# Farnell

## OMNIBUS OB1 and OB2

## INSTRUCTION BOOK

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Card Systems 3

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## CONTENTS

## SCHEDULE OF EQUIPMENT

The instrument has been carefully packed to protect against damage in transit.

When removing the unit from the box be sure to remove all parts and accessories from the packing material.

The complete equipment consists of:-

a. 1 off Omnibus OB1 (standard unit) or OB2 (panel meter option)

b. 1 off mains lead

c. 1 off 88 way p.c.b. connector

d. Interconnection lead between Omnibus and DM141BCD (If ordered)

NOTE:- In the event of damage in transit or shortage in delivery, separate notice in writing should be given to both carriers and Farnell Instruments Ltd., within three days of receipt of goods followed by a complete claim within five days.

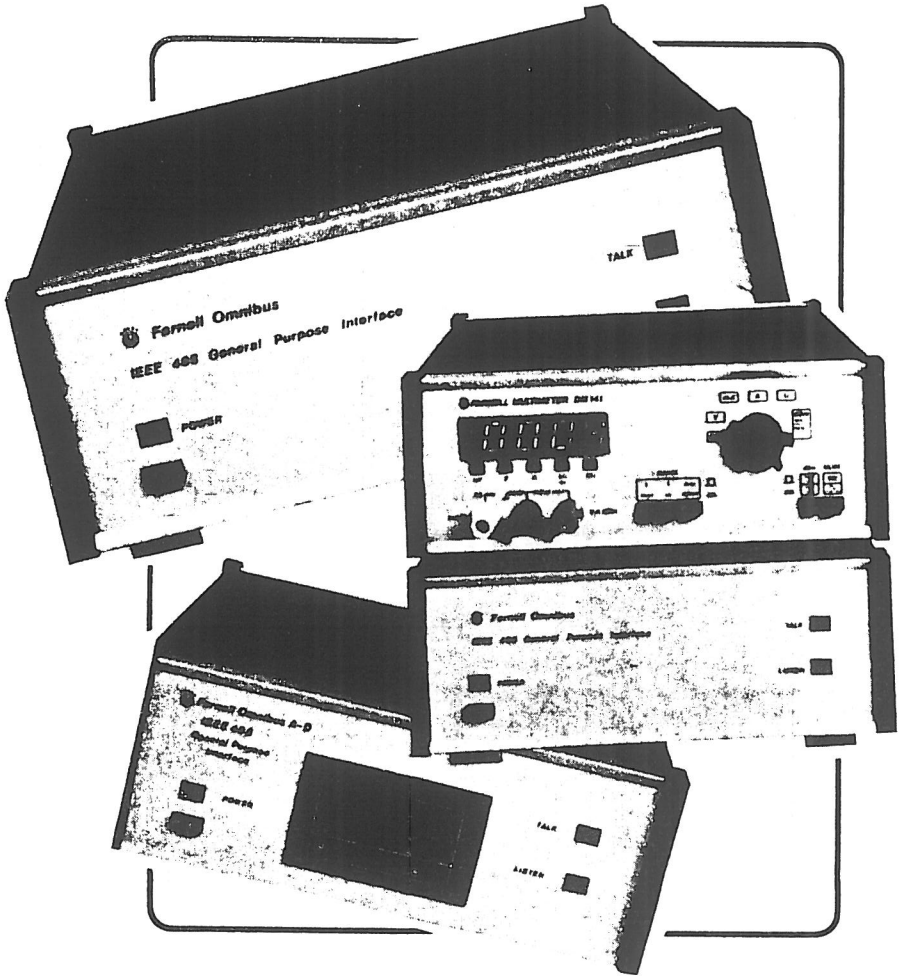
All goods which are the subject of any claim for damage in transit or shortage in delivery should be preserved intact as delivered, for a period of seven days after making the claim, pending instructions from Farnell Instruments Ltd., or an agent of the company.

## INTRODUCTION

The Omnibus is a unit which will interface a wide variety of digital instruments to the IEEE488 bus. The unit has both instrument input and output capability i.e. it can input b.c.d. (binary coded decimal) information from digital multimeters, digital tachometers, digital frequency counters and digital panel meters or output information to programmable instruments like digital multimeters for range programming, start conversion and hold data.

The Omnibus performs all the IEEE488 handshake procedures necessary to perform talker and listener functions.

A integral a/d converter is available with the Omnibus to interface analogue instruments with the IEEE488 bus system. (option OB2)






## SPECIFICATION

OMNIBUS OB1

Performs both IEEE488 talk and listen functions.

| | |
|---|---|
| BUS LINES | 8 data lines, 3 handshake lines and 5 management lines. All drive lines open collector terminated with 3k0 to Vcc and 6k2 to ground.<br>Driver and receiver lines t.t.l. compatible |
| DATA TRANSFER | In accorance with IEEE488 recommendation data is bit-parallel, byte-serial flow of ASCII characters. |
| ADDRESS CAPABILITY | 0 to 30 for both *listen* and *talk*. Set by five switches on the back panel. |
| *LISTEN* FORMAT | 3 characters received in string or individual character format<br>1 character to request *data-hold*. |
| *TALK* FORMAT | 1 dedicated sign character followed by 13 characters of b.c.d. data |
| INSTRUMENT OUTPUT (*listener* mode) | All outputs t.t.l. compatible<br>24 parallel lines in the form 3 four bit words, both true & complementry outputs being available.<br>Max loading 5 standard t.t.l. |
| INSTRUMENT INPUT (*talk* mode) | All inputs t.t.l. compatible<br>1 line: sign valid, logic high = sign valid<br>logic low = sign not valid<br>1 line: sign logic high = positive<br>logic low = negative<br>52 lines: for parallel b.c.d. data arranged in 13 x 4 bit words, positive true.<br>2 lines: for *data valid/end of conversion*<br>Logic high = *data valid*<br>Logic low = invalid data<br>Transition low to high = *end of conversion* |
| INDICATORS: | Power on, *talk* and *listen*<br>Power on by push button |
| GENERAL | 0V and +5V at instrument connector for signal reference<br>2 t.t.l. logic inverters available at instrument output connector for signal inversion (if required) |

Address code selected by five switches on back panel

Bus connection by 24 way IEEE488 socket

Instrument connection by 88 way printed circuit board connector.

Operating temperature range 0 to 40°C

DIMENSIONS

Height 80mm Width 220mm Depth 296mm

SUPPLY

Mains input voltages 198 to 260V 100 to 130V a.c. 50 to 400Hz.

Mains input by standard IEC plug and socket



## OPERATING INSTRUCTIONS

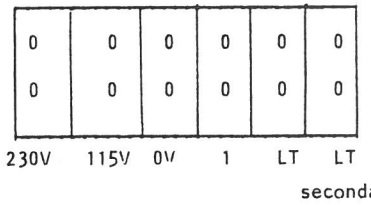
*Installation*

The Omnibus is normally supplied set for use with a.c. mains supplies of nominal 230V 50/60Hz. Check on the back panel label that the instrument supplied is suitable for use on the local mains supply.

To change from 230V to 115V supply setting

1. Ensure that the MAINS lead and interconnecting leads are disconnected
2. Remove the top and bottom covers as detailed on the back panel
3. Remove mains switch wire from 230V position on terminal block situated on the transformer frame, and connect to 115V position refer Fig. 1.

Fig. 1 terminal block arrangement




4. Alter the label bearing the mains voltage on the back panel to read the correct input

The three core mains lead must be connected as follows:-

| | | |
|---|---|---|
| brown | - | mains LIVE |
| blue | - | mains NEUTRAL |
| green/yellow | - | mains EARTH |

*Operation*

*Connection to the IEEE488 bus*

A standard 24 way Amphenol IEEE488 bus socket is provided at the rear of the instrument. The captive nuts may be used in conjunction with the captive male-female fixings provided with any standard bus connector to secure the interconnecting lead to the unit. Each of the signal lines from the GPIB is correctly terminated by the Omnibus according to the IEEE488 standard.

*Address code switches*

It is necessary to give the Omnibus a unique 'adddress' to which it may be referred by the controller on a GPIB system. The address code for the Omnibus is set by five toggle switches at the rear of the unit. These adjust the lower five bits of the ASCII code of both listen and talk addresses. Table 1 lists the ASCII characters associated with the codes set on these address switches for listen and talk modes.

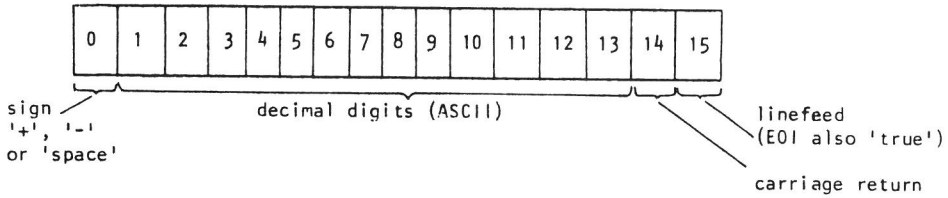
*Connection of b.c.d. data to the Omnibus*

Table 2 lists the connections to the rear panel edge connector. An 88-way edge connector is provided with the Omnibus, if further connectors are needed Viking Part No.s 3-VH441JN5 (socket), 036-0097001 (hood) and 3VH091-0071-000 (polarising key) are recommended. The unit is designed to accept 13 decimal digits in b.c.d. (binary coded decimal) format at t.t.l. compatible levels. i.e. voltages between 2.4V and 5V are regarded as logic '1' or 'true', and voltages between 0V and 0.8V are regarded as logic '0' or 'false'.

All 13 digits, or as many as are used, are expected to be present simultaneously. Unused inputs of the 13 digits may be left unconnected, in which case a '?' character is transmitted for those character positions. The decimal digits will be transmitted over the bus as their ASCII character equivalents.

*Transmitted message*

When the Omnibus is asked to talk by the controller on a GPIB system it will always send a message composed of a string of 16 ASCII characters in the following format:




*Sign character*

Two inputs to the edge connector determine what the first transmitted character is:

| Sign valid | Sign | Character |
|---|---|---|
| 0 | X | space |
| 1 | 0 | - |
| 1 | 1 | + |

X = either 0 or 1

*Data valid*

Many instruments with which the Omnibus may be used, such as digital multimeters and counters take readings repetitively, and change the output data after each reading.

Following a request for data by the bus controller, it would be undesirable for the Omnibus to transmit this data whilst it is changing, so two inputs are provided which can be used to delay transmission until the external equipment indicates that data is valid. There are two ways in which this facility can be used. After a request for data by the bus controller the Omnibus will send the data immediately if data-valid is true or as soon as it becomes so, alternatively, it will wait until the 'data-valid' has gone false and become true again - useful for single-shot readings. In operation the controller must first send either an ASCII P or Q character to the Omnibus (other characters are also possible, see later). When 'Q' has been sent followed by a request for data the Omnibus circuit will only transmit the data if both inputs are high. (If one input is disconnected it is pulled high internally by the Omnibus).



If one or both inputs are low the Omnibus will delay transmission until they both become high. When 'P' has been sent prior to the data request, the Omnibus will not transmit the data until one of the data-valid inputs has gone low and returned high again. When the 'data-valid' facility is used, with either P or Q an output is provided for connection to the external equipment - 'data-hold'.

*Data hold*

This is an output provided by the Omnibus when the 'data-valid' facility is used (see *Data valid*). Whichever of the two modes of use of the 'data-valid' is selected, when the condition becomes true for data to be transmitted, the 'data-hold' line will go low. This output can then be used to hold data steady in the output latches of the external instruments with which the Omnibus is used, where these instruments are provided with such a facility. The 'data-hold' output returns 'high' its inactive state, after the data transmission is complete.

*Inverters*

Two free t.t.l. inverters are provided on the rear panel edge connector, primarily intended for use with the 'data-hold' or 'data-valid' facilities where it is desired to use the complementary logic signals of these functions.

*Listening function*

The outputs from the Omnibus resulting from messages sent to it over the bus, are in three groups of four bits, together with their complements, 24 lines altogether. To cause data to appear at these outputs single ASCII characters must be sent by the controller to the Omnibus The three groups of outputs are addressed as follows:

GROUP 1 by ASCII characters decimal value 48 to 63

GROUP 2 by ASCII characters decimal value 64 to 79

GROUP 3 by ASCII characters decimal value 96 to 111

Data can be made to appear at the outputs in the manner shown in Table 3. The groups are completely independent, and the outputs of only one group of four lines may be updated by sending one character within its group, or two changed by sending two characters, or all three by sending three characters, one for each group, in any order.

At initial switch-on, prior to receiving any characters, a reset circuit within the Omnibus will set all the outputs to '0', complements to '1', providing there is no activity on the bus at the time of switch-on.

*Connection of more than one instrument*

More than one instrument can be connected to the Omnibus. For instance two 4½ digit multimeters such as the DM141BCD may be connected to the 13 available decimal digit inputs with some spare. It is for this reason that two 'data-valid' inputs have been provided. The two readings will of course, be sent merged together as one character string, but most controllers have ample string handling functions to make separation of the two readings simple. For example the BASIC language functions LEFT$ (M$, n), RIGHT$ (M$, n) and MID$ (M$, n, c) can be used, where M$ is the transmitted character string and n is the number of characters from the beginning or end that are required. See sample programme at the end of the book.

*Omnibus option with panel meter* (OB2)

This option may be considered just as if a digital instrument had been externally supplied and connected up to some of the data inputs, digits 1 to 4, and sign inverter 2 and data valid 1. Table 4 lists the connections used, this leaves digits 5-13 inverter 1 and data valid 2 available for external use. The analogue input at the rear can be adjusted internally to give either a ± 199.9mV or ± 1.999V full scale reading. It should be noted that the common input connection for the analogue voltage input is not isolated from the common 0V and ground of the bus system. For further details refer to the DPM2 handbook provided with this option.

*Notes on sample programme*

The sample programme at the end of the book is one which was written on a Commodore PET used as controller of a system with an Omnibus set to decimal address 8 and a DM141BCD connected to the Omnibus. First time users of an IEEE bus system would get the 'feel' of such a system by typing in this programme and trying for themselves. Only the programme lines which are multiples of 10 need be entered, (apart from lines 505, 605, 805 which must be included but need only be written as 505 REM, etc) as the others are only explanatory REM (remark) statements. If a voltage of about 1.5V d.c. is measured by the DM141 the programme will illustrate the various methods of taking readings onto the bus.

*Note on 'data-valid'*

As mentioned in the text other characters besides P and Q can cause the 'data-valid' facility to be activated. These characters are all those with bit patterns having 101 for their most significant bits. Characters within this group having a least significant bit of 0 will have the same effect as P, and those with 1 as Q.



*Table 1 Talk and listen address codes*

| ASCII decimal value | binary address switches | | | | | ASCII listen address | ASCII talk address |
|---|---|---|---|---|---|---|---|
| | A4 | A3 | A2 | A1 | A0 | | |
| 0 | 0 | 0 | 0 | 0 | 0 | Space | @ |
| 1 | 0 | 0 | 0 | 0 | 1 | ! | A |
| 2 | 0 | 0 | 0 | 1 | 0 | " | B |
| 3 | 0 | 0 | 0 | 1 | 1 | | C |
| 4 | 0 | 0 | 1 | 0 | 0 | ✓ | D |
| 5 | 0 | 0 | 1 | 0 | 1 | % | E |
| 6 | 0 | 0 | 1 | 1 | 0 | & | F |
| 7 | 0 | 0 | 1 | 1 | 1 | ' | G |
| 8 | 0 | 1 | 0 | 0 | 0 | ( | H |
| 9 | 0 | 1 | 0 | 0 | 1 | ) | I |
| 10 | 0 | 1 | 0 | 1 | 0 | * | J |
| 11 | 0 | 1 | 0 | 1 | 1 | + | K |
| 12 | 0 | 1 | 1 | 0 | 0 | , | L |
| 13 | 0 | 1 | 1 | 0 | 1 | - | M |
| 14 | 0 | 1 | 1 | 1 | 0 | . | N |
| 15 | 0 | 1 | 1 | 1 | 1 | / | O |
| 16 | 1 | 0 | 0 | 0 | 0 | 0 | P |
| 17 | 1 | 0 | 0 | 0 | 1 | 1 | Q |
| 18 | 1 | 0 | 0 | 1 | 0 | 2 | R |
| 19 | 1 | 0 | 0 | 1 | 1 | 3 | S |
| 20 | 1 | 0 | 1 | 0 | 0 | 4 | T |
| 21 | 1 | 0 | 1 | 0 | 1 | 5 | U |
| 22 | 1 | 0 | 1 | 1 | 0 | 6 | V |
| 23 | 1 | 0 | 1 | 1 | 1 | 7 | W |
| 24 | 1 | 1 | 0 | 0 | 0 | 8 | X |
| 25 | 1 | 1 | 0 | 0 | 1 | 9 | Y |
| 26 | 1 | 1 | 0 | 1 | 0 | : | Z |
| 27 | 1 | 1 | 0 | 1 | 1 | ; | [ |
| 28 | 1 | 1 | 1 | 0 | 0 | < | \ |
| 29 | 1 | 1 | 1 | 0 | 1 | = | ] |
| 30 | 1 | 1 | 1 | 1 | 0 | > | ^ |

(Note: A side edge is the underside)

| Function | Side A | Side B | Function | | |
|---|---|---|---|---|---|
| | Circuit board edge connections | | | | |
| sign i/p | 1 | 1 | bit $\bar{a}$ | o/p | group 1 (see table 3) |
| sign valid i/p | 2 | 2 | " a | selected from " | |
| bit a digit 1 i/p | 3 | 3 | " $\bar{b}$ | lower 4 bits " | |
| " a " 2 " | 4 | 4 | " b | of ASCII " | |
| " a " 3 " | 5 | 5 | " $\bar{c}$ | characters " | |
| " a " 4 " | 6 | 6 | " c | "9" to "9" and " | |
| " a " 5 " | 7 | 7 | " $\bar{d}$ | rest to "?" " | |
| " a " 6 " | 8 | 8 | " d | " | |
| " a " 7 " | 9 | 9 | " $\bar{a}$ | " | group 2 (see table 3) |
| " b " 1 " | 10 | 10 | " a | selected from " | |
| " b " 2 " | 11 | 11 | " $\bar{b}$ | lower 4 bits " | |
| " b " 3 " | 12 | 12 | " b | of ASCII " | |
| " b " 4 " | 13 | 13 | " $\bar{c}$ | characters " | |
| " b " 5 " | 14 | 14 | " c | '@' and 'A' to 'O' " | |
| " b " 6 " | 15 | 15 | " $\bar{d}$ | " | |
| " b " 7 " | 16 | 16 | " d | " | |
| " c " 1 " | 17 | 17 | " $\bar{a}$ | " | group 3 (see table 3) |
| " c " 2 " | 18 | 18 | " a | " | |
| " c " 3 " | 19 | 19 | " $\bar{b}$ | selected from " | |
| " c " 4 " | 20 | 20 | " b | lower 4 bits " | |
| " c " 5 " | 21 | 21 | " $\bar{c}$ | of ASCII " | |
| " c " 6 " | 22 | 22 | " c | characters " | |
| " c " 7 " | 23 | 23 | " $\bar{d}$ | ' and 'a' to 'O' " | |
| " d " 1 " | 24 | 24 | " d | lower case | |
| " d " 2 " | 25 | 25 | data hold | o/p | |
| " d " 3 " | 26 | 26 | data valid 1 (E.O.C.) | i/p | |
| " d " 4 " | 27 | 27 | data valid 2 (E.O.C.) | i/p | |
| " d " 5 " | 28 | 28 | 0V | | |
| " d " 6 " | 29 | 29 | 0V | | |
| " d " 7 " | 30 | 30 | +5V reference | o/p | |
| " a " 8 " | 31 | 31 | inverter 1 | o/p | |
| " a " 9 " | 32 | 32 | inverter 1 | i/p | |
| " a " 10 " | 33 | 33 | inverter 2 | o/p | |
| " a " 11 " | 34 | 34 | inverter 2 | i/p | |
| " a " 12 " | 35 | 35 | bit d digit 13 | i/p | |
| " a " 13 " | 36 | 36 | " d " | 12 " | |
| " b " 8 " | 37 | 37 | " d " | 11 " | |
| " b " 9 " | 38 | 38 | " d " | 10 " | |
| " b " 10 " | 39 | 39 | " d " | 9 " | |
| " b " 11 " | 40 | 40 | " d " | 8 " | |
| " b " 12 " | 41 | 41 | " c " | 13 " | |
| " b " 13 " | 42 | 42 | " c " | 12 " | |
| " c " 8 " | 43 | 43 | " c " | 11 " | |
| " c " 9 " | 44 | 44 | " c " | 10 " | |



*Table 3*

*Outputs resulting from characters sent in listen mode*

| | | | | | Complements | | | |
|---|---|---|---|---|---|---|---|---|
| | d | c | b | a | $\bar{d}$ | $\bar{c}$ | $\bar{b}$ | $\bar{a}$ |
| Group 1 edge connections | B7 | B5 | B3 | B1 | B8 | B6 | B4 | B2 |
| Group 2 edge connections | B15 | B13 | B11 | B9 | B16 | B14 | B12 | B10 |
| Group 3 edge connections | B23 | B21 | B19 | B17 | B24 | B22 | B20 | B18 |
| Character sent and decimal value | | | | | | | | |
| Group 1 / Group 2 / Group 3 | | | | | | | | |
| ø 48 / @ 64 / ' 96 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 1 49 / A 65 / a 97 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 |
| 2 50 / B 66 / b 98 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 |
| 3 51 / C 67 / c 99 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| 4 52 / D 68 / d 100 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 |
| 5 53 / E 69 / e 101 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 |
| 6 54 / F 70 / f 102 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 |
| 7 55 / G 71 / g 103 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 8 56 / H 72 / h 104 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| 9 57 / I 73 / i 105 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 |
| : 58 / J 74 / j 106 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 |
| ; 59 / K 75 / k 107 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 |
| < 60 / L 76 / l 108 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| = 61 / M 77 / m 109 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 |
| > 62 / N 78 / n 110 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| ? 63 / O 79 / o 111 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |

*IEEE bus lines*

The three 'handshake', five 'management' and eight data lines from the external IEEE488 bus are each correctly terminated with a 3kohm resistor to +5V and a 6.2kohm resistor to 0V. They also feed, or are fed by transceiver i.c.s IC13 to 16. These i.c.s feature open collector drive to the bus. On the internal side of the transceiver i.c.s the handshake and management lines, and seven of the data lines are taken to IC10 which is a Signetics/Philips/Mullard HEF4738V. This i.c. is specifically designed to handle the IEEE488 bus. It automatically handles the handshake procedure for all data or command transfers and implements the management commands sent or received over the bus. It determines when data is valid when receiving data off the bus, or puts data on to the bus in an orderly sequence. These two aspects will be considered separately.

For IC10 to function it needs some direct support circuits. A clock drive is provided by a crystal oscillator running at 2MHz using two of the gates in IC12 (quad NAND) to sustain oscillation and drive IC10. A third gate in IC12 in conjunction with R3 and C5, provide a start-up pulse at power-up to initiate IC10. The Omnibus units address, set on toggle switches at the rear panel is loaded into IC10 in serial form via IC11, an eight-bit shift register which effects the parallel to serial conversion.

*Listening or receiving data from the bus*

The Omnibus which has been designed primarily to interface with 'talking' instruments provides a more limited listening facility. It is designed to accept data in ASCII format, and thus on only 7 of the eight data lines. This is decoded by using the upper three bits to direct the data on the lower four bits. These lower four lines are fed to each of three 4-bit latches, IC1 to 3. The upper thr e lines are decoded to provide a single enabling output from one of three gates in IC4 and 5 (dual 4 i/p NAND) by inserting an inverter (from IC6) in a different one of each of the lines for three of the four inputs to each NAND gate. The fourth input to each gate comes from the 'data-true' output of IC10 via a buffer in IC17 (quad 2 i/p OR).

The one enabled output from the three NAND gates is inverted and gated by IC7 with a power-up or IFC (interface clear). One of the IC7 outputs then enables one of the three latches IC1 to 3. Both the true and complementary outputs from these data latches are taken to the edge connector at the rear of the instrument.

The 'data-true' output from IC10, via IC17, is also used to trigger IC18 (monostable) lengthening the data-true pulse which is used to light l.e.d. LD2, via buffer transistor VT1, to provide visual indication of listening.

*Talking or putting data on the bus*

The Omnibus is designed to accept in parallel form, 13 decimal digits of information each presented in b.c.d. format preceded by a sign which can be either '+', '-', or 'sign not valid'. The Omnibus automatically adds the correct extra bits to convert the input information into ASCII format for transmission on the bus. Also, after each message transmitted ASCII 'carriage return' and 'line feed' characters are sent to terminate the message, making a sixteen character transmission in all. Multiplexer i.c.s IC19 to 26 (1 of 8 data selectors) are used to poll the information presented. Assuming the b.c.d. lines are referred to as a, b, c, d, the a's of the first eight characters sent are selected by IC19, the b's by



IC20 and so on, and for the second eight characters the a's are selected by IC23, b's by IC24 and so on. The inputs for these data selectors are directly from the edge connector at the rear. The inputs for the last two characters sent, CR and LF are hard wired to the lower four bits of the appropriate codes. The first character, the sign character, uses two input lines on the edge connector - 'actual sign' and 'sign valid', to feed gates in IC29, 30 and 32 to generate the lower four bits for the ASCII characters + or - or 'space' as appropriate.

A four bit binary counter IC27 is clocked by the 'don't change data' pulse output from IC10 via a buffer in IC17. The three least significant bits from this counter are used to address all the data selector i.c.s. The most significant bit from the counter is inverted in IC32 (hex inverter) and again in IC31 and then supplies the chip select inputs for the first four data selectors. It also feeds, via gates in IC31, and IC30 (quad 2 i/p AND), which provides one inversion only, the chip select inputs for the last four data selectors.

The purpose of these extra gates plus extra circuits including IC33 and IC31 is to allow for widening the number of inputs, but this is an option not available on the standard Omnibus.

The outputs from the two groups of data selector i.c.s which are of the tri-state type, are paralleled up and the resulting signals feed the transceiver IC15 forming the lower four bits of the ASCII characters sent. The upper three bits sent depend upon whether it is the first character (sign) or the next thirteen (numerals) or the final two, CR, LF.

The ASCII m.s.b. (most significant bit) for all these characters is '0'. Counter IC27 zero state is detected by gates in IC29 (quad 2 i/p OR) which sets ASCII bit 5 to '0'. A gate in IC28 (dual 4 i/p NAND) sets ASCII bit 6 high except when the counter IC27 has a count of 14 or 15. When the count is between 2 and 13 inclusive both bit 5 and bit 6 are set to '1'. A further gate in IC28 detects a count of 15 and this is used to enable EOI on the bus management lines.

*Holding data*

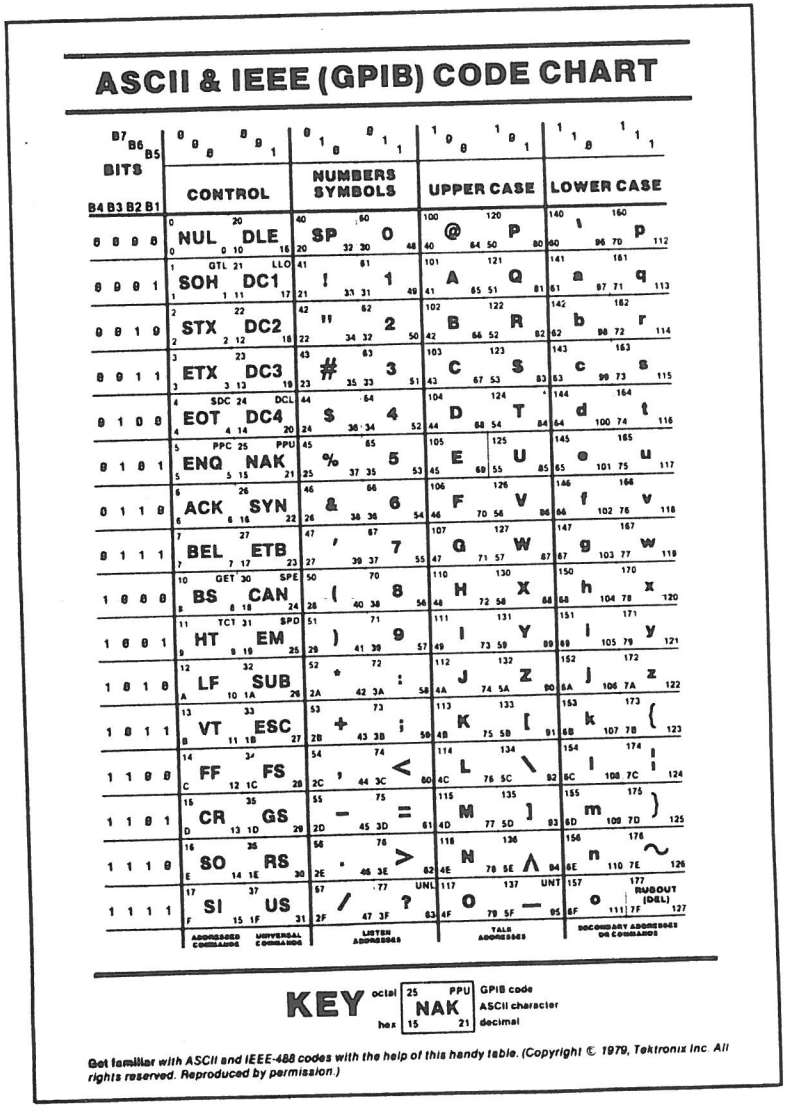
There are two ways in which the controller on the bus can command the Omnibus to wait for and hold data in the external device (such as the DM141BCD) to which the Omnibus is connected while the data is to be transmitted and for this hold to be automatically cleared after transmission of data has terminated. The upper three bits of incoming ASCII characters when in a listening mode are checked by a gate in IC4 for a '101' group (characters P6 to 'back space'). When true this sets a flip-flop in IC9 (dual D type). The least significant bit in the character is also checked and if a '1', then the pulse given by this 'true' condition is inverted in IC6 and feeds a gate in IC7 (quad 2 i/p NAND), and because bit 1 is set, the pulse feeds through to IC8 where it is gated with the external data-valid condition.

A gate in IC8 allows for two external data-valid conditions to be checked. When external data-valid is, or becomes '1', it allows the output from IC8 through to reset the flip flop in IC9. During the time IC9 is set the output feeds a gate in IC17 feeding IC10 in such a way that completion of the data handshake is prevented thus 'jamming' the bus. When external data is valid and IC9 flip flop is reset this sets a second flip flop in IC9 which feeds out a data hold signal to the external equipment. This flip flop is cleared by the E.O.I. pulse which is generated at the end of the character string. The other mode is used when the command character has a bit 1 of '0'. When this is selected the sequence is much as before, except the first flip flop in IC9 will only be reset by the external data-true line(s) going from false to true. Meanwhile the flip flop will remain set, jamming the bus.

Visual indication of the 'talking' mode is provided by l.e.d. LD1 which is fed via buffer VT2 from 'don't change data' pulses out of IC10 which have been buffered by IC17 and lengthened by a monostable in IC18.

*Power supply*

The transformer secondary output is rectified by the bridge formed by diodes D2 to D5, smoothed by C24 and C25 and the supply regulated to 5V by an i.c. regulator IC34. L.E.D. LD3 is fed from this line to provide power-on indication.



## ASCII & IEEE (GPIB) CODE CHART

| B4 B3 B2 B1 | CONTROL | NUMBERS SYMBOLS | UPPER CASE | LOWER CASE |
|---|---|---|---|---|
| 0 0 0 0 | NUL DLE | SP 0 | @ P | ` p |
| 0 0 0 1 | SOH DC1 | ! 1 | A Q | a q |
| 0 0 1 0 | STX DC2 | " 2 | B R | b r |
| 0 0 1 1 | ETX DC3 | # 3 | C S | c s |
| 0 1 0 0 | EOT DC4 | $ 4 | D T | d t |
| 0 1 0 1 | ENQ NAK | % 5 | E U | e u |
| 0 1 1 0 | ACK SYN | & 6 | F V | f v |
| 0 1 1 1 | BEL ETB | ' 7 | G W | g w |
| 1 0 0 0 | BS CAN | ( 8 | H X | h x |
| 1 0 0 1 | HT EM | ) 9 | I Y | i y |
| 1 0 1 0 | LF SUB | * : | J Z | j z |
| 1 0 1 1 | VT ESC | + ; | K [ | k { |
| 1 1 0 0 | FF FS | < | L \ | l \| |
| 1 1 0 1 | CR GS | - = | M ] | m } |
| 1 1 1 0 | SO RS | . > | N ^ | n ~ |
| 1 1 1 1 | SI US | / ? | O — | o RUBOUT (DEL) |
| | ADDRESSED COMMANDS / UNIVERSAL COMMANDS | LISTEN ADDRESSES | TALK ADDRESSES | SECONDARY ADDRESSES OR COMMANDS |

**KEY** octal 25 PPU / hex 15 NAK / 21 decimal — GPIB code, ASCII character

*Get familiar with ASCII and IEEE-488 codes with the help of this handy table. (Copyright © 1979, Tektronix Inc. All rights reserved. Reproduced by permission.)*



```
10 PRINT"3    DM141 TEST PROGRAMME" : PRINT
20 M$="2"
30 GOSUB505
32 REM- USING OMNIBUS IN LISTEN MODE, SENDING 2 WILL
33 REM- SET THE DM141 TO RANGE 2 (EG 2.0000V).
34 REM-

40 FOR I=1TO 500:NEXT I
45 REM- DELAY NECESSARY TO ALLOW DM141 TO SETTLE ON NEW RANGE
50 GOSUB605
55 REM

60 PRINT"DATA STRING FROM BUS IS "JD$ : PRINT
76 REM- THE VOLTMETER READING IS NOW DISPLAYED ON THE PET SCREEN
80 PRINT
90 PRINT"DM141 VOLTMETER READS "JLEFT$(D$,6)J" ON RANGE "JMID$(D$,7,1)
91 REM- USE OF LEFT$ STRING FUNCTION IS NEEDED AS DM141 ONLY USES THE
92 REM- FIRST 6 CHARACTERS THAT THE OMNIBUS SENDS. FURTHER PROCESSING
93 REM- IS NEEDED TO CORRECTLY POSITION THE DECIMAL POINT.
94 REM- THIS IS DONE USING RANGE DATA TRANSMITTED AS 7TH CHARACTER.
105 REM- THIS TIME A FURTHER READING WILL BE TAKEN WITH THE DATA-VALID
106 REM- PROTECTION FACILITY, ON RANGE 3.
110 M$="3":GOSUB505
115 REM- SETS DM141 TO RANGE 3
120 FOR I=1 TO 500 : NEXT I
125 REM- DELAY FOR DM141 SETTLING TIME
130 M$="P":GOSUB505
135 REM- SET DATA-VALID PROTECTION MODE
140 GOSUB605: REM- TAKE READING
150 GOSUB605
155 REM- TO SEPARATE PARTS OF DATA STRING
160 PRINT:PRINT"DM141 READS "JV$J" ON RANGE "JR$
170 PRINT:PRINT"NOW THE RANGE INFO IS USED TO PLACE DP":PRINT
180 PRINT:PRINT"DM141 MEASURED VOLTAGE ="JV
182 REM
183 REM
185 REM- USING DM141 IN SINGLE SHOT MODE THUS AVOIDING HAVING
187 REM- TO PROGRAMME DELAYS IN SOFTWARE.
190 M$="B"
200 GOSUB 505
205 REM- SETS DM141 IN SINGLE-SHOT MODE
210 M$="4":GOSUB505
215 REM- SETS DM141 ON RANGE 4.

220 FOR I=1TO500 : NEXT I
225 REM- DELAY NECESSARY TO LET DM141 COMPLETE ITS LAST READING.
227 REM- NOT NECESSARY IF WE HAD STARTED THE PROG IN SINGLE-SHOT MODE.
230 M$="A":GOSUB505
235 REM- INITIATES A READING.
240 M$="BP":GOSUB505
245 REM- SUPPRESSES FURTHER READINGS AND SETS
246 REM- THE DATA-VALID PROTECTION MODE
260 GOSUB605
261 REM- REQUEST DATA
270 GOSUB 805

271 REM- POSITION DECIMAL POINT
280 PRINT:PRINT"SINGLE-SHOT READING ON DM141 ="JV
290 END
505 REM- THIS SUBROUTINE SENDS THE CHARACTER STRING REPRESENTED BY M$
515 REM- ON THE IEEE BUS TO THE INSTRUMENT WITH LISTEN ADDRESS 8
520 OPEN1,8
525 REM- REFERS PET FILE 1 TO BUS ADDRESS 8
530 PRINT#1,M$
535 REM- PET'S SOFTWARE HANDLES BUS PROTOCOLS TO SEND OUT M$
540 CLOSE1 :REM- TIDIES UP PET FILE
550 RETURN
560 REM
605 REM- THIS SUBROUTINE RECEIVES DATA VIA THE BUS FROM A TALKER
615 REM- ON THE BUS WITH ADDRESS 8.
620 OPEN2,8
625 REM- REFERS PET FILE 2 TO BUS TALK ADDRESS 8
630 INPUT#2,D$
635 REM- DATA FROM TALKER IS PLACED IN STRING VARIABLE D$
645 REM- AGAIN PET'S SOFTWARE HANDLES ALL BUS PROTOCOLS AUTOMATICALLY.
650 CLOSE2: REM- TIDIES PET FILES
660 RETURN
805 REM- THIS SUBROUTINE USES THE RANGE INFORMATION TO CORRECTLY
815 REM- POSITION THE DECIMAL POINT.
820 V$=LEFT$(D$,6)
825 REM PUTS VOLTAGE PART OF DATA STRING INTO STRING V$.
830 R$=MID$(D$,7,1)
835 REM- EXTRACTS RANGE INFORMATION FROM DATA STRING.
840 V=VAL(V$)*10↑VAL(R$)/10↑6
845 REM- MULTIPLIES READING VALUE BY TEN TO POWER OF RANGE NO.
855 REM- AND DIVIDES THIS BY 1 MILLION TO GIVE CORRECT VOLTAGE.
870 RETURN
READY.
```

## MAINTENANCE

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The equipment supplied by Farnell Instruments Ltd., is guaranteed against defective material and faulty manufacture for a period of twelve months from the date of despatch. In the case of material or components employed in the equipment but not manufactured by us, we allow the customer the period of any guarantee extended to us.

The equipment has been carefully inspected and submitted to comprehensive tests at the factory prior to despatch. If, within the guarantee period, any defect is discovered in the equipment in respect of material or workmanship and reasonably within our control, we undertake to make good the defect at our own expense subject to our standard conditions of sale. In exceptional circumstances and at the discretion of the Service Manager, a charge for labour and carriage costs incurred may be made.

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*Maintenance*

For repairs it is recommended that the instrument be returned to:-

The Service Dept.,
Farnell Instruments Ltd.,
Sandbeck Way,
Wetherby,
West Yorkshire. LS22 4DH.
Tel. 0937 61961 Telex 557294 Farist G

or

The Service Dept,
Farnell Instruments Ltd.,
Bowers Way, Harpenden,
Herts. AL5 4HX.
Tel (05827) 69071 Telex 826307

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