	ECO.3449 450850 ADDED. IL. 15 NOV 89
1.3	ECO. 3768 INSULATOR 450850 DELETED IJL 29 NOV 91
2.0	ECO.4174 400914 & 400919 ADDED. SHT2 ADDED IJL 18 NOV 92
2.1	ECO.4372 MOD LEVEL LABEL ADDED IJL 19 NOV 93
2.2	ECO 4564 401083 (U107) 280191 (U101) & TL102 ADDED. IJL. 25 AUG 94
2.3	ECO. 4771 LABEL 420117-1 REMOVED; REPLACED WITH 420146 IJL 23 FEB 95
2.4	ECO 6209 451395 ADDED JHN 18 OCT 01

THIRD ANGLE PROJECTION	DRAWN	DATE	DIMENSIONS IN	TOLERANCES	MATERIAL	TITLE	DRAWING No.
	B.S.JACKSON	21. APR. 89.	MILLIMETRES	DECIMAL TO 2 PLACES ± .1mm DECIMAL TO 1 PLACE ± .2mm WHOLE DIMENSIONS ± .4mm ANGULAR ± ½°	—	1362 FINISHED ASSEMBLY.	DA 400910
	CHECKED	DATE	SCALE		FINISH		
ALL BURRS TO BE REMOVED	DJH	7 JUL 89	—	UNLESS OTHERWISE STATED	—		SHEET 1 OF 2
	APPR.	DATE	NOT TO BE SCALED				
	Rwk	7 JULY 89					

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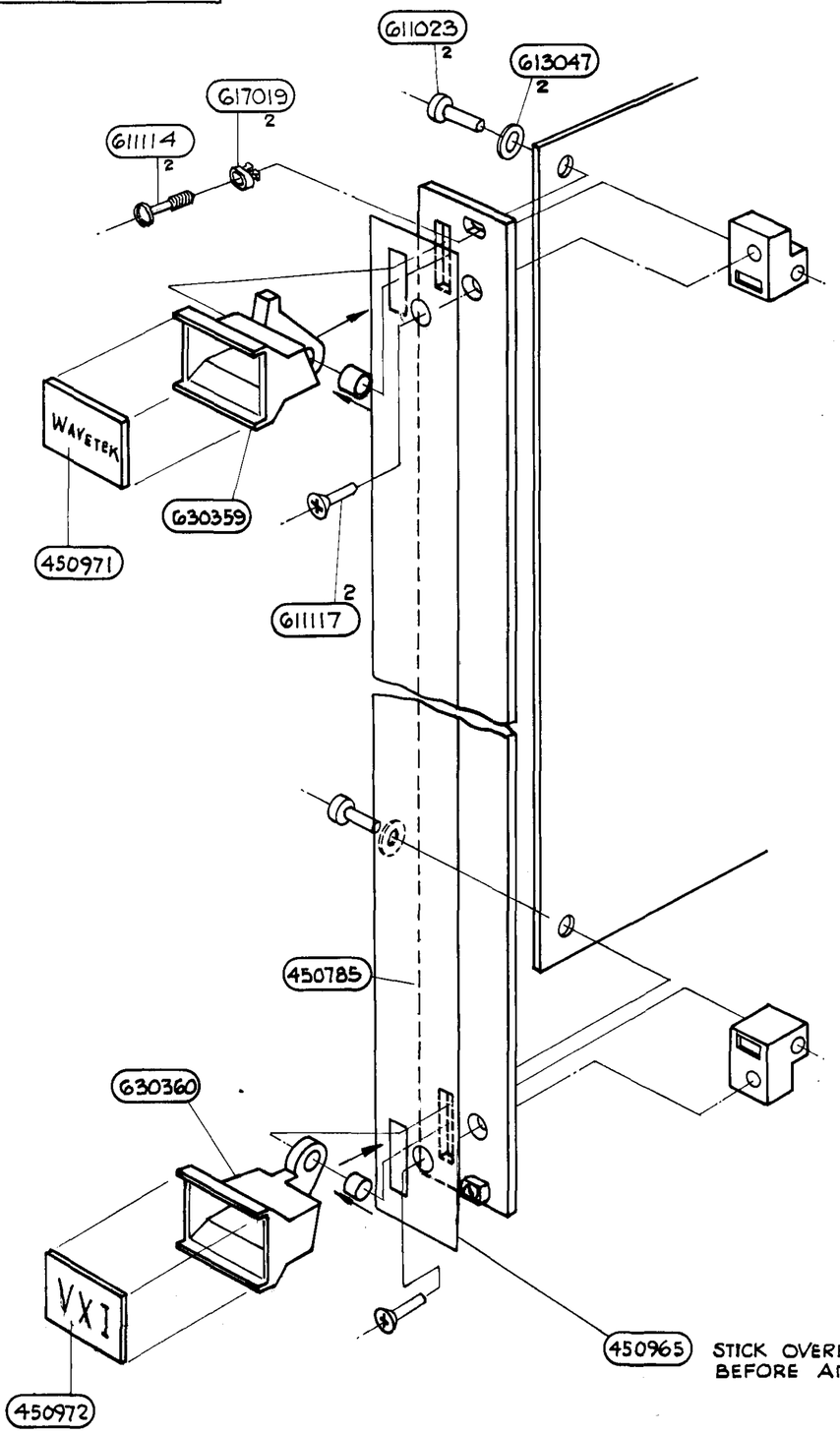
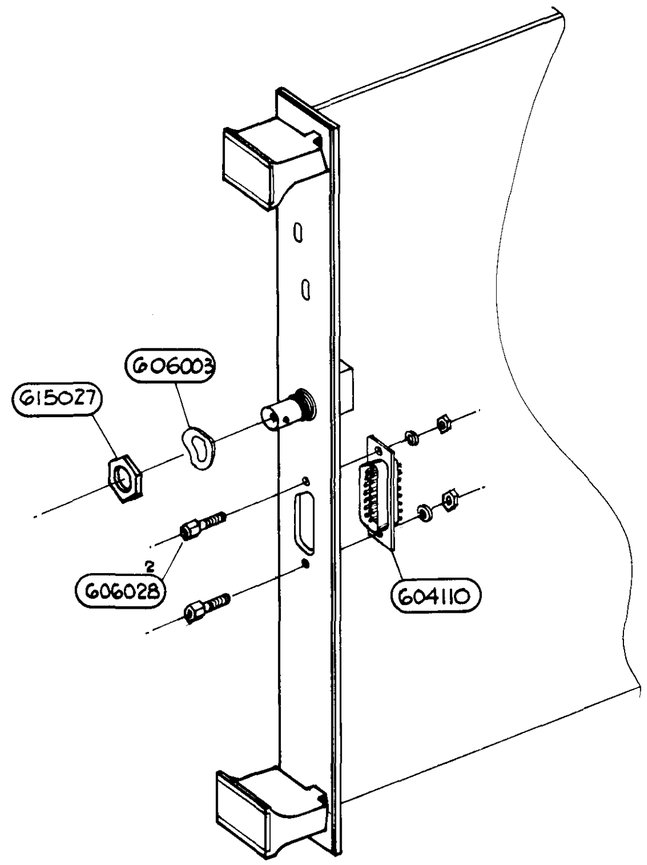
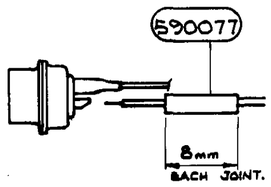
ISS	CHANGES
2.0	ECO. 4174 NEW SHEET. IJL 18 NOV 92

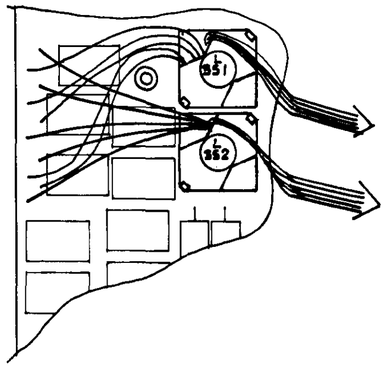
DRAWING No.
DA 400910



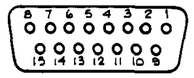
STICK OVERLAY TO FRONT PANEL BEFORE ANY ASSY.







VIEW OF REAR FACE.



ALL WIRES TO J351 15 WAY 'D' TYPE 604110		
FROM	COLOUR	TO
L351	RED	PIN 1
L351	BROWN	" 2
—	NO CONNECTION	" 3
—	NO CONNECTION	" 4
L351	BLACK	" 5
L351	BLUE	" 6
L351	YELLOW	" 7
—	NO CONNECTION	" 8
L352	YELLOW	" 9
L352	BLUE	" 10
L352	BLACK	" 11
—	NO CONNECTION	" 12
—	NO CONNECTION	" 13
L352	BROWN	" 14
L352	RED	" 15

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THIRD ANGLE PROJECTION

ALL BURRS TO BE REMOVED

DRAWN	B.S.JACKSON	DATE 13. MAR. 89
CHECKED	B.S.J.	DATE 6-7-89.
APPR.	[illegible]	DATE 7 July 89

DIMENSIONS IN MILLIMETRES
SCALE NOT TO SCALE.
NOT TO BE SCALED

TOLERANCES
DECIMAL TO 2 PLACES ±·1mm
DECIMAL TO 1 PLACE ±·2mm
WHOLE DIMENSIONS ±·4mm
ANGULAR + ½°
UNLESS OTHERWISE STATED

MATERIAL —

FINISH —

TITLE
1362 CARD DMM ASSEMBLY.

DRAWING No.
DA 400910

SHEET 2 OF 2

BAYLISS WISDOM PDS 870729

DRAWING No
DA 401080

FORM BOXES AS SHOWN. SOLDER ALL CORNER SEAMS ON INSIDE FACES.

450790
630355 2
450789
2 618016
FIT TO PCB & SOLDER FOUR LEGS.
400914
400911
U452
280220
TL403
S403
U101
U102(A)
401082
TL102
U103(B)
U107
401197
SOLDER LINK TL403
TL102 1 2 3
SOLDER LINK TL102-3 TO TL102-2
FIT TO PCB & SOLDER FOUR LEGS.
450791

612056 6
410442
630255 2×50mm
410442

450788
615029 10
611121 4
611120 2
612057 6
410441

450779
420119
450778
611120 4
900009
STICK INSULATION TO INSIDE OF COVER USING DOUBLE SIDED TAPE.
450819
630255

420146 MARK AS SHOWN
ADD NUMBER HERE
420120 2 SECURE OVER SCREW HEAD BOTH SIDES.
420119 SECURE OVER SCREW HEAD THIS SIDE ONLY.
WAVETEK LTD
MODEL : 1362S
OPTION :
SERIAL No : XXXXX
MADE IN THE EC
OUTLINE OF INSULATION.

451395
630255
FIX TO COPPER SIDE USING DOUBLE SIDED TAPE

NOTE 450779 HAS TO BE ASSEMBLED TO PCB BEFORE 450778.

ISS.	CHANGES
1.0	ECO.4234 RELEASED 17 DEC 92
1.1	ECO 4564 280191 (U101), 401083 (U107) & TL102 ADDED IJL 25AUG 94
1.2	ECO.4771 LABEL 420117-1 REMOVED; REPLACED WITH 420146. IJL 23 FEB 95
2.0	ECO 4871 U101 WAS 280191 U107 WAS 401083 TL102 PINS 1 & 2 WERE LINKED. IJL 30JUN 95
2.1	ECO 6209 451395 ADDED JHN 18 OCT 01

THIRD ANGLE PROJECTION
ALL BURRS TO BE REMOVED

DRAWN	IJL	DATE 17 DEC 92
CHECKED		DATE 31 AUG 94
APPR.	SRS	DATE 1 SEP 94

DIMENSIONS IN MILLIMETRES
SCALE —
NOT TO BE SCALED

TOLERANCES
DECIMAL TO 2 PLACES ±·1mm
DECIMAL TO 1 PLACE ±·2mm
WHOLE DIMENSIONS ±·4mm
ANGULAR ÷ ½°
UNLESS OTHERWISE STATED

MATERIAL —
FINISH —

TITLE
1362S
FINISHED ASSEMBLY.

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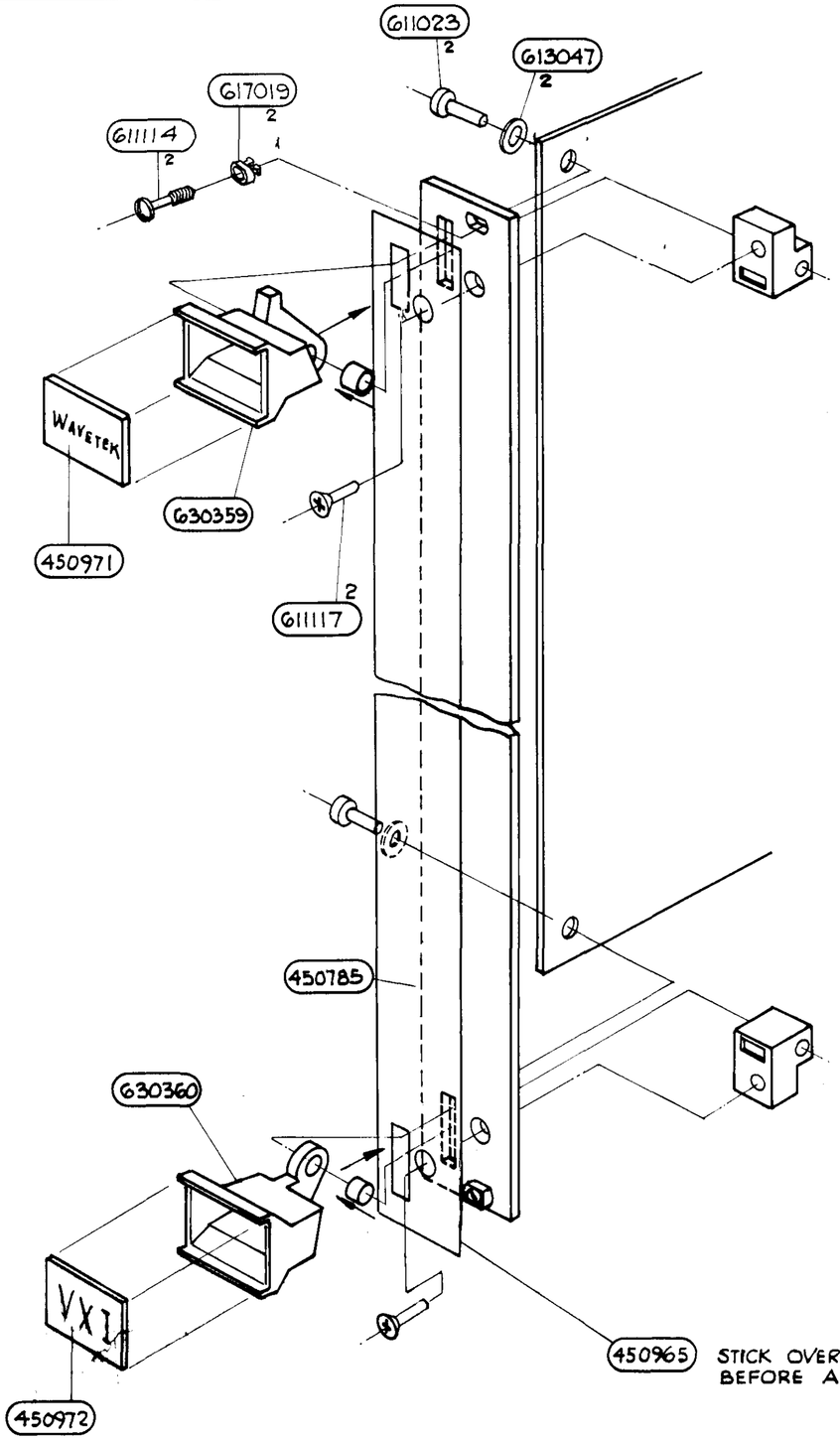
DRAWING No.
DA 401080

SHEET 1 OF 2

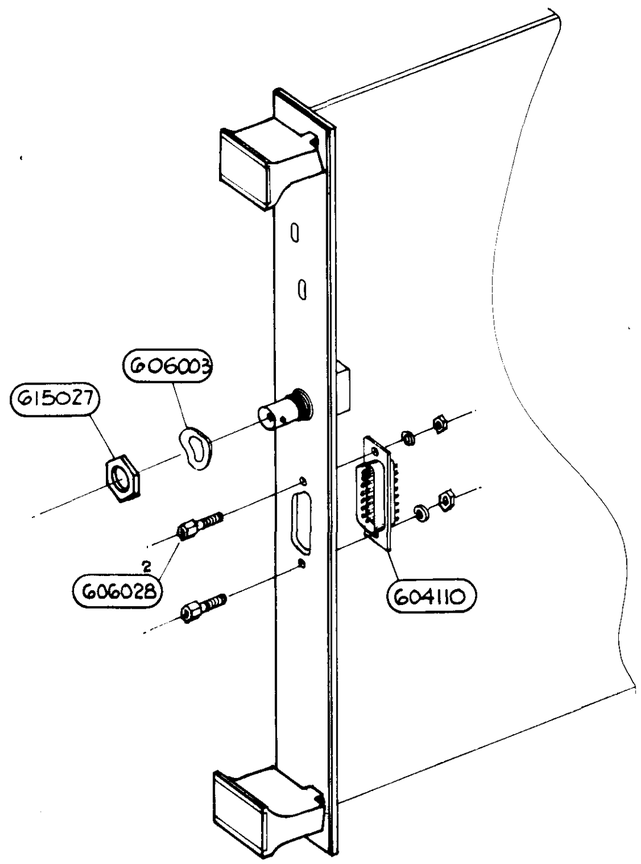
BAYLISS WISDOM PDS 870728

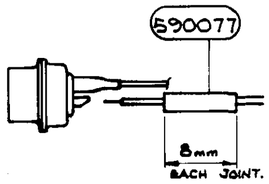
DRAWING No.
DA401080

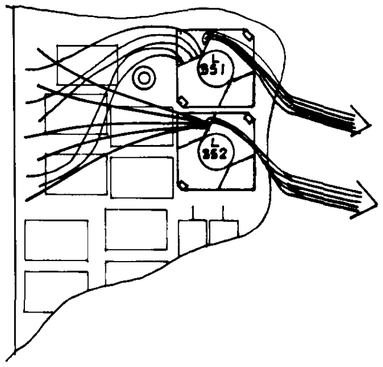
ISS	CHANGES
1.0	ECO 4234 RELEASED 17 DEC 92
2.0	ECO. 4871 ISS. LEVEL UPDATE



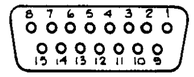
STICK OVERLAY TO FRONT PANEL BEFORE ANY ASSY.







VIEW OF REAR FACE.



ALL WIRES TO J351 15 WAY 'D' TYPE 604110

FROM	COLOUR	TO
L351	RED	PIN 1
L351	BROWN	" 2
—	NO CONNECTION	" 3
—	NO CONNECTION	" 4
L351	BLACK	" 5
L351	BLUE	" 6
L351	YELLOW	" 7
—	NO CONNECTION	" 8
L352	YELLOW	" 9
L352	BLUE	" 10
L352	BLACK	" 11
—	NO CONNECTION	" 12
—	NO CONNECTION	" 13
L352	BROWN	" 14
L352	RED	" 15

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THIRD ANGLE PROJECTION

ALL BURRS TO BE REMOVED

DRAWN IJL	DATE 17 DEC 92	DIMENSIONS IN MILLIMETRES
CHECKED d.s	DATE 31 AUG 94	SCALE NOT TO SCALE.
APPR. SRS	DATE 1 SEP 94	NOT TO BE SCALED

TOLERANCES

DECIMAL TO 2 PLACES ± ·1mm
DECIMAL TO 1 PLACE ± ·2mm
WHOLE DIMENSIONS ± ·4mm
ANGULAR + ½°

UNLESS OTHERWISE STATED

MATERIAL —

FINISH —

TITLE

13625 CARD DMM ASSEMBLY.

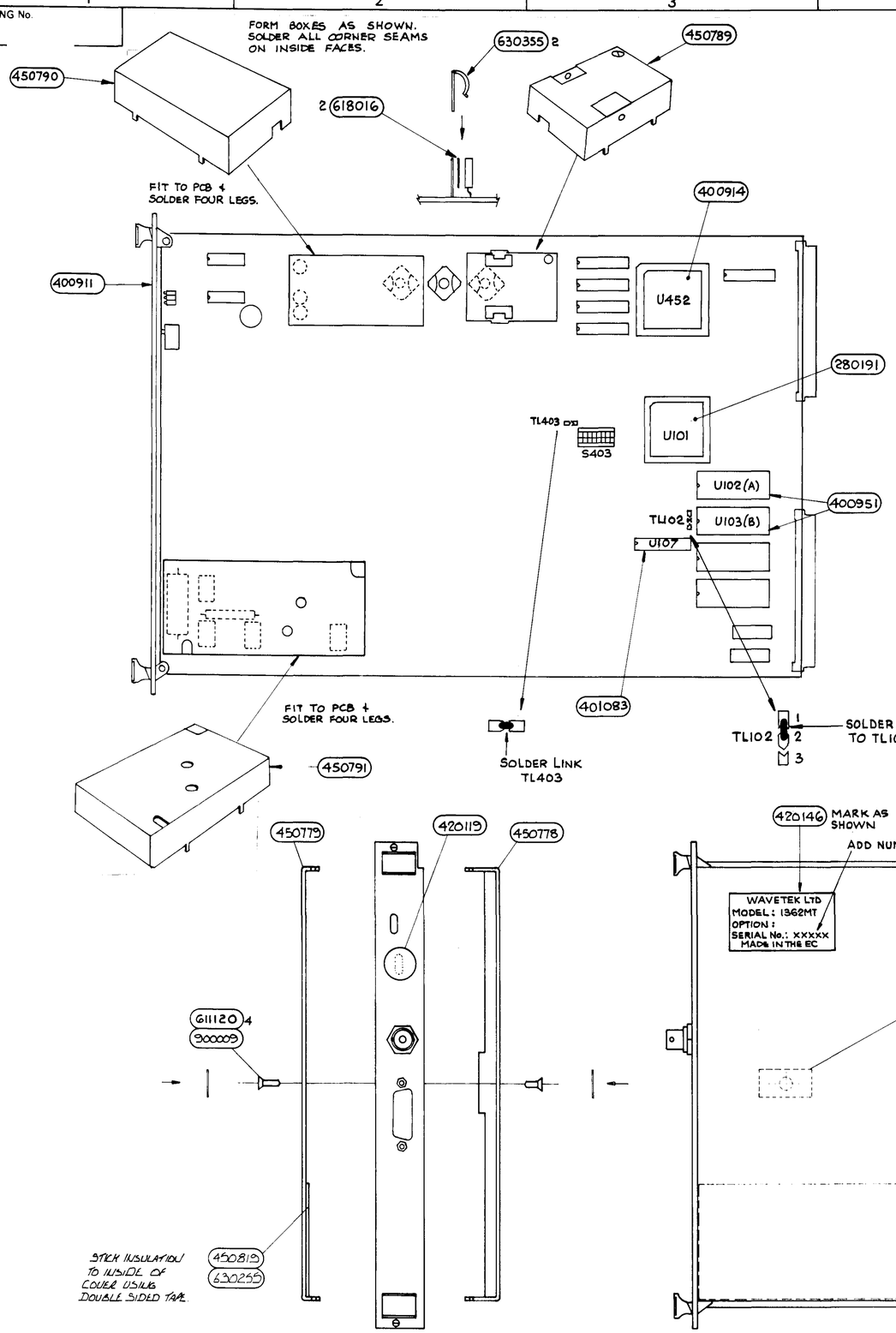
DRAWING No.
DA401080

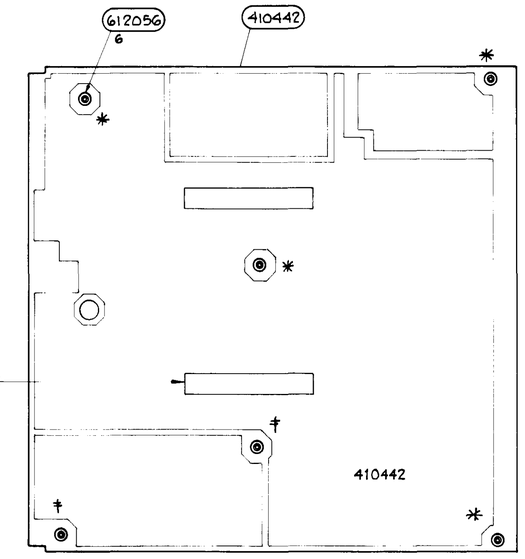
SHEET 2 OF 2

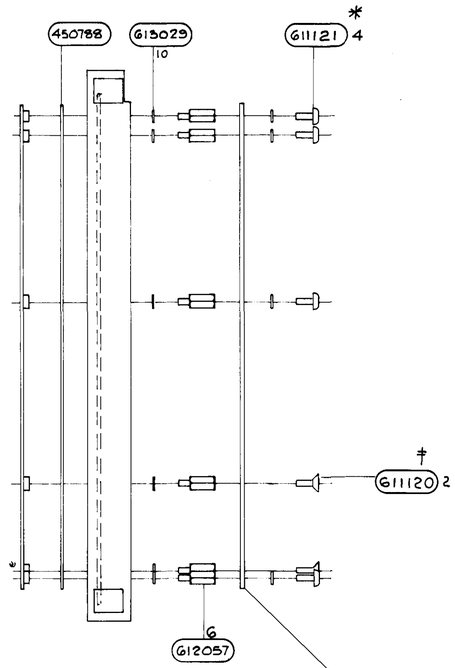
BAYLISS WISDOM POS 870729

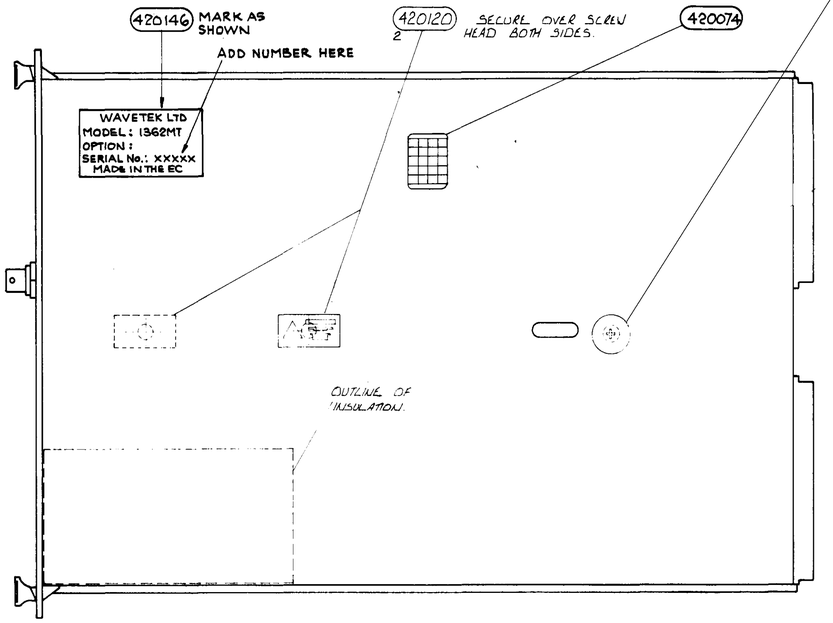
DRAWING No.

ISS.	CHANGES
2.0	ECO. 4174 REDRAWN IJL 18 NOV 92
2.1	ECO. 4372 MOD LEVEL LABEL ADDED. IJL 18 NOV 93
2.2	ECO. 4564 280191 (U101), 401083 (U107) & TL102 ADDED IJL 25 AUG 94
2.3	ECO. 4771 LABEL 420117-1 REMOVED; REPLACED WITH 420146 IJL 23 FEB 95
2.4	ECO 6209 451395 ADDED JHN 18 OCT 01



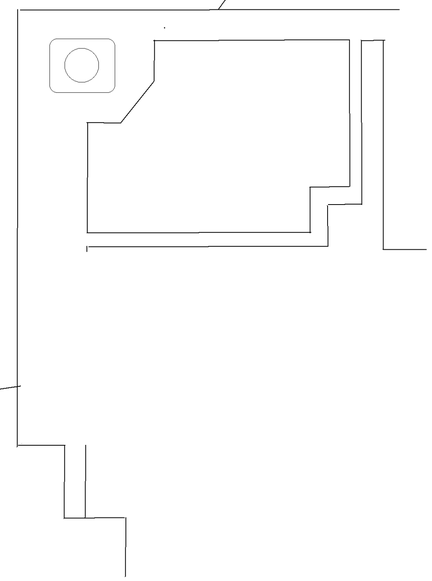






NOTE : STRIKE OFF ONLY INCLUDED MOD LEVELS.

420119 SECURE OVER SCREW HEAD THIS SIDE ONLY.



NOTE 450779 HAS TO BE ASSEMBLED TO PCB BEFORE 450778.

THIRD ANGLE PROJECTION	DRAWN IJL	DATE 19 NOV 92	DIMENSIONS IN MILLIMETRES	TOLERANCES DECIMAL TO 2 PLACES ± .1mm; DECIMAL TO 1 PLACE ± .2mm; WHOLE DIMENSIONS ± .4mm; ANGULAR ± ½°; UNLESS OTHERWISE STATED	MATERIAL ——	TITLE 1362 MT. FINISHED ASSEMBLY.
ALL BURRS TO BE REMOVED	CHECKED MJO	DATE 10 DEC 92	SCALE ——		FINISH ——	
	APPR	DATE 11 Dec 92	NOT TO BE SCALED			

datron INSTRUMENTS NORWICH ENGLAND

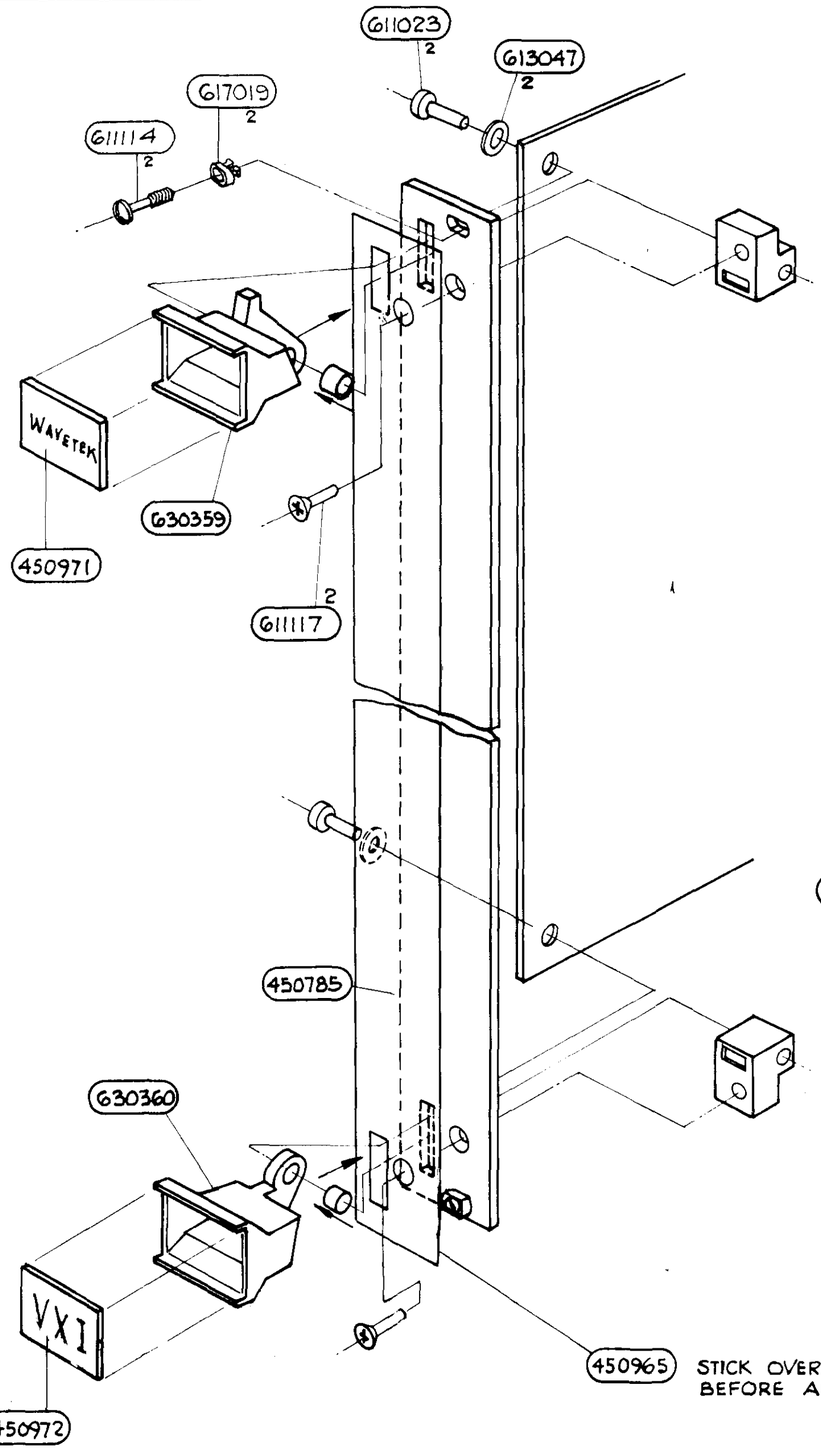
DRAWING No. DA 400952

SHEET 1 OF 2

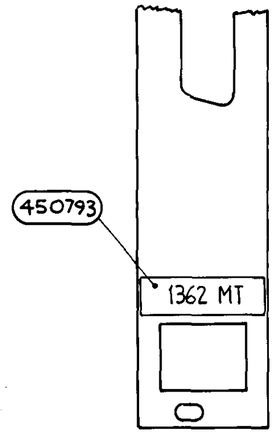
BAYLISS WISDOM PDS 870728

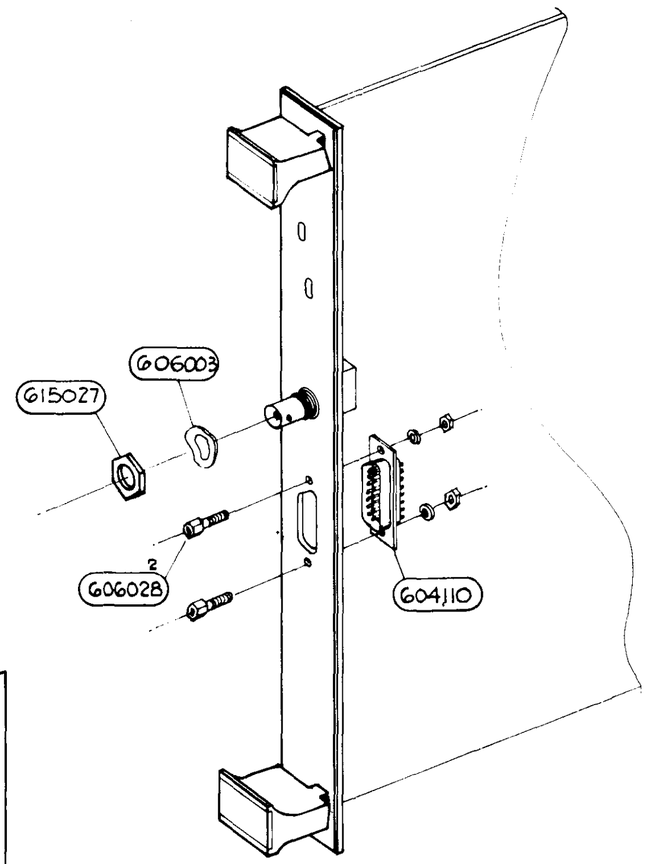
ISS	CHANGES
2.0	ECO. 4174 NEW SHEET. IJL 18 NOV 92

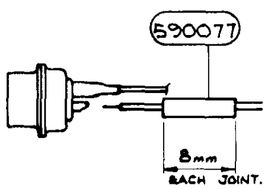
DRAWING No.
DA 400952

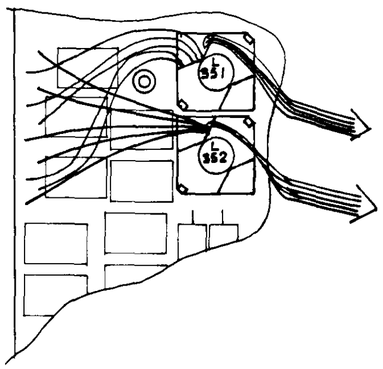


STICK OVERLAY TO FRONT PANEL BEFORE ANY ASSY.

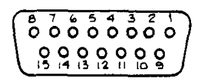








VIEW OF REAR FACE.



ALL WIRES TO J351 15 WAY 'D' TYPE 604110		
FROM	COLOUR	TO
L351	RED	PIN 1
L351	BROWN	" 2
—	NO CONNECTION	" 3
—	NO CONNECTION	" 4
L351	BLACK	" 5
L351	BLUE	" 6
L351	YELLOW	" 7
—	NO CONNECTION	" 8
L352	YELLOW	" 9
L352	BLUE	" 10
L352	BLACK	" 11
—	NO CONNECTION	" 12
—	NO CONNECTION	" 13
L352	BROWN	" 14
L352	RED	" 15

datron
INSTRUMENTS
NORWICH
ENGLAND

THIRD ANGLE PROJECTION

ALL BURRS TO BE REMOVED

DRAWN IJL	DATE 19 NOV 92	DIMENSIONS IN MILLIMETRES
CHECKED MJO	DATE 10 DEC 92	SCALE NOT TO SCALE.
APPR. OK	DATE 11 Dec 92	NOT TO BE SCALED

TOLERANCES
DECIMAL TO 2 PLACES ± ·1mm
DECIMAL TO 1 PLACE ± ·2mm
WHOLE DIMENSIONS ± ·4mm
ANGULAR + ½°
UNLESS OTHERWISE STATED

MATERIAL —

FINISH —

TITLE
1362 MT CARD DMM ASSEMBLY.

DRAWING No.
DA 400952

SHEET 2 OF 2

BAYLISS WISDOM POS 870729

DRAWING NO
DA400911

ISS	CHANGES
5.0	ECO 4174 SCPI COMPATIBILITY INCORPORATED IN DESIGN IJL 19 NOV 92
5.1	ECO 4251 PCB WAS ISS.A IJL 4 FEB 93
6.0	ECO 4564 PCB WAS ISS 1 JD 22 JUN 94
6.1	ECO 6208 PCB ASSY ADDED 401587 JHN 16 OCT 01
6.2	ECO 6209 401589 ADDED U710 SOCKET WAS 605050 JHN 19 OCT 01
6.3	ECO 6232 HIDDEN DETAIL CLARIFIED. JHN 23 JAN 02
6.4	ECO 6256 420117 REMOVED 420098 ADDED RCG 05 JUL 02

E801
603003
602025

E602 , E802 , E902 AND E903
4 603004
COMPONENT SIDE
3.5mm

U155 AND U703
618018 2

ENSURE THAT TRANSISTORS Q903, Q904 ARE PUSHED DOWN TO THE SHOULDER BEFORE SOLDERING

401589

CROP COMPONENT LEADS TO 2mm OR LESS IN THIS AREA

NOTE: WHEN THE CURRENT OPTION IS NOT FITTED, OMIT THESE COMPONENTS F351, R363, K253, Q256, Q257 AND FIT THE LINKS SHOWN BELOW.

Q256
Q257
K257
J301
T301
F351
R164
R163
R363
K253
R156
R157
J301
T903
T902
T901
Q903
E903
E902
Q904
U155
R707
E802
E801
U710
Y701
U452
P301
630024 8
D303, R163, R606, R164 (1 PER LEAD)
D303
104056
U101
612004 2
612055 2

NOTE: WHEN THE RATIO OPTION IS NOT FITTED, OMIT THESE COMPONENTS K258, K259, K260, L352, Q252, Q253 AND FIT THE LINKS SHOWN BELOW

Q252
Q253
K260
K259
K267
K258
K266
L352
R838
R836
R835
R837
C810
U703
R835
R833
Q256
Q257
Q252
Q253
U353
U354
U355
U352
U351
U202
U102 (A)
U103 (B)
U104
U105
420112
SECURE S.S.D LABEL TO U104
P302
420098

E359
E357
E360
E356
E355
E361
E364
E352
E351
E365
K267
K266

E602
C603
R606
C605
C607
TL252
TL254

920145 2
R836 AND R837

MOUNT C603 & C605 ON EDGE, THUS

4 630243
C809 AND C810

C620
4 602001
C607 AND C620

2 605127
CONFIGURATION OF OPTION LINKS

NOTE REVERSE ORIENTATION OF U351 AND U352

401587

414009-2

611023 4
615006 4

LINK CENTRE PINS OF THREE WAY CONNECTORS EITHER TO PINS 1 OR 3 , AS SHOWN IN CHART.

	TL252	TL254
CURRENT AND RATIO	3	3
RATIO FITTED	3	1
CURRENT FITTED	1	3
NO CURRENT OR RATIO	1	1

MOUNTING I C'S

No OF PINS	PART No	No OFF	WHERE USED
16	605061	1	U153
18	605062	2	U251 , U252
20	605070	2	U203 , U356
24	605175	3	U107 , U108 , U204
24	605064	1	U106
28	605065	4	U102 , U103 , U104 , U105
40	604171	1	U710
68	605204	2	U101, U202
84	605205	1	U452

THIRD ANGLE PROJECTION
ALL BURRS TO BE REMOVED

DRAWN	JD	DATE	5 FEB 92
CHECKED	RC	DATE	18 NOV 92
APPROVED	GI	DATE	18 NOV 92

DIMENSIONS IN MILLIMETRES
SCALE N.T.S.
NOT TO BE SCALED

TOLERANCES UNLESS OTHERWISE STATED
DECIMAL TO 2 PLACES ± 0.1mm
DECIMAL TO 1 PLACE ± 0.2mm
WHOLE DIMENSIONS ± 0.4mm
ANGULAR ± 0.5°

MATERIAL ——
FINISH ——

TITLE
1362S CARD DMM ASSEMBLY

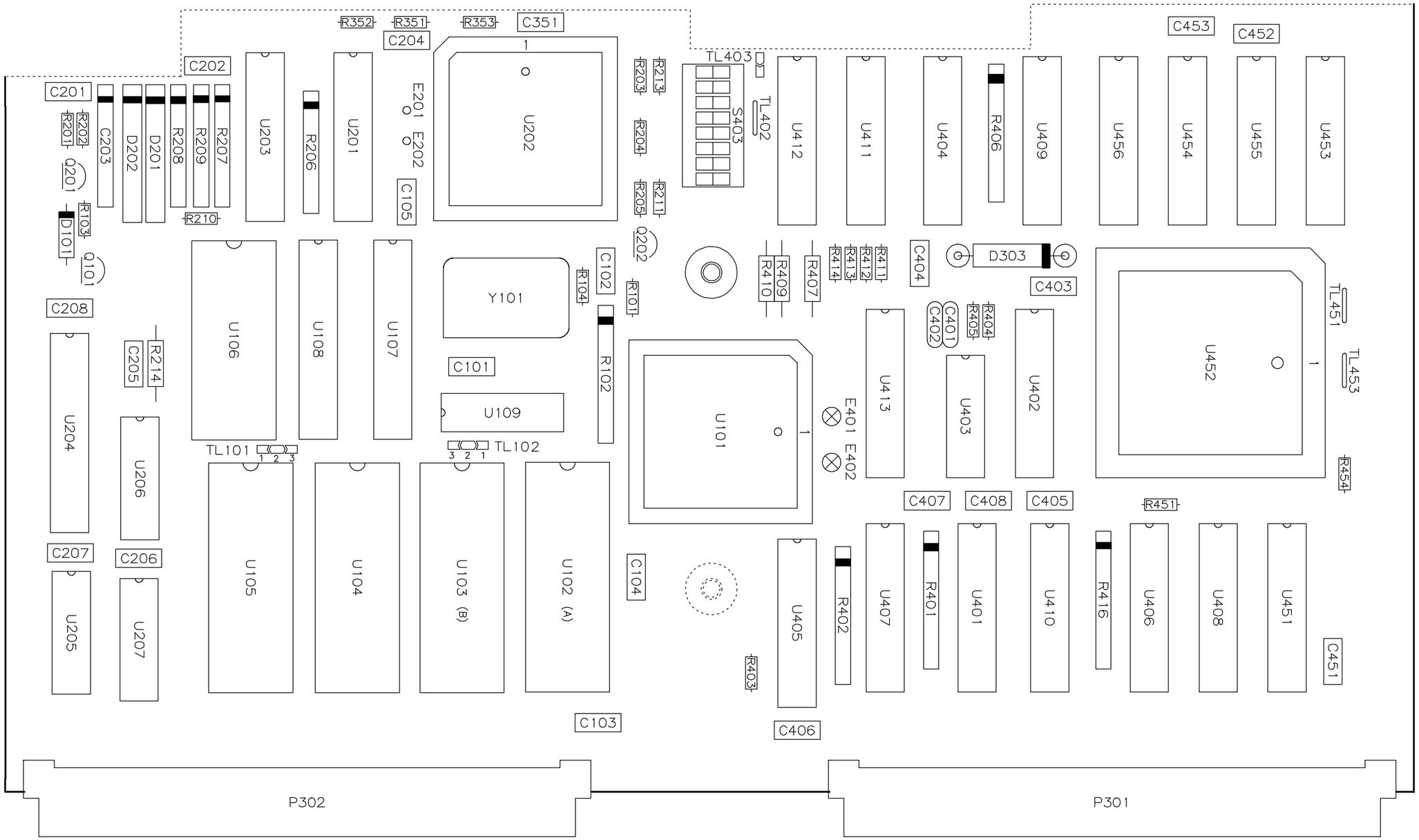
datron WAVETEK
NORWICH ENGLAND

DRAWING NO.
DA400911

SHEET 1 OF 4

DRAWING NO
DA400911

ISS	CHANGES
5.0	ECO 4174 SCPI COMPATIBILITY INCORPORATED IN DESIGN IJL 19 NOV 92
6.0	ECO4564 R104 ADDED JD 22 JUN 94



N.B. TL101, 102, 403 ARE NOT COMPONENTS

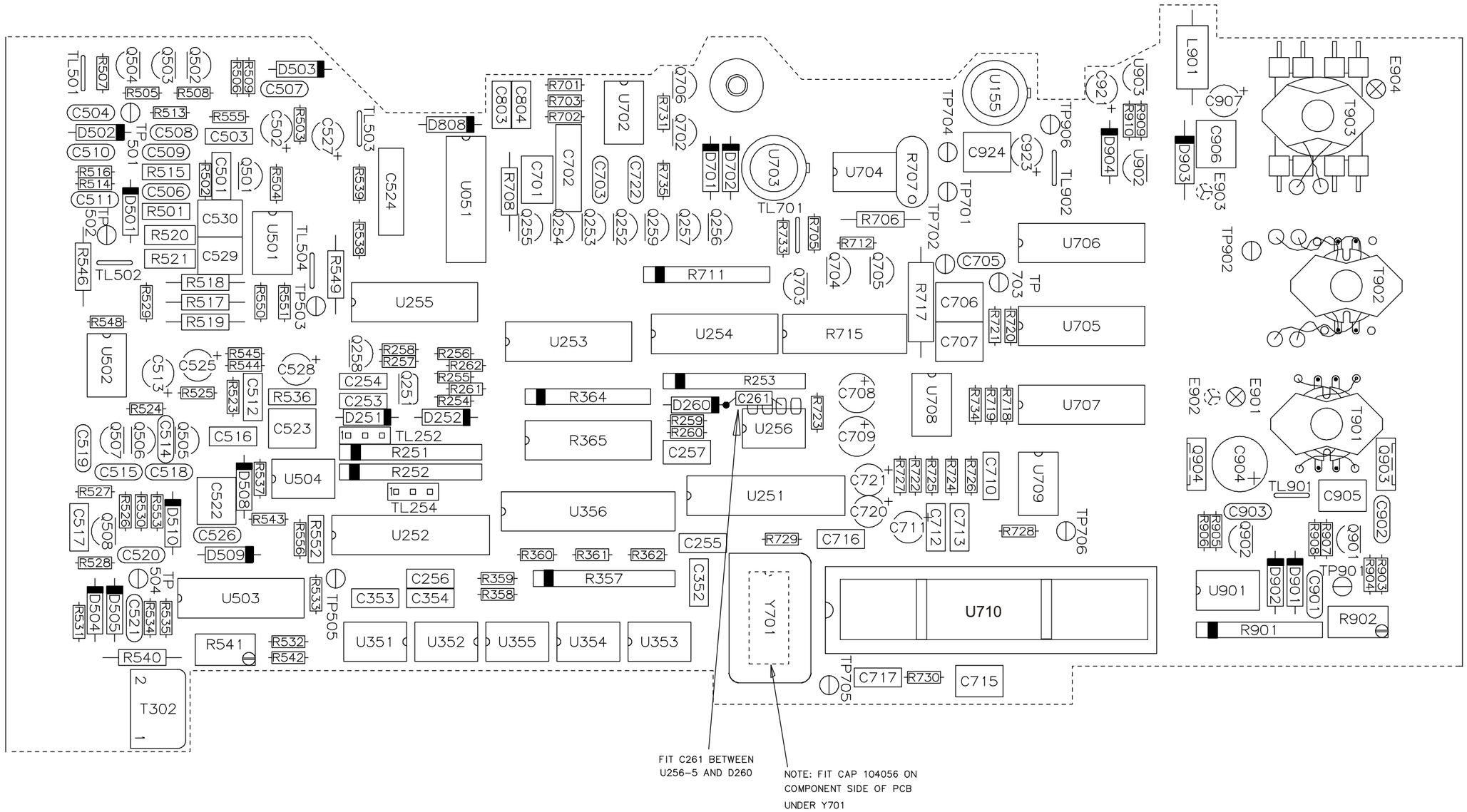
THIRD ANGLE PROJECTION	DRAWN JD	DATE 5 FEB 92	DIMENSIONS IN MILLIMETRES	TOLERANCES	MATERIAL	TITLE
ALL BURRS TO BE REMOVED	CHECKED RC	DATE 18 NOV 92	SCALE N.T.S.	DECIMAL TO 2 PLACES ± 0.1mm DECIMAL TO 1 PLACE ± 0.2mm WHOLE DIMENSIONS ± 0.4mm ANGULAR ± 0.5°	FINISH	1362S CARD DMM ASSEMBLY
	APPROVED GI	DATE 18 NOV 92	NOT TO BE SCALED	UNLESS OTHERWISE STATED		

datron WAVETEK
NORWICH ENGLAND

DRAWING NO.
DA400911

DRAWING NO
DA400911

ISS	CHANGES
5.0	ECO 4174 SCPI COMPATIBILITY INCORPORATED IN DESIGN IJL 19 NOV 92
5.1	ECO 4248 Q901/Q902 ROTATED 180 DEG. IJL 1 FEB 93
6.0	ECO 4564 JD 22 JUN 94
6.1	ECO 5004 NOTE ADDED RE FITTING OF CAP UNDER Y701 IJL 17 JAN 96
6.2	ECO 5065 C261 ADDED IJL 5 FEB 96
6.3	ECO 6209 U710 WAS 280129 JHN 22 OCT 01

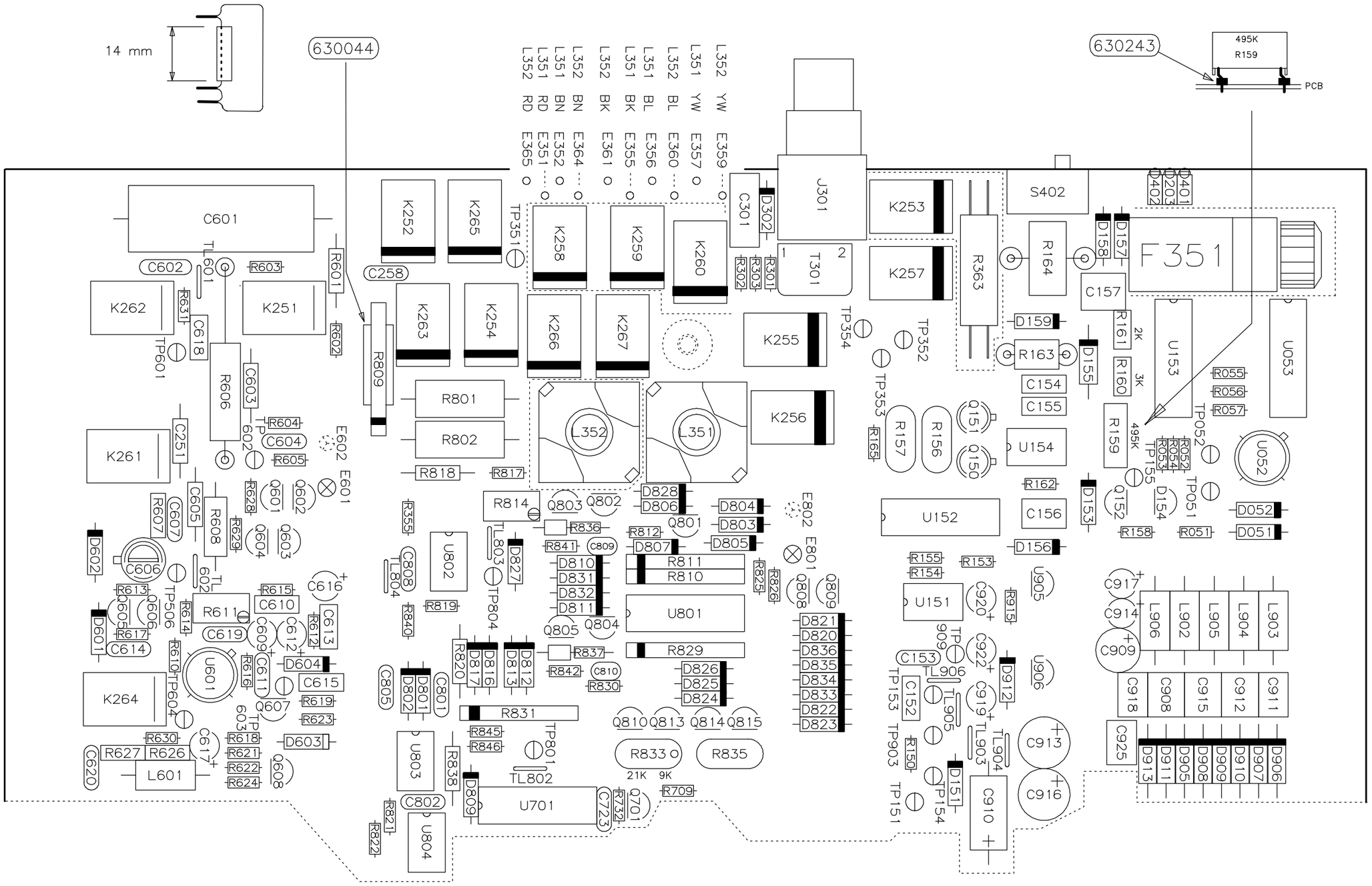


THIRD ANGLE PROJECTION ALL BURRS TO BE REMOVED	DRAWN JD	DATE 5 FEB 92	DIMENSIONS IN MILLIMETRES SCALE N.T.S. NOT TO BE SCALED	TOLERANCES DECIMAL TO 2 PLACES ± 0.1mm DECIMAL TO 1 PLACE ± 0.2mm WHOLE DIMENSIONS ± 0.4mm ANGULAR ± 0.5° UNLESS OTHERWISE STATED	MATERIAL ——	TITLE 1362S CARD DMM ASSEMBLY	DRAWING NO. DA400911
	CHECKED RC	DATE 18 NOV 92			FINISH ——		SHEET 3 OF 4
	APPROVED GI	DATE 18 NOV 92					

DRAWING NO
DA400911

ISS	CHANGES
5.0	ECO 4174 SCPI COMPATIBILITY INCORPORATED IN DESIGN IJL 19 NOV 92
6.0	ECO 4564 JD 22 JUN 94
6.1	ECO 5004 R159,R160 & R161 WERE SHOWN AS ROUND PACKAGES 2 off BEAD 630243 ADDED IJL 15 JAN 96

L351 AND L352 CHOKE CONNECTIONS



THIRD ANGLE PROJECTION	DRAWN JD	DATE 5 FEB 92	DIMENSIONS IN MILLIMETRES	TOLERANCES DECIMAL TO 2 PLACES ± 0.1mm DECIMAL TO 1 PLACE ± 0.2mm WHOLE DIMENSIONS ± 0.4mm ANGULAR ± 0.5°	MATERIAL ——	TITLE 1362S CARD DMM ASSEMBLY
ALL BURRS TO BE REMOVED	CHECKED RC	DATE 18 NOV 92	SCALE N.T.S.		FINISH ——	
	APPROVED GI	DATE 18 NOV 92	NOT TO BE SCALED	UNLESS OTHERWISE STATED		

datron WAVETEK
NORWICH ENGLAND

DRAWING NO.
DA400911

SHEET 4 OF 4

DRAWING_NO
DC400911

ISS	CHANGES
5.0	ECO 4174 SCPI COMPATIBILITY INCORPORATED IN DESIGN IJL 18 NOV 92
6.0	ECO 4564 TL101,TL102 & R104 ADDED IJL 29 JUN 29
6.1	ECO 4564 R104 WAS 68R MJD 22 JUL 94

ADDRESS BUS

ADDRESS_BUS 2 14

+5V_1

TL101 8K 32K

LA14

U101
MC68HC001FN16
16BIT PROCESSOR

HALT-L
LRESET-L
LBERR-L
LDTACK-L
IPL0_2-L
IPL1-L
BR-L
BGACK-L

CLK HALT RESET BERR DTACK IPL0 IPL1 IPL2 VPA BR BGACK

AS UDS LDS R/W VMA E BG

LAS-L UDS-L LDS-L RDWR-L FC0 FC1 FC2

LD0 LD1 LD2 LD3 LD4 LD5 LD6 LD7 LD8 LD9 LD10 LD11 LD12 LD13 LD14 LD15

DATA

ADR

LA1 LA2 LA3 LA4 LA5 LA6 LA7 LA8 LA9 LA10 LA11 LA12 LA13 LA14 LA15 LA16 LA17 LA18 LA19 LA20 LA21 LA22 LA23

R101 10K 1%

U102
AM27C512-90
UV EPROM 512KBIT
PROM64KX8
A 0 65535

U103
AM27C512-90
UV EPROM 512KBIT
PROM64KX8
A 0 65535

U104
CXK58257AP-70L
STATIC RAM
RAM 32KX8
A 0 32767
RAM-L
G1
EN
M3 [WE]
A,1,2,3D▽
A,1,2,3D

U105
CXK58257AP-70L
STATIC RAM
RAM 32KX8
A 0 32767

U106
X2816A-25
EEPROM 16KBIT
PROM 2KX8
A 0 2047
G1
EN
M2 [WE]
A,1,2▽
A,1,2D

CONTROL_BUS 2 14

DATA_BUS 2 14

DATA BUS

ADDRESS DECODE

U107
22V10
FPLD 10NS LP
LIACK-L
LA15 LA16 LA17 LA18 LA19 LA20 LA21 LA22 LA23
ROMEN-L RAM-L CALSTEN-L ASICEN-L SWEN-L VMEEN-L CPUEVWR-L BUFEN-L
LAS-L LDS-L TRGREN-L RDWR-L

U108
20V8
FPLD 10NS LP
CONTROL
FC0 FC1 FC2 LAS-L ROMEN-L RAM-L CALSTEN-L BUFEN-L RDWR-L WREN-L LDS-L UDS-L
LIACK-L DATACK-L DACK-L WRRD-L

U403
RAM-L LDS-L ROMEN-L UDS-L

CALSTEN-L WRRD-L CALEN-H LBWE-L UBWE-L

R102 10K 2%
R103 10K 1%
Q101 BC184
D101 1N4148

+5V_1

LDTACK-L LBERR-L BR-L BGACK-L IPL0_2-L IPL1-L LRESET-L

CONTROL BUS

CLK8-R CLK1-R

CLK1-R 2

TL102

U109
74LS393
DUAL BIN CNTR
CTR DIV16
CT=0
CT

CLK16-R

Y101
16MHz
CRYSTAL OSC
VCC GND OUT

R104 39R 1%

C101 100NF 63V

0V_1

C102 100NF 63V
C103 100NF 63V
C104 100NF 63V
C105 100NF 63V

U103 AM27C512-90 GND
U104 58257AP-70L GND
U105 58257AP-70L GND
U106 X2816A-25 GND
U107 22V10 GND
U108 20V8 GND
U109 74LS393 GND
U101 MC68HC001FN16 GND1 GND2 GND3 GND4
VCC VCC1 VCC2

DRAWN	JD	DATE	20 JAN 92
CHKD	RC	DATE	18 NOV 92
APPD	GI	DATE	18 NOV 92

TITLE
1362S SINGLE CARD DMM
PROCESSOR AND MEMORY

DRAWING_NO
DC400911

SHEET 1 OF 14

DRAWING_NO
DC400911

ISS	CHANGES
5.0	ECO 4174 SCPI COMPATIBILITY ADDED TO DESIGN IJL 18 NOV 92
6.0	ECO 4564 ISSUE UPDATE IJL 29 JUN 94

CONTROL_BUS
ADDRESS_BUS
VME
DATA_BUS
BCDAT
TRIGGER-H
TRIG_GND
E201
E202

U202 CLA3721 DIGITAL GATE ARRAY
U201 74HCT245 3-STATE TRNCVR
U203 74HCT244 3-STATE BUFFER
U204 22V10 FPLD
U205
U206 74AS109 DUAL J-K FF
U207 74F151 8:1 MUX

CLK1-R, CLK8-R, IFCLK, PFAIL-H, PFAIL, RESET, LRESET-L
LA1, LA2, LA3, LA4, ADR
ASICEN-L, LAS-L, LDS-L, RDWR-L, LIACK-L, DATACK-L
375NS, 500NS, 1US, 2US, 4US, 8US, 16US, 32US
SCEN, PCEN, SUNV, SSCAL, SPCAL
CALEN-H, CALSTEN-L
HOLD, SAVE, TRIG, GET, RTCINT, FPINT, GPIAINT, NMI
SCLK, EN, DOUT, DINA, DINB, ERR, SER IF
DTACK, BERR, FPSTB, RTCSTB, WREN, RTX, CI, SMPL, IPL1, IPL0/2, TEST, TEST1
IPL1-L, IPL0_2-L, DLWINT-L, RESET-L
LSCLK-F, LEN-H, LDOUT-H, LDINB-H, LERR-L, LDTACK-L, LBERR-L, WREN-L, LATX-R, LCI-R
BUFEN-L, RDWR-L
LD0–LD7, BCD0–BCD7, DATA
LSCLK-F, LDOUT-H, LEN-H, LCI-R, LERR-L
LDINB-H, LERR-L, LATX-R
LED+, SSCLK-F, SDOUT-H, SEN-H, SCI-R
SRTX-R, SERR-L, SINB-H
LDS-L, TRGREN-L, LRESET-L
TTLTRG0–TTLTRG7, CLK1-R

R201 10K 1%, R202 10K 1%, R203 10K 1%, R204 10K 1%, R205 10K 1%
R206 68R 2%, R207 68R 2%, R208 4K7 2%, R209 270R 2%, R210 680R 1%
R211 10K 1%, R213 100R 1%, R214 2K21 1%
Q201 BC184, Q202 BC184
2303 555-D203
D201–D202 1N4148
C201 100NF 63V, C202 100NF 63V, C204 100NF 63V, C206 100NF 63V, C207 100NF 63V, C208 100NF 63V
C203 50V 220PF, C205 47NF 63V

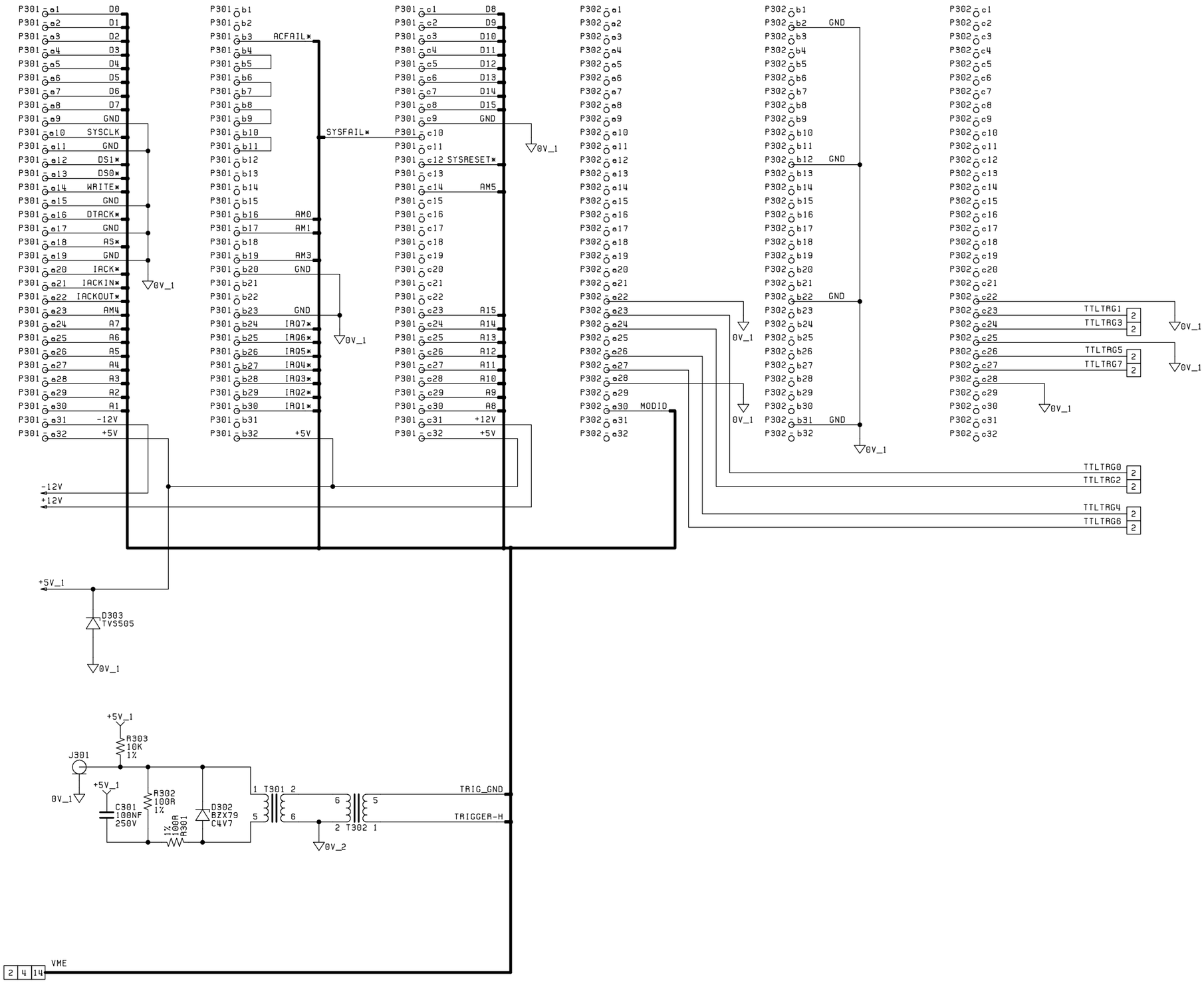
+5V_1, 0V_1

datron WAVETEK
NORWICH ENGLAND

DRAWN JD	DATE 20 JAN 92	TITLE 1362S SINGLE CARD DMM SERIAL INTERFACE
CHKD RC	DATE 18 NOV 92	DRAWING_NO DC400911
APPD GI	DATE 18 NOV 92	SHEET 2 OF 14

DRAWING_NO
DC400911

ISS	CHANGES
5.0	ECO 4174 SCPI COMPATIBILITY ADDED TO DESIGN IJL 18 NOV 92
6.0	ECO 4564 ISSUE UPDATE IJL 29 JUN 94



DRAWN JD	DATE 20 JAN 92	TITLE 1362S SINGLE CARD DMM DIGITAL CONNECTIONS
CHKD RC	DATE 18 NOV 92	
APPD GI	DATE 18 NOV 92	

DRAWING_NO
DC400911

SHEET 3 OF 14

DRAWING_NO
DC400911

ISS	CHANGES
5.0	ECO 4174 SCPI COMPATIBILITY ADDED TO DESIGN IJL 18 NOV 92
6.0	ECO 4564 TL403 ADDED R413 WAS 10K IJL 29 JUN 94

VME
WRITE-L
DEN-L
VME_HIGHBYTE
CONTROL_BUS
CALEN-H
SWEN-L
CPUEVWR-L
NVEN-H
LADD
BCDAT
PFAIL-H
CAL SWITCH
LATCH-L
LED+
SYSFAIL*
IACKOUT*
RESET-L
LATX-R
FAIL-L
BUSY_LED-L
FAILLED-L
DTACK-L
INT_BUS
BA1
BA2
BA3
BA4
BA5
IACK-L
VLACPR-L
BSCPR-L
SYSRST-L
VME_LOWBYTE
DTEN-L
EVENTEN-L
LAEN-L
LAWR-L
LAREN-L
LAREST-L
LHALT-L
LDTACK-L

U401 74F545 3-STATE TRNCVR
U402 74F521 8 BIT MAG COMP
U403 74ALS04
U404 74F521 8 BIT MAG COMP
U405 74HCT244 3-STATE BUFFER
U406 74F545 3-STATE TRNCVR
U407 74ALS574A 3-STATE D FF
U408 74ALS573 3-STATE LATCH
U409 74LS541 3-STATE BUFFER
U410 74ALS641A-1 OC TRNCVR
U411 74ALS574A 3-STATE D FF
U412 74LS541 3-STATE BUFFER
U413 74ALS641A-1 OC TRNCVR

R401–R416 10K 2%
R402 1.0K 2%
R403 100K 1%
R404 68R 1%
R405 68R 1%
R407 100R 5%
R409 100R 5%
R410 100R 5%
R411 10K 1%
R412 10K 1%
R413 680R 1%
R414 10K 1%
C401 4N7F 100V
C402 4N7F 100V
C403–C407 100NF 63V
C408 100NF 63V
555-2007 D401 RED
555-2403 D402 YELLOW
E401 RST
E402
S402
S403
TL402
TL403

DRAWN	JD	DATE	20 JAN 92
CHKD	RC	DATE	18 NOV 92
APPD	GI	DATE	18 NOV 92

TITLE
1362S SINGLE CARD DMM
DIGITAL SUBSYSTEM
VME INTERFACE

DRAWING_NO
DC400911

SHEET 4 OF 14

datron WAVETEK
NORWICH ENGLAND

DRAWING_NO
DC400911

ISS	CHANGES
5.0	ECO 4174 SCPI COMPATIBILITY ADDED TO DESIGN IJL 18 NOV 92
5.1	ECO 4258 R540 WAS 1R80 IJL 11 FEB 93
6.0	ECO 4564 ISSUE UPDATE IJL 29 JUN 94
6.1	ECO 5530 R540 WAS 3R01 IJL 29 MAY 97

RMS_IN TL501 R501 5K000 0.01% C506 4P7F 100V
R555 82R 1% C503 6N8F 100V
C501 100NF 63V R502 33K 1% R503 22K 1% 35V 1UF C502
Q501 BC184 Q502 BC214 Q503 2N3906 Q504 2N3904
R504 1K2 1% R506 680R 1% R508 56R 1% R509 8K2 1%
D503 BZX79 C5V6 C507 1NF 100V
+15V_8 -15V_8 0V_2
U501 OP77EP
C504 33PF 100V R505 220R 1% R507 68R 1%
TP501 TP502 TP503 TP504 TP505 TP506
D501 1N6263 D502 1N6263 D508 1N4148 D505 1N4148
R513 4K7 1% C508 15PF 100V R514 2K7 1% C510 10PF 100V C511 10PF 100V
R515 5K000 0.01% C509 15PF 100V R516 2K7 1% R517 10K0 0.1%
R518 20K0 0.1% R519 PART OF 290026-3 R520 20K00 0.01% R521 10K00 0.01%
R549 8M2 5% R550 1M0 1% R551 1K2 1%
U503 290026-3 RMS CHIP
R529 47R 1% R546 PART OF 290026-3 R548 47R 1%
TL504 TL502 TL503
R532 33K 1% R533 68K 1%
R526 1K0 1% C516 100NF 63V
Q505 BC184 Q506 BC214 Q507 2N3906 Q508 2N3904
C512 100NF 63V R523 33K 1% R524 12K 1% 35V 1UF C513
C514 330PF 100V R525 1K5 1% R553 680R 1%
C515 1PF 500V R527 220R 1% R528 100R 1%
C517 100NF 63V C518 4P7F 100V C519 2P2F 100V
D504 BZX79 C5V6 C520 1NF 100V R530 560R 1%
R534 1K5 1% C521 33PF 100V R531 10K 1% R535 330R 1%
U502 OP77EP
R536 40K0 0.1% R537 3K3 1% C529 1UF 50V C530 1UF 50V C522 1UF 50V C523 1UF 50V
U504 OP200GP R538 170K 1% R539 33K 1% C524 220NF 63V
U051 DG413DJ
10HZ-L AC_OUT ACFB
R556 22K 1% R540 FSV (1R5-3R3) R541 50K R542 68K 1% R552 40K0 0.1%
R543 1K0 1% C526 68PF 100V 10V 47UF C525
D509 1N458A D510 1N458A
R544 10R 1% C527 10UF 50V C528 10UF 50V R545 10R 1%
+15V -15V 0V_6

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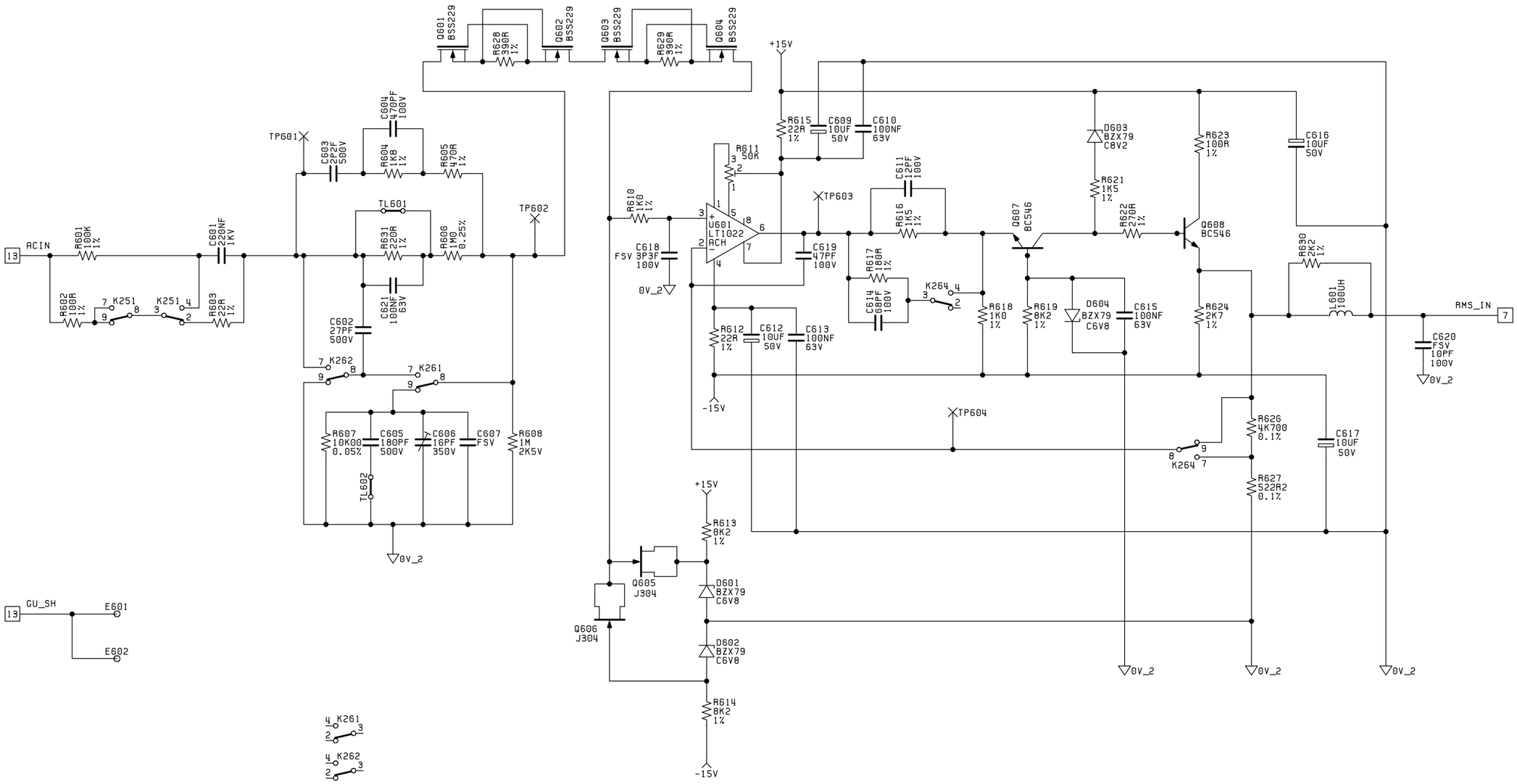
DRAWN JD	DATE 20 JAN 92	TITLE 1362S SINGLE CARD DMM RMS CONVERTER	DRAWING_NO DC400911
CHKD RC	DATE 18 NOV 92		
APPD GI	DATE 18 NOV 92		SHEET 5 OF 14

DRAWING_NO
DC400911

ISS	CHANGES
5.0	ECO 4174 SCPI COMPATIBILITY ADDED TO DESIGN IJL 18 NOV 92
6.0	ECO 4564 ISSUE UPDATE IJL 30 JUN 94



DRAWN JD	DATE 20 JAN 92	TITLE 1362S SINGLE CARD DMM AC PREAMP	DRAWING_NO DC400911
CHKD AC	DATE 18 NOV 92		
APPD GI	DATE 18 NOV 92		SHEET 6 OF 14

datron WAVETEK
NORWICH ENGLAND

DRAWING_NO
DC400911

ISS	CHANGES
5.0	ECO 4174 SCPI COMPATIBILITY ADDED TO DESIGN IJL 18 NOV 92
6.0	ECO 4564 ISSUE UPDATE IJL 30 JUN 94
6.1	ECO 5796 U702 WAS OP97 AMC 01 JUN 98
6.2	ECO 6209 U710 WAS 280129 C715 WAS 110051 JHN 22 OCT 01

DCSEL-L
AC_OUT
DC_OUT
ACFB
FILTER-L
HEAT
U051
U703 6V95 LM399AH
U701 U706 U707 DG413DJ
U705 DG211
U710 CLA3722 A-D GATE ARRAY
U702 LT1012 CN8
U704 OP200GP
U708 LT1012 CN8
U709 LM311N
Q701 BC546
Q702 BC556
Q703 J105
Q704 BC556
Q705 BC546
Q706 BC546
D701 BZX79 C5V1
D702 BZX79 C5V1
TL701
TP701 TP702 TP703 TP704 TP705 TP706
Y701 4M9152Hz CRYSTAL OSC
Y701 MOUNTED ON 20NF 50V FLAT DIL CAPACITOR
SCLK-F
EN-H
ERR-L
D_FR_C
D_TO_OPT
SERIAL_IF
CI-R
RTX-R

DRAWN JD	DATE 20 JAN 92	TITLE: 1362S SINGLE CARD DMM A TO D CONVERTER
CHKD RC	DATE 18 NOV 92	
APPD GI	DATE 18 NOV 92	

DRAWING_NO
DC400911

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DRAWING_NO
DC400911

RANGE		1V	100mV	10V	10V
IN	X	1	1	0	0
	Y	0	1	0	1
OUT	VA	ON	ON	OFF	OFF
	VB	OFF	OFF	ON	ON
	VC	ON	OFF	OFF	OFF
	VD	OFF	ON	OFF	OFF
FOR 'X', '0' IS ON					

ISS	CHANGES
5.0	ECO 4174 SCPI COMPATIBILITY ADDED TO DESIGN IJL 18 NOV 92
6.0	EC 4564 ISSUE UPDATE IJL 30 JUN 94

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NORWICH ENGLAND

DRAWN	JD	DATE	20 JAN 92
CHKD	RC	DATE	18 NOV 92
APPD	GI	DATE	18 NOV 92

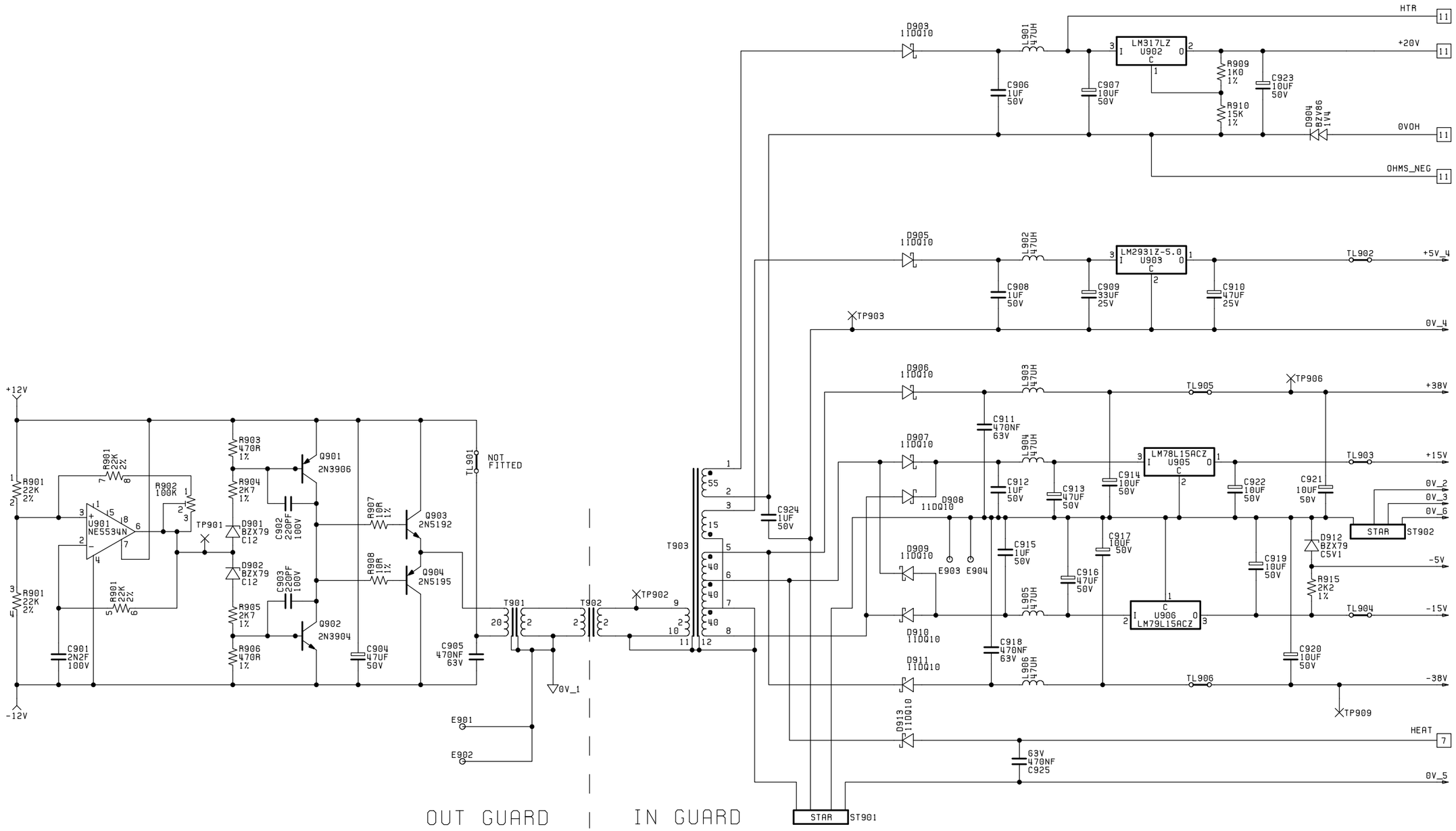
TITLE
1362S SINGLE CARD DMM
DC PREAMP

DRAWING_NO
DC400911

SHEET 8 OF 14

DRAWING_NO
DC400911

ISS	CHANGES
5.0	ECO 4174 SCPI COMPATIBILITY ADDED TO DESIGN IJL 18 NOV 92
5.1	ECO 4248 Q901 WAS BC214 Q902 WAS BC184 IJL 1 FEB 93
6.0	ECO 4564 ISSUE UPDATE IJL 30 JUN 94



DRAWN	JD	DATE	20 JAN 92
CHKD	RC	DATE	18 NOV 92
APPD	GI	DATE	18 NOV 92

TITLE
1362S SINGLE CARD DMM
POWER SUPPLIES

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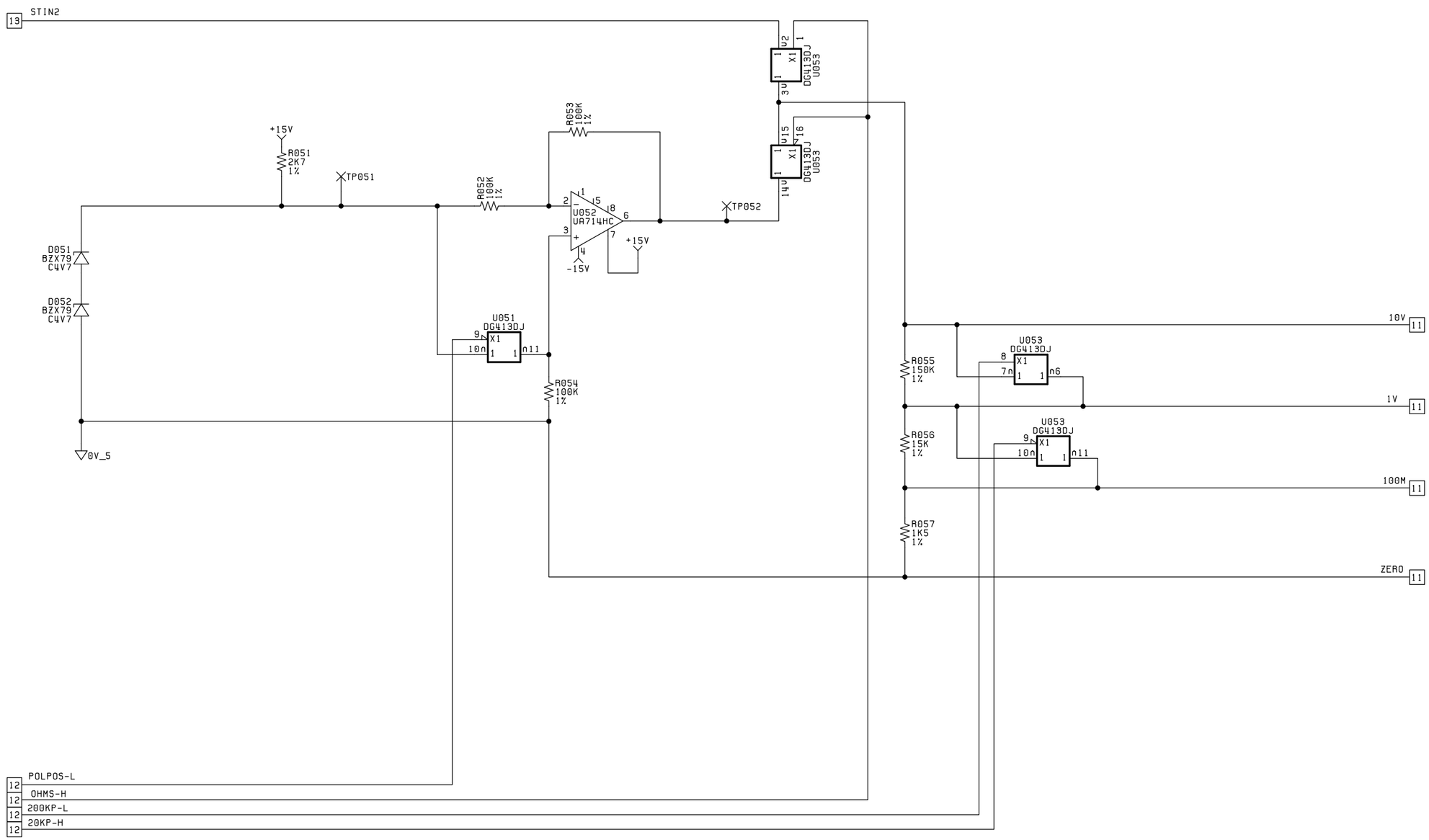
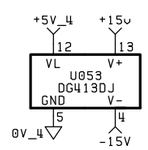
NORWICH ENGLAND

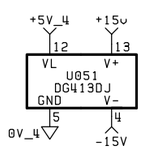
DRAWING_NO
DC400911

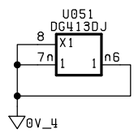
DRAWING_NO
DC400911

ISS	CHANGES
5.0	ECO 4174 SCPI COMPATIBILITY ADDED TO DESIGN IJL 18 NOV 92
6.0	ECO 4564 ISSUE UPDATE IJL 30 JUN 94









DRAWN	JD	DATE	20 JAN 92
CHKD	RC	DATE	18 NOV 92
APPD	GI	DATE	18 NOV 92

TITLE
1362S SINGLE CARD DMM
SELF TEST SUBSYSTEM

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DRAWING_NO
DC400911

DRAWING_NO
DC400911

CURRENTS	
100R/1K 1,2	1mA
10K 3	100uA
100K 4	10uA = 1mA / 100
1M 5	4uA = 1mA / 250
10M 6	400n = 100uA / 250

ISS	CHANGES
5.0	ECO 4174 SCPI COMPATIBILITY ADDED TO DESIGN IJL 18 NOV 92
6.0	ECO 4564 ISSUE UPDATE IJL 30 JUN 94

D / E	0	1
0	1M/10M S1	100K S2
1	10K/1K/100R S3	USED IN SELFTEST ONLY

NOTE : DG509
0-3 = S1-S4

DRAWN	JD	DATE 20 JAN 92
CHKD	RC	DATE 18 NOV 92
APPD	GI	DATE 18 NOV 92

TITLE
1362S SINGLE CARD DMM
FLOATING OHMS

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NORWICH ENGLAND

DRAWING_NO
DC400911

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DRAWING_NO
DC400911

OPTIONS NOTE

WHEN THE CURRENT OPTION IS NOT FITTED Q256 , Q257 AND K253 ARE OMITTED . THE BASE AND EMITTER OF Q257 ARE LINKED TOGETHER .

WHEN THE RATIO OPTION IS NOT FITTED Q252 , Q253 , K260 , K259 AND K258 ARE OMITTED .

CONFIGURATION OF OPTION LINKS

LINK CENTRE PINS OF 3 WAY CONNECTORS EITHER TO PINS 1 OR 3 AS SHOWN IN CHART.

	TL252	TL254
CURRENT AND RATIO	3	3
RATIO FITTED	3	1
CURRENT FITTED	1	3
NO CURRENT OR RATIO	1	1

ISS	CHANGES
5.0	ECO 4174 SCPI COMPATIBILITY ADDED TO DESIGN IJL 18 NOV 92
6.0	ECO 4564 ISSUE UPDATE IJL 30 JUN 94
6.1	ECO 5065 C261 ADDED IJL FEB 96

PULSE STRETCH

DRAWN	DATE
JD	20 JAN 92
CHKD RC	DATE 18 NOV 92
APPD GI	DATE 18 NOV 92

TITLE
1362S SINGLE CARD DMM CONTROL

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INPUT CONNECTOR

CHANNEL A

CHANNEL B
(RATIO OPTION)

L351
HI J351-1 RED
I+ J351-2 BRN
LO J351-5 BLK
I- J351-6 BLU
GU J351-7 YEL

L352
HI J351-15 RED
I+ J351-14 BRN
LO J351-11 BLK
I- J351-10 BLU
GU J351-9 YEL

E351 HI_A
E365 HI_B
E352 I+_A
E364 I+_B
E355 LO_A
E361 LO_B
E356 I-_A
E360 I-_B
E357 GU_A
E359 GU_B

K258 K259 K260 K265 K266 K267 K253 K254 K255 K256 K252

TP353 TP354 TP351 TP352

R355 330R 1%
F351 1.6A
R363 0R1 1%

STOUT 11
STIN2 10
OH2WP 11
DCIN 8
ACIN 6
OH4WP 11
OH4WN 11
GU_SH 6
8

0V_1 0V_2 0V_4 0V_6 BS

+5V_1 +5V_4

R351 2K2 1%
R352 4K7 1%
R353 4K7 1%
R357 4K7 2%
R358 270R 1%
R359 270R 1%
R360 270R 1%
R361 10K 1%
R362 1K0 1%
R364 10K 2%
R365 1K 2%

C351 100NF 63V
C352 100NF 63V
C353 100NF 63V
C354 100NF 63V

U351 HCPL-2631 OPTOCOUPLER
U352 6N136 OPTO
U353 6N136 OPTO
U354 HCPL-2601 OPTOCOUPLER
U355 HCPL-2531 OPTOCOUPLER
U356 74HCT244 3-STATE BUFFER
U356 74HCT244 GND VCC

+5V_1
SINB-H
SRTX-R
SERR-L
SEN-H
0V_1
SSCLK-F
SCI-R
SDOUT-H

D_TO_OPT
RTX-R
ERR-L
SERIAL_IF
EN-H
SCLK-F
CI-R
D_TO_C

OUT GUARD | IN GUARD

OPTION NOTES

WHEN THE CURRENT OPTION IS NOT FITTED
K253 , F351 AND R363 ARE OMITTED BUT
PINS 8 AND 9 OF K253 ARE LINKED TOGETHER .

WHEN THE RATIO OPTION IS NOT FITTED
L352 , K258 , K259 AND K260 ARE OMITTED BUT
K258 PINS 8 AND 9 , 2 AND 3 , K259 PINS 8 AND 9 ,
K260 PINS 8 AND 9 , 2 AND 3 ARE LINKED TOGETHER .

ISS	CHANGES
5.0	ECO 4174 SCPI COMPATIBILITY ADDED TO DESIGN IJL 18 NOV 92
6.0	ECO 4564 ISSUE UPDATE IJL 30 JUN 94

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NORWICH ENGLAND

DRAWN JD	DATE 20 JAN 92	TITLE 1362S SINGLE CARD DMM INPUT AND A-D OPTOS
CHKD RC	DATE 18 NOV 92	
APPD GI	DATE 18 NOV 92	

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DC400911

DRAWING_NO
DC400911

ISS	CHANGES
5.0	ECO 4174 SCPI COMPATIBILITY ADDED TO DESIGN IJL 18 NOV 92
6.0	ECO 4564 ISSUE UPDATE IJL 30 JUN 94

INT_BUS
CONTROL_BUS
ADDRESS_BUS
VME
LADD
DLWINT-L
LA1
LA2
VMEEN-L
LDS-L
RDWR-L
+5V_1
0V_1
U451
74LS541
3-STATE BUFFER
MODID
SYSCLK
DS0*
DS1*
AS*
IACKIN*
R454
820R
1%
U452
ACT1020
VME IF
SYSCLK
SYSRST
LA01
LA02
CE
LDS
LWR
LAD0
LAD1
LAD2
LAD3
LAD4
LAD5
LAD6
LAD7
LOG ADR
IACK
IACKIN
DS0
DS1
WRITE
MODID
BSCPR
VALCPR
VME ADR
MODE
NC
DATA
VME DATA
RESET
FAIL
DLW_INT
LATCH
DEN
LAWR
DTEN
DLR_RD
DLR_WR
DLW_RD
DLW_WR
LAREN
LAEN
EVENTEN
IACKOUT
DTACK
SYSFAIL
VME IRQ
IRQ1-L
IRQ2-L
IRQ3-L
IRQ4-L
IRQ5-L
IRQ6-L
IRQ7-L
TL453
TL451
BCD0
BCD1
BCD2
BCD3
BCD4
BD0
BD1
BD2
BD3
BD7
BD9
BD10
BD11
BD12
BD13
BD14
BD15
R451
10K
1%
SYSRST-L
IACK-L
WRITE-L
BSCPR-L
VLACPR-L
BA1
BA2
BA3
BA4
BA5
C451
100NF
63V
VCCA1 VCCA2 VCC3 VCC4 VCC5 VCC6 VPP
GNDA1 GNDA2 GND3 GND4 GND5 GND6
C452
100NF
63V
C453
100NF
63V
VCC
74LS541
GND
74ALS574A
U453
U454
U455
U456
3-STATE D FF
EN
C1
1D
BCD0
BCD1
BCD2
BCD3
BCD4
BCD5
BCD6
BCD7
LD8
LD9
LD10
LD11
LD12
LD13
LD14
LD15
BD0
BD1
BD2
BD3
BD4
BD5
BD6
BD7
BD8
BD9
BD10
BD11
BD12
BD13
BD14
BD15
RESET-L
FAIL-L
LATCH-L
DEN-L
LAWR-L
DTEN-L
LAREN-L
LAEN-L
EVENTEN-L
IACKOUT-H
DTACK-L
SYSFAIL-L
BCDAT
VME_LOWBYTE
VME_HIGHBYTE
DATA_BUS

DRAWN JD	DATE 20 JAN 92	TITLE 1362S SINGLE CARD DMM VXI I/F CHIP
CHKD RC	DATE 18 NOV 92	
APPD GI	DATE 18 NOV 92	

DRAWING_NO
DC400911

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SECTION 12 1362 Component Lists

Contents

N.B. **1**. **Servicing Diagrams** appear in Section 11.
2. The pages in this section are not numbered, but the Parts Lists are placed in the following order.

DESIG	PART NUMBER	DESCRIPTION	PRINCIPAL MANUF	MANUF PART NUMBER	CLASS	UM	QUANTITY
U101	280191	IC DIG PROCESSOR 16 BIT 8MHz	PHILIPS	SCN68000CBA68	AO	EA	1
U102	400919-3	ASSY EPROM 1362	FLUKE	SEE DRG		S2	1
U103	400919-3	ASSY EPROM 1362	FLUKE	SEE DRG		S2	-
U107	401083-1	ASSY FPLD ADDR DECODE 1362S	FLUKE	SEE DRG		EA	1
U452	400914-4	ASSY FPGA VXI INT 1362	FLUKE	SEE DRG		EA	1
#1	400911-6	ASSY PCB VXI CARD DMM 1362	BI ELECTRONICS	SEE DRG		EA	1
#1	400912-1	ASSY CABLE SINGLE I/P 1505	FLUKE	SEE DRG		EA	0
#1	400953-1	ASSY CABLE RATIO I/P 1506	FLUKE	SEE DRG		EA	0
#1	410441-5	PCB TOP SCREEN 1362	INLYNE	SEE DRG		EA	1
#1	410442-1	PCB BOTTOM SCREEN 1362	INLYNE	SEE DRG		EA	1
#1	420074-1	LABEL MOD RECORD 1281	RS COMPONENTS	606-226		EA	1
#1	420114	LABEL SSD WARNING DESTRUCTABLE	3M	7102	A	EA	1
#1	420119-1	LABEL CAL STICKER	CJM LABELS	SEE DRG		EA	2
#1	420120	LABEL SSD WARNING DESTRUCTABLE	STATIC SAFE ENVIRONM	SWL 1939		EA	2
#1	420143-2	LABEL CARTON 148.5 X 50	CROWE	SEE DRG		EA	1
#1	420146	LABEL 63.5 X 25.4 SILVER/PE	BRADY	LAT-21-773-1		EA	1
#1	440164-1	KIT CURRENT OPTION 1362	FLUKE	SEE DRG		EA	0
#1	440165-1	KIT RATIO OPTION 1362	FLUKE	SEE DRG		EA	0
#1	450778-3	TOP COVER 1361	FARNELL TECH	SEE DRG		EA	1
#1	450779-2	BOTTOM COVER 1362	FARNELL TECH	SEE DRG		EA	1
#1	450785-3	PANEL FRONT 1362	FARNELL TECH	SEE DRG		EA	1
#1	450787-2	PACKING BOX 1362	A.E.SUTTON	SEE DRG		EA	1
#1	450788-1	INSULATION SHEET 1362	KENSULAT	SEE DRG		EA	1
#1	450789-3	EARTHING SHIELD PSU 1362	FARNELL TECH	SEE DRG		EA	1
#1	450790-3	GUARD SHIELD PSU 1362	FARNELL TECH	SEE DRG		EA	1
#1	450791-3	GUARD SHIELD AC 1361	FARNELL TECH	SEE DRG		EA	1
#1	450819-1	COVER INSULATION 1362	HUGHES & WYNNE	SEE DRG		EA	1
#1	450965-3	OVERLAY 1362	TRIMCRAFT	SEE DRG		EA	1
#1	450971-1	NAMEPLATE 'WAVETEK' 1362	SCREENCRAFT	SEE DRG		EA	1
#1	450972-1	NAMEPLATE 'VXI' 1362	SCREENCRAFT	SEE DRG		EA	1
#1	451395-1	INSULATOR A-D FPGA 1362	HUGHES & WYNNE	SEE DRG		EA	1
#1	590077	SLEEVE HS 0.125 DIA CLEAR	RAYCHEM	KYNAR 1/8x1.2m CLEAR		AR	1
#1	604110	PLUG 15-WAY D TYPE	CANNON	DAM-15P	A	EA	1
#1	605206	SOCKET 15-WAY D TYPE	CANNON	DAM-15S		EA	1
#1	606003	WASHER 1/2" WAVY	PYE CONNECTORS	MLW		EA	1
#1	606028	SCREW LOCK D TYPE	CANNON	D20418-2		EA	2
#1	606036	CABLE MOUNT MET JUNC SHELL	3M	3357-9215		EA	1
#1	611023	SCREW M2.5 X 10 POZIPAN SZP	GKN	SEE DRG DP611000		EA	2
#1	611114	SCREW M2.5 X 11 COLLAR	SCHROFF	21100-379		EA	2
#1	611117	SCREW M2.5 X 8 POZICSK SZP	GKN	SEE DRG DP611000		EA	2
#1	611120	SCREW M3 X 6 POZICSK SS	GKN	SEE DRG DP611000		EA	6
#1	611121	SCREW M3 X 6 POZIPAN SS	GKN	SEE DRG DP611000		EA	4
#1	612056-2	STANDOFF M3 X 2.5	SWIFT ENGINEERING	SEE DRG		EA	6
#1	612057	SPACER M3 X 14 M/F HEX	HARWIN	R30-3001402		EA	6
#1	613029	WASHER M3 CRINKLE SS	GKN	SEE DRG DP611000	P	EA	10
#1	613047	WASHER M2.5 CRINKLE SS	GKN	SEE DRG DP611000	P	EA	2
#1	615027	NUT SPECIAL BNC 1/2"-28 HEX	AMP	1-329631-2		EA	1
#1	617019	SLEEVE SCREW RETAINING GREY	SCHROFF	21100-464		EA	2
#1	618016	PAD INSUL SIL TO220 SELF ADH	WARTH	K177-AC-819		EA	2
#1	630255	TAPE SELF ADH DBL SIDED	3M	Y9469 X 1/2" WIDE		AR	1
#1	630355	CLIP CABLE SUPPORT	LEWIS SPRING	L.S.108/65		EA	2
#1	630359	EJECTOR HANDLE TOP	SCHROFF	20817-328		EA	1
#1	630360	EJECTOR HANDLE BOTTOM	SCHROFF	20817-327		EA	1
#1	630373-1	SILICA GEL SELF-IND 50G	GEEJAY CHEMICALS	SEE DRG		EA	1
#1	630476	BAG ANTI STATIC CUSHIONED 40 X	3M	2120/16 X 11		EA	1
#1	850255-4	HANDBOOK USERS 1362	CROWE	SEE DRG		EA	1
#1	900009	LOCKING COMPOUND	LOCTITE	222		AR	1

DESIG	PART NUMBER	DESCRIPTION	PRINCIPAL MANUF	MANUF PART NUMBER	CLASS	UM	QUANTITY
U101	280220	IC DIG PROCESSOR 16 BIT 16MHz	MOTOROLA	MC68HC001FN16		EA	1
U102	401082-5	ASSY EPROM 1362S	FLUKE	SEE DRG		S2	1
U103	401082-5	ASSY EPROM 1362S	FLUKE	SEE DRG		S2	-
U107	401197-1	ASSY FPLD ADDR DECODE VX4237	FLUKE	SEE DRG		EA	1
U452	400914-4	ASSY FPGA VXI INT 1362	FLUKE	SEE DRG		EA	1
#1	400911-6	ASSY PCB VXI CARD DMM 1362	BI ELECTRONICS	SEE DRG		EA	1
#1	400912-1	ASSY CABLE SINGLE I/P 1505	FLUKE	SEE DRG		EA	0
#1	400953-1	ASSY CABLE RATIO I/P 1506	FLUKE	SEE DRG		EA	0
#1	401328-2	ASSY DISK VXI P&P DRIVER 1362	FLUKE	SEE DRG		EA	1
#1	410441-5	PCB TOP SCREEN 1362	INLYNE	SEE DRG		EA	1
#1	410442-1	PCB BOTTOM SCREEN 1362	INLYNE	SEE DRG		EA	1
#1	420114	LABEL SSD WARNING DESTRUCTABLE	3M	7102	A	EA	1
#1	420119-1	LABEL CAL STICKER	CJM LABELS	SEE DRG		EA	2
#1	420120	LABEL SSD WARNING DESTRUCTABLE	STATIC SAFE ENVIRONM	SWL 1939		EA	2
#1	420143-2	LABEL CARTON 148.5 X 50	CROWE	SEE DRG		EA	1
#1	420146	LABEL 63.5 X 25.4 SILVER/PE	BRADY	LAT-21-773-1		EA	1
#1	440164-1	KIT CURRENT OPTION 1362	FLUKE	SEE DRG		EA	0
#1	440165-1	KIT RATIO OPTION 1362	FLUKE	SEE DRG		EA	0
#1	450778-3	TOP COVER 1361	FARNELL TECH	SEE DRG		EA	1
#1	450779-2	BOTTOM COVER 1362	FARNELL TECH	SEE DRG		EA	1
#1	450785-3	PANEL FRONT 1362	FARNELL TECH	SEE DRG		EA	1
#1	450787-2	PACKING BOX 1362	A.E.SUTTON	SEE DRG		EA	1
#1	450788-1	INSULATION SHEET 1362	KENSULAT	SEE DRG		EA	1
#1	450789-3	EARTHING SHIELD PSU 1362	FARNELL TECH	SEE DRG		EA	1
#1	450790-3	GUARD SHIELD PSU 1362	FARNELL TECH	SEE DRG		EA	1
#1	450791-3	GUARD SHIELD AC 1361	FARNELL TECH	SEE DRG		EA	1
#1	450819-1	COVER INSULATION 1362	HUGHES & WYNNE	SEE DRG		EA	1
#1	450965-3	OVERLAY 1362	TRIMCRAFT	SEE DRG		EA	1
#1	450971-1	NAMEPLATE 'WAVETEK' 1362	SCREENCRAFT	SEE DRG		EA	1
#1	450972-1	NAMEPLATE 'VXI' 1362	SCREENCRAFT	SEE DRG		EA	1
#1	451395-1	INSULATOR A-D FPGA 1362	HUGHES & WYNNE	SEE DRG		EA	1
#1	590077	SLEEVE HS 0.125 DIA CLEAR	RAYCHEM	KYNAR 1/8x1.2m CLEAR		AR	1
#1	604110	PLUG 15-WAY D TYPE	CANNON	DAM-15P	A	EA	1
#1	605206	SOCKET 15-WAY D TYPE	CANNON	DAM-15S		EA	1
#1	606003	WASHER 1/2" WAVY	PYE CONNECTORS	MLW		EA	1
#1	606028	SCREW LOCK D TYPE	CANNON	D20418-2		EA	2
#1	606036	CABLE MOUNT MET JUNC SHELL	3M	3357-9215		EA	1
#1	611023	SCREW M2.5 X 10 POZIPAN SZP	GKN	SEE DRG DP611000		EA	2
#1	611114	SCREW M2.5 X 11 COLLAR	SCHROFF	21100-379		EA	2
#1	611117	SCREW M2.5 X 8 POZICSK SZP	GKN	SEE DRG DP611000		EA	2
#1	611120	SCREW M3 X 6 POZICSK SS	GKN	SEE DRG DP611000		EA	6
#1	611121	SCREW M3 X 6 POZIPAN SS	GKN	SEE DRG DP611000		EA	4
#1	612056-2	STANDOFF M3 X 2.5	SWIFT ENGINEERING	SEE DRG		EA	6
#1	612057	SPACER M3 X 14 M/F HEX	HARWIN	R30-3001402		EA	6
#1	613029	WASHER M3 CRINKLE SS	GKN	SEE DRG DP611000	P	EA	10
#1	613047	WASHER M2.5 CRINKLE SS	GKN	SEE DRG DP611000	P	EA	2
#1	615027	NUT SPECIAL BNC 1/2"-28 HEX	AMP	1-329631-2		EA	1
#1	617019	SLEEVE SCREW RETAINING GREY	SCHROFF	21100-464		EA	2
#1	618016	PAD INSUL SIL TO220 SELF ADH	WARTH	K177-AC-819		EA	2
#1	630255	TAPE SELF ADH DBL SIDED	3M	Y9469 X 1/2" WIDE		AR	1
#1	630355	CLIP CABLE SUPPORT	LEWIS SPRING	L.S.108/65		EA	2
#1	630359	EJECTOR HANDLE TOP	SCHROFF	20817-328		EA	1
#1	630360	EJECTOR HANDLE BOTTOM	SCHROFF	20817-327		EA	1
#1	630373-1	SILICA GEL SELF-IND 50G	GEEJAY CHEMICALS	SEE DRG		EA	1
#1	630476	BAG ANTI STATIC CUSHIONED 40 X	3M	2120/16 X 11		EA	1
#1	850255-4	HANDBOOK USERS 1362	CROWE	SEE DRG		EA	1
#1	900009	LOCKING COMPOUND	LOCTITE	222		AR	1

DESIG	PART NUMBER	DESCRIPTION	PRINCIPAL MANUF	MANUF PART NUMBER	CLASS	UM	QUANTITY
U101	280191	IC DIG PROCESSOR 16 BIT 8MHz	PHILIPS	SCN68000CBA68	AO	EA	1
U102	400951-3	ASSY EPROM 1362MT	FLUKE	SEE DRG		S2	1
U103	400951-3	ASSY EPROM 1362MT	FLUKE	SEE DRG		S2	-
U107	401083-1	ASSY FPLD ADDR DECODE 1362S	FLUKE	SEE DRG		EA	1
U452	400914-4	ASSY FPGA VXI INT 1362	FLUKE	SEE DRG		EA	1
#1	400911-6	ASSY PCB VXI CARD DMM 1362	BI ELECTRONICS	SEE DRG		EA	1
#1	400912-1	ASSY CABLE SINGLE I/P 1505	FLUKE	SEE DRG		EA	0
#1	400953-1	ASSY CABLE RATIO I/P 1506	FLUKE	SEE DRG		EA	0
#1	410441-5	PCB TOP SCREEN 1362	INLYNE	SEE DRG		EA	1
#1	410442-1	PCB BOTTOM SCREEN 1362	INLYNE	SEE DRG		EA	1
#1	420074-1	LABEL MOD RECORD 1281	RS COMPONENTS	606-226		EA	1
#1	420114	LABEL SSD WARNING DESTRUCTABLE	3M	7102	A	EA	1
#1	420119-1	LABEL CAL STICKER	CJM LABELS	SEE DRG		EA	2
#1	420120	LABEL SSD WARNING DESTRUCTABLE	STATIC SAFE ENVIRONM	SWL 1939		EA	2
#1	420143-2	LABEL CARTON 148.5 X 50	CROWE	SEE DRG		EA	1
#1	420146	LABEL 63.5 X 25.4 SILVER/PE	BRADY	LAT-21-773-1		EA	1
#1	440164-1	KIT CURRENT OPTION 1362	FLUKE	SEE DRG		EA	0
#1	440165-1	KIT RATIO OPTION 1362	FLUKE	SEE DRG		EA	0
#1	450778-3	TOP COVER 1361	FARNELL TECH	SEE DRG		EA	1
#1	450779-2	BOTTOM COVER 1362	FARNELL TECH	SEE DRG		EA	1
#1	450785-3	PANEL FRONT 1362	FARNELL TECH	SEE DRG		EA	1
#1	450787-2	PACKING BOX 1362	A.E.SUTTON	SEE DRG		EA	1
#1	450788-1	INSULATION SHEET 1362	KENSULAT	SEE DRG		EA	1
#1	450789-3	EARTHING SHIELD PSU 1362	FARNELL TECH	SEE DRG		EA	1
#1	450790-3	GUARD SHIELD PSU 1362	FARNELL TECH	SEE DRG		EA	1
#1	450791-3	GUARD SHIELD AC 1361	FARNELL TECH	SEE DRG		EA	1
#1	450793-1	OVERLAY 1362MT	TRIMCRAFT	SEE DRG		EA	1
#1	450819-1	COVER INSULATION 1362	HUGHES & WYNNE	SEE DRG		EA	1
#1	450965-3	OVERLAY 1362	TRIMCRAFT	SEE DRG		EA	1
#1	450971-1	NAMEPLATE 'WAVETEK' 1362	SCREENCRAFT	SEE DRG		EA	1
#1	450972-1	NAMEPLATE 'VXI' 1362	SCREENCRAFT	SEE DRG		EA	1
#1	451395-1	INSULATOR A-D FPGA 1362	HUGHES & WYNNE	SEE DRG		EA	1
#1	590077	SLEEVE HS 0.125 DIA CLEAR	RAYCHEM	KYNAR 1/8x1.2m CLEAR		AR	1
#1	604110	PLUG 15-WAY D TYPE	CANNON	DAM-15P	A	EA	1
#1	605206	SOCKET 15-WAY D TYPE	CANNON	DAM-15S		EA	1
#1	606003	WASHER 1/2" WAVY	PYE CONNECTORS	MLW		EA	1
#1	606028	SCREW LOCK D TYPE	CANNON	D20418-2		EA	2
#1	606036	CABLE MOUNT MET JUNC SHELL	3M	3357-9215		EA	1
#1	611023	SCREW M2.5 X 10 POZIPAN SZP	GKN	SEE DRG DP611000		EA	2
#1	611114	SCREW M2.5 X 11 COLLAR	SCHROFF	21100-379		EA	2
#1	611117	SCREW M2.5 X 8 POZICSK SZP	GKN	SEE DRG DP611000		EA	2
#1	611120	SCREW M3 X 6 POZICSK SS	GKN	SEE DRG DP611000		EA	6
#1	611121	SCREW M3 X 6 POZIPAN SS	GKN	SEE DRG DP611000		EA	4
#1	612056-2	STANDOFF M3 X 2.5	SWIFT ENGINEERING	SEE DRG		EA	6
#1	612057	SPACER M3 X 14 M/F HEX	HARWIN	R30-3001402		EA	6
#1	613029	WASHER M3 CRINKLE SS	GKN	SEE DRG DP611000	P	EA	10
#1	613047	WASHER M2.5 CRINKLE SS	GKN	SEE DRG DP611000	P	EA	2
#1	615027	NUT SPECIAL BNC 1/2"-28 HEX	AMP	1-329631-2		EA	1
#1	617019	SLEEVE SCREW RETAINING GREY	SCHROFF	21100-464		EA	2
#1	618016	PAD INSUL SIL TO220 SELF ADH	WARTH	K177-AC-819		EA	2
#1	630255	TAPE SELF ADH DBL SIDED	3M	Y9469 X 1/2" WIDE		AR	1
#1	630355	CLIP CABLE SUPPORT	LEWIS SPRING	L.S.108/65		EA	2
#1	630359	EJECTOR HANDLE TOP	SCHROFF	20817-328		EA	1
#1	630360	EJECTOR HANDLE BOTTOM	SCHROFF	20817-327		EA	1
#1	630373-1	SILICA GEL SELF-IND 50G	GEEJAY CHEMICALS	SEE DRG		EA	1
#1	630476	BAG ANTI STATIC CUSHIONED 40 X	3M	2120/16 X 11		EA	1
#1	850255-4	HANDBOOK USERS 1362	CROWE	SEE DRG		EA	1
#1	900009	LOCKING COMPOUND	LOCTITE	222		AR	1

DESIG	PART NUMBER	DESCRIPTION	PRINCIPAL MANUF	MANUF PART NUMBER	CLASS	UM	QUANTITY
R051	050117	RES MF 2k7 1% .12W 100PPM	NEOHM	LR0204 2K7 1%	A	EA	6
R052	050136	RES MF 100k 1% .12W 100PPM	NEOHM	LR0204 100K 1%	A	EA	6
R053	050136	RES MF 100k 1% .12W 100PPM	NEOHM	LR0204 100K 1%	A	EA	-
R054	050136	RES MF 100k 1% .12W 100PPM	NEOHM	LR0204 100K 1%	A	EA	-
R055	050138	RES MF 150k 1% .12W 100PPM	NEOHM	LR0204 150K 1%		EA	2
R056	050126	RES MF 15k 1% .12W 100PPM	NEOHM	LR0204 15K 1%	A	EA	4
R057	050114	RES MF 1k5 1% .12W 100PPM	NEOHM	LR0204 1K5 1%	A	EA	8
R101	050124	RES MF 10k 1% .12W 100PPM	NEOHM	LR0204 10K 1%	A	EA	21
R102	090163	RES NTWK 10k X 8 2%	BECKMAN	L09-1S-103	A	EA	8
R103	050124	RES MF 10k 1% .12W 100PPM	NEOHM	LR0204 10K 1%	A	EA	-
R104	050095	RES MF 39R 1% .12W 100PPM	NEOHM	LR0204 39R 1%	A	EA	1
R150	050112	RES MF 1k0 1% .12W 100PPM	NEOHM	LR0204 1K0 1%	A	EA	8
R153	050124	RES MF 10k 1% .12W 100PPM	NEOHM	LR0204 10K 1%	A	EA	-
R154	050128	RES MF 22k 1% .12W 100PPM	NEOHM	LR0204 22K 1%	A	EA	6
R155	050128	RES MF 22k 1% .12W 100PPM	NEOHM	LR0204 22K 1%	A	EA	-
R156	080122	RES FL 7k 0.05% 3PPM	VISHAY	VH202L 7K0000 0.05%		EA	1
R157	080153	RES FL 63k 0.05% 3PPM	VISHAY	VH202L 63K000 0.05%		EA	1
R158	050121	RES MF 5k6 1% .12W 100PPM	NEOHM	LR0204 5K6 1%	A	EA	3
R159	090194-1	RES WW SET 495k/3k/2k 0.2%R	VISHAY	PC350/175 TO DRG		S3	1
R160	090194-1	RES WW SET 495k/3k/2k 0.2%R	VISHAY	PC350/175 TO DRG		S3	-
R161	090194-1	RES WW SET 495k/3k/2k 0.2%R	VISHAY	PC350/175 TO DRG		S3	-
R162	050128	RES MF 22k 1% .12W 100PPM	NEOHM	LR0204 22K 1%	A	EA	-
R163	090182	THERMISTOR PTC 1k 40% 1kV	MIDWEST	180Q10215		EA	1
R164	090001	THERMISTOR PTC 80R	PHILIPS	VA8650		EA	1
R165	050119	RES MF 3k9 1% .12W 100PPM	NEOHM	LR0204 3K9 1%	A	EA	1
R201	050124	RES MF 10k 1% .12W 100PPM	NEOHM	LR0204 10K 1%	A	EA	-
R202	050124	RES MF 10k 1% .12W 100PPM	NEOHM	LR0204 10K 1%	A	EA	-
R203	050124	RES MF 10k 1% .12W 100PPM	NEOHM	LR0204 10K 1%	A	EA	-
R204	050124	RES MF 10k 1% .12W 100PPM	NEOHM	LR0204 10K 1%	A	EA	-
R205	050124	RES MF 10k 1% .12W 100PPM	NEOHM	LR0204 10K 1%	A	EA	-
R206	090165	RES PACK 68R X 4 2%	BECKMAN	L08-3S-680	A	EA	2
R207	090165	RES PACK 68R X 4 2%	BECKMAN	L08-3S-680	A	EA	-
R208	090041	RES NTWK 4k7 X 7 2%	BECKMAN	L08-1S-472	A	EA	1
R209	090162	RES PACK 270R X 4 2%	AB	770-83-270R	A	EA	1
R210	050110	RES MF 680R 1% .12W 100PPM	NEOHM	LR0204 680R 1%	A	EA	4
R211	050124	RES MF 10k 1% .12W 100PPM	NEOHM	LR0204 10K 1%	A	EA	-
R213	050100	RES MF 100R 1% .12W 100PPM	NEOHM	LR0204 100R 1%	A	EA	10
R214	012211	RES MF 2k21 1% .12W 50PPM	MEC	H8 2K21 1% 50PPM	AP	EA	1
R251	090163	RES NTWK 10k X 8 2%	BECKMAN	L09-1S-103	A	EA	-
R252	090163	RES NTWK 10k X 8 2%	BECKMAN	L09-1S-103	A	EA	-
R253	090163	RES NTWK 10k X 8 2%	BECKMAN	L09-1S-103	A	EA	-
R254	050134	RES MF 68k 1% .12W 100PPM	NEOHM	LR0204 68K 1%	A	EA	6
R255	050128	RES MF 22k 1% .12W 100PPM	NEOHM	LR0204 22K 1%	A	EA	-
R256	050136	RES MF 100k 1% .12W 100PPM	NEOHM	LR0204 100K 1%	A	EA	-
R257	050124	RES MF 10k 1% .12W 100PPM	NEOHM	LR0204 10K 1%	A	EA	-
R258	050136	RES MF 100k 1% .12W 100PPM	NEOHM	LR0204 100K 1%	A	EA	-
R259	050130	RES MF 33k 1% .12W 100PPM	NEOHM	LR0204 33K 1%	A	EA	6
R260	050118	RES MF 3k3 1% .12W 100PPM	NEOHM	LR0204 3K3 1%	A	EA	2
R261	050148	RES MF 1M0 1% .12W 100PPM	NEOHM	LR0204 1M0 1%		EA	2
R262	050124	RES MF 10k 1% .12W 100PPM	NEOHM	LR0204 10K 1%	A	EA	-
R301	050100	RES MF 100R 1% .12W 100PPM	NEOHM	LR0204 100R 1%	A	EA	-
R302	050100	RES MF 100R 1% .12W 100PPM	NEOHM	LR0204 100R 1%	A	EA	-
R303	050124	RES MF 10k 1% .12W 100PPM	NEOHM	LR0204 10K 1%	A	EA	-
R351	050116	RES MF 2k2 1% .12W 100PPM	NEOHM	LR0204 2K2 1%	A	EA	4
R352	050120	RES MF 4k7 1% .12W 100PPM	NEOHM	LR0204 4K7 1%	A	EA	4
R353	050120	RES MF 4k7 1% .12W 100PPM	NEOHM	LR0204 4K7 1%	A	EA	-
R355	050106	RES MF 330R 1% .12W 100PPM	NEOHM	LR0204 330R 1%	A	EA	2
R357	090179	RES NTWK 4k7 X 8 2%	BECKMAN	L09-1S-472	AP	EA	1
R358	050105	RES MF 270R 1% .12W 100PPM	NEOHM	LR0204 270R 1%	A	EA	4
R359	050105	RES MF 270R 1% .12W 100PPM	NEOHM	LR0204 270R 1%	A	EA	-
R360	050105	RES MF 270R 1% .12W 100PPM	NEOHM	LR0204 270R 1%	A	EA	-
R361	050124	RES MF 10k 1% .12W 100PPM	NEOHM	LR0204 10K 1%	A	EA	-
R362	050112	RES MF 1k0 1% .12W 100PPM	NEOHM	LR0204 1K0 1%	A	EA	-
R363	00000N	NOT FITTED	FLUKE	00000N		EA	33
R364	090046	RES NTWK 10k X 7 2%	BECKMAN	L08-1S-103	A	EA	1
R365	090154	RES PACK 1k X 8 2%	AB	761-3-1K	A	EA	1
R401	090163	RES NTWK 10k X 8 2%	BECKMAN	L09-1S-103	A	EA	-
R402	090163	RES NTWK 10k X 8 2%	BECKMAN	L09-1S-103	A	EA	-
R403	050136	RES MF 100k 1% .12W 100PPM	NEOHM	LR0204 100K 1%	A	EA	-
R404	050098	RES MF 68R 1% .12W 100PPM	NEOHM	LR0204 68R 1%	A	EA	3
R405	050098	RES MF 68R 1% .12W 100PPM	NEOHM	LR0204 68R 1%	A	EA	-
R406	090163	RES NTWK 10k X 8 2%	BECKMAN	L09-1S-103	A	EA	-
R407	000101	RES CF 100R 5% .25W	NEOHM	CFR25 100R 5%	A	EA	3
R409	000101	RES CF 100R 5% .25W	NEOHM	CFR25 100R 5%	A	EA	-
R410	000101	RES CF 100R 5% .25W	NEOHM	CFR25 100R 5%	A	EA	-
R411	050124	RES MF 10k 1% .12W 100PPM	NEOHM	LR0204 10K 1%	A	EA	-
R412	050124	RES MF 10k 1% .12W 100PPM	NEOHM	LR0204 10K 1%	A	EA	-
R413	050110	RES MF 680R 1% .12W 100PPM	NEOHM	LR0204 680R 1%	A	EA	-
R414	050124	RES MF 10k 1% .12W 100PPM	NEOHM	LR0204 10K 1%	A	EA	-
R416	090163	RES NTWK 10k X 8 2%	BECKMAN	L09-1S-103	A	EA	-
R451	050124	RES MF 10k 1% .12W 100PPM	NEOHM	LR0204 10K 1%	A	EA	-
R454	050111	RES MF 820R 1% .12W 100PPM	NEOHM	LR0204 820R 1%	A	EA	1
R501	080106	RES FL 5k 0.01% 1PPM	VISHAY	S102K 5K0000 0.01%	A	EA	2
R502	050130	RES MF 33k 1% .12W 100PPM	NEOHM	LR0204 33K 1%	A	EA	-
R503	050128	RES MF 22k 1% .12W 100PPM	NEOHM	LR0204 22K 1%	A	EA	-
R504	050113	RES MF 1k2 1% .12W 100PPM	NEOHM	LR0204 1K2 1%	A	EA	2
R505	050104	RES MF 220R 1% .12W 100PPM	NEOHM	LR0204 220R 1%	A	EA	5
R506	050110	RES MF 680R 1% .12W 100PPM	NEOHM	LR0204 680R 1%	A	EA	-
R507	050098	RES MF 68R 1% .12W 100PPM	NEOHM	LR0204 68R 1%	A	EA	-
R508	050097	RES MF 56R 1% .12W 100PPM	NEOHM	LR0204 56R 1%	A	EA	1
R509	050123	RES MF 8k2 1% .12W 100PPM	NEOHM	LR0204 8K2 1%	A	EA	5
R513	050120	RES MF 4k7 1% .12W 100PPM	NEOHM	LR0204 4K7 1%	A	EA	-
R514	050117	RES MF 2k7 1% .12W 100PPM	NEOHM	LR0204 2K7 1%	A	EA	-
R515	080106	RES FL 5k 0.01% 1PPM	VISHAY	S102K 5K0000 0.01%	A	EA	-
R516	050117	RES MF 2k7 1% .12W 100PPM	NEOHM	LR0204 2K7 1%	A	EA	-

DESIG	PART NUMBER	DESCRIPTION	PRINCIPAL MANUF	MANUF PART NUMBER	CLASS	UM	QUANTITY
R517	050076	RES MF 10k0 0.1% .12W 50PPM	MEC	H8 10K0 0.1% 50PPM		EA	1
R518	050077	RES MF 20k0 0.1% .12W 50PPM	MEC	H8 20K0 0.1% 50PPM		EA	1
R519	290026-3	KIT RMS SELECTED	FLUKE	SEE DRG		S3	1
R520	080082	RES FL 20k 0.01% 3PPM	VISHAY	S102C 20K000 0.01%	A	EA	1
R521	080047-2	RES FL 10k 0.01% 3PPM	VISHAY	S102C TO DRG	A	EA	1
R523	050130	RES MF 33k 1% .12W 100PPM	NEOHM	LR0204 33K 1%	A	EA	-
R524	050125	RES MF 12k 1% .12W 100PPM	NEOHM	LR0204 12K 1%	A	EA	1
R525	050114	RES MF 1k5 1% .12W 100PPM	NEOHM	LR0204 1K5 1%	A	EA	-
R526	050112	RES MF 1k0 1% .12W 100PPM	NEOHM	LR0204 1K0 1%	A	EA	-
R527	050104	RES MF 220R 1% .12W 100PPM	NEOHM	LR0204 220R 1%	A	EA	-
R528	050100	RES MF 100R 1% .12W 100PPM	NEOHM	LR0204 100R 1%	A	EA	-
R529	050096	RES MF 47R 1% .12W 100PPM	NEOHM	LR0204 47R 1%	A	EA	2
R530	050109	RES MF 560R 1% .12W 100PPM	NEOHM	LR0204 560R 1%	A	EA	1
R531	050124	RES MF 10k 1% .12W 100PPM	NEOHM	LR0204 10K 1%	A	EA	-
R532	050130	RES MF 33k 1% .12W 100PPM	NEOHM	LR0204 33K 1%	A	EA	-
R533	050134	RES MF 68k 1% .12W 100PPM	NEOHM	LR0204 68K 1%	A	EA	-
R534	050114	RES MF 1k5 1% .12W 100PPM	NEOHM	LR0204 1K5 1%	A	EA	-
R535	050106	RES MF 330R 1% .12W 100PPM	NEOHM	LR0204 330R 1%	A	EA	-
R536	080159	RES FL 40k 0.1% 3PPM	VISHAY	S102L 40K000 0.1%		EA	2
R537	050118	RES MF 3k3 1% .12W 100PPM	NEOHM	LR0204 3K3 1%	A	EA	-
R538	050144	RES MF 470k 1% .12W 100PPM	NEOHM	LR0204 470K 1%		EA	1
R539	050130	RES MF 33k 1% .12W 100PPM	NEOHM	LR0204 33K 1%	A	EA	-
R540	00000F	FSV	FLUKE	00000F		EA	1
R541	065012	RES CT 50k TOP ADJ M/T	BOURNS	3296W-1-503		EA	2
R542	050134	RES MF 68k 1% .12W 100PPM	NEOHM	LR0204 68K 1%	A	EA	-
R543	050112	RES MF 1k0 1% .12W 100PPM	NEOHM	LR0204 1K0 1%	A	EA	-
R544	050088	RES MF 10R 1% .12W 100PPM	NEOHM	LR0204 10R 1%	A	EA	8
R545	050088	RES MF 10R 1% .12W 100PPM	NEOHM	LR0204 10R 1%	A	EA	-
R546	290026-3	KIT RMS SELECTED	FLUKE	SEE DRG		S3	-
R548	050096	RES MF 47R 1% .12W 100PPM	NEOHM	LR0204 47R 1%	A	EA	-
R549	040825	RES MG 8M2 5% .25W 200PPM	PHILIPS	VR25-8M2-5	A	EA	3
R550	050148	RES MF 1M0 1% .12W 100PPM	NEOHM	LR0204 1M0 1%		EA	-
R551	050113	RES MF 1k2 1% .12W 100PPM	NEOHM	LR0204 1K2 1%	A	EA	-
R552	080159	RES FL 40k 0.1% 3PPM	VISHAY	S102L 40K000 0.1%		EA	-
R553	050110	RES MF 680R 1% .12W 100PPM	NEOHM	LR0204 680R 1%	A	EA	-
R555	050099	RES MF 82R 1% .12W 100PPM	NEOHM	LR0204 82R 1%	A	EA	1
R556	050128	RES MF 22k 1% .12W 100PPM	NEOHM	LR0204 22K 1%	A	EA	-
R601	011003	RES MF 100k 1% .12W 50PPM	MEC	H8 100K 1% 50PPM	AP	EA	1
R602	050100	RES MF 100R 1% .12W 100PPM	NEOHM	LR0204 100R 1%	A	EA	-
R603	050092	RES MF 22R 1% .12W 100PPM	NEOHM	LR0204 22R 1%	A	EA	3
R604	050115	RES MF 1k8 1% .12W 100PPM	NEOHM	LR0204 1K8 1%	A	EA	1
R605	050108	RES MF 470R 1% .12W 100PPM	NEOHM	LR0204 470R 1%	A	EA	4
R606	050236-1	RES MF 1M 0.25% .25W 5PPM	WELWYN	MAR7T16 1M 0.25% A		EA	1
R607	080118	RES FL 10k 0.05% 3PPM	VISHAY	S102J 10K000 0.05%	A	EA	1
R608	008004	RES MG 1M 5% .5W 2.5kV	PHILIPS	VR37-1M-5		EA	1
R610	050112	RES MF 1k0 1% .12W 100PPM	NEOHM	LR0204 1K0 1%	A	EA	-
R611	065012	RES CT 50k TOP ADJ M/T	BOURNS	3296W-1-503		EA	-
R612	050092	RES MF 22R 1% .12W 100PPM	NEOHM	LR0204 22R 1%	A	EA	-
R613	050123	RES MF 8k2 1% .12W 100PPM	NEOHM	LR0204 8K2 1%	A	EA	-
R614	050123	RES MF 8k2 1% .12W 100PPM	NEOHM	LR0204 8K2 1%	A	EA	-
R615	050092	RES MF 22R 1% .12W 100PPM	NEOHM	LR0204 22R 1%	A	EA	-
R616	050114	RES MF 1k5 1% .12W 100PPM	NEOHM	LR0204 1K5 1%	A	EA	-
R617	050103	RES MF 180R 1% .12W 100PPM	NEOHM	LR0204 180R 1%	A	EA	1
R618	050112	RES MF 1k0 1% .12W 100PPM	NEOHM	LR0204 1K0 1%	A	EA	-
R619	050123	RES MF 8k2 1% .12W 100PPM	NEOHM	LR0204 8K2 1%	A	EA	-
R621	050114	RES MF 1k5 1% .12W 100PPM	NEOHM	LR0204 1K5 1%	A	EA	-
R622	050105	RES MF 270R 1% .12W 100PPM	NEOHM	LR0204 270R 1%	A	EA	-
R623	050100	RES MF 100R 1% .12W 100PPM	NEOHM	LR0204 100R 1%	A	EA	-
R624	050117	RES MF 2k7 1% .12W 100PPM	NEOHM	LR0204 2K7 1%	A	EA	-
R626	080133	RES FL 4k7 0.1% 3PPM	VISHAY	S102J 4K7000 0.1%	A	EA	1
R627	080119	RES FL 522R2 0.1% 3PPM	VISHAY	S102J 522R20 0.1%	A	EA	1
R628	050107	RES MF 390R 1% .12W 100PPM	NEOHM	LR0204 390R 1%	A	EA	2
R629	050107	RES MF 390R 1% .12W 100PPM	NEOHM	LR0204 390R 1%	A	EA	-
R630	050116	RES MF 2k2 1% .12W 100PPM	NEOHM	LR0204 2K2 1%	A	EA	-
R631	050104	RES MF 220R 1% .12W 100PPM	NEOHM	LR0204 220R 1%	A	EA	-
R701	050133	RES MF 56k 1% .12W 100PPM	NEOHM	LR0204 56K 1%	A	EA	3
R702	050129	RES MF 27k 1% .12W 100PPM	NEOHM	LR0204 27K 1%	A	EA	1
R703	050130	RES MF 33k 1% .12W 100PPM	NEOHM	LR0204 33K 1%	A	EA	-
R705	050123	RES MF 8k2 1% .12W 100PPM	NEOHM	LR0204 8K2 1%	A	EA	-
R706	014022	RES MF 40k2 1% .12W 50PPM	MEC	H8 40K2 1% 50PPM	A	EA	1
R707	090209	RES FL 10k/10k 0.01%	VISHAY	VHD144 2X10K 1A .01M	A	EA	1
R708	041005	RES MF 10M0 1% .12W 100PPM	STEATITE	MK2010MFC	AP	EA	1
R709	050124	RES MF 10k 1% .12W 100PPM	NEOHM	LR0204 10K 1%	A	EA	-
R711	090131	RES PACK 10k X 4 2%	BECKMAN	L08-3S-103	A	EA	1
R712	050133	RES MF 56k 1% .12W 100PPM	NEOHM	LR0204 56K 1%	A	EA	-
R715	090214	RES PACK 30k X 8 0.1%	BECKMAN	698-3-R30KB		EA	1
R717	050150	RES MF 641k5 0.05% .12W 15PPM	IRC	MAR6-T10-641K5-0.05%	A	EA	1
R718	050135	RES MF 82k 1% .12W 100PPM	NEOHM	LR0204 82K 1%	A	EA	2
R719	050135	RES MF 82k 1% .12W 100PPM	NEOHM	LR0204 82K 1%	A	EA	-
R720	050121	RES MF 5k6 1% .12W 100PPM	NEOHM	LR0204 5K6 1%	A	EA	-
R721	050121	RES MF 5k6 1% .12W 100PPM	NEOHM	LR0204 5K6 1%	A	EA	-
R722	050088	RES MF 10R 1% .12W 100PPM	NEOHM	LR0204 10R 1%	A	EA	-
R723	050088	RES MF 10R 1% .12W 100PPM	NEOHM	LR0204 10R 1%	A	EA	-
R724	050108	RES MF 470R 1% .12W 100PPM	NEOHM	LR0204 470R 1%	A	EA	-
R725	050100	RES MF 100R 1% .12W 100PPM	NEOHM	LR0204 100R 1%	A	EA	-
R726	050088	RES MF 10R 1% .12W 100PPM	NEOHM	LR0204 10R 1%	A	EA	-
R727	050088	RES MF 10R 1% .12W 100PPM	NEOHM	LR0204 10R 1%	A	EA	-
R728	050120	RES MF 4k7 1% .12W 100PPM	NEOHM	LR0204 4K7 1%	A	EA	-
R729	050100	RES MF 100R 1% .12W 100PPM	NEOHM	LR0204 100R 1%	A	EA	-
R730	050124	RES MF 10k 1% .12W 100PPM	NEOHM	LR0204 10K 1%	A	EA	-
R731	050114	RES MF 1k5 1% .12W 100PPM	NEOHM	LR0204 1K5 1%	A	EA	-
R732	050100	RES MF 100R 1% .12W 100PPM	NEOHM	LR0204 100R 1%	A	EA	-
R733	050138	RES MF 150k 1% .12W 100PPM	NEOHM	LR0204 150K 1%		EA	-
R734	050140	RES MF 220k 1% .12W 100PPM	NEOHM	LR0204 220K 1%		EA	1
R735	050100	RES MF 100R 1% .12W 100PPM	NEOHM	LR0204 100R 1%	A	EA	-

DESIG	PART NUMBER	DESCRIPTION	PRINCIPAL MANUF	MANUF PART NUMBER	CLASS	UM	QUANTITY
R801	002333	RES HM 33k 5% 1W	ALLEN BRADLEY	GB 33K 5%	A	EA	2
R802	002333	RES HM 33k 5% 1W	ALLEN BRADLEY	GB 33K 5%	A	EA	-
R809	090180	RES NTWK 100k0/9M9	VISHAY	112VTF		EA	1
R810	090167	RES PACK 100k X 4 2%	BECKMAN	L08-3S-104	A	EA	2
R811	090167	RES PACK 100k X 4 2%	BECKMAN	L08-3S-104	A	EA	-
R812	050134	RES MF 68k 1% .12W 100PPM	NEOHM	LR0204 68K 1%	A	EA	-
R814	065008	RES CT 100k TOP ADJ M/T	BOURNS	3296W-1-104	A	EA	2
R817	050112	RES MF 1k0 1% .12W 100PPM	NEOHM	LR0204 1K0 1%	A	EA	-
R818	000686	RES HM 68M 5% .25W	ALLEN BRADLEY	CB 68M 5%	A	EA	1
R819	050116	RES MF 2k2 1% .12W 100PPM	NEOHM	LR0204 2K2 1%	A	EA	-
R820	040825	RES MG 8M2 5% .25W 200PPM	PHILIPS	VR25-8M2-5	A	EA	-
R821	050134	RES MF 68k 1% .12W 100PPM	NEOHM	LR0204 68K 1%	A	EA	-
R822	050134	RES MF 68k 1% .12W 100PPM	NEOHM	LR0204 68K 1%	A	EA	-
R825	050126	RES MF 15k 1% .12W 100PPM	NEOHM	LR0204 15K 1%	A	EA	-
R826	050126	RES MF 15k 1% .12W 100PPM	NEOHM	LR0204 15K 1%	A	EA	-
R829	090166	RES PACK 470k X 4 2%	AB	770-83-470K	A	EA	1
R830	050124	RES MF 10k 1% .12W 100PPM	NEOHM	LR0204 10K 1%	A	EA	-
R831	090139	RES PACK 2k2 X 4 2%	BECKMAN	L08-3S-222	A	EA	1
R833	090114-1	RES FL SET 21k6228/9k/1k 0.02%	VISHAY	VH202C/300570 TO DRG		S2	1
R835	090114-1	RES FL SET 21k6228/9k/1k 0.02%	VISHAY	VH202C/300570 TO DRG		S2	-
R836	050104	RES MF 220R 1% .12W 100PPM	NEOHM	LR0204 220R 1%	A	EA	-
R837	050104	RES MF 220R 1% .12W 100PPM	NEOHM	LR0204 220R 1%	A	EA	-
R838	040825	RES MG 8M2 5% .25W 200PPM	PHILIPS	VR25-8M2-5	A	EA	-
R840	050133	RES MF 56k 1% .12W 100PPM	NEOHM	LR0204 56K 1%	A	EA	-
R841	050114	RES MF 1k5 1% .12W 100PPM	NEOHM	LR0204 1K5 1%	A	EA	-
R842	050114	RES MF 1k5 1% .12W 100PPM	NEOHM	LR0204 1K5 1%	A	EA	-
R845	050146	RES MF 680k 1% .12W 100PPM	NEOHM	LR0204 680K 1%		EA	2
R846	050146	RES MF 680k 1% .12W 100PPM	NEOHM	LR0204 680K 1%		EA	-
R901	090176	RES PACK 22k X 4 2%	AB	770-83-22K	A	EA	1
R902	065008	RES CT 100k TOP ADJ M/T	BOURNS	3296W-1-104	A	EA	-
R903	050108	RES MF 470R 1% .12W 100PPM	NEOHM	LR0204 470R 1%	A	EA	-
R904	050117	RES MF 2k7 1% .12W 100PPM	NEOHM	LR0204 2K7 1%	A	EA	-
R905	050117	RES MF 2k7 1% .12W 100PPM	NEOHM	LR0204 2K7 1%	A	EA	-
R906	050108	RES MF 470R 1% .12W 100PPM	NEOHM	LR0204 470R 1%	A	EA	-
R907	050088	RES MF 10R 1% .12W 100PPM	NEOHM	LR0204 10R 1%	A	EA	-
R908	050088	RES MF 10R 1% .12W 100PPM	NEOHM	LR0204 10R 1%	A	EA	-
R909	050112	RES MF 1k0 1% .12W 100PPM	NEOHM	LR0204 1K0 1%	A	EA	-
R910	050126	RES MF 15k 1% .12W 100PPM	NEOHM	LR0204 15K 1%	A	EA	-
R915	050116	RES MF 2k2 1% .12W 100PPM	NEOHM	LR0204 2K2 1%	A	EA	-
C101	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	43
C102	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C103	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C104	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C105	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C152	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C153	100101	CAP CP 100pF 2% 100V N150	PHILIPS	2222 683 34101	P	EA	1
C154	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C155	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C156	140077	CAP PP 100pF 5% 100V	WIMA	FKP2 100 5% 100V		EA	1
C157	110046	CAP PE 1uF 20% 63V	WIMA	MKS2 1.0 20% 63V		EA	10
C201	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C202	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C203	104052	CAP NTWK 220pF X 7 10%	MURATA	B8XCO117-33N		EA	1
C204	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C205	110020	CAP PE 47nF 20% 63V	WIMA	MKS2 0.047 20% 63V		EA	3
C206	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C207	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C208	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C251	110020	CAP PE 47nF 20% 63V	WIMA	MKS2 0.047 20% 63V		EA	-
C253	110015	CAP PE 15nF 20% 63V	WIMA	MKS2 0.015 20% 63V		EA	2
C254	110015	CAP PE 15nF 20% 63V	WIMA	MKS2 0.015 20% 63V		EA	-
C255	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C256	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C257	110035	CAP PE 220nF 20% 63V	WIMA	MKS2 0.22 20% 63V		EA	1
C258	110020	CAP PE 47nF 20% 63V	WIMA	MKS2 0.047 20% 63V		EA	-
C261	110040	CAP PE 33nF 20% 63V	WIMA	MKS2 0.033 20% 63V		EA	1
C301	110013	CAP PE 100nF 10% 250V	PHILIPS	2222 368 45104		EA	1
C351	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C352	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C353	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C354	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C401	100472	CAP CP 4n7F 10% 100V 2C2	PHILIPS	2222 630 19472	P	EA	2
C402	100472	CAP CP 4n7F 10% 100V 2C2	PHILIPS	2222 630 19472	P	EA	-
C403	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C404	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C405	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C406	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C407	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C408	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C451	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C452	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C453	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C501	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C502	150016	CAP DT 1uF 20% 35V	AVX	TAP105M035C	A	EA	2
C503	110026	CAP PE 6n8F 20% 100V	WIMA	FKS2 6800 20% 100V		EA	1
C504	100330	CAP CP 33pF 2% 100V N150	PHILIPS	2222 683 34339	P	EA	2
C506	100478	CAP CP 4p7F .25pF 100V NPO	PHILIPS	2222 683 09478	P	EA	4
C507	100102	CAP CP 1nF 10% 100V 2C2	PHILIPS	2222 630 19102	P	EA	4
C508	100478	CAP CP 4p7F .25pF 100V NPO	PHILIPS	2222 683 09478	P	EA	-
C509	100478	CAP CP 4p7F .25pF 100V NPO	PHILIPS	2222 683 09478	P	EA	-
C510	100100	CAP CP 10pF 2% 100V NPO	PHILIPS	2222 683 10109		EA	3
C511	100100	CAP CP 10pF 2% 100V NPO	PHILIPS	2222 683 10109		EA	-
C512	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C513	150016	CAP DT 1uF 20% 35V	AVX	TAP105M035C	A	EA	-
C514	100331	CAP CP 330pF 2% 100V N750	PHILIPS	2222 683 58331		EA	2

DESIG	PART NUMBER	DESCRIPTION	PRINCIPAL MANUF	MANUF PART NUMBER	CLASS	UM	QUANTITY
C515	102108	CAP CD 1pF .5pF 500V P100	BECK	CD06AG01P0DSCR	A	EA	1
C516	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C517	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C518	100478	CAP CP 4p7F .25pF 100V NPO	PHILIPS	2222 683 09478	P	EA	-
C519	100228	CAP CP 2p2F .25pF 100V NPO	PHILIPS	2222 683 09228		EA	2
C520	100102	CAP CP 1nF 10% 100V 2C2	PHILIPS	2222 630 19102	P	EA	-
C521	100330	CAP CP 33pF 2% 100V N150	PHILIPS	2222 683 34339	P	EA	-
C522	110046	CAP PE 1uF 20% 63V	WIMA	MKS2 1.0 20% 63V		EA	-
C523	110046	CAP PE 1uF 20% 63V	WIMA	MKS2 1.0 20% 63V		EA	-
C524	120020	CAP PC 220nF 10% 63V	ASHCROFT	M2B22101B	AO	EA	2
C525	180065	CAP AE 47uF 20% 25V	NIPPON CHEMI-CON	KMEVB47/25M	A	EA	1
C526	100680	CAP CP 68pF 2% 100V N150	PHILIPS	2222 683 34689	P	EA	2
C527	180060	CAP AE 10uF 20% 50V	NIPPON CHEMI-CON	KMEVB10/50M	AP	EA	17
C528	180060	CAP AE 10uF 20% 50V	NIPPON CHEMI-CON	KMEVB10/50M	AP	EA	-
C529	110046	CAP PE 1uF 20% 63V	WIMA	MKS2 1.0 20% 63V		EA	-
C530	110046	CAP PE 1uF 20% 63V	WIMA	MKS2 1.0 20% 63V		EA	-
C601	120001	CAP PC 220nF 10% 1kV	LCR	SK772	O	EA	1
C602	102270	CAP CD 27pF 20% 500V NPO	BECK	CD10CG27P0MSCR	A	EA	1
C603	140083	CAP GL 2p2F .25pF 500V	AVX	CY10C2R2C		EA	1
C604	100471	CAP CP 470pF 10% 100V 2C2	PHILIPS	2222 630 19471	P	EA	1
C605	140027	CAP GL 180pF 2% 500V	AVX	CY10C181G		EA	1
C606	140076-1	CAP VAR 16pF 350V	TRONSER	60-0713-10016-904		EA	1
C607	10000F	CAP FSV	FLUKE	10000F		EA	2
C609	180060	CAP AE 10uF 20% 50V	NIPPON CHEMI-CON	KMEVB10/50M	AP	EA	-
C610	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C611	100120	CAP CP 12pF 2% 100V NPO	PHILIPS	2222 683 10129	P	EA	1
C612	180060	CAP AE 10uF 20% 50V	NIPPON CHEMI-CON	KMEVB10/50M	AP	EA	-
C613	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C614	100680	CAP CP 68pF 2% 100V N150	PHILIPS	2222 683 34689	P	EA	-
C615	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C616	180060	CAP AE 10uF 20% 50V	NIPPON CHEMI-CON	KMEVB10/50M	AP	EA	-
C617	180060	CAP AE 10uF 20% 50V	NIPPON CHEMI-CON	KMEVB10/50M	AP	EA	-
C618	00000N	NOT FITTED	FLUKE	00000N		EA	-
C619	100470	CAP CP 47pF 2% 100V N150	PHILIPS	2222 683 34479	P	EA	1
C620	10000F	CAP FSV	FLUKE	10000F		EA	-
C621	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C701	110039	CAP PE 470nF 20% 63V	WIMA	MKS2 0.47 20% 63V		EA	5
C702	120020	CAP PC 220nF 10% 63V	ASHCROFT	M2B22101B	AO	EA	-
C703	100561	CAP CP 560pF 10% 100V 2C2	PHILIPS	2222 630 19561		EA	1
C705	100100	CAP CP 10pF 2% 100V NPO	PHILIPS	2222 683 10109		EA	-
C706	140086	CAP PP 10nF 5% 63V	WIMA	FKP2 0.01 5% 63V		EA	2
C707	140086	CAP PP 10nF 5% 63V	WIMA	FKP2 0.01 5% 63V		EA	-
C708	150015	CAP DT 10uF 20% 35V	AVX	TAP106M035C	A	EA	2
C709	150015	CAP DT 10uF 20% 35V	AVX	TAP106M035C	A	EA	-
C710	110027	CAP PE 3n3F 20% 100V	WIMA	FKS2 3300 20% 100V		EA	1
C711	180060	CAP AE 10uF 20% 50V	NIPPON CHEMI-CON	KMEVB10/50M	AP	EA	-
C712	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C713	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C715	104162	CAP CM 470nF 20% 50V Z5U	AVX	SR215E474MAA		EA	1
C716	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C717	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C720	180060	CAP AE 10uF 20% 50V	NIPPON CHEMI-CON	KMEVB10/50M	AP	EA	-
C721	180060	CAP AE 10uF 20% 50V	NIPPON CHEMI-CON	KMEVB10/50M	AP	EA	-
C722	100102	CAP CP 1nF 10% 100V 2C2	PHILIPS	2222 630 19102	P	EA	-
C723	100102	CAP CP 1nF 10% 100V 2C2	PHILIPS	2222 630 19102	P	EA	-
C801	100331	CAP CP 330pF 2% 100V N750	PHILIPS	2222 683 58331		EA	-
C802	100220	CAP CP 22pF 2% 100V N150	PHILIPS	2222 683 34229	P	EA	2
C803	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C804	110042	CAP PE 100nF 20% 63V	WIMA	MKS2 0.1 20% 63V		EA	-
C805	100220	CAP CP 22pF 2% 100V N150	PHILIPS	2222 683 34229	P	EA	-
C808	100228	CAP CP 2p2F .25pF 100V NPO	PHILIPS	2222 683 09228		EA	-
C809	104048	CAP CM 1nF 20% 100V	PHILIPS	CW15A102M	A	EA	2
C810	104048	CAP CM 1nF 20% 100V	PHILIPS	CW15A102M	A	EA	-
C901	100222	CAP CP 2n2F 10% 100V 2C2	PHILIPS	2222 630 19222		EA	1
C902	100221	CAP CP 220pF 2% 100V N750	PHILIPS	2222 683 58221		EA	2
C903	100221	CAP CP 220pF 2% 100V N750	PHILIPS	2222 683 58221		EA	-
C904	180064	CAP AE 47uF 20% 63V	NIPPON CHEMI-CON	KMEVB47/63M	A	EA	3
C905	110039	CAP PE 470nF 20% 63V	WIMA	MKS2 0.47 20% 63V		EA	-
C906	110046	CAP PE 1uF 20% 63V	WIMA	MKS2 1.0 20% 63V		EA	-
C907	180060	CAP AE 10uF 20% 50V	NIPPON CHEMI-CON	KMEVB10/50M	AP	EA	-
C908	110046	CAP PE 1uF 20% 63V	WIMA	MKS2 1.0 20% 63V		EA	-
C909	180028	CAP AE 47uF 20% 50V	NIPPON CHEMI-CON	SMEVB47/50M	P	EA	1
C910	180006	CAP AE 47uF +50/-10% 25V	PHILIPS	2222 030 36479		EA	1
C911	110039	CAP PE 470nF 20% 63V	WIMA	MKS2 0.47 20% 63V		EA	-
C912	110046	CAP PE 1uF 20% 63V	WIMA	MKS2 1.0 20% 63V		EA	-
C913	180064	CAP AE 47uF 20% 63V	NIPPON CHEMI-CON	KMEVB47/63M	A	EA	-
C914	180060	CAP AE 10uF 20% 50V	NIPPON CHEMI-CON	KMEVB10/50M	AP	EA	-
C915	110046	CAP PE 1uF 20% 63V	WIMA	MKS2 1.0 20% 63V		EA	-
C916	180064	CAP AE 47uF 20% 63V	NIPPON CHEMI-CON	KMEVB47/63M	A	EA	-
C917	180060	CAP AE 10uF 20% 50V	NIPPON CHEMI-CON	KMEVB10/50M	AP	EA	-
C918	110039	CAP PE 470nF 20% 63V	WIMA	MKS2 0.47 20% 63V		EA	-
C919	180060	CAP AE 10uF 20% 50V	NIPPON CHEMI-CON	KMEVB10/50M	AP	EA	-
C920	180060	CAP AE 10uF 20% 50V	NIPPON CHEMI-CON	KMEVB10/50M	AP	EA	-
C921	180060	CAP AE 10uF 20% 50V	NIPPON CHEMI-CON	KMEVB10/50M	AP	EA	-
C922	180060	CAP AE 10uF 20% 50V	NIPPON CHEMI-CON	KMEVB10/50M	AP	EA	-
C923	180060	CAP AE 10uF 20% 50V	NIPPON CHEMI-CON	KMEVB10/50M	AP	EA	-
C924	110046	CAP PE 1uF 20% 63V	WIMA	MKS2 1.0 20% 63V		EA	-
C925	110039	CAP PE 470nF 20% 63V	WIMA	MKS2 0.47 20% 63V		EA	-
D051	210047	DIODE ZN 4V7 400mW	MOTOROLA	BZX79C4V7	A	EA	4
D052	210047	DIODE ZN 4V7 400mW	MOTOROLA	BZX79C4V7	A	EA	-
D101	200001	DIODE GP 75mA 75V	NATIONAL	1N4148	AP	EA	16
D151	210039	DIODE ZN 3V9 400mW	MOTOROLA	BZX79C3V9	A	EA	3
D153	210100	DIODE ZN 10V 400mW	MOTOROLA	BZX79C10	AP	EA	1
D154	220043	DIODE FET 10mA	SILICONIX	JPAD50		EA	1
D155	200029	DIODE GP 1A 1000V	INT RECTIFIER	1N4007	AP	EA	1

DESIG	PART NUMBER	DESCRIPTION	PRINCIPAL MANUF	MANUF PART NUMBER	CLASS	UM	QUANTITY
D156	210051	DIODE ZN 5V1 400mW	MOTOROLA	BZX79C5V1	AP	EA	4
D157	200008	DIODE GP 200mA 125V	NATIONAL	1N458A	A	EA	10
D158	200008	DIODE GP 200mA 125V	NATIONAL	1N458A	A	EA	-
D159	213033	DIODE ZN 6V8 2% 400mW	PHILIPS	BZX79B6V8		EA	3
D201	400695-1	ASSY COM CATHODE DIODE	FLUKE	SEE DRG		EA	1
D202	400696-1	ASSY COM ANODE DIODE	FLUKE	SEE DRG		EA	1
D203	220051	DIODE LE GRN 5V	DIALIGHT	555-2303		EA	1
D251	200001	DIODE GP 75mA 75V	NATIONAL	1N4148	AP	EA	-
D252	200001	DIODE GP 75mA 75V	NATIONAL	1N4148	AP	EA	-
D260	200001	DIODE GP 75mA 75V	NATIONAL	1N4148	AP	EA	-
D302	210047	DIODE ZN 4V7 400mW	MOTOROLA	BZX79C4V7	A	EA	-
D303	213006	DIODE TS 5V 5/500W	UNITRODE	TVS505	AP	EA	1
D401	220050	DIODE LE RED 5V	DIALIGHT	555-2007		EA	1
D402	220052	DIODE LE YLW 5V	DIALIGHT	555-2403		EA	1
D501	220010	DIODE SB	AGILENT	1N6263	A	EA	2
D502	220010	DIODE SB	AGILENT	1N6263	A	EA	-
D503	210056	DIODE ZN 5V6 400mW	MOTOROLA	BZX79C5V6	A	EA	2
D504	210056	DIODE ZN 5V6 400mW	MOTOROLA	BZX79C5V6	A	EA	-
D505	200001	DIODE GP 75mA 75V	NATIONAL	1N4148	AP	EA	-
D508	200001	DIODE GP 75mA 75V	NATIONAL	1N4148	AP	EA	-
D509	200008	DIODE GP 200mA 125V	NATIONAL	1N458A	A	EA	-
D510	200008	DIODE GP 200mA 125V	NATIONAL	1N458A	A	EA	-
D601	210068	DIODE ZN 6V8 400mW	MOTOROLA	BZX79C6V8	A	EA	3
D602	210068	DIODE ZN 6V8 400mW	MOTOROLA	BZX79C6V8	A	EA	-
D603	210082	DIODE ZN 8V2 400mW	MOTOROLA	BZX79C8V2	AP	EA	2
D604	210068	DIODE ZN 6V8 400mW	MOTOROLA	BZX79C6V8	A	EA	-
D701	210051	DIODE ZN 5V1 400mW	MOTOROLA	BZX79C5V1	AP	EA	-
D702	210051	DIODE ZN 5V1 400mW	MOTOROLA	BZX79C5V1	AP	EA	-
D801	200008	DIODE GP 200mA 125V	NATIONAL	1N458A	A	EA	-
D802	200008	DIODE GP 200mA 125V	NATIONAL	1N458A	A	EA	-
D803	200001	DIODE GP 75mA 75V	NATIONAL	1N4148	AP	EA	-
D804	200001	DIODE GP 75mA 75V	NATIONAL	1N4148	AP	EA	-
D805	200001	DIODE GP 75mA 75V	NATIONAL	1N4148	AP	EA	-
D806	200001	DIODE GP 75mA 75V	NATIONAL	1N4148	AP	EA	-
D807	210047	DIODE ZN 4V7 400mW	MOTOROLA	BZX79C4V7	A	EA	-
D808	210039	DIODE ZN 3V9 400mW	MOTOROLA	BZX79C3V9	A	EA	-
D809	210039	DIODE ZN 3V9 400mW	MOTOROLA	BZX79C3V9	A	EA	-
D810	213034	DIODE ZN 11V 2% 400mW	PHILIPS	BZX79B11	A	EA	4
D811	213034	DIODE ZN 11V 2% 400mW	PHILIPS	BZX79B11	A	EA	-
D812	213033	DIODE ZN 6V8 2% 400mW	PHILIPS	BZX79B6V8		EA	-
D813	213033	DIODE ZN 6V8 2% 400mW	PHILIPS	BZX79B6V8		EA	-
D816	200008	DIODE GP 200mA 125V	NATIONAL	1N458A	A	EA	-
D817	200008	DIODE GP 200mA 125V	NATIONAL	1N458A	A	EA	-
D820	200001	DIODE GP 75mA 75V	NATIONAL	1N4148	AP	EA	-
D821	200001	DIODE GP 75mA 75V	NATIONAL	1N4148	AP	EA	-
D822	200008	DIODE GP 200mA 125V	NATIONAL	1N458A	A	EA	-
D823	200008	DIODE GP 200mA 125V	NATIONAL	1N458A	A	EA	-
D824	200001	DIODE GP 75mA 75V	NATIONAL	1N4148	AP	EA	-
D825	210091	DIODE ZN 9V1 400mW	MOTOROLA	BZX79C9V1	A	EA	3
D826	200001	DIODE GP 75mA 75V	NATIONAL	1N4148	AP	EA	-
D827	213011	DIODE VR 1V4 250mW	PHILIPS	BZV86-1V4		EA	2
D828	210082	DIODE ZN 8V2 400mW	MOTOROLA	BZX79C8V2	AP	EA	-
D831	200001	DIODE GP 75mA 75V	NATIONAL	1N4148	AP	EA	-
D832	200001	DIODE GP 75mA 75V	NATIONAL	1N4148	AP	EA	-
D833	213034	DIODE ZN 11V 2% 400mW	PHILIPS	BZX79B11	A	EA	-
D834	210091	DIODE ZN 9V1 400mW	MOTOROLA	BZX79C9V1	A	EA	-
D835	210091	DIODE ZN 9V1 400mW	MOTOROLA	BZX79C9V1	A	EA	-
D836	213034	DIODE ZN 11V 2% 400mW	PHILIPS	BZX79B11	A	EA	-
D901	210120	DIODE ZN 12V 400mW	MOTOROLA	BZX79C12	A	EA	2
D902	210120	DIODE ZN 12V 400mW	MOTOROLA	BZX79C12	A	EA	-
D903	200032	DIODE SB 1A 100V	INT RECTIFIER	11DQ10		EA	9
D904	213011	DIODE VR 1V4 250mW	PHILIPS	BZV86-1V4		EA	-
D905	200032	DIODE SB 1A 100V	INT RECTIFIER	11DQ10		EA	-
D906	200032	DIODE SB 1A 100V	INT RECTIFIER	11DQ10		EA	-
D907	200032	DIODE SB 1A 100V	INT RECTIFIER	11DQ10		EA	-
D908	200032	DIODE SB 1A 100V	INT RECTIFIER	11DQ10		EA	-
D909	200032	DIODE SB 1A 100V	INT RECTIFIER	11DQ10		EA	-
D910	200032	DIODE SB 1A 100V	INT RECTIFIER	11DQ10		EA	-
D911	200032	DIODE SB 1A 100V	INT RECTIFIER	11DQ10		EA	-
D912	210051	DIODE ZN 5V1 400mW	MOTOROLA	BZX79C5V1	AP	EA	-
D913	200032	DIODE SB 1A 100V	INT RECTIFIER	11DQ10		EA	-
Q101	240001	TRAN NPN	MOTOROLA	BC184	A	EA	5
Q150	230019	TRAN MOSFET P-CHAN 40V TO72	VISHAY-SILICONIX	3N163		EA	2
Q151	230019	TRAN MOSFET P-CHAN 40V TO72	VISHAY-SILICONIX	3N163		EA	-
Q152	230002	TRAN JFET N-CHAN	VISHAY-SILICONIX	J304	A	EA	3
Q201	240001	TRAN NPN	MOTOROLA	BC184	A	EA	-
Q202	240001	TRAN NPN	MOTOROLA	BC184	A	EA	-
Q251	230086	TRAN MOSFET P-CHAN 60V	ZETEX	ZVP2106A		EA	1
Q252	00000N	NOT FITTED	FLUKE	00000N		EA	-
Q253	00000N	NOT FITTED	FLUKE	00000N		EA	-
Q254	240029	TRAN NPN	MOTOROLA	BC546	AP	EA	7
Q255	250018	TRAN PNP	MOTOROLA	BC556	AP	EA	5
Q256	00000N	NOT FITTED	FLUKE	00000N		EA	-
Q257	00000N	NOT FITTED	FLUKE	00000N		EA	-
Q258	230082	TRAN MOSFET N-CHAN 60V	VISHAY-SILICONIX	VN10LM		EA	2
Q259	230082	TRAN MOSFET N-CHAN 60V	VISHAY-SILICONIX	VN10LM		EA	-
Q501	240001	TRAN NPN	MOTOROLA	BC184	A	EA	-
Q502	250001	TRAN PNP	MOTOROLA	BC214	A	EA	2
Q503	250004	TRAN PNP TO92	MOTOROLA	2N3906	AP	EA	4
Q504	240006	TRAN NPN TO92	MOTOROLA	2N3904	AP	EA	4
Q505	240001	TRAN NPN	MOTOROLA	BC184	A	EA	-
Q506	250001	TRAN PNP	MOTOROLA	BC214	A	EA	-
Q507	250004	TRAN PNP TO92	MOTOROLA	2N3906	AP	EA	-
Q508	240006	TRAN NPN TO92	MOTOROLA	2N3904	AP	EA	-
Q601	230101	TRAN MOSFET N-CHAN	INFINEON	BSS229		EA	4

DESIG	PART NUMBER	DESCRIPTION	PRINCIPAL MANUF	MANUF PART NUMBER	CLASS	UM	QUANTITY
Q602	230101	TRAN MOSFET N-CHAN	INFINEON	BSS229		EA	-
Q603	230101	TRAN MOSFET N-CHAN	INFINEON	BSS229		EA	-
Q604	230101	TRAN MOSFET N-CHAN	INFINEON	BSS229		EA	-
Q605	230002	TRAN JFET N-CHAN	VISHAY-SILICONIX	J304	A	EA	-
Q606	230002	TRAN JFET N-CHAN	VISHAY-SILICONIX	J304	A	EA	-
Q607	240029	TRAN NPN	MOTOROLA	BC546	AP	EA	-
Q608	240029	TRAN NPN	MOTOROLA	BC546	AP	EA	-
Q701	240029	TRAN NPN	MOTOROLA	BC546	AP	EA	-
Q702	250018	TRAN PNP	MOTOROLA	BC556	AP	EA	-
Q703	230093	TRAN JFET N-CHAN	VISHAY-SILICONIX	J105	A	EA	1
Q704	250018	TRAN PNP	MOTOROLA	BC556	AP	EA	-
Q705	240029	TRAN NPN	MOTOROLA	BC546	AP	EA	-
Q706	240029	TRAN NPN	MOTOROLA	BC546	AP	EA	-
Q801	250018	TRAN PNP	MOTOROLA	BC556	AP	EA	-
Q802	240029	TRAN NPN	MOTOROLA	BC546	AP	EA	-
Q803	230049	TRAN JFET I LIM 560uA	VISHAY-SILICONIX	J503		EA	2
Q804	250018	TRAN PNP	MOTOROLA	BC556	AP	EA	-
Q805	230049	TRAN JFET I LIM 560uA	VISHAY-SILICONIX	J503		EA	-
Q808	250004	TRAN PNP TO92	MOTOROLA	2N3906	AP	EA	-
Q809	240006	TRAN NPN TO92	MOTOROLA	2N3904	AP	EA	-
Q810	239112-1	TRAN JFET N-CHAN VP1.5-4.5	FLUKE	230003 TO DRG		EA	3
Q813	239112-1	TRAN JFET N-CHAN VP1.5-4.5	FLUKE	230003 TO DRG		EA	-
Q814	239112-1	TRAN JFET N-CHAN VP1.5-4.5	FLUKE	230003 TO DRG		EA	-
Q815	230110	TRAN JFET N-CHAN 35V	VISHAY-SILICONIX	J113	AP	EA	1
Q901	250004	TRAN PNP TO92	MOTOROLA	2N3906	AP	EA	-
Q902	240006	TRAN NPN TO92	MOTOROLA	2N3904	AP	EA	-
Q903	240042	TRAN NPN	SGS-THOMSON	2N5192		EA	1
Q904	250030	TRAN PNP	SGS-THOMSON	2N5195	A	EA	1
U051	280190	IC DIG SWITCH ANLG 2NO 2NC	SILICONIX	DG413DJ	P	EA	4
U052	260027	IC LIN OP AMP	NATIONAL	OP07CJ	A	EA	1
U053	280190	IC DIG SWITCH ANLG 2NO 2NC	SILICONIX	DG413DJ	P	EA	-
U101	00000N	NOT FITTED	FLUKE	00000N		EA	-
U102	00000N	NOT FITTED	FLUKE	00000N		EA	-
U103	00000N	NOT FITTED	FLUKE	00000N		EA	-
U104	280222	IC DIG RAM STAT 32kX8 70ns	SONY	CXK58257AP-70L	A	EA	2
U105	280222	IC DIG RAM STAT 32kX8 70ns	SONY	CXK58257AP-70L	A	EA	-
U106	280175	IC DIG EEPROM 2kX8 250ns	XICOR	X2816CP-20		EA	1
U107	00000N	NOT FITTED	FLUKE	00000N		EA	-
U108	401196-1	ASSY FPLD CONTROL 1362S	FLUKE	SEE DRG		EA	1
U109	270103	IC DIG COUNT4 ASYNC BIN X2	PHILIPS	N74LS393N	A	EA	1
U151	260108	IC LIN OP AMP	ANALOG DEVICES	OP97FP	A	EA	2
U152	280190	IC DIG SWITCH ANLG 2NO 2NC	SILICONIX	DG413DJ	P	EA	-
U153	280116	IC DIG MUX 4:1 ANLG X2	SILICONIX	DG509ACJ		EA	1
U154	260082	IC LIN OP AMP CHOPPER	LINEAR TECHNOLOGY	LTC1052CN8		EA	2
U155	290181-1	IC LIN MOD PREC REF BURNT IN	FLUKE	SEE DRG		EA	2
U201	280134	IC DIG TRNCVR8 3S	PHILIPS	74HCT245N	AP	EA	1
U202	401587-1	ASSY PCB ADAPTOR FPGA DIG 1281	BI ELECTRONICS	SEE DRG		EA	1
U203	280137	IC DIG BUFF4 3S X2	PHILIPS	74HCT244N	AP	EA	3
U204	401084-1	ASSY FPLD TRIGGER REG 1362S	FLUKE	SEE DRG		EA	1
U205	270112	IC DIG NAND2 OC BUFF X4	TEXAS	SN74S38N		EA	1
U206	270126	IC DIG FLIP FLOP JK X2	TEXAS	SN74AS109N	A	EA	1
U207	270127	IC DIG MUX 8:1	FAIRCHILD	74F151APC		EA	1
U251	280132	IC DIG GATE ARRAY TX/RX	GEC/PLESSEY	CLA3106 DP18	O	EA	2
U252	280132	IC DIG GATE ARRAY TX/RX	GEC/PLESSEY	CLA3106 DP18	O	EA	-
U253	260039	IC LIN OP AMP QUAD	NATIONAL	LM324N	AP	EA	3
U254	260039	IC LIN OP AMP QUAD	NATIONAL	LM324N	AP	EA	-
U255	260039	IC LIN OP AMP QUAD	NATIONAL	LM324N	AP	EA	-
U256	260043	IC LIN OP AMP DUAL	MOTOROLA	LM358N	A	EA	1
U351	220041	OPTO ISOL 3kV DUAL	AGILENT	HCPL2631	AP	EA	1
U352	220030	OPTO ISOL HI SPEED	AGILENT	6N136	A	EA	2
U353	220030	OPTO ISOL HI SPEED	AGILENT	6N136	A	EA	-
U354	220027	OPTO ISOL HIGH CMR	AGILENT	HCPL2601	A	EA	1
U355	220039	OPTO ISOL DUAL	AGILENT	HCPL2531	A	EA	1
U356	280137	IC DIG BUFF4 3S X2	PHILIPS	74HCT244N	AP	EA	-
U401	270111	IC DIG TRNCVR8 3S	PHILIPS	N74F545N	A	EA	2
U402	270118	IC DIG COMP8 MAG	PHILIPS	N74F521	A	EA	2
U403	270050	IC DIG INV X6	FAIRCHILD	DM74LS04N		EA	1
U404	270118	IC DIG COMP8 MAG	PHILIPS	N74F521	A	EA	-
U405	280137	IC DIG BUFF4 3S X2	PHILIPS	74HCT244N	AP	EA	-
U406	270111	IC DIG TRNCVR8 3S	PHILIPS	N74F545N	A	EA	-
U407	270121	IC DIG FLIP FLOP8 D3S	TEXAS	SN74ALS574BN	A	EA	6
U408	270123	IC DIG LATCH8 3S	TEXAS	SN74ALS573CN	A	EA	1
U409	270122	IC DIG BUFF8 3S	TEXAS	SN74LS541N	A	EA	3
U410	270120	IC DIG TRNCVR8 OC	TEXAS	SN74ALS641A-1N		EA	2
U411	270121	IC DIG FLIP FLOP8 D3S	TEXAS	SN74ALS574BN	A	EA	-
U412	270122	IC DIG BUFF8 3S	TEXAS	SN74LS541N	A	EA	-
U413	270120	IC DIG TRNCVR8 OC	TEXAS	SN74ALS641A-1N		EA	-
U451	270122	IC DIG BUFF8 3S	TEXAS	SN74LS541N	A	EA	-
U452	00000N	NOT FITTED	FLUKE	00000N		EA	-
U453	270121	IC DIG FLIP FLOP8 D3S	TEXAS	SN74ALS574BN	A	EA	-
U454	270121	IC DIG FLIP FLOP8 D3S	TEXAS	SN74ALS574BN	A	EA	-
U455	270121	IC DIG FLIP FLOP8 D3S	TEXAS	SN74ALS574BN	A	EA	-
U456	270121	IC DIG FLIP FLOP8 D3S	TEXAS	SN74ALS574BN	A	EA	-
U501	260103	IC LIN OP AMP	ANALOG DEVICES	OP77EP		EA	2
U502	260103	IC LIN OP AMP	ANALOG DEVICES	OP77EP		EA	-
U503	290026-3	KIT RMS SELECTED	FLUKE	SEE DRG		S3	-
U504	260130	IC LIN OP AMP DUAL LOFFST LP	ANALOG DEVICES	OP200GP	P	EA	2
U601	260112	IC LIN OP AMP	LINEAR TECHNOLOGY	LT1022ACH		EA	1
U701	280190	IC DIG SWITCH ANLG 2NO 2NC	SILICONIX	DG413DJ	P	EA	-
U702	260140	IC LIN OP AMP	LINEAR TECHNOLOGY	LT1012CN8		EA	2
U703	290181-1	IC LIN MOD PREC REF BURNT IN	FLUKE	SEE DRG		EA	-
U704	260130	IC LIN OP AMP DUAL LOFFST LP	ANALOG DEVICES	OP200GP	P	EA	-
U705	280167	IC DIG SWITCH ANLG 4NO	SILICONIX	DG211BDJ	PS	EA	3
U706	280167	IC DIG SWITCH ANLG 4NO	SILICONIX	DG211BDJ	PS	EA	-
U707	280167	IC DIG SWITCH ANLG 4NO	SILICONIX	DG211BDJ	PS	EA	-

DESIG	PART NUMBER	DESCRIPTION	PRINCIPAL MANUF	MANUF PART NUMBER	CLASS	UM	QUANTITY
U708	260140	IC LIN OP AMP	LINEAR TECHNOLOGY	LT1012CN8		EA	-
U709	260080	IC LIN V COMP	NATIONAL	LM311N	P	EA	1
U710	401589-1	ASSY PCB ADAPTOR FPGA A-D 1281	BI ELECTRONICS	SEE DRG		EA	1
U801	260091	IC LIN COMP QUAD	NATIONAL	LM339N	P	EA	1
U802	260108	IC LIN OP AMP	ANALOG DEVICES	OP97FP	A	EA	-
U803	260136	IC LIN OP AMP DIFET I/P	BURR BROWN	OPA606KP		EA	1
U804	260082	IC LIN OP AMP CHOPPER	LINEAR TECHNOLOGY	LTC1052CN8		EA	-
U901	260081	IC LIN OP AMP	PHILIPS	NE5534AN		EA	1
U902	260116	IC LIN REG 1.2-37V 0.1A	NATIONAL	LM317LZ		EA	1
U903	260115	IC LIN REG 5V LO DROPOUT	NATIONAL	LM2931Z-5.0		EA	1
U905	260137	IC LIN REG 15V 0.1A	NATIONAL	LM78L15ACZ		EA	1
U906	260138	IC LIN REG -15V 0.1A	NATIONAL	LM79L15ACZ	A	EA	1
T301	310003	TRANSF PULSE	NEWPORT COMPONENTS	76610/1		EA	2
T302	310003	TRANSF PULSE	NEWPORT COMPONENTS	76610/1		EA	-
T901	400810-1	ASSY TRANSF INPUT 1365	SIGA	SEE DRG	A	EA	1
T902	400943-2	ASSY TRANSF ISOL 1362	SIGA	SEE DRG	A	EA	1
T903	400922-3	ASSY TRANSF OUTPUT 1362	SIGA	SEE DRG	A	EA	1
K251	330048	RELAY 2PCO LATCH 12V	MATSUSHITA	TQ2-L-12V	A	EA	13
K252	330048	RELAY 2PCO LATCH 12V	MATSUSHITA	TQ2-L-12V	A	EA	-
K253	00000N	NOT FITTED	FLUKE	00000N		EA	-
K254	330048	RELAY 2PCO LATCH 12V	MATSUSHITA	TQ2-L-12V	A	EA	-
K255	330048	RELAY 2PCO LATCH 12V	MATSUSHITA	TQ2-L-12V	A	EA	-
K256	330048	RELAY 2PCO LATCH 12V	MATSUSHITA	TQ2-L-12V	A	EA	-
K257	330048	RELAY 2PCO LATCH 12V	MATSUSHITA	TQ2-L-12V	A	EA	-
K258	00000N	NOT FITTED	FLUKE	00000N		EA	-
K259	00000N	NOT FITTED	FLUKE	00000N		EA	-
K260	00000N	NOT FITTED	FLUKE	00000N		EA	-
K261	330048	RELAY 2PCO LATCH 12V	MATSUSHITA	TQ2-L-12V	A	EA	-
K262	330048	RELAY 2PCO LATCH 12V	MATSUSHITA	TQ2-L-12V	A	EA	-
K263	330048	RELAY 2PCO LATCH 12V	MATSUSHITA	TQ2-L-12V	A	EA	-
K264	330048	RELAY 2PCO LATCH 12V	MATSUSHITA	TQ2-L-12V	A	EA	-
K265	330048	RELAY 2PCO LATCH 12V	MATSUSHITA	TQ2-L-12V	A	EA	-
K266	330048	RELAY 2PCO LATCH 12V	MATSUSHITA	TQ2-L-12V	A	EA	-
K267	330048	RELAY 2PCO LATCH 12V	MATSUSHITA	TQ2-L-12V	A	EA	-
L351	400924-1	ASSY CHOKE COMMON MODE 1362	SIGA	SEE DRG	A	EA	1
L352	00000N	NOT FITTED	FLUKE	00000N		EA	-
L601	370004	CHOKE RF 100uH 146mA	SIGMA	10-10-0537-10		EA	1
L901	370036	CHOKE RF 47uH 235mA	SIGMA	15-10-1037-10	P	EA	6
L902	370036	CHOKE RF 47uH 235mA	SIGMA	15-10-1037-10	P	EA	-
L903	370036	CHOKE RF 47uH 235mA	SIGMA	15-10-1037-10	P	EA	-
L904	370036	CHOKE RF 47uH 235mA	SIGMA	15-10-1037-10	P	EA	-
L905	370036	CHOKE RF 47uH 235mA	SIGMA	15-10-1037-10	P	EA	-
L906	370036	CHOKE RF 47uH 235mA	SIGMA	15-10-1037-10	P	EA	-
P301	604093	PLUG PCB 96-WAY	HARTING	09 03 196 6921	A	EA	2
P302	604093	PLUG PCB 96-WAY	HARTING	09 03 196 6921	A	EA	-
J301	602035	SOCKET PCB BNC ELBOW 50R	AMP	413524-2		EA	1
E201	00000N	NOT FITTED	FLUKE	00000N		EA	-
E202	00000N	NOT FITTED	FLUKE	00000N		EA	-
E351	00000N	NOT FITTED	FLUKE	00000N		EA	-
E352	00000N	NOT FITTED	FLUKE	00000N		EA	-
E355	00000N	NOT FITTED	FLUKE	00000N		EA	-
E356	00000N	NOT FITTED	FLUKE	00000N		EA	-
E357	00000N	NOT FITTED	FLUKE	00000N		EA	-
E359	00000N	NOT FITTED	FLUKE	00000N		EA	-
E360	00000N	NOT FITTED	FLUKE	00000N		EA	-
E361	00000N	NOT FITTED	FLUKE	00000N		EA	-
E364	00000N	NOT FITTED	FLUKE	00000N		EA	-
E365	00000N	NOT FITTED	FLUKE	00000N		EA	-
E401	620003	PIN SOLDER	MILL-MAX	3130200010000080		EA	2
E402	620003	PIN SOLDER	MILL-MAX	3130200010000080		EA	-
E601	00000N	NOT FITTED	FLUKE	00000N		EA	-
E602	603004	SPRING CONTACT PROBE 9.8mm	CODA	PC1A		EA	4
E801	603003	SPRING CONTACT PROBE 17mm	CODA	PA2QX		EA	1
E802	603004	SPRING CONTACT PROBE 9.8mm	CODA	PC1A		EA	-
E901	00000N	NOT FITTED	FLUKE	00000N		EA	-
E902	603004	SPRING CONTACT PROBE 9.8mm	CODA	PC1A		EA	-
E903	603004	SPRING CONTACT PROBE 9.8mm	CODA	PC1A		EA	-
E904	00000N	NOT FITTED	FLUKE	00000N		EA	-
TL101	99902L	SOLDER LINK 2W NOT FITTED	FLUKE	99902L		EA	2
TL102	99902L	SOLDER LINK 2W NOT FITTED	FLUKE	99902L		EA	-
TL252	604046	PLUG PCB 3-WAY .1"	MOLEX	22-10-2031	P	EA	2
TL254	604046	PLUG PCB 3-WAY .1"	MOLEX	22-10-2031	P	EA	-
TL402	620013-1	TEST LOOP	FLUKE	SEE DRG		EA	18
TL403	99901L	SOLDER LINK 1W NOT FITTED	FLUKE	99901L		EA	1
TL451	620013-1	TEST LOOP	FLUKE	SEE DRG		EA	-
TL453	620013-1	TEST LOOP	FLUKE	SEE DRG		EA	-
TL501	620013-1	TEST LOOP	FLUKE	SEE DRG		EA	-
TL502	620013-1	TEST LOOP	FLUKE	SEE DRG		EA	-
TL503	620013-1	TEST LOOP	FLUKE	SEE DRG		EA	-
TL504	620013-1	TEST LOOP	FLUKE	SEE DRG		EA	-
TL601	620013-1	TEST LOOP	FLUKE	SEE DRG		EA	-
TL602	620013-1	TEST LOOP	FLUKE	SEE DRG		EA	-
TL701	620013-1	TEST LOOP	FLUKE	SEE DRG		EA	-
TL802	620013-1	TEST LOOP	FLUKE	SEE DRG		EA	-
TL803	620013-1	TEST LOOP	FLUKE	SEE DRG		EA	-
TL804	620013-1	TEST LOOP	FLUKE	SEE DRG		EA	-
TL901	00000N	NOT FITTED	FLUKE	00000N		EA	-
TL902	620013-1	TEST LOOP	FLUKE	SEE DRG		EA	-
TL903	620013-1	TEST LOOP	FLUKE	SEE DRG		EA	-
TL904	620013-1	TEST LOOP	FLUKE	SEE DRG		EA	-
TL905	620013-1	TEST LOOP	FLUKE	SEE DRG		EA	-
TL906	620013-1	TEST LOOP	FLUKE	SEE DRG		EA	-
TP051	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	33
TP052	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP151	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-

DESIG	PART NUMBER	DESCRIPTION	PRINCIPAL MANUF	MANUF PART NUMBER	CLASS	UM	QUANTITY
TP153	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP154	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP155	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP351	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP352	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP353	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP354	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP501	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP502	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP503	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP504	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP505	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP506	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP601	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP602	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP603	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP604	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP701	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP702	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP703	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP704	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP705	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP706	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP801	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP804	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP901	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP902	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP903	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP906	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
TP909	620007	TEST POINT TERMINAL 1.6 PCB	MICROVAR	TYPE C29	P	EA	-
S402	700128	SWITCH 1PCO SLIDE	MORS	25336N	A	EA	1
S403	700127	SWITCH 1PST X 8 DIL	HIGHLAND	76SB08	A	EA	1
Y101	800035	CRYSTAL OSC 16MHz	IQD	16MHz IQXO-100		EA	1
Y701	800032	CRYSTAL OSC 4.91520MHz	EUROQUARTZ	EQX0-1100HC-4.9152MH		EA	1
F351	00000N	NOT FITTED	FLUKE	00000N		EA	-
#1	104056	CAP CI 20nF 50V DIL14	ROGERS CORP	203A14		EA	1
#1	414009-2	PCB VXI DMM 1362S	INVOTEC	SEE DRG		EA	1
#1	420098	LABEL SER/ASSY No 19x6 TH WHT	BRADY	THT-1-497-10	P	EA	1
#1	420112-1	LABEL SSD WARNING 12 X 12mm	BRADY	SSW8D	AP	EA	1
#1	540002	WIRE 1/.7 TINNED COPPER 22SWG	BICC	BS4109	A	AR	1
#1	602001	TERMINAL FSV	MILL-MAX	1065015013002102	A	EA	4
#1	602025	SOCKET PCB 1.0mm DIA	HARWIN	H3163-01		EA	1
#1	604171	PLUG ADAPTOR 40-WAY DIL	SAMTEC	APA-640-G-A1		EA	1
#1	605061	SOCKET PCB 16-WAY DIL	JERMYN	J23-18016	A	EA	1
#1	605062	SOCKET PCB 18-WAY DIL	JERMYN	J23-18018	A	EA	2
#1	605064	SOCKET PCB 24-WAY DIL	JERMYN	J23-18024	A	EA	1
#1	605065	SOCKET PCB 28-WAY DIL	JERMYN	J23-18028	A	EA	4
#1	605070	SOCKET PCB 20-WAY DIL	JERMYN	J23-18020	A	EA	2
#1	605127	SOCKET LINK 2-WAY .1" BLK	ASSMANN	AKSPL-G		EA	2
#1	605175	SOCKET PCB 24-WAY DIL 0.3P	HARWIN	D2924	A	EA	3
#1	605204	SOCKET PCB 68-WAY JLCC	BURNDY	QILE68P-410T		EA	2
#1	605205	SOCKET PCB 84-WAY JLCC	BURNDY	QILE84P-410T	AP	EA	1
#1	611023	SCREW M2.5 X 10 POZIPAN SZP	GKN	SEE DRG DP611000		EA	4
#1	612004-1	STANDOFF M3 X 4	SWIFT ENGINEERING	SEE DRG		EA	2
#1	612055-1	STANDOFF M3 X 19.0	SWIFT ENGINEERING	SEE DRG		EA	2
#1	615006	NUT FULL M2.5 SZP	GKN	SEE DRG DP611000		EA	4
#1	618018	PAD MTG TO18 X 5.5mm	JERMYN	TO18-006	A	EA	2
#1	630024	BEAD CERAMIC 16 SWG	PARK ROYAL PORCELAIN	No2/D0006		EA	8
#1	630044	GROMMET STRIP SIZE 3	CRITCHLEY	0495		AR	1
#1	630243	BEAD GLASS 2.4 X 0.81 X 1.8	MANSOL PREFORMS LT	M5363B/3		EA	6
#1	920145	FERRITE 3 OD 0.7 ID 4 LG	PHILIPS	FX4026	A	EA	2

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