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PEAK NDT

Command Reference

MicroPulse 5

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1 Introduction

MicroPulse 5PA is the latest in the MicroPulse family of high speed, multi-channel digital flaw detectors, now offering phased array capability as well as separate channels for conventional high performance pulse-echo/TOFD. Up to 128 phased array channels (all of which may be used for beam forming) and 16 conventional channels may all be housed in one enclosure. Where more phased array channels are required, then two units can be linked together. The phased array channels and conventional channels are configured and controlled independently to allow the high-speed firing of the transducers at rates of up to 20KHz. With selectable digitisation rates of up to 100MHz (and at a maximum of 12 bit resolution) data can be reported as RF/AScan or up to 80 peaks. Where lower digitisation rates are selected, then there is no loss of resolution for element delays of phased array focal laws as the 100MHz clock rate is maintained until the final data output. Output data can be synchronised with up to four axes of motor positional data.

Control of the MicroPulse 5 is via 1000BaseT (Gigabit) Ethernet to the host PC. The command language allows the user to configure up to 1024 phased array tests and 255 ultrasonic tests using any combination of transmit/receive channels that can be executed in sequence or individually. The phased array tests can be grouped together into sweeps to allow the test for example comprising a sector scan to be addressed collectively. Each test can have its ultrasonic parameters configured independently.

On the receiver the parameters include:

- Amplifier gain
- Filter selection
- Waveform type (r/f, full wave, positive half cycle or negative half cycle)
- Waveform smoothing
- Distance amplitude correction (DAC).

Also under user control are the transmitter parameters these include:

- Pulser width
- Pulser voltage
- Pulser Damping (conventional channels only)

The resultant data are presented in a number of ways. These include:

- Peak reporting (from 1 to 80 with timebase)
- Coupling level
- AScan or Rf waveform capture
- Averaged data

Gates are defined relative to the firing of the pulser, but it is also possible to define an ‘inspection gate’ relative to a peak within a ‘search gate’, this is known as echo gate triggering.

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2 The MicroPulse Command Language

The communication interface of MicroPulse 5 is Ethernet. The IP address is normally set to 10.1.1.2. Commands to MicroPulse consist of ASCII characters and are of the general format:

<mnemonic> <parm1> <parm2> … <parm n>

Where <mnemonic> is a 3 or 4 alphabetical command name (upper or lower case) and <parm> is a signed decimal integer or unsigned hexadecimal integer terminated by ‘h’ (or ‘H’). Mnemonics and parameters are terminated by a space character; a command is terminated by either return or the mnemonic of the next command. Several commands may appear on one line up to a total length of 256 characters.

The # character is used to allow the use of comments on a line. All characters on the same line after the # character will ignored by the MicroPulse.

Each test is identified by a number from 1 to 1279. Tests 1 to 255 are used for conventional probes. This ensures backward compatibility with MicroPulse 4. The NUM command defines the number of conventional tests in use at any one time, and using test number 0 causes a command to apply to all tests up to the NUM parameter.

The MicroPulse 5 standard data output format is 8 bits, and so all data relating to signal amplitude are in the range 0 to 255. This applies to all threshold values (UPL, LWL, GPL, and GLH commands). Gain parameters (GAN, BAL, and auto-CAL commands) are in the range 0 to 280 and represent units of 0.25 dBs. DAC curves are programmed by the DSET and DFIL commands in 0.25dB units.

Gate commands (GAT, EGT, and IGT) may use distance units as defined by the VEL command. VEL defines the speed of sound for a specific DAC curve, and test is assigned a DAC curve by the CUR command. If the VEL command is not used or is set to the default then the units of the gate commands are machine units. A machine unit is defined by the digitisation rate (i.e. 10nSec for 100MHz digitisation).

Encoder control commands (FLX, FLZ, FLR, and LCP) use axis numbers 1 to 4, set up commands (MPE, SPA and BKL) carry up to 4 parameters, one for each axis. Axis locations are signed 24-bit values.

Tests numbers of 256 or greater are used for phased array probes. Each one of these tests can be assigned a focal law by utilising the TXN/RXN commands. The TXN/RXN command will interpret that test numbers below 256 are assigned directly to a channel whilst tests 256 and above are assigned to a focal law. These phased array tests can be grouped into a sweep. A sweep is a number of tests that are fired sequentially and are defined by the SWP command. For example, if defined, a sweep could be tests 300 to 349 fired sequentially.

The transmit and receive focal laws are defined by using TXF/RXF commands. From the number of TXF/RXF commands sent relating to a particular law the MicroPulse can determine the number of array elements. After any changes to a focal law the appropriate TXN/RXN command must be sent to reassign the changed focal law to a test. The rx_delay and tx_delay are specified in 1 nanosecond units irrespective of the sample frequency of the system.

Dynamic depth focusing (DDF) is defined in a similar way to a focal law. The DXN command assigns a DDF law to a test whilst the DXF command details the DDF law itself

To accommodate the fact that when changing a parameter it is desirable to change that parameter for all tests in a sweep a fourth letter ‘S’ can be added to many of the existing

MicroPulse commands. This new command will then alter the parameter for the defined sweep number or all defined sweeps if set to zero.

For example:

CAL 0 fires all tests defined by the NUM command
CAL 1 fires test 1
CALS 1 fires all tests in Sweep 1 as defined by the SWP command.

If the system is configured with parallel conventional channels then this allows conventional pulse-echo/TOFD tests to parallel fire. To accommodate this certain MicroPulse commands can have an optional fourth letter "G" added. This allows control of the test groups specified by the GRUP command. The configuration of the MicroPulse system should be checked with Peak NDT prior to use of group firing.

3 Command Language Overview

The commands recognised by the MicroPulse can be grouped according to the functions that they perform. There are nine groups discussed in this section, these cover:

3.1 General Control Commands
3.2 Ultrasonic Commands (e.g. gates, gain, etc)
3.3 Test Commands
3.4 Axis Control Commands
3.5 Inspection Commands
3.6 Data Control Commands
3.7 User Interface Commands
3.8 Input/Output Commands
3.9 Multi-gate on a Test Commands

In this section the following abbreviations are used:

< > These parameters are mandatory

[ ] These parameters are optional

( ) This is a note for clarity; they do not actually appear in either input or output.

3.1 General Control Commands

OUT XXA XXAS XXB XXR XXT RST SRST STA SDS STS ZFL

The STA command is often used as a quick way of testing communications with a host. The response consists of an LLC message, which indicates the current axis positions. RST performs a full reset of the system and replies with an LLC message identifying the system version number. SRST performs a soft reset clearing only the parameters held in MicroPulse back to the power on state, it also replies with an LLC message identifying the system version. The OUT command causes MicroPulse to reply with a defined message, this is useful for recognition of an event such as axis stall (see INE and MSE), or to flag the end of a command sequence containing CAL or STP commands (which may or may not produce data depending on the ultrasonics). The SDS command allows the user to define the power-on/RST default sample Frequency and data output mode. The XXA, XXAS, XXB, XXR, XXT and STS commands are used to query various parameters and settings from the MicroPulse. The ZFL command allows the storing of commands within the MicroPulse that are executed after a power-on/RST.

Format:

OUT	(Send Message)	<Hd><Arg>…[]
RST	(Reset System)	[Frq]
SDS	(Default sample frequency/DOF)	<Sample>[DOF]
SRST	(Software Reset)	[Frq]
STA	(System Status)	[Status]
XXA	(Request Ultrasonic Parameters)	<Tn>
XXAS	(Request Test Numbers in sweep)	<Sweep No.>
XXR	(Request Receive Focal Law Details)	<Law No.>
XXT	(Request Transmit Focal Law Details)	<Law No.>
XXB	(Display Ultrasonic Parameters)	<Tn>
STS	(Request Axis Control Parameters)	<Mode>
ZFL	(Store/Erase Commands)	<Mode>

3.2 Ultrasonic Commands

AAV AWF(S) BAL(S) CUR(S) DDAC DFIL DLY(S), DRTE DSET DTG DXF EGT(S) ETM EUPL EPL(S) FRQ(S) GAN(S) GAT(S) HYS(S) IGT(S) LOF LON PAV PAW PDW PSV RTD RXF RXN TGA(S) TRM(S) TTD TXF TXN UPL(S) VEL

The ultrasonic settings of any test are primarily accessed via the AWF(S), EGT(S), FRQ(S), GAN(S), GAT(S), HYS(S), IGT(S), RXN, TXN, and UPL(S) commands. Since the parameters of GAT(S), IGT(S) and EGT(S) are in distance units, the prior use of VEL is required to select the velocity of sound in the material. If VEL is not used, the system defaults to machine units. A machine unit is defined by the digitisation rate (i.e. 10nSec for 100MHz digitisation).

The BAL(S), TGA(S), DLY(S) and TRM(S) commands provide means of relative adjustment of the basic parameters. The DDAC, DSET, DRTE, DFIL and DLIN commands provide interface with the D.A.C. memory to enable user-defined curves that can then be assigned to tests via the CUR command. Note that VEL applies to a DAC curve number. The D.A.C. is turned on/off using the LON/LOF commands.

DTG allows the D.A.C. to be either triggered from the initial pulse or an interface echo.

AAV only applies to tests enabled with the gain reduction facility (GRE) and sets the amount of gain drop required.

ETM is used for tests using echo trigger facility to enable/disable echo trigger mode or to display the echo trigger gate on the A-scan monitor, this is used in conjunction with EGT(S) and IGT(S).

For conventional channels, PDW allows the adjustment of pulse width and damping, whilst PSV adjusts the pulser voltage. Phased array channels utilised the PAV and PAW commands to adjust the transmit voltage and width respectively.

The RXF and TXF commands are used to define the receive and transmit focal laws whilst the DXF command defines the Dynamic depth focus law. The receive and transmit laws can be trimmed using the RTD and TTD commands.

The SGA command can be used to increase the gain on phased array tests by altering the dividing factor for that test

Format:

AAV	(Amplitude Adjustment Valve)	<Gred>
AWF(S)	(Analogue Waveform)	<Tn><sw>
BAL(S)	(Balance Gain)	<Tn ><Gchange>
CUR(S)	(DAC Curve number)	<Tn><Cn>
DDAC	(Define DAC Memory)	<Cn><Clen><Caddr>[Rate]
DFIL	(DAC Memory Fill)	<Cadd1><nul><Cval>
DLIN	(Fill DAC Memory with line)	<Cn><Setting><Count> <Rate of Change><Repeat No.>
DLY(S)	(Delay)	<Tn><Delay>
DRTE	(Set System DAC Rate)	<Rate>
DSET	(DAC Memory Set)	<Cadd><Cval>
DTG	(DAC Trigger Mode)	<mode>
DXF	(DDF Law Define)	<DDF Law><channel><Count> <law details>
DXN	(DDF Law Assign to a Test)	<Tn><DDF Law>
EGT(S)	(Echo Gate)	<Tn><Gs><Ge>
EPL(S)	(FMC mode interface trigger threshold)	<Tn><Value>
ETM	(Enable Echo Trigger Mode)	<Tn><Mode>

EUPL	(Echo Gate Trigger Threshold)	<Tn><Value>
FRQ(S)	(Frequency Filter Select)	<Tn><Fn><Sn>
GAN(S)	(Gain)	<Tn><Gval>
GAT(S)	(Search Gate)	<Tn><Gs><Ge>
HYS(S)	(Hysteresis)	<Tn><Hys>
IGT(S)	(Echo Inspection Gate)	<Tn><Gs><Ge>
LOF	(DAC Off)	<Value>
LON	(DAC On)	<Value>
PAV	(Adjust Phased array pulse voltage)	<1st channel><last channel><volts>
PAW	(Adjust Phased array pulse width)	<1st channel><last channel><width>
PDW	(Pulser Damping with Width)	<channel><dd><ww>
PSV	(Pulser Voltage)	<channel><voltage>
RTD	(Receive Focal Law Trim)	<Focal Law><Value>
RXF	(Set Receive Focal Law)	<Focal Law><channel> <delay><element gain trim>
RXN	(Receive Channel Connector)	<Tn><Conn>
SGA(S)	(Phased array sum gain)	<Tn><Value>
TGA(S)	(Trim Gain)	<Tn><Gval>
TRM(S)	(Trim a test delay)	<Tn><Value>
TTD	(Transmit Focal Law Trim)	<Focal Law><Value>
TXF	(Set Transmit Focal Law)	<Focal Law><channel><delay> [optional pulser volts]
TXN	(Transmit Channel Connector)	<Tn><Conn>
UPL(S)	(Upper Threshold Level)	<Tn><Value>
VEL	(Velocity)	<Vel><Cn>

3.3 Test Commands

DIS(S) DISG ENA(S) ENAG GRUP NUM(G) PRF SWP

These commands control which tests are enabled for inspection and how fast the tests are repeated.

The NUM command specifies the current length of the test cycle for conventional probes, that is the number of the last test to be executed at any inspection point. ENA(S) and DIS(S) enable and disable specific tests, although disabled tests are still executed in response to STL, STP(S) or CAL(S) with a specific test number.

The SWP command defines the phased arrays tests that are grouped into any of the 16 sweeps.

The PRF command provides a means of setting a maximum pulse repetition rate; this can be useful to ensure that electronic or acoustic limits are not exceeded.

Format:

DIS(S)	(Disable Test)	<Tn>
DISG	(Disable group of Tests)	<Gn>
ENA(S)	(Enable Test)	<Tn>
ENAG	(Enable group of Tests)	<Gn>
GRUP	(specify a group of tests)	<GPn><Tn><Tn><Tn><Tn><Tn>
NUM(G)	(Test Cycle)	<No.>
PRF	(Pulse Repetition Frequency)	<rate>
SWP	(Define Sweep)	<Swp No><list of tests>

3.4 Axis Control Commands

BKL ENCF ENCM ENCO ENCT LCP MPE MSE SPA SPQ SPR STOP TERM

These commands set up the data necessary for reading of encoders

MPE, BKL must be set up before any axis move is performed, these specify the number of encoder pulses per user distance unit and backlash timeout.

SPA sets the pitch as which the tests are executed for FLR/FLX/FLZ inspections.

LCP presets axis position and may be used at any time, and so can for example be invoked by an input line to provide an external datum.

MOV,MOVU and MRE are axis movement commands only available with the motor controller option fitted.

MSE provides the user with a means of programming the action to be taken of certain axis conditions.

TERM allows the user to either turn on or off the encoder axis termination

Format:

BKL	(Backlash)	<Awt1><Awt2><Awt3><Awt4>
ENCF	(Encoder Filter)	<Axis1><Axis2><Axis3><Axis4>
ENCM	(Encoder Mode)	<Mode>[Input Mode][Filter Count]
ENCO	(Encoder Overshoot)	<Axis1><Axis2><Axis3><Axis4>
ENCT	(EncoderType)	<Axis1><Axis2><Axis3><Axis4>
JIT	(Encoder Jitter)	<Axis1><Axis2><Axis3><Axis4>
LCP	(Location Preset)	<An><Apos>
MOV	(Move axis to location)	<Axis><Location>
MOVU	(Move axis)	<Axis><Direction><Speed>
MPE	(Millimetre Per Encoder)	<Aep1><Aep2><Aep3><Aep4>
MRE	(Move axis relative)	<Axis><Displacement>
MSE	(Message Status Enable)	<ass><mode>[off]
SPA	(Spacing – Inspection)	<Axis1><Axis2><Axis3><Axis4>
SPQ	(Axis Stop Slow Period)	<Axis1><Axis2><Axis3><Axis4>
SPR	(Axis Start Slow Period)	<Axis1><Axis2><Axis3><Axis4>
STOP	(Stop Axis Movement)	<Axis><Mode>
TERM	(Define Encoder Termination)	<An><on/off>

3.5 Inspection Commands

STL STX CAL(S) STP(S) STR(S) FDEF FLM FLR FLX FLY FLZ

Non-reporting modes

The commands STL and STX are used to place MicroPulse into an idle state where a selected test may be displayed on the A-scan monitor. No ultrasonic data is sent to the host.

Static Modes

The CAL(S), STR(S) and STP(S) commands are provided mainly for calibration purposes and can be used as single test commands or with a test number 0 for all tests specified by the NUM command. The CAL(S) command differs from all the other inspection commands in that MicroPulse performs one test or cycle of tests after processing the CAL(S) command and then reverts to whatever idle mode was previously selected. The other commands set up the required mode but do not execute them directly. MicroPulse first processes all pending commands before entering the most recently selected mode.

Moving inspection mode

Inspection is performed at points separated by a pitch specified via the encoder control command MPE and SPA (these points are referred to as SPA points in the command descriptions). Any data reported is preceded by an LCI message showing to which inspection point the data applies. The ultrasonics proceeds while the axis is moving and data is continuously buffered. Because of the asynchronous nature of the ultrasonics, axis motion, and host data processing rate, there is a potential problem associated with this kind of inspection. The axis motion may be such that the ultrasonics for one SPA point does not finish before the next point is reached, when this occurs the data for the missed point is lost and this fact is flagged by an LCA message.

FLX, FLZ and FLR set up the inspection mode and rely on axis motion generated externally. FLY is available if the motor controller option is fitted and in this mode MicroPulse controls the inspection axis.

The FLM command specifies the type of tests to be carried out at each inspection point. This can be conventional tests, phased array tests or both. FDEF can be used to define a sequence of sweeps to be carried out at inspection points.

Format:

CAL(S)	(Calibration)	<Tn>[Amp]
CALG	(Calibration Group)	<Tn>< Gn>[Amp]
FDEF	(Define Sweep Sequence)	<Ena/dis><Mode><No. of sweeps><No. of sweeps/ tests at each point><list of sweeps>
FLM	(Inspection Type)	<Mode>
FLR	(Fly Inspection Relative)	<Axis><disp><dir>
FLX	(Fly Inspection Start)	<Axis><start><dir>
FLY	(Fly Inspection Mode)	<axis><end location>
FLZ	(Fly Inspection End)	<Axis><end>
STL	(Stopped Non-reporting)	<Tn>
STP(S)	(Stopped and Reporting)	<Tn>
STPG	(Stopped and Reporting Groups)	<Gn>
STR(S)	(Stopped and Reporting, using buffer)	<Tn>
STRG	(Stopped and Reporting Groups, using buffer)	<Gn>
STX	(Enter Idle Mode)	

3.6 Data Control Commands

ACNT AMP(S) DCM(S) ECON LWL(S) GPL(S) GPH(S) GRE(S) OLM(S) PIG SCHK

This group of commands allows the user to define how the ultrasonic data for a particular test is to be reported. The test specific commands AMP(S), LWL(S), GPL(S), GPH(S) and GRE(S) are mutually exclusive. In particular this means that any of these commands overrides any previous command for the same test number. PIG applies to all tests which report multiple peaks, and specifies the maximum number of peaks to report and whether to give priority to peaks earlier in the gate or to the largest peaks. The DCM command allows the reduction of data from a test. ECON allows the activation various extra information. The first of these is Cycle time reporting where a message gives the user the actual cycle time achieved in STR/STP modes. The second is extended error message reporting where more information is given on incorrect commands received.

The OLM command enables the reporting of individual phased array element saturation, whilst SCHK allows the automated ADC and linearity checks on phased array channels.

Format:

ACNT (Display Ascan Rate)	<Tn><count>[optional count start]
AMP(S) (Amplitude)	<Tn><mode>[optional count][optional mode]
DCM(S) (Data compression)	<Tn><mode>[optional count]
ECON (Enable v parameter reporting)	<value1><value2><value3><value3>
GPL(S) (Grass Coupling Low)	<Tn><Value>
GPH(S) (Grass Coupling High)	<Tn><Value>
GRE(S) (Auto Gain Reduction)	<Tn><mode>
LWL(S) (Lower Threshold Level)	<Tn><Value>
OLM(S) (Overload reporting mode)	<Tn><Mode><No. elements>
PIG (Peaks In Gate)	<no.>
SCHK (System check)	<Mode><Chstrt> <Chend> <Gtstrt><Gtend> <Filter><Pulwidth> <Pulvolt><Pulrep>

3.7 User Interface Commands

BAB DOF IMF IPM MAS SNM

The DOF/BAB commands are provided to allow the user to change between output reporting modes.

The IMF command is accepted to provide backward compatibility to earlier MicroPulse versions. It has no effect.

MAS is used to determine the master slave configuration when more than one MicroPulse is used in an inspection

The IPM and SNM commands can be used to set the IP address and subnet mask for Ethernet communication. This is an alternative method to using the 'PeakIPAssign' utility.

The BAB command is to allow a limited use of the MicroPulse 5 Phased Array tests with older versions of the MIPS software. It is not for use in new software development (see appendix 6.6).

Format:

BAB	(Output mode)	<Mode>
DOF	(Output mode)	<Mode>
IMF	(Computer Interface Control)	<Mode>
IPM	(set the Ethernet IP address)	<Value><Value><Value><Value>
MAS	(Master/Slave mode)	<Mode>
SNM	(set the Ethernet subnet mask)	<Value><Value><Value><Value>

3.8 Input/Output Commands

CPIN INE SCPE

There are eight general purpose hardware input and output lines which may be used for inspection systems which provide external event data (e.g. axis datum) or require direct control from MicroPulse rather than a host (e.g. to operate a reject indicator). CPIN is used to output signal levels on the external outputs. The INE command has the ability of invoking any sequence of commands on external event; this makes it possible to configure stand alone systems to respond to events without the need of an intelligent host. The SCPE command allows the enabling/disabling of the oscilloscope outputs for specific tests.

Format:

CPIN	(Control Pin)	<pin><sense>
INE	(Input Line Enable)	<pin><sense>[Off]
SCPE	(Oscilloscope output enable)	<Tn>

3.9 Multi-gate on a Test Commands

AMM(S) CML GIN(S) GMH(S) GML(S) GMT(S) HMS(S) LML(S) PMG(S) UML(S)

There are a set of commands that control the use of multiple gates on a test. Multiple gate modes are accessed via special AMP modes (31 and 32). Up to Four Peak Detection gates can be specified. These commands are the multi-gate equivalent of the standard single gate commands

AMM(S) (Multi-gate Amplitde)	<Tn><Gn><mode>
CML (Multi-gate Calibration)	<Tn> <Gn> <amplitude>
GIN(S) (Invert gate)	<Tn><Gn> <value>
GMH(S) (Multi-gate Grass Coupling High)	<Tn><Gn><value>
GML(S) (Multi-gate Grass Coupling Low)	<Tn><Gn><value>
GMT(S) (Multi-gate Search Gate)	<Tn> <Gn><Gs><Ge>
HMS(S)(Multi-gate Hysteresis)	<Tn><Gn><Hysteresis Level>
LML(S) (Multi-gate Lower Threshold Level)	<Tn><Gn><value>
PMG(S) (Multi-gate Peaks In Gate)	<Tn><Gn><value>
UML(S) (Multi-gate Upper Threshold Level)	<Tn><Gn><value>

4 MicroPulse Output Messages

All MicroPulse messages are binary and carry a byte count, either explicitly as part of the message or implicitly by virtue of message type. This means that the host can ascertain the length of a message before the whole message has been sent.

To allow existing software to interface with the MicroPulse 5, different output formats are supported. The output mode is controlled by the DOF command:

DOF 0 Mode: Backward compatible mode for MicroPulse 4. The standard peak mode (peak count in header) of MicroPulse 4 is not supported. Only the newer peak reporting mode that supports up to 80 peaks is implemented (Peak count in the header can be accessed by utilising BAB 1 mode). Reports 8 Bit Data. Details of the command format and output messages can be found in the MicroPulse 4 Manual (PNL1055).

Note in DOF 0:

Test 1 is reported as 0
Test 256 is reported as 0
Test 511 is reported as 0xff

This mode is therefore of limited use as test numbers are duplicated in the output messages.

DOF 1 Mode: Standard mode for MicroPulse 5. This allows for all 1279 tests and reports 8 Bit Data.

DOF 2 Mode: This mode allows for 10 bit data to be reported. The message format is as per DOF 1 mode except all amplitudes are 10 bit data.

DOF 3 Mode: This mode allows for 12 bit data to be reported. The message format is as per DOF 1 mode except all amplitudes are 12 bit data.

DOF 4 Mode: This mode allows for 16 bit data to be reported. The message format is as per DOF 1 mode except all amplitudes are 16 bit data.

DOF 5 Mode: This mode allows for 8 bit logarithmic data to be reported. The message format is as per DOF 1 mode except all amplitudes are 8 bit logarithmic data.

DOF 6 Mode: This mode allows for byte packed 12 bit data to be reported. This gives a 25% reduction in the data transferred. This is only for Ascan data, all other data is as per DOF3.

4.1 Standard Data Output Messages

Data Message

<Header> <count lsb><count tsb><count msb>><Sweep No./Test No. lsb><Sweep No./Test No. msb><dof ><spare><amp 1>….. <amp n >

Where:

Header byte:	1AH	Ascan
	1CH	normal indications
	1DH	gain reduced indications
	1EH	LWL/GPL (coupling failure)
Count:	24 bit total data length count	
Sweep/Test No:	16 bits. Bottom 11 bits Test No. Top 5 bits sweep No.	
dof:	Bits 0 – 4 = data format Bits 5 – 7 = 0 except in muti-gate mode where they give the gate number that the data is from (1 – 4)	
channel:	Normally 0, except in full matrix capture tests it is used to indicate the channel number	
amp:	In 8 bit Modes, for Ascan = amplitudes of digitised signal else for peak indications the format of the data is <amp n >timebase lstb n><timebase mstb n> In greater than 8 bit modes, in Ascans the amplitudes are least significant byte first, else for peak indications the format of the data is <amp lstb n><amp mstb n> <timebase lstb n><timebase mstb n>	

Note in DOF 1 to DOF 6:
Test 1 is reported as 0
Test 255 is reported as 0xfe
Test 256 is reported as 0xff
Test 511 is reported as 0x1fe

Auto-CAL - 10 Bytes in total:

<26Hex>
<Sweep/Test No. lsb >
<Sweep/Test No. lsb >
<dof>
<amp lsb>
<amp msb>
<timebase lsb>
<timebase msb>
<gain lsb>
<gain msb>

GPL Grass Coupling –10 Bytes in total:

<25Hex>
<Sweep/Test No. lsb >
<Sweep/Test No. msb >
<dof>
<32 bit waveform integral Byte 0>
<32 bit waveform integral Byte 1>
<32 bit waveform integral Byte 2>
<32 bit waveform integral Byte 3>

<amp lsb>
<amp msb>

GPH Grass Coupling – 10 Bytes in total:

<24Hex>
<Sweep/Test No. lsb >
<Sweep/Test No. msb >
<dof>
<32 bit waveform integral Byte 0>
<32 bit waveform integral Byte 1>
<32 bit waveform integral Byte 2>
<32 bit waveform integral Byte 3>
<amp lsb>
<amp msb>

LWL Coupling failure – 4 Bytes in total:

<28Hex>
<Sweep/Test No. lsb >
<Sweep/Test No. msb >
<dof>

Echo Trigger failure – 4 Bytes in total:

<27Hex>
<Sweep/Test No. lsb >
<Sweep/Test No. msb >
< Channel >

Where:
Channel: Normally 0, except in full matrix capture tests it is used to indicate the channel number

Overload failure (1) – 4 Bytes in total:

<29Hex>
<Sweep/Test No. lsb >
<Sweep/Test No. msb >
<Count of elements saturating during gate>

Overload failure (2)

<2aHex>
<Total message length count (n+4)>
<Sweep/Test No. lsb >
<Sweep/Test No. msb >
<n Bytes containing a bitwise representation of each channels overload status>

4.2 Information Messages

RST

The format of this message is now 32 bytes in total length:

1	Header Bytes 23Hex
2	System number
3	LSB of the number of Phased Array channels in system
4	Number of Conventional channels in system
5	Always 0 in MP5 (MP LT – always set to 10Hex)
6	Hardware version most significant byte
7	Hardware version least significant byte
8	Actual data output format
9	Default sample Frequency
10	Actual system sample Frequency
11	Default data output format
12	Conventional channels per CUIF ADC (bottom 5 bits)
13	Main processor software version byte 1
14	Main processor software version byte 2
15	Main processor software version byte 3
16	Main processor software version byte 4
17	Master control
18	Bit 0 - 3 = MSB of the number of Phased Array channels in system + 1 Bit 4 - 6 = For future use. Bit 7 = Bit set indicates extra transmit channels present
19	RF Slot 1
20	RF Slot 2
21	RF Slot 3
22	RF Slot 4
23	RF Slot 5
24	RF Slot 6
25	RF Slot 7
26	RF Slot 8
27	RF Slot 9
28	Spare
29	Ethernet processor software version byte 1
30	Ethernet processor software version byte 2
31	Ethernet processor software version byte 3
32	Ethernet processor software version byte 4

Decode of RF slot bytes is as follows:

Top nibble:	0	=	Nothing expected in slot
	1	=	PAIF expected in slot
	2	=	CPIF expected in slot
	4	=	External system interface in slot
Bottom nibble	0 or 1	=	Slot is empty
	8	=	Slot has PAIF in
	9	=	Slot has a CPIF in

MasCon Pass in indicated by 0xff

The Conventional Channels per CUIF is used to indicate the number of ADCs on a CUIF PCB for parallel firing of conventional channels. The byte is set to 0 or 16 on standard systems to indicate that the feature is not available. The configuration of the MicroPulse system should be checked with Peak NDT prior to use of group firing.

To obtain the PA channel count on a system with greater than 255 channels:
count = (BYTE3) + (((BYTE18 & 0x7f) - 1) * 0x100)

XXA <Test No.>

This query message now replies with a 40 Byte message as follows giving full test information:

1	Header Bytes 20Hex
2	Test No lsb
3	Test No msb
4	Tx focal law Number (channel number in conventional test) lsb
5	Tx focal law Number (channel number in conventional test) msb
6	Gain lsb
7	Gain msb
8	Bits 0-3 smoothing and bits 4 –7 Filter
9	Amp / reporting mode Byte 1
10	Amp / reporting mode Byte 2
11	Amp / reporting mode Byte 3
12	Amp / reporting mode Byte 4
13	Gate start lsb
14	Gate start msb
15	Gate end lsb
16	Gate end msb
17	Delay lsb
18	Delay msb
19	Upl lsb
20	Upl msb
21	Echo gate mode - echo gate start lsb
22	Echo gate mode - echo gate start msb
23	Echo gate mode - echo gate end lsb
24	Echo gate mode - echo gate end msb
25	Echo gate mode - inspection gate start lsb
26	Echo gate mode - inspection gate start msb
27	Echo gate mode - inspection gate end lsb
28	Echo gate mode - inspection gate end msb
29	Hysteresis
30	Test on/off, DAC on/off and DTG setting
31	DAC number
32	Sample frequency
33	Velocity for this test lsb
34	Velocity for this test msb
35	Echo gate EUPL lsb
36	Echo gate EUPL msb
37	Rx focal law Number (channel number in conventional test) lsb
38	Rx focal law Number (channel number in conventional test) msb
39	Spare
40	Spare

XXAS <Sweep No.>

This query message replies with a variable length message giving the test numbers contained in the sweep. The message length is No tests in ((sweep * 2) + 8). If no tests are in the sweep the message length is 8

1	Header Bytes 21Hex
2	Message count lsb
3	Message count msb
4	Sweep No
5	Sweep enabled/ disabled
6	Spare
7	Number of tests in sweep lsb
8	Number of tests in sweep msb
9	First test number in sweep lsb
10	First test number in sweep msb
x	Last test number in sweep lsb
x+1	Last test number in sweep msb

XXT <Tx Focal Law No.> / XXR <Rx Focal Law No.>

These query messages reply with a fixed length message giving the details of 128 channels of focal law. The message length is 520 bytes

1	Header Bytes 22Hex
2	Message count lsb
3	Message count msb
4	1 = Tx focal law, 0 = Rx focal law
5	Focal law No. lsb
6	Focal law No. msb
7	Spare
8	Spare
9	Channel 1 law byte 1 (delay lsb)
10	Channel 1 law byte 2 (delay msb)
11	Channel 1 law byte 3 (enable byte)
12	Channel 1 law byte 4 (gain trim on RX / voltage apodization on TX)
.	
.	
517	Channel 128 law byte 1 (delay lsb)
518	Channel 128 law byte 2 (delay msb)
519	Channel 128 law byte 3 (enable byte)
520	Channel 128 law byte 4 (gain trim on RX / voltage apodization on TX)

4.3 Error Messages

<Header 0x6><char>

MicroPulse uses the CER (header 6) message as a general purpose error message. This message occurs when command input contains a syntax error, and the second byte (char) of the CER is the index of the first input character not to be recognised. Other CER messages will occur if input is syntactically correct but contains invalid parameters. In this case the second byte is greater than 128.

If the extended command error mode this has been selected the format is as follows:

<Universal Header 0x2d><count lsb><count tsb><count msb>
<Ext CER Sub-header 0x43><type>< error pos lsb><error pos msb><data...datan)

Where:

Header:	universal header 0x2d
Count:	24 bit total data length count
type:	0 = argument conflict 1 = unrecognised command 2 = argument outside standard limits
error pos:	16 bit location of error on input line, least significant first.
data...datan:	Copy of the input line that contained the error.

4.4 Axis Related Messages

For axis information the default mode is 24 bit (standard mode that is compatible with previous MicroPulse systems). A full 32 bit output mode is optional.

<u>LLC message</u>

The LLC message is generated in response to a STA command and gives the current location for all axes.

(24 Bit mode)

<Header 0x15><status>< K1><K2><K3><K4><K5><0>

Where:

Status:	Status Byte
Kn:	Three byte location of axis n, least significant first.

(32 Bit mode)

< Universal Header 0x2d><count lsb><count tsb><count msb>
< LLC Sub-header 0x40><status><K1><K2><K3><K4><K5>

Where:

Header:	Universal header 0x2d
Count:	24 bit total data length count
Sub-header:	The LLC sub-header 0x40
Status:	Status Byte
Kn:	Four byte location of axis n, least significant first.

<u>LCI message</u>

The LCI message is output during a moving inspection mode. It precedes any data from an inspection point and gives the actual location of that inspection point.

(24 Bit mode)

<Header 0x13><axis><K axis>

Where:

axis:	Axis number n
Kn:	Three byte location of axis n, least significant first.

(32 Bit mode)

< Universal Header 0x2d ><count lsb><count tsb><count msb>
< LCI Sub-header 0x41><axis><K axis>

Where:

Header:	Universal header 0x2d
Count:	24 bit total data length count
Sub-header:	The LCI sub-header 0x41
axis:	Axis number n
Kn:	Four byte location of axis n, least significant first.

LCA message

The LCA message is used to indicate a missed inspection point. The format of this message is as shown above, unless the message is generated due to the MicroPulse buffer being full. In this case the LCA has the top bit of the axis byte is set to 1.

(24 Bit mode)

<Header 0x14><axis><K axis>

Where:

Status:	Status Byte
Kn:	Three byte location of axis n, least significant first.

(32 Bit mode)

< Universal Header 0x2d ><count lsb><count tsb><count msb>
< LCA Sub-header 0x42><axis><K axis>

Where:

Header:	Universal header 0x2d
Count:	24 bit total data length count
Sub-header:	The LCA sub-header 0x42
axis:	Axis number n
Kn:	Four byte location of axis n, least significant first.

4.5 Extended modes/Special Messages

These messages are used to support newer modes and features implemented in the MicroPulse system. All of these messages now use the Universal header format

EGT Range message (For ETM Tn 3 in Multi-gate modes)

To support the reporting of the interface echo range for Multi-gate modes:

< Universal Header 0x2d><count lsb><count tsb><count msb><Sub-header 0x02>
<Sweep/Test No. lsb ><Sweep/Test No. msb ><dof><Echo Range lsb >
<Echo Range msb ><spare 0><spare 0>

Where:

Header:	universal header 0x2d
Count:	24 bit total data length count
Sub-header byte:	0x02 = EGT range
Sweep/Test No:	16 bits. Bottom 11 bits Test No. Top 5 bits sweep No.
dof:	data format
Channel:	Normally 0, except in full matrix capture tests it is used to indicate the channel number
Echo Range:	Echo Range is reported at the sample frequency and from the time of the initial pulse
Spare	Not used and set to 0

Data Message with EGT Range message in FMC

To support FMC mode individual channel echo gate trigger the following messages are used

< Universal Header 0x2d><count lsb><count tsb><count msb><Sub-header 0x01>
<Sweep No./Test No. lsb> <Sweep No./Test No. msb><dof ><Channel >
<Echo range lsb><Echo range msb><Spare> <amp 1>….. <amp n >

Where:

Header:	universal header 0x2d
Count:	24 bit total data length count
Sub-header byte:	0x01 = FMC Ascan
Sweep/Test No:	16 bits. Bottom 11 bits Test No. Top 5 bits sweep No.
dof:	data format
Channel:	Normally 0, except in full matrix capture tests it is used to indicate the channel number
Echo Range:	Range of the interface echo from the start of the interface echo gate.
Spare	Not used.
amp:	In 8 bit Modes, for Ascan = amplitudes of digitised signal. In greater than 8 bit modes, the amplitudes are least significant byte first.

Cycle Time Message

< Universal Header 0x2d ><count lsb><count tsb><count msb>< Sub-header 0x44>
<prf cycle time lsb>< prf cycle time tsb>< prf cycle time msb>

Where:

Header:	universal header 0x2d
Count:	24 bit total data length count = 0x8
Subheader byte:	0x44 = PRF cycle time
Prf cycle time:	24 bit count of time taken to complete all tests in the cycle (640nsec steps)

SCHK: Simple Report Message

< Universal Header 0x2d><count lsb ><count tsb><count msb><Sub-header 0x30>
<channel number><result code><spare>

Where:

Header:	universal header 0x2d
Count:	24 bit total data length count = 0x8
Sub-header byte:	0x30 = SCHK simple report
Channel number:	Phased array channel number
Result code:	See detailed message

SCHK: Detailed Report Message

< Universal Header 0x2d><count lsb><count tsb><count msb ><Sub-header 0x31>
<channel number><result code><spare><Pulser voltage used lsb>
<Pulser voltage used msb><Reference gain used for 80% lsb>
<Reference gain used for 80% msb>

Then 6 sets of 8 bytes for each of the gain settings
(default 0dB, +2dB, -6dB, -12dB, -18dB, -24dB)

<positive limit 8 bit><spare><negative limit 8 bit><spare><Amplitude obtained 8 bit >
<spare>>timebase lsb><timebase msb>

Where:

Header:	universal header 0x2d
Count:	24 bit total data length count = 0x3c
Sub-header byte:	0x31 = SCHK detailed report
Channel number:	Phased array channel number

Result Code Format:

0 = pass
1 = on auto cal no peak found in gate
2 = even at minimum pulser volts the reference signal too high
3 = reference peak too low
4 = reference peak found but too little gain for linearity checks
5 = reference peak found but too much gain for linearity checks
6 = Linearity check outside limits

5 Instruction Set Details

AAV

Purpose: Amplitude Attenuation Value applied to GRE tests.

Format: AAV <Value>

Description: Selects amount of gain reduction applied to tests with GRE modes 1 or 2 selected when amplitudes greater than 200 are detected. When gain reduction occurs the test is fired a second time and the received signals attenuated by the amount <value> specified.

Parameters: <Value> : Integer number between 0 and 80 corresponding to 0.25 dB increments.
Default: 24 (6dB)

Example: AAV 24 : Sets gain reduction to 6dB.

ACNT

Purpose: To specify the count for the output an Ascan data every Nth test firing.

Format: ACNT <Tn><count>[optional count start]

Description: For use in AMP 32 mode to specify the count (N) for the output an Ascan data every Nth test firing. This is useful to reduce the rate of an Ascan that is for display purpose only.

Parameters:

<Tn>	:	Test number. An integer value from 0 to 1279. Tn = 0 for all tests.
<Count>	:	Integer 0 between 10000. Where an ascan will be output every count +1 firing of the test. 0 = (Default every firing)
[optional count start]	:	When the third parameter is omitted the ANCT command synchronizes the Ascan output cycle count and the next test fired will output an Ascan. If used this parameter can offset the count start value for a test. This is used for multiple tests with the ACNT command to offset the firing at which an Ascan is output.

AMM(S)

Purpose: Select amplitude reporting mode in multi-gate modes

Format: AMM <Tn> <Gn> <mode>

Description: Multi-gate version of AMP command. The specified test is set to report amplitude and timebase data as follows:

Mode	= 0	First peak in gate.
	= 1	Largest peak in gate.
	= 2	All peaks reported with timebase.

Parameters:

<Tn>	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps
<Gn>	:	Gate Number, an integer value from 0 to 4. Gn = 0 for all gates in the test
<mode>	:	0 1, and 2

Note: Valid in Multi-gate Mode only (AMP 31 & 32)

AMP(S)

Purpose: Select amplitude reporting mode.

Format: AMP <Tn><mode> [optional count][optional mode]

Description: The specified test is set to report amplitude and timebase data as follows:

Mode	= 0	First peak in gate.
	= 1	Largest peak in gate.
	= 2	All peaks reported with timebase.
	= 3	A-scan data reported (modes 2, 3 and 13 : if count n is specified the test is repeated 2^n count times and averaged.)
	=13	Full matrix capture. Ascan reported from each channel in the focal law. In this mode, the gate size is limited to 3000 sample points per channel for each transducer firing. Although gates of up to 8000 samples per channel are achievable.
	=30	A-scan data and all peaks reported with timebase reported.
	=31	All peaks reported with timebase for up to four hardware gates in multi-gate mode. Gates specified by GMT command. Averaging can be specified as a third parameter.
	=32	All peaks reported with timebase for up to four hardware gates in multi-gate mode. Gates specified by GMT command. Also an A-scan of the gate that encompasses the enabled peak detection gates for the test is reported. Averaging can be specified as a third parameter.

Here ‘all peaks’ means the first n peaks as defined by the PIG command.

Parameters:

<Tn>	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.
<mode>	:	0 1,2,3,13,30,31 and 32
[optional count]	:	Repeat count for Averaging/persistence modes 1 to 8 for 2 to 256 averages 1 to 1000 for maximum/minimum persistence
[optional mode]	:	0 = normal averaging, with the number of averages n specified by 2^n count 1 = persistence maximums of n Ascans where n is specified by the count parameter. Only available in AMP modes 3 and 30. 2 = persistence minimums of n Ascans where n is specified by the count parameter. Only available in AMP modes 3 and 30

Examples:

AMP 1 2 3	:	averages 8 firings (2^3)
AMP 1 3 10 1	:	The test is repeated 10 times and the maximums output as a single Ascan

AWF(S)

Purpose: Analogue Waveform Switch

Format: AWF <Tn><Value>

Description: Selects for test specified the analogue input signal. Either the Detected or R.F input may be used for signal processing.

Parameters:	<Tn>	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.
	<Value>	:	0 – display and process rectified signal. 1 – display and process full RF signal. 2 – +ve half wave. 3 – -ve half wave.
Examples:	AWF 5 0	:	Set Test 5 to display and processed rectified Ultrasonic signal.
	AWF 3 1	:	Set test 3 to display and process Full Wave RF Ultrasonic signal.
	AWF 0 0	:	Set all tests to display and process rectified Ultrasonic signal.

BAL(S)

Purpose: Relative Gain Adjustment (Balance).

Format: BAL <Tn><Value>

Description: Permits a RELATIVE gain adjustment to be applied to the ABSOLUTE value given by the GAN command. This can be useful during calibration and compensating differences in efficiency between transducers of the same type.

Parameters:	<Tn >	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.
	<Value>	:	dB change to be applied. Entered in units of 0.25dB. If the resultant gain exceeds 280 (70.00 dB) or falls below 0 it is set to 280 or 0. The value can be positive or negative.
Example:	BAL 1 100	:	Increase gain of test 1 by 25 dB.

BKL

Purpose: Backlash Period.

Format: BKL <Axis><Axis2> <Axis3><Axis4>

Description: This command defines the number of times that the motor control processor must detect no movement on an axis before a stop condition is recognised. This allows the mechanical system to overcome backlash. The rate at which the controller polls the encoder input is fairly consistent and the BKL Parameters may be set empirically. If a stall is detected then an LLC message is reported, or if MSE has been enabled then the programmed command line is executed at the end of the current test cycle.

If BKL is set too low then a stall will be detected while the axis is still moving, conversely if BKL is too large there will be a delay between the time at which the axis stops and the detection of the stop by MicroPulse.

Parameters: <Axis n> : wait period for axis n : 1 to 20000
Units are 500uSec.

Example: BKL 100 350 100 100 : This sets Axis 1, 2, 3 and 4 backlash delays.

CAL(S)

Purpose: To perform one test cycle, or to calibrate a test to specific amplitude.

Format: CAL <Tn> [amplitude]

Description: If amplitude is omitted the specified test (or all tests if 0 is used) is performed and the indications (if any) sent to the host. The ultrasonics are performed as part of the CAL command and so several CAL commands may be used in one line of input.

On the completion of a CAL 0 the system will output a two byte message to indicate its completion The format of this message is header <01> followed by a single <01>.

If <amplitude> is specified then this means auto calibration mode, where the test is repeated for all gain values and the gain which gives a maximum peak closest to the specified amplitude is reported along with the corresponding indication. The test then remains with this gain.
Test 0 or CALS is not allowed in auto calibration mode.

Parameters:

<Tn> : Test Number, an integer value from 0 to 1279.
Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.

<amplitude>: Target amplitude for auto-calibration 1 to 255 (8 bit modes, 1 to 1023 (10 bit modes) and 1 to 4095 (12 bit modes)

Note: **CALG** <Gn>

A version that is for use with parallel conventional channels only

This is a version of the CAL command for groups. The CALG executes once either a single group or all groups enabled within the NUMG. A number between 0 and 16. As with the CAL 0/CALS 0 on the completion of a CALG 0 the system will output a two byte message to indicate its completion The format of this message is header <01> followed by a single <01>.

CML

Purpose: To calibrate a test to a specific amplitude in multi-gate modes

Format: CML <Tn> <Gn> [amplitude]

Description: Multi-gate version of CAL auto calibration mode .The test is repeated for all gain values and the gain which gives a maximum peak closest to the specified amplitude in the specified gate is reported along with the corresponding indication. The test then remains with this gain.

Parameters:

<Tn>	:	Test Number, an integer value from 1 to 1279.
<Gn>	:	Gate Number, an integer value from 1to 4.
[amplitude]:		Target amplitude for auto-calibration 1 to 255 (8 bit modes, 1 to 1023 (10 bit modes) and 1 to 4095 (12 bit modes)

Note: Valid in Multi-gate Mode only (AMP 31 & 32)

CPIN

Purpose: Set output line sense.

Format: CPIN <pin><sense>

Description: The specified output pin is set to the specified sense.

Parameters:

<pin>	:	Number of output bit 0 to 7
<sense>	:	1 = high 0 = low

Availability: 16 input lines are available (0 - 15) are available with extended I/O option fitted.

CUR(S)

Purpose: Distance Amplitude Correction Curve Selection

Format: CUR <Tn><Curve No.>

Description: The specified test is set to use the specified DAC curve, Notes: **If DDAC is used CUR must be sent after DDAC.**

Curve 256 is a special curve. It is a flat 0dB curve that can be used to provide DAC off on a test.

Parameters:

<Tn>	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.
<Curve No.>	:	Integer number between 1 and 256

Example: CUR 1 3 : test 1 to use curve 3

DCM(S)

Purpose: To select a data compression algorithm

Format: DCM <Tn><mode>[optional count]

Description: The specified test is set to use the compression mode. Averaging prior to compression of the data is still available via the AMP command

Parameters:

<Tn>	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.
<mode>	:	0 = OFF, this is the default (requires no third parameter) 1 = Sample frequency decimation. 3rd parameter gives compression i.e. Reduce by taking 1 sample out of n points 2 = Maximums, 3rd parameter gives compression i.e. largest out of n points. Where n can be up to 64.
[optional count]	:	Repeat count. An integer value from 2 to 64.

Example:

AMP 1 3
GAT 1 1000 2000
DCM 1 2 10 : test 1 will take maximum value of every 10 points, this will result in a 100 point Ascan

Note: DCM modes are not available in logarithmic (DOF5) and byte packing (DOF6) output formats. Persistence AMP modes also cannot be used with DCM.

DDAC

Purpose: Define memory for DAC curve.

Format: DDAC <Curve No.><length><Base Address>[Rate]

Description: Defines the base address of the specified DAC curve. Note if the DAC length specified does not reach the test end the last value in the curve will be held until the test end.

The base address, length and value may be entered in decimal or hexadecimal formats

The Rate is an optional parameter that sets the clock rate of the DAC curve. If not used then the system wide clock rate specified by the DRTE is used.

Parameters:	<Curve No.>	:	Integer number between 1 and 255.
	<Length>	:	Length of the DAC curve
	<Base Address>	:	Base address for curve. 0 to 65530
	[Rate]	:	Integer number between 1 and 6. 1 = 25.0MHz 2 = 12.5MHz 3 = 6.25MHz 4 = 3.125MHz 5 = 1.5625MHz 6 = 0.78125MHz
Example:	DDAC 2 300 512	:	defines curve number 2 to start at memory location 512 and a length of 300.

DFIL

Purpose: DAC Memory Fill.

Format: DFIL <addr 1><addr 2><value>

Description: Fills all addresses from address 1 to address 2 with the specified value. The addresses are within the range 0 to 65530 for standard DAC and the range 70000 to 70511 for water path DAC used in FMC echo gate mode. This command is useful for gain gating specific signals at specific ranges.

Parameters:

<Addr 1>	:	Start address from which the specified value is to fill. Integer number between 0 and 65530 or 70000 and 70511
<Addr 2>	:	End address to which the specified value is filled Integer number between 0 and 65530 or 70000 and 70511
<Value>	:	Integer number between 0 and 160 representing a gain increase between 0 and 40 dB in 0.25 dB steps.

The address and value may be entered in decimal or hexadecimal Formats.

Examples:

DFIL 100 200 20	:	Fill from absolute address 100 to absolute address 200 with gain value 5dB.
DFIL 20H C0H 120	:	Fill from HEX address 20 to HEX address C0 with gain value 30.0dB

DIS(S)

Purpose: Disable Test.

Format: DIS <Tn>

Description: Disable test specified by Tn that has been previously enabled by ENA. This means that the test will not be executed during FLR/FLX/FLZ, CAL 0 or STP 0, but the test remains enabled for CAL and STP with specific test number.

Parameters: <Tn> : Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used then sweep number specified is disabled: 1-16, 0 = all sweeps.

Example:

ENA 1	:	this enabled test number 1.
DIS 1	:	this disables test number 1.
XXA 1	:	will show if test disabled.
DISS 1	:	this disables sweep 1

Note: **DISG** <Gn>

A version that is for use with parallel conventional channels only

This is a version of the DIS command for groups. The DISG command disables a group so it will not be executed in a set of groups firing even if it is within the NUMG. Group number is between 0 and 16. Gn = 0 for all Groups

DLIN

Purpose: To allow DAC memory to be filled with DAC line information

Format: DLIN <Curve No.><Setting No.><Count><Rate of change><Repeat No.>

Description: Used as an alternative method to DFIL/DSET for entering DAC information to memory. This input method uses less DAC memory for each curve therefore allowing more DAC curves to be specified. The information is entered as a series of settings for each DAC curve. The setting is made up of a count that defines the number of DAC points before the change, then a Rate of change amount followed by the number of times to repeat this change.

Parameters:

<Curve No.>	:	Integer number between 257 and 2304
<Setting No >	:	Integer number between 1 and 16
<Count>	:	Integer number between 2 and 255
<Rate of change >	:	The 1/4 dB change. -2 = -0.5dB -1 = -0.25dB -0 = 0 dB 1 = +0.25dB 2 = +0.5dB
<Repeat No.>	:	The number of times the count then change should be repeated before the DAC moves on to the next setting (0 – 31)

Note: The first setting differs from the others in that the Rate of change parameter is an absolute DAC gain value (0 - 160 which is 0 to 40dB in 1/4dB steps) that is applied from the start of the DAC curve. This value is held for Count No of DAC points and the next setting is executed

The DDAC is still valid with the DLIN as with the DFIL/DSET. The length should be set to twice the amount of settings required for the DAC curve and is therefore limited to 32 (2 x 16 settings). This is because each of the new settings requires 2 DAC memory positions.

DAC curves of the old format and DAC curves of the new format can be used at the same time.

Example:

DDAC	257 4 100 3	Define DAC 257 to start at 100 with a length of 4 (2 settings) . The rate is 6.25Mhz
CUR	256 257	Assign curve 257 to test 256
DLIN	257 1 100 40 0	Define curve 257 point 1. Start gain of 40 (10dB). This DAC gain is held for 100 DAC points.
DLIN	257 2 20 1 10	Define curve 257 point 2. Count for 20 DAC points then increase the DAC gain by 0.25dB. Repeat this 10 times. By the end the DAC gain will be 15dB. The total length of the curve in DAC points would be: 100 + (20 x 10) = 300

DLY(S)

Purpose: Delay

Format: DLY <Test No.><Value>

Description: Allows for an offset of all timing measurements to compensate for travel time through the probe shoe. The 'DLY' command does not offset the A-scan monitor display, only the conversion of GAT Parameters into timebase units. In echo trigger mode DLY has no effect.

Parameters:

<Tn>	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.
<Value>	:	Integer number between 0 and 20000 each increment representing 1 timebase delay. i.e. a delay may be set between 0 and 0.8 milliseconds when the sample frequency is 25MHz (0.04μsec timebase units)

Examples:

DLY 1 100	:	set delay for test 1 to 4μsec (for 25MHz sampling).
DLY 0 200	:	set delay for all tests to 8μsec (for 25MHz sampling).

DOF

Purpose: Computer Interface Mode Format Select.

Format: DOF <Mode>

Description: Seven modes are available:

0: Backward compatible mode for MicroPulse 4. The standard peak mode (peak count in header) of MicroPulse 4 is not supported. Only the newer peak reporting mode that supports up to 80 peaks is implemented (Peak count in the header can be accessed by utilising BAB 1 mode). Reports 8 Bit Data. Details of the command format and output messages can be found in the MicroPulse 4 Manual.

Note in DOF 0:
Test 1 is reported as 0.
Test 256 is reported as 0.
Test 511 is reported as 0xff.

This mode is therefore of limited use as test numbers are duplicated in the output messages.

1: Standard mode for MicroPulse 5. Allows for all 1279 tests. Reports 8 Bit Data.

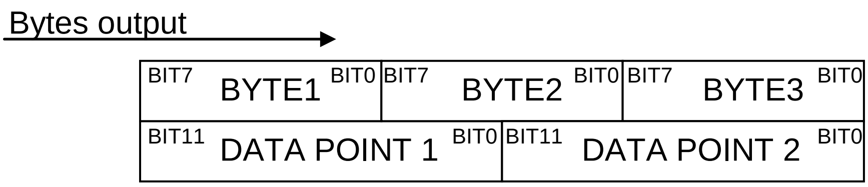
2: This mode is 10 bit data output mode.

3: This mode is 12 bit data output mode.

4: This mode is 16 bit data output mode.

5: This mode is 8 bit logarithmic data mode All data is output in logarithmic format except the integral part of the grass coupling message (GPL and GPH). Input parameters for commands are as per DOF3.

6: This mode is 12 bit packed data output mode. This gives a reduction of 25% in the number of bytes sent. This only affects Ascan data output, all other data is in 12bit format (DOF3). Input parameters for commands are as per DOF3.



Note in DOF 1 to 6:
Test 1 is reported as 0.
Test 256 is reported as 0xff.
Test 511 is reported as 0xlfe.

Parameters: <Mode> : 0, 1, 2, 3, 4, 5, 6

DRTE

Purpose: Define the system wide DAC clock rate.

Format: DRTE < Rate>

Description: Defines the system wide clock rate of the DAC. This parameter can be overridden for individual curves by utilising the extra parameter on the DDAC command.

Parameters: <Rate> : Integer number between 1 and 6.

1 = 25.0MHz
2 = 12.5MHz
3 = 6.25MHz
4 = 3.125MHz
5 = 1.5625MHz
6 = 0.78125MHz

Example: DRTE 2 : Defines the system wide DAC rate to 12.5MHz

DSET

Purpose: DAC Memory Set.

Format: DSET <address><value>

Description: Sets addressed location to the specified value. The address is within the range 0 to 65530 for standard DAC and the range 70000 to 70511 for water path DAC used in FMC mode. This command is used to generate and adjust gain profiles.

The address and value may be entered in decimal or hexadecimal Formats.

Parameters:

<Address>	:	Address at which the specified value is stored. Integer number between 0 and 65530 or 70000 and 70511
<Value>	:	Integer number between 0 and 160 representing a gain increase between 0 and 40 dB in 0.25 dB steps.

Example:

DDAC 1 0 512	:	Define memory for DAC curve 1.
DSET 512 80	:	set DAC gain at first byte to 20dB.

DTG

Purpose: To change DAC trigger source.

Format: DTG <Tn><value>

Description: This command allows the user to select the source of the DAC trigger. It can be set to trigger the DAC either on the initial pulse an interface signal as specified by the interface echo gate (EGT)

.

Parameters:

<Tn>	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.
<Value>	:	0 = trigger DAC on initial pulse 1 = trigger DAC on interface echo (Default = 0)

DXF

Purpose: To define element dynamic depth focus law.

Format: DXF <DDF Law No><channel><count><values 1 to n>

Description: For each Dynamic Depth Focus Law a number of DXF commands define the focus change for each element used. The delays and change are in 10 nSec steps.

Parameters:

<DDF Law No> : Dynamic depth focus law. An integer value from 1 to 256.

<channel> : MicroPulse phased array channel number. An integer value from 0 to 128. 0 is used with a delay of –1 to clear the whole law

<count> : Number of DDF values in law. An integer value from 1 to 32.
A zero for any element means no DDF is needed

<values 1 to n> : The first value is the number of 10nSec steps to the first focus change. It is an integer value from 1 to 65535. Subsequent values are of a different format. The bottom 12 bits of each number is the number of 10nSec steps until the focus change from the last focus change. It is an integer value from 1 to 4095. The top 4 bits is the number of times this change should be implemented. It is an integer value from 1 to 15. If the top 4 bits are set to 0 then the system will count the value set in the bottom 12 bits one time and then perform no focus change.

Example: DXF 1 2 2 1000 16394

DDF law number 1 on element 2 has 2 values. The first means go for 1000 10nSec steps to the first 10nSec change. The second 16394 (400A Hex) means go for another 10 10nSec steps then change by 10nSec. This should be repeated 4 times.

DXN

Purpose: To assign a Dynamic Depth Focus (DDF) law to a test.

Format: <Tn><DDF Law No>

Description: Selects a DDF law for a given test number. The DDF law should be defined using DXF commands prior to assigning the law to a test.

Parameters:

<Tn>	:	Test number. An integer value from 256 to 1279. 0 can be used to assign to all phased array tests.
<DDF Law No>	:	Dynamic Depth focus Law. An integer value from 1 to 256. 0 clears any DDF law from a test.

Example: DXN 256 1 Assign DDF Law 1 to test 256.

ECON

Purpose: To enable various parameter reporting

Format: ECON <value1><value2><value3><value3>

Description: To allow the selection of new data output modes. The extended error reporting mode is useful when a large sequence of commands is sent to MicroPulse. If an error is found, the line containing the error is sent back and information on the position in the line where the error occurred. For the format of output messages see the MicroPulse Output Messages Section.

Parameters:

<value1>	:	Turn on actual time for a test cycle in STP, STPS, STPG, STR, STRS and STRG modes 0 = off (default) 1 = on
<value2>	:	Turn on extended command error mode. 0 = off (default) 1 = on
<value3>	:	For future use
<value4>	:	For future use

EGT(S)

Purpose: Echo Gate.

Format: EGT <Tn><Gate Start><Gate End>

Description: Defines the 'Echo Gated' area, i.e. the area in which the specified echo-trigger signal is expected for the specified test. The Parameters are in distance units according to the material velocity set, even though in reality the acoustic medium usually has a different velocity.

If no signal appears in the echo gate above the UPL/EUPL (or EPL for FMC echo gate mode) then a four byte message is reported to indicate an echo-gate failure

Calibration is performed during Echo Trigger gate display Mode (ETM mode 1 conventional tests only).

Parameters:

<Tn>	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.
<Gate Start>	:	Distance units
<Gate End>	:	Distance units from 1 to 20000, i.e. each increment representing 0.1mm at the specified ultrasonic velocity

Example:

ETM 3 1	:	Set Test 3 to Echo Trigger display Mode.
EGT 3 200 600	:	Set Test 3 with an echo gate from 200 to 600 distance units
ETM 3 2	:	Set Test 3 to Echo Trigger Mode

ENA(S)

Purpose: Enable Test.

Format: ENA <Tn>

Description: Enables test specified by test number Tn. Used to enable a test previously disabled by DIS.

Parameters: <Tn> : Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests If the S extension is used then sweep number specified is anabled: 1-16, 0 = all sweeps.

Example:

ENA 1	:	this enables test number 1.
XXA 1	:	will show if test enabled.
ENAS 1	:	this enables sweep 1

Note: **ENAG** <Gn>

A version that is for use with parallel conventional channels only

This is a version of the ENA command for groups. The ENAG command enables a group so it will be executed in a set of groups firing. . Group number is between 0 and 16. Gn = 0 for all Groups

ENCF

Purpose: Select the input Filter setting for the encoders

Format: ENCF <Axis1><Axis2><Axis3><Axis4>

Description: The Filter for each axis can be separately configured. The Filter count is a parameter that can used to clean up the edges of noisy encoders by time hysteresis. This defines the length of time before a decision is made on any input transitions and can filter out noise spikes and noisy level transitions.

Parameters: <Axis n> : Integer number between 0 and 255 (default 0)
0 = off
1 to 255 = approximately 100nSec to 20uSec

Note: This parameter can be set globally by use of an optional parameter on the ECON command. It is recommended that ENCF is used

ENCM

Purpose: To globally set encoder parameters

Format: ENCM <Mode>[Input Mode][Filter Count]

Description: This command allows the global setting of encoder parameters. The Mode is either 0 or 1. Mode 0 is the default mode of 24 bit encoders with the standard output message format. Mode 1 is the full 32 bit output mode. In mode 2 the output mode is full 32 bit but also the output message of inspection modes FLR and FLX/FLZ are now a 32 bit LLC message giving all axis positions instead of the normal LCI message that only gave information about a single axis.

The input mode and filter count are optional parameters. The input mode sets all axis as either full Quadrature or Step/Direction. In Step/Direction the ‘A+’ input is the Step whilst the ‘B+’ is the Direction. Each complete Step pulse is one encoder count. The filter count is a parameter that can used to clean up the edges of noisy encoders by time hysteresis. This defines the length of time before a decision is made on any input transitions and can filter out noise spikes and noisy level transitions.

For individual setting of the Input Mode and Filter Count see the ENCT and ENCF command respectively. It is recommended that these are used.

Parameters:

<Mode> : Integer 0 between 1
0 = 24 Bit output (Default)
1 = 32 Bit output
2 = 32 Bit output with LLC message for moving inspection modes

[Input Mode] : Integer 0 between 1
0 = Quadrature (Default)
1 = Step/Direction

[Filter Count] : Integer number between 0 and 255 (default 0)
0 = off
1 to 255 = approximately 100nSec to 20uSec

Note: The 32 bit encoders require longer messages for LLC, LCI and LCA. The format is shown in the MicroPulse Output Messages Section.

ENCO

Purpose: To define the distance that an axis can undershoot or overshoot before it is reported as an stall or overshoot in the LLC message status code. The default is 0.

Format: ENCO <Axis1><Axis2><Axis3><Axis4>

Description: Each axis can have a separately configured value set in millimetres as defined by the MPE command. If during a move an axis undershoots by more than the amount set then it will be reported as an undershoot. Alternatively, if during a move an axis overshoots by more than the amount set then it will be reported as an overshoot

Parameters: <Axis n> : Integer 0 between 1000

Availability: Only with motor controller option fitted.

ENCT

Purpose: Select the input count mode of the encoders as either Quadrature or Step/Direction. The default count mode of MicroPulse is Quadrature.

Format: ENCT <Axis1><Axis2><Axis3><Axis4>

Description: Each axis can be separately configured as either full Quadrature or Step/Direction. In Step/Direction the 'A+' input is the Step whilst the 'B+' is the Direction. Each complete Step pulse is one encoder count.

Parameters: <Axis n> : Integer 0 between 1
0 = Quadrature (Default)
1 = Step/Direction

Note: This parameter can be set globally by use of an optional parameter on the ECON command. It is recommended that ENCT is used

EPL(S)

Purpose: Threshold for FMC mode interface echo.

Format: EPL <Tn><value>

Description: Specifies the Threshold that must be exceeded for a valid interface echo in full matrix capture Interface Echo Mode. If no signal appears in the echo gate above the EPL then a four-byte message is reported to indicate an echo-gate failure

Parameters:

<Tn>	:	Test Number, an integer value from 256 to 1279. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.
<value>	:	Integer between 10 and 255 (8 bit modes) Integer between 10 and 1023 (10 bit modes) Integer between 10 and 4095 (12 bit modes)

Example:

EPL 256 100	:	Sets the interface echo threshold of test 256 to 100 machine units.

ETM(S)

Purpose: Echo Trigger Mode.

Format: ETM <Tn><Mode><Test No for PA>

Description: Selects/deselects Interface Echo Trigger Modes, sometimes referred to as immersion testing with echo start. There are three modes, one for calibration in conventional tests, one for echo trigger inspection in conventional/Phased Array tests and one for echo gate inspection in FMC tests.

Mode=0 Normal triggering.

Mode=1 Display mode forms part of the calibration for conventional tests. Only the 'Echo Gate' is displayed allowing precise adjustment via the 'EGT' command.

Mode=2 Echo Trigger Mode for conventional tests. If a signal above the EUPL (is detected within the echo gate (EGT), MicroPulse processes the part of the signal derived from the IGT Parameters taken relative to the point in the echo gate where the signal breaks the EUPL .

Mode=3 For FMC Tests (AMP modes 13):
Echo Trigger Mode for FMC tests If a signal above the EPL is detected within the echo gate (EGT), MicroPulse processes the part of the signal derived from the IGT Parameters taken relative to the point in the echo gate where the signal breaks the EPL. This happens independently on each receive channel used in the law. The data messages use a new universal header format to accommodate the extra information required in this mode. For details on FMC mode interface echo see Appendix 6.4
For Multi-gate Tests (AMP modes 31 & 32):
The system performs interface echo mode and also output an Ascan that is referenced to the initial trigger. The interface echo range is now reported. So it is now possible to set up an interface trigger gate, 4 hardware peak detection gates and 1 Ascan data gate on the same test. The interface echo range is output in a EGT range message (see output messages section)

Parameters:

<Tn> : Test Number, an integer value from 0 to 1279.
Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.

<Mode> : 0 = Echo Trigger Mode 'OFF'.
1 = Use Echo Trigger Gate (Conventional test only).
2 = Echo Trigger Mode 'ON' (Conventional/ Phased Array test).
3 = Echo Trigger Mode 'ON (FMC test)/ Multi-gate with ascan.

Default : Mode 0 – Echo Trigger Mode 'OFF'.

Example: ETM 3 1 : Set test 3 to echo trigger display mode.

EGT 3 200 300	:	Adjust interface echo monitor gate.
ETM 3 2	:	Set test 3 to echo trigger mode.

Note: ETM mode 2 can be used for phased array tests in non-FMC applications. For phased array tests the echo gate functions differently to conventional tests. For a Phased array test the user can specify another test (and therefore possibly another focal law) as the interface echo test. This test then triggers the inspection test relative to an interface echo found. The test to be used as the interface echo test is specified by using a third parameter on the ETM command.
Mode “ETM X 1” is not valid for phased array tests. The interface echo test can simply be displayed if required.
Delay (DLY) and trim (TRM) are still used in echo gate mode for phased array tests. These parameters should normally be set to 0.

Note: The selection of an ETM mode for a test will clear any averaging setup on the test.

EUPL

Purpose: Threshold for interface echo.

Format: EUPL <Tn><value>

Description: Specifies the Threshold that must be exceeded for a valid interface echo in Interface Echo Mode.
If no signal appears in the echo gate above the EUPL then a two byte ING message is reported: 8<Tn>

Parameters:

<Tn>	:	Test number. An integer value from 0 to 255. Tn = 0 for all tests. Not used for phased array tests as echo gate mode is performed in a different manor.
<value>	:	Integer between 10 and 255 (8 bit modes) Integer between 10 and 1023 (10 bit modes) Integer between 10 and 4095 (12 bit modes) (Default = If no EUPL is specified the current UPL is used in the interface echo gate.)

Example: EUPL 10 100 : Sets the interface echo threshold of test 10 to 100 machine units.

FDEF

Purpose: To allow the setup of a sequence of sweeps to be executed in STR, FLR and FLX/FLZ inspection modes

Format: FDEF <Ena/dis><Mode><Number of sweeps n><number of sweeps/ test at each point><sweep 1>.... <sweep n>

Description: Used to define a sequence of sweeps that are carried out in inspection modes. Two modes are available. In the first mode a set number of sweeps are carried out at an inspection point and then another different set at each subsequent point until the sequence loops around again. At each point this can be a single sweep or multiple ones. In the second mode at each inspection point all the defined sweeps are executed, but only a set number of tests from each sweep. The tests executed differ at each point as the sequence moves through the contents of the sweep. The test sequence restarts back at the beginning when the sweep end is reached. If the sweep only contains a single test then this test will be carried out once at each inspection point.

Parameters:

< Ena/dis.> : Integer number between 0 and 1
1 = enable
0 = disable (no further parameters required)

<Mode> : Integer number between 0 and 1
0 = executes all the tests in the number of sweeps specified by the 4th parameter and at the next inspection point executes the next set.
1 = executes all the sweeps in the sequence, but executes only the number of tests in the sweep specified by the 4th parameter and at the next inspection point executes the next set.

<Number of sweeps n> : Integer number between 1 and 32
The number of sweeps used in the definition.

<Number of sweeps/tests at each point > : In mode 0 defines the number of sweeps carried out at each point. In mode 1 defines the number of tests carried out at each point.

<sweep 1>...<sweep n> : List of sweeps

Example 1:

```
SWP 1 301
SWP 2 302
SWP 3 303
SWP 4 304
SWP 5 305
SWP 6 306
SWP 10 310
FDEF 1 0 12 2 1 10 2 10 3 10 4 10 5 10 6 10
STRS 0
```

Inspection sequence:	
Inspection Point	Tests executed
1	301 310
2	302 310
3	303 310
4	304 310
5	305 310
6	306 310
7	301 310
8 .... n	Sequence continues

Example 2: SWP 1 301 302 303 304 305 306
SWP 10 310
FDEF 1 1 2 1 1 10
STRS 0

Inspection sequence:	
Inspection Point	Tests executed
1	301 310
2	302 310
3	303 310
4	304 310
5	305 310
6	306 310
7	301 310
8 .... n	Sequence continues

Example 3: SWP 1 301 302 303 304 305 306
SWP 10 310
FDEF 1 1 2 2 1 10
STRS 0

Inspection sequence:	
Inspection Point	Tests executed
1	301 302 310
2	303 304 310
3	305 306 310
4	301 302 310
5 .... n	Sequence continues

Note: By specifying FLM 5 the same results can be obtained for FLR and FLX/FLZ inspection modes.

Note: Examples 1 and 2 demonstrate that the same sequence of tests can be setup using either mode with the difference being that in example 1 the sequencing tests are each in a different sweep while in example 2 the sequencing tests are grouped into one sweep with the constantly fired test in another. These two different modes are to allow for how different software use sweeps in different ways to contain tests.

FLM

Purpose: Specifies the type of tests to be carried out at each inspection point. This can be conventional tests, phased array tests or both.

Format: FLM <mode>

Description: Inspections where MicroPulse is monitoring encoders and firing a test sequence on position it is necessary to determine the type of tests to be carried out at each inspection point.

Parameters: <mode> : number 0 to 3 where
0 = Perform convention tests only (CAL 0)
1 = Perform convention tests and then Phased array tests (CAL 0 then CALS 0)
2 = Perform Phased array tests and then conventional tests(CALS 0 then CAL 0)
3 = Perform Phased array tests only(CALS 0)
4 = Perform all enabled groups within the NUMG (CALG0)
5= Perform phased array sweep sequence as defined by the FDEF command

Example: FLM 3 : Perform a CALS 0 on each inspection point

FLR

Purpose: To enable FLR mode for a relative displacement.

Format: FLR <axis><displacement><direction>

Description: FLR inspection mode is enabled. Inspection begins at the current location and continues at each subsequent SPA point reached in the specified direction (0 = forwards, 1 = backwards) until the axis has moved the specified displacement. LCP commands may be used during the inspection and will not effect the displacement calculations. At the end of the displacement the MSE command line is invoked.

Parameters:

<axis>	:	axis number 1 to 4
<displacement>	:	relative displacement in distance units 1 to 1600000000
<direction>	:	0/1 = forward/backwards

Example:

FLR 2 100 1	:	Inspect on axis 2 for 100 distance units in a negative direction

FLX

Purpose: To perform fly mode from a fixed position.

Format: FLX <axis><start location><direction>

Description: Fly inspection mode is enabled. Inspection begins at the specified start location and continues at each subsequent SPA point reached in the specified direction (0 = forwards, 1 = backwards) until the inspection is terminated by change of mode command or (more usually) until the axis reaches the end location as defined in FLZ command.

In the latter case the MSE command line 1 is invoked.

Parameters:	<axis>	:	axis number 1 to 4.
	<start location>	:	Location at which inspection is to begin
	<direction>	:	0/1 = forwards/backwards

Example:	FLX 2 100 0		
	FLZ 2 200	:	Inspect on axis 2 from 100 to 200.

FLY

Purpose: To perform fly mode from a current position to a fixed destination.

Format: FLY <axis><end location>

Description: Fly inspection mode is enabled. Inspection begins on the specified axis at the current location and continues until the end location is reached. The axis is controlled in the same way as if a MOV command had been used. Inspection is carried out on the start location and thereafter on every point separated by the inspection spacing distance (see SPA) from the previous point.

If an inspection point is missed, due to any reason, an LCA message is reported

Parameters:	<axis>	:	axis number 1 to 4
	<end location>	:	Location at which inspection is to end –800000000 to 800000000 decimal
Example:	FLY 1 1000	:	Inspect on axis 1 to location 1000 from current location.

Availability: Only with motor controller option fitted.

FLZ

Purpose: To terminate Fly mode at a specified location.

Format: FLZ <axis><end location>

Description: FLZ is used in conjunction with FLX to define the absolute range of an inspection. See FLX command.

Parameters:

<axis>	:	axis number 1 to 4
<end location>	:	Location at which inspection is to end –800000000 to 800000000 decimal

Example: See FLX

FRQ(S)

Purpose: Frequency Filter Select

Format: FRQ <Tn><Filter><Smoothing>

Description: For conventional channels this selects one of twelve frequency filters. The frequency filters are preferred probe centres frequencies or various broadband settings. For phased array channels this selects one of four filters. The third parameter defines for each test the level of smoothing on the rectified waveform.

Parameters:

<Tn>	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.
<Filter> (Conventional)	:	1 = 1 MHz Bandpass (0.75 – 1.7MHz 3dB Typ) 2 = 2 MHz Bandpass (1.5 – 3.1MHz 3dB Typ) 3 = 4 MHz Bandpass (2.6 – 5.5MHz 3dB Typ) 4 = 5 MHz Bandpass (3.7 – 6.4MHz 3dB Typ) 5 = 10 MHz Bandpass (8.2 – 12MHz 3dB Typ) 6 = 2.5 MHz to 18 MHz Broadband 7 = 0.75 MHz to 12 MHz Broadband 8 = 0.5 MHz Bandpass (0.30 – 0.8MHz 3dB Typ) 9 = 5 MHz 2nd order TOFD (0.8 – 8MHz 3dB Typ) 10 = 10 MHz 2nd order TOFD (3 – 15MHz 3dB Typ) 11 = 3.0 MHz to 25 MHz Broadband 12 = 3.0 MHz to 30 MHz Broadband
<Filter> (Phased Array)	:	1 = 5.00 MHz to 10.0 MHz 2 = 2.00 MHz to 10.0 MHz 3 = 0.75 MHz to 5.00 MHz 4 = 0.75 MHz to 20.0 MHz
<Smoothing>	:	Sets the level of smoothing on the rectified waveform for this test. An integer value from 1 to 8

Example: FRQ 0 2 7 : Sets 2 MHz filter and smoothing setting 7 to all conventional tests.

GAN(S)

Purpose:	Gain Control.		
Format:	GAN <Tn><Value>		
Description:	Sets the absolute gain for the test number specified		
Parameters:	<Tn>	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.
	<Value>	:	Integer in the range 0 to 280, each increment corresponding to 0.25dB.
Example:	GAN 0 80	:	Adjust gain for all tests to 20dB.

GAT(S)

Purpose: Search Gate, alternatively referred to as the Monitor Gate.

Format: GAT <Tn><Gate Start><Gate End>

Description: Defines search gate start and end positions for the specified test. Conversion from millimetres to timebase units is controlled by the VEL command, which therefore must be issued prior to the 'GAT' command. Otherwise the default VEL value will be used. The probe shoe delay command (DLY) adjusts the effective gate values and may be set at any time.

Parameters:

<Tn>	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.
<Gate Start> <Gate End>	:	Integer in the range 2 to 96000 each increment representing 0.1mm at the specified ultrasonic velocity. (Note: the maximum gate length is 32000 sample points)

Example:

VEL 2960 1	:	Compression wave velocity assigned to DAC curve 1.
CUR 1 1	:	Assign DAC curve 1 to test 1.
DLY 1 100	:	Set probe shoe delay to 4 microseconds (at 25MHz sample rate)
GAT 1 200 500	:	Set search gate start position = 20mm and end gate = 50mm for a material ultrasonic velocity of 2960 $msec^{-1}$

GIN(S)

Purpose: Gate negative peak detect

Format: GIN <Tn><Gn> <value>

Description: To allow the detection of negative peaks in a gate. This function is intended for use with RF signals and the UML value now becomes the threshold for reporting when the signal breaks it in a negative direction

Parameters:

<Tn>	:	Test number. An integer value from 0 to 1279. Tn = 0 for all tests.
<Gn>	:	Gate Number Integer between 0 and 4. Gn = 0 for all gates on the test.
<value>	:	Integer 0 between 1. 0 = normal positive peak detection gate 1 = negative peak detection gate.

Example:

```
DOF   1
GML   1   1     1000   2000
AWF   1   1
GIN   1   1
AMM   1   1
UML   1   100
```

This gate is looking at RF data in 8 bit mode (normally 127), the largest negative going signal that breaks the 100 threshold will be reported.

Note: Valid in Multi-gate Mode only (AMP 31 & 32)

GMH(S)

Purpose: Grass Coupling Level in multi-gate modes,

Format: GMH <Tn> <Gn> <value>

Description: Multi-gate version of GPH command. It provides the same facility as GML except that the test reports only if the average signal height is above the defined threshold. It is useful for setting up the GML level.

Parameters:

<Tn>	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.
<Gn>	:	Gate Number, an integer value from 0 to 4. Gn = 0 for all gates in the test
<Value>	:	Integer between 5 and 255 (8 bit modes) Integer between 5 and 1023 (10 bit modes) Integer between 5 and 4095 (12 bit modes)

Note: Valid in Multi-gate Mode only (AMP 31 & 32)

GML(S)

Purpose: Grass Coupling Monitor assignment in multi-gate modes.

Format: GML <Tn> <Gn> <value>

Description: Multi-gate version of GPH command. It provides facility to monitor coupling integrity using the average of amplitude of signals within the specified gated area (GMT). Generally used with high gain to enhance the ultrasonic noise of the material. The reported data indicates the total of all amplitude values in the gate (i.e. the integral of the waveform) and the average signal height. The average value is used to determine whether the data is reported, if the average is below the level specified in the GML command a message is reported, otherwise there is no message.

Parameters:	<Tn>	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.
	<Gn>	:	Gate Number, an integer value from 0 to 4. Gn = 0 for all gates in the test
	<Value>	:	Integer between 5 and 255 (8 bit modes) Integer between 5 and 1023 (10 bit modes) Integer between 5 and 4095 (12 bit modes)

Note: Valid in Multi-gate Mode only (AMP 31 & 32)

GMT(S)

Purpose: Search gate in multi-gate modes.

Format: GMT <Tn><Gn> <Gate Start><Gate End>

Description: Multi-gate version of GAT command. Defines search gate start and end positions for the specified test. Conversion from millimetres to timebase units is controlled by the VEL command, which therefore must be issued prior to the 'GMT' command. Otherwise the default VEL value will be used. The probe shoe delay command (DLY) adjusts the effective gate values and may be set at any time.

Parameters:

<Tn>	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.
<Gn>	:	Gate Number, an integer value from 0 to 4. Gn = 0 for all gates in the test
<Gate Start> <Gate End>	:	Integer in the range 2 to 96000 each increment representing 0.1mm at the specified ultrasonic velocity. To turn off a gate in multiple gate modes: set the start and end to 0**.** (Note: the maximum gate length is 32000 sample points)

Note: Valid in Multi-gate Mode only (AMP 31 & 32)

When using echo gate mode with multiple gates per test then the gates set by GMT are used and triggered by the Echo gate (EGT).

GPH(S)

Purpose: Grass Coupling Level.

Format: GPH <Tn><Value>

Description: Provides the same facility as GPL except that the test reports only if the average signal height is above the defined threshold. It is useful for setting up the GPL level.

Parameters:

<Tn> : Test Number, an integer value from 0 to 1279.
Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.

<Value> : Integer between 5 and 255 (8 bit modes)
Integer between 5 and 1023 (10 bit modes)
Integer between 5 and 4095 (12 bit modes)

GPL(S)

Purpose: Grass Coupling Monitor.

Format: GPL <Tn><Value>

Description: Provides facility to monitor coupling integrity using the average of amplitude of signals within the specified gated area (GAT). Generally used with high gain to enhance the ultrasonic noise of the material. The reported data indicates the total of all amplitude values in the gate (i.e. the integral of the waveform) and the average signal height. The average value is used to determine whether the data is reported, if the average is below the level specified in the GPL command a message is reported, otherwise there is no message.

Parameters:

<Tn>	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.
<Value>	:	Integer between 5 and 255 (8 bit modes) Integer between 5 and 1023 (10 bit modes) Integer between 5 and 4095 (12 bit modes)

GRE(S)

Purpose: Select gain reduction mode.

Format: GRE <Tn><mode>

Description: Gain reduction (modes 1 and 2):

In these modes the test is repeated if the amplitude of any peak in the gate exceeds 200 machine units (800 and 3200 in 10bit and 12bit modes respectively). The gain is temporarily reduced by the number of dB defines by the AAV command for the second firing. Modes 1 and 2 differs in that mode 1 does not report the data from the first execution of the test if a refire takes place. The data is reported with no adjustment but with the header byte set to indicate that gain reduction has occurred, so that the user may adjust the amplitudes accordingly. Note that this means that the user must maintain a record of the AAV values used.

Parameters:

<Tn>	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.
<mode>	:	= 0 Default to AMP mode 2 = 1 Refire test if signal >200 and report second = 2 Refire test if signal >200 and report both firings.

GRUP

Purpose: To define tests in a group firing

Format: GRUP <GPn><Tn><Tn><Tn><Tn><Tn><Tn><Tn><Tn><Tn><Tn>

Description: To allow the specifying of a group firing of conventional tests only. Tests must specify channels that are on different CUIF PCB's. Only available if the system is configured with parallel conventional channels

Parameters:

<GPn>	:	Group number. Integer between 1 and 16 .
<Tn>	:	Test number. An integer value from 0 to 255 Tn = 0 is no test used .

Example: GRUP 1 1 5 9 13 0 0 0 0 0 0

: This sets up a group firing of 4 channels using tests 1, 5, 9 and 13.

Note 1: If only 4 channels are used, as in the example above the remaining <Tn>'s must be set to 0.

Note 2: If the firing of a single test is required then a single test can be specified in a group. All other <Tn>'s must be set to 0.

Limitations: Dependant upon the configuration of the system there are limitations on which channels can be specified within a group. If in doubt as to the configuration of a system please contact Peak NDT. The number of channels per ADC is obtained from the RST message.

Each conventional ultrasonic (CPIF) PCB within the Micropulse has 16 pulse/receiver channels with 4 ADC's per PCB, the wiring of the system can mean different configurations. For example a 20 channel system can have 3 CPIF PCB's wired to have 2 channels per ADC.

Channels used in parallel firing with each CPIF PCB will use the same filter setting, all other ultrasonic parameters are independent

The first test in a group has no limitations as to gate length or reporting modes etc., but the other tests in the group MUST be Amp 3 mode (Ascan or RF). These other parallel tests can be compressed (DCM) or uncompressed but the output data of the tests is limited to 16000 data points (16000 bytes in 8 bit or 32000 in 16 bit). For example: Gate of 8000 points with compression ratio of 2 gives a 4000 bytes output in 8 bit mode (8000 in 16 bit).

HMS(S)

Purpose: Hysteresis, peak discrimination control in multi-gate modes

Format: HMS <Tn><Gn><Hysteresis Level>

Description: Multi-gate version of HYS command. The hysteresis function governs whether secondary peaks are reported as separated indications or not and works by assigning a value in dB that the signal must fall before the half cycle is considered as a separate meaningful signal. Conversely, following a peak validation the system tracks and validates the trough using the same value.

Parameters:

<Tn> : Test Number, an integer value from 0 to 1279.
Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.

<Gn> : Gate Number, an integer value from 0 to 4.
Gn = 0 for all gates in the test

<Hysteresis level>: 0 = No Hys
1 = 3dB
2 = 6dB (Default level)
3 = 9dB
4 = 12dB

Note: Valid in Multi-gate Mode only (AMP 31 & 32)

HYS(S)

Purpose: Hysteresis, peak discrimination control.

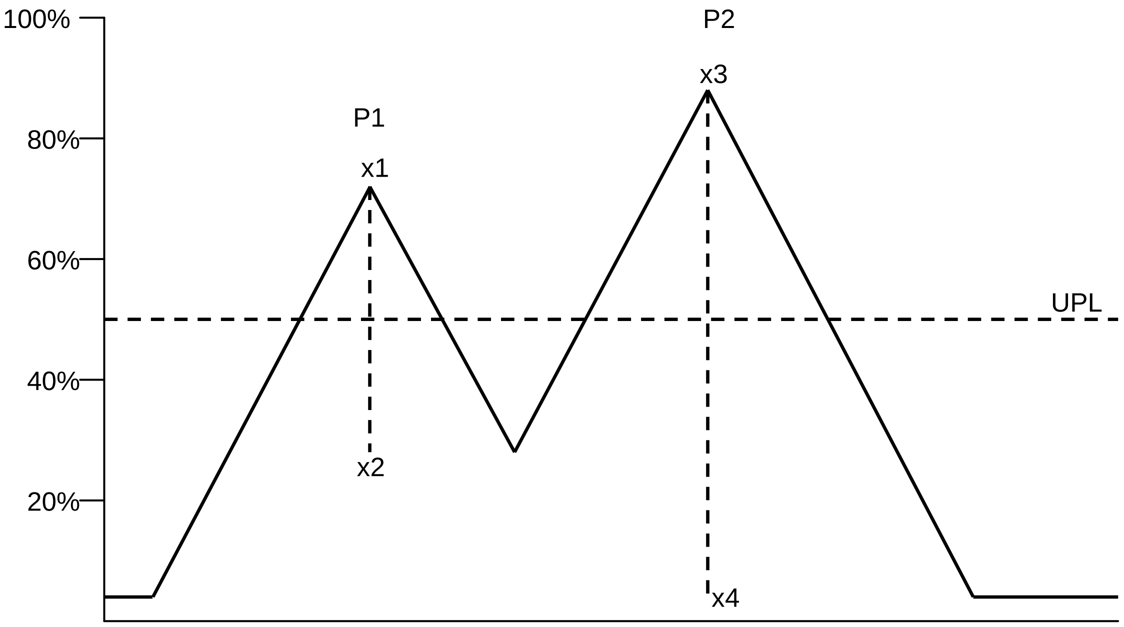
Format: HYS <Tn><Hysteresis Level>

Description: The hysteresis function governs whether secondary peaks are reported as separated indications or not and works by assigning a value in dB that the signal must fall before the half cycle is considered as a separate meaningful signal. Conversely, following a peak validation the system tracks and validates the trough using the same value.

Parameters: <Tn> : Test Number, an integer value from 0 to 1279.
Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.

<Hysteresis level>: 0 = No Hys
1 = 3dB
2 = 6dB (Default level)
3 = 9dB
4 = 12dB

Example: HYS 0 1 : Assign 3dB hysteresis for all conventional tests



With a 6dB threshold set, each trough after a peak above the UPL level must be at least 6dB below the corresponding peak to produce an indication. Thus if x1 to x2 and x3 to x4 are above the 6dB threshold then peaks P1 and P2 will be reported.

IGT(S)

Purpose: Defines inspection gate in echo trigger mode.

Format: IGT <Tn><Gate Start><Gate End>

Description: Defines the 'inspection gate' area. The actual gated data is derived from the IGT Parameters taken relative to the point in the echo gate (as defined by the EGT command) where the signal breaks the EUPL (EPL in FMC tests). The Parameters are in distance units according to the material velocity set. IGT is not used by phased array tests except when in FMC mode In FMC tests MicroPulse has the ability process inspection gates that start before the trigger peak, i.e. IGT may have negative parameters.

Parameters:

<Tn>	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.
<Gate Start> <Gate End>	:	Distance units from 0 to 20000 (in FMC the gate start may be negative but the total gate length cannot exceed 3000 Bytes)

Example:

ETM 3 2	:	Set test 3 to echo trigger mode.
EGT 3 200 600	:	Set test 3 with echo gate from 200 to 600 distance units
IGT 3 0 200	:	Set inspection gate to 100 units after the trigger.

IMF

Purpose: Computer Interface Mode Format Select in earlier MicroPulse versions.

Format: IMF <Mode>

Description: This command has no affect.

Parameters: <Mode> : An integer value from 0 to 255

INPUT/OUTPUT COMMANDS

INE

Purpose: Sensor Input Line Configuration.

Format: INE <Pin><Sense> [Off]

Description: Eight input sensor lines can be programmed to initiate any line of command entered immediately after the INE command. This means that any action can be taken on any sense of any line.

Parameters:

<Pin> : Value from 0 to 7 representing the electrical connection.

<Sense> : Low to High or High to Low electrical sense.

1 = Low to high
0 = High to low

<Off> : Optional. If this parameter is omitted the function is enabled.

0 = Disabled

Example:

INE 6 1 : Initiate the following line of commands on input to line 6 on a low to high transition. As the option parameter is omitted the function is enabled.

CAL 1 CAL 6 CAL 8 LCP 1 0 : Inspect on Tests 1, 6 and 8 then preset axis 1 position to 0.

Note: **T**he INE command must be terminated with a carriage return before the entering of the commands to be executed on the INE event.

Availability: 16 input lines are available (0 - 15) are available with extended I/O option fitted.

IPM

Purpose: To set the IP address for Ethernet communication

Format: IPM <Value><Value><Value><Value>

Description: This command allows the changing of the IP address of MicroPulse 5. The value is stored in flash memory and so is retained when the MicroPulse 5 is turned off. To use the new IP address the MicroPulse 5 must be turned off after sending the command (wait for 10 seconds before turning off to allow the flash to be written to). Caution should be used when using this command as setting the MicroPulse 5 to an unknown IP address will cause problems with communication. Alternatively the Peak NDT software utility ‘PeakIPAssign’ can be used to program the IP address.

Parameters:

<Value.>	:	1 to 255
<Value.>	:	1 to 255
<Value.>	:	1 to 255
<Value.>	:	1 to 255

Example: IPM 10 1 1 2 : Sets the MicroPulse 5 IP address to 10.1.1.2

JIT

Purpose: To define the maximum amount of axis jitter allowed.

Format: JIT <Axis1><Axis2><Axis3><Axis4>

Description: To define the maximum amount of axis jitter allowed while still recognising that an axis is stationary and movement has ended. The user should use this command prior to moving any axis.

Parameters: <axis n> : Range 0 – 100 raw axis units

Example: JIT 1 1 1 1 : Set the jitter on all four axis to 1 axis unit

LCP

Purpose: Location Preset.

Format: LCP <Axis No.><Value>

Description: This command presets the current axis position to be the value specified. This may be used in conjunction with MSE to set up a datum switch for Example.

Parameters:

<axis no.>	:	1 to 4
<value>:	-8000000 to +8000000	

Example:

LCP 2 –33	:	Sets motor 2's current position to –33
INE 8 1		
LCP 2 0	:	Sets up input line 8 to datum axis 2 when polarity changes from 0 to 1.

LOF

Purpose: Set output line off.

Format: LOF <pin>

Description: LOF is provided for downward compatibility with MicroPulse 1.
The only valid parameter is 11

LOF 11 : switch DAC off.

LON

Purpose: Set output line on.

Format: LON <pin>

Description: LON if provided for downward compatibility with MicroPulse 1. The only valid parameter is 11

LON 11 : switch DAC on.

LML(S)

Purpose: Lower Threshold Level assignment in multi-gate modes

Format: LML <Tn> <Gn> <value>

Description: Multi-gate version of LWL Defines a LOWER threshold level BELOW which an indication is to be reported. Can be used to detect low coupling conditions or, when in through transmission mode, the presence of defects. When the maximum signal within the gated area falls below the Lower Threshold Level (LML) an 'INC' message is sent indicating the timebases and amplitudes of the signal lying within the gated region. On setting a LML threshold, MicroPulse automatically adjusts the UML threshold to 1/3 of the LML value. If the signal falls below this threshold, and 'coupling failure' message is reported.

LML mode is disabled by sending any overriding mode control command for the specified test (AMM, GML, GMH).

NOTE. If the operator requires to set a different UML for a LML test, the UML command must be issued after the LML command.

Parameters:

<Tn>	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps
<Gn>	:	Gate Number, an integer value from 0 to 4. Gn = 0 for all gates in the test
<Value>	:	Integer between 10 and 255 (8 bit modes) Integer between 10 and 1023 (10 bit modes) Integer between 10 and 4095 (12 bit modes)

Note: Valid in Multi-gate Mode only (AMP 31 & 32)

LWL(S)

Purpose: Lower Threshold Level.

Format: LWL <Tn><Value>

Description: Defines a LOWER threshold level BELOW which an indication is to be reported. Can be used to detect low coupling conditions or, when in through transmission mode, the presence of defects. When the maximum signal within the gated area falls below the Lower Threshold Level (LWL) an 'INC' message is sent indicating the timebases and amplitudes of the signal lying within the gated region. On setting a LWL threshold, MicroPulse automatically adjusts the UPL threshold to 1/3 of the LWL value. If the signal falls below this threshold, and 'coupling failure' message is reported.

LWL mode is disabled by sending any overriding mode control command for the specified test (AMP, GPL, GPH, GRE).

NOTE. If the operator requires to set a different UPL for a LWL test, the UPL command must be issued after the LWL command.

Parameters:

<Tn> : Test Number, an integer value from 0 to 1279.
Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.

<Value>: Integer between 10 and 255 (8 bit modes)
Integer between 10 and 1023 (10 bit modes)
Integer between 10 and 4095 (12 bit modes)
0 = return to default reporting mode
(AMP mode 2)

MAS

Purpose: To set the master/slave configuration

Format: MAS <Mode>

Description: When two MicroPulse systems are connected together using the master/slave connection cable, the MAS command should be used. The MAS command should be sent to one MicroPulse which then becomes the master system. Both the master and slave system will then reset and upon completion the master system responds with a 'RST message' that indicates the new overall system configuration.

When a master/slave combination is used the slave will not communicate over the Ethernet communication link. All communication is via the master system and the slave acts as extra pulser/receiver channels. Encoders need only be connected to the master system automated inspection modes.

Parameters: <Mode>: 0 = Not master/slave mode, revert to independent.
1 = Master/slave mode

MOV

Purpose: To move an axis to location.

Format: MOV <Axis><Location>

Description: The motor controller is configured to move the specified axis to the specified location using the start/end slow periods defined by SPR/SPQ. MicroPulse will continue operating in the mode set prior to the MOV command. When the controller detects no encoder pulses (see BKL) MicroPulse responds with LLC messages unless the MSE command has been enabled for the corresponding axis/stop condition.

Simultaneous moves of two or more axes are allowed. It is not recommended to issue MOV,MRE or MOVU for an axis that is already in motion.

Parameters:

<axis>	:	axis number 1 to 4
<location>	:	location in user distance units –800000000 to 800000000 decimal

Example:

LCP 1 0 LCP 2 0

MOV 1 100	:	move axis 1 to 100
MOV 2 50	:	move axis 2 to 50

Availability: Only with motor controller option fitted.

MOVU

Purpose: To set a continuous axis move.

Format: MOVU <Axis><Direction><Speed>

Description: The motor controller is configured to move the specified axis continually in a specified direction. The speed can set to either permanently slow or a slow period defined by the SPR. When the controller detects no encoder pulses (see BKL) MicroPulse responds with LLC messages unless the MSE command has been enabled for the corresponding axis/stop condition. The motion is typically stopped by using a STOP command

Simultaneous moves of two or more axes are allowed. It is not recommended to issue MOV, MRE or MOVU for an axis that is already in motion.

Parameters:

<axis>	:	axis number 1 to 4
<direction>	:	0/1 = forward/backwards
<speed>	:	0 = slow speed continually, 1 = slow speed for distance defined by SPR followed by fast speed.

Example:

LCP 1 0 LCP 2 0		
MOVU 1 0 0	:	move axis 1 forwards at a slow speed
STOP 1 0	:	stop axis 1 immediately

Availability: Only with motor controller option fitted.

MPE

Purpose: Encoder units per millimetre.

Format: MPE <Axis1><Axis2> <Axis3><Axis4>

Description: This command sets the number of encoder pulses per millimetre on an individual motor/axis basis.

NOTE: It MUST be set before any other motor commands are used. It is usual to set this command once only at power-up.

Parameters: <Axis n>: Number of encoder pulses per millimetre on axis
Range is from 1 to 100000.

Example: MPE 200 1000 10 10 : This sets axis 1 to 200 and axis 2 to 1000 encoder pulses per millimetre, whilst setting axis 3 and 4 to 10 pulses per millimetre.

MRE

Purpose: To move an axis relatively.

Format: MOV <Axis><Displacement>

Description: This is the same as MOV command except that the end location is taken as the current location plus the specified displacement (which may be negative).

Simultaneous moves of two or more axes are allowed. It is not recommended to issue MOV,MRE or MOVU for an axis that is already in motion.

Parameters:

<Axis>	:	Axis number 1 to 4
< Displacement >	:	Relative displacement in user distance units –800000000 to 800000000 decimal

Example: MRE 1 -30 : move axis 1 -30 from current location

Availability: Only with motor controller option fitted.

MSE

Purpose: To program action on axis condition.

Format: MSE <axis> <mode> [off]

Description: This command works in the same way as INE in that the command line following the MSE command is stored and invoked when the specified condition occurs. There are four such conditions corresponding to different events at the end of the axis move or inspection commands (MOV, MRE or FLY). In particular the programmed command line may redefine the MSE setting. If MSE is disabled, then MicroPulse defaults to its normal mode of sending LLC message to host on any axis stop.

Parameters:

<axis>	:	Axis number 1 to 4	
<mode>	:	0	normal stop
		1	end of FLR or FLZ
		2	stall
		3	overshoot
		4	any axis stop
[off]	:	Optional. If this parameter is omitted the function is enabled. 0 = disabled, reverts to LLC	

Example:

MSE 2 2
OUT 6 10 : Causes CER 10 message when axis 2 stalls

Availability: modes 0,3, and 4 are only available with motor controller option fitted.

NUM

Purpose: Test Cycle.

Format: NUM <No.>

Description: This command specifies the number of conventional tests through which MicroPulse multiplexes when in the CAL 0, STP 0, and fly modes.

In addition the NUM command specifies the number of conventional tests to which commands using 0 test number apply.

Parameters: <No.> : Number of tests used. 1 to 255

Example:

NUM 50	:	Sets a test sequence from 1 to 50 All ENABLED tests from 1 to 50 will be multiplexed.
NUM 10 GAN 0 40	:	Tests 1 to 5 gain 20 dB.
NUM 5 GAN 0 80	:	Tests 6 to 10 gain 10 dB.

Note: **NUMG** <No>

A version that is for use with parallel conventional channels only

This is a version of the NUM command for groups. The NUMG command specifies the number of conventional test groups which are executed in a set of group firings. A number between 1 and 16.

OLM(S)

Purpose: To set the overload reporting mode on a Phased Array Test.

Format: OLM <Tn><Mode><No. elements>

Description: MicroPulse can be set to report the saturation of individual phased array elements. As element saturation can affect the results, the user can then determine the action to be taken.

Parameters:

<Tn>	:	Test Number, an integer value from 256 to 1279. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.
<Mode>	:	Integer value from 0 to 2. 0 = turn off element overload reporting 1 = report the count of the saturated elements 2 = report the details of the saturated elements
<No. elements>	:	Integer value from 0 to 128 that is the number of elements that need to be saturated before the warning message is generated by MicroPulse (0 always reports).

OUT

Purpose: To cause a message to be sent to host.

Format: OUT <header><parm1> … <parm>

Description: The message defined is sent to the host. The header byte must be a valid header code and the corresponding number of parameters should be supplied, although the message will be truncated or padded with 0's.
OUT can be useful when used in conjunction with the INE command to output messages upon the change of an input.

Parameters:

<header>	:	Any valid header code
<parm>	:	0 – 255

Example:

INE 1 1
OUT 6 123 : Will cause 6 123 to be sent to the host when the input INE 1 changes to 1

PAV

Purpose: To change a phased array channel Pulser Voltage.

Format: PAV <channel start><channel end ><value>

Description: Selects the voltage required for the phased array pulsers. The default is all channels set to 100 volts.

Parameters:	<channel start> :	Start MicroPulse channel number to be set.
	<channel end> :	End MicroPulse channel number to be set.
	<value> :	Pulser voltage required, settings are: 50 to 200volts in 5 volt steps .
Example:	PAV 1 16 200 :	sets channel 1 to 16 to a 200 volt pulser.

PAW

Purpose: To change a phased array channel Pulser Width.

Format: PAW <channel start><channel end ><value>

Description: Selects the pulse width required for the phased array pulsers.. The default is all channels set to 100nsec.

Parameters:

<channel start>	:	Start MicroPulse channel number to be set.
<channel end>	:	End MicroPulse channel number to be set.
<value>	:	Pulser width required, settings are: 20 to 500nsec in 2nsec steps .

Example: PAV 1 16 200 : sets channel 1 to 16 to a 200nsec pulse width.

PDW

Purpose: Define pulse width and damping for conventional channels.

Format: PDW <channel><damping><width>

Description: Selects the damping and pulser width for a given channel (or all channels if <channel> is 0). The settings will apply to all tests using the specified channel as RXN or TXN parameters. There are 8 standard pulse widths (as MicroPulse 3) and pulse widths between 16nSec and 502nSec in 2nSec steps.

Parameters:

<channel> : Integer value from 0 to 24
0 for all channels.

<damping> :
0 = 660Ω
1 = 458Ω
2 = 220Ω
3 = 149Ω
4 = 102Ω
5 = 82Ω
6 = 63Ω
7 = 51Ω

<width> :
0 = 50 nSec
1 = 100 nSec
2 = 150 nSec
3 = 200 nSec
4 = 250 nSec
5 = 300 nSec
6 = 350 nSec
7 = 225 nSec
16 – 502 = specifies the pulse width in nSec.
i.e. 30 = 30nSec. Valid every 2nSec step.

Default: PDW 0 4 3

Example: PDW 1 7 4 : Set pulser/receiver channel 1 to 54ohm damping and 250nSec pulse width.

PIG

Purpose: Peaks in gate.

Format: PIG <Value>

Description: Used to define how many peaks are reported in AMP mode 2. The first n-1 plus the largest of the remaining peaks are reported.

Parameters: <Value> : Integer value n from 1 to 80

PMG(S)

Purpose: Peaks in gate in multi-gate modes

Format: PMG <Tn> <Gn> <value>

Description: Multi-gate version of PIG command Used to define how many peaks are reported in AMM mode 2. The first n-1 plus the largest of the remaining peaks are reported.

Parameters:

<Tn>	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps
<Gn>	:	Gate Number, an integer value from 0 to 4. Gn = 0 for all gates in the test
<Value>	:	Integer value n from 1 to 80

Note: Valid in Multi-gate Mode only (AMP 31 & 32)

PRF

Purpose: Pulse Repetition Frequency.

Format: PRF <rate>

Description: The <rate> parameter specifies the maximum rate in firings per second. The time period is derived from a timer device and so is accurate provided that the rate specified is not greater than that which MicroPulse can achieve or the ultrasonics will allow.

Parameters:	<rate>	:	Test repetition rate in Hz, between 1 Hz and 20 KHz in 1 Hz steps.
Example:	PRF 1000	:	Sets p.r.f. of 1000 Hz. This ensures that firings will be at least 1 millisecond apart.

PSV

Purpose: To change a conventional channel Pulser Voltage.

Format: PSV <channel><value>

Description: Selects the voltage required for the pulsers on an individual channel basis. The default is all channels set to 300 volts.

Parameters:	<channel>	:	MicroPulse channel. 0 = for all channels.
	<value>	:	Pulser voltage required, settings are: 50, 100, 150, 200, 250 and 300 volts.
Example:	PSV 4 200	:	sets channel 4 to a 200 volt pulser.

RST

Purpose: To reset MicroPulse and optionally change its sample frequency.

Format: RST [sample freq]

Description: The RST command completely resets the MicroPulse. On a power on reset the MicroPulse will go to its default sample frequency set by the SDS command. If a RST command is sent with no other parameters the MicroPulse will reset to its default sample frequency. If the user sends a valid second parameter with the RST then the system sample frequency will be changed. Subsequent to a reset command completion the system responds with a 'RST message' that indicates the system configuration.

Parameters: [sample freq] : If omitted the system sample frequency is set to the system default otherwise:

10 = 10 MHz (Default DAC rate 1/8th sample freq)
25 = 25 MHz (Default DAC rate 1/8th sample freq)
40 = 40 MHz (Default DAC rate 1/8th sample freq)
50 = 50 MHz (Default DAC rate 1/8th sample freq)
80 = 80 MHz (Default DAC rate 1/16th sample freq)
100 = 100 MHz (Default DAC rate 1/16th sample freq)

Note: 40Mhz and 80Mhz are provided for backward compatibility with earlier versions of MicroPulse only.

RTD

Purpose: To trim the receive focal law.

Format: RTD <focal law No.>< value>

Description: To correct the receive focal law delay to make the reference point as the array centre.

Parameters:

<focal law No.>	:	Focal law number, an integer value from 0 to 1024.
< value >	:	Receive trim delay value in nanoseconds. Integer in the range 0 to 25000

RXF

Purpose: To define the element delay for a receive focal law.

Format: RXF <focal law No.><channel><delay><elt gain trim>

Description: For each focal law a number of RXF commands define the receive delays for each individual element used. The gain of an individual element can also be trimmed.

Parameters:

<focal law No.>	:	Focal law number, an integer value from 0 to 1024.
<channel>	:	MicroPulse phased array channel number. An integer in the range 0 to 128. 0 is used with a delay of –1 to clear the whole law. Where a slave system is present the range of channels is increased to allow for the slave channels.
< delay>	:	Receive delay value in nanoseconds. An integer in the range -1 to 25000. –1 is used to clear the whole law or individual elements.
<elt gain trim>	:	From – 64 to +64 that corresponds to –16 to +16dB in 0.25dB steps

Example:

RXF 1 0 –1 0	:	Clear receive focal law 1
RXF 1 1 0 0	:	Add MicroPulse channel 1 to law 1 with 0 delay and 0 gain trim.
RXF 1 2 100 4	:	Add MicroPulse channel 2 to law 1 with 100nsec delay and 1dB of additional gain trim

RXN

Purpose: Receiver Channel Select

Format: RXN <Tn><Channel>

Description: Selects the receiver probe connection for a given test number (Tn).

Parameters:	<Tn>	:	Test number. An integer value from 0 to 1279. Tn = 0 for all tests.
	<Channel>	:	Integer in the range of 1 to 1024. When the <Tn> is 256 or greater, this parameter refers to a phased array focal law and not an actual MicroPulse channel
Example:	RXN 7 4	:	Assign pulser/receiver channel 4 as receiver for Test Number 7.
	RXN 256 1	:	Assign receive phased array focal law 1 to test 256.

SCHK

Purpose: To allow automated ADC and linearity checks on MicroPulse PA channels

Format: SCHK <Mode><Chstrt> <Chend> <Gtstrt> <Gtend><Filter><Pulwidth><Pulvolt><Pulrep>

Description: To allow automated checking of the gain and ADC linearity using a probe coupled to a test block. The MicroPulse performs an auto calibration on each of the specified channels to achieve an 80% fsh reference signal. The gain is then adjusted to preset levels and the amplitudes checked against stored limits. The results of the checks are then reported for each channel. There are 6 gain levels used. The default gain values are +2dB, 0dB, -6dB, -12dB, -18dB and -24dB.

Parameters:

<Mode> : Reporting mode. An integer value from 0 to 1
0 = simple report (see output message format)
1 = detailed report (see output message format)

<Chstrt> : The start channel number. An integer between 1 and the <Chend> parameter

<Chend> : The end channel number. An integer between the <Chstrt> parameter and the maximum number of PA channels.

<Gtstrt> : The inspection gate start. An integer in the range 0 to 64000. Units are the sample frequency of the system (e.g. 100Mhz = 10nSec)

<Gtend> : The inspection gate end. An integer in the range <Gtstrt> to 64000 (Note: the maximum gate length is 32000 sample points). Units are the sample frequency of the system (e.g. 100Mhz = 10nSec)

<Filter> :
1 = 5.00 MHz to 10.0 MHz
2 = 2.00 MHz to 10.0 MHz
3 = 0.75 MHz to 5.00 MHz
4 = 0.75 MHz to 20.0 MHz

<Pulwidth> : Pulser width required, settings are: 20 to 500nsec in 2nsec steps.

<Pulvolt> : The maximum Pulser voltage to be used. The settings are 50 to 200volts in 5 volt steps. The system will reduce the pulse voltage if the signal received is too large.

<Pulrep> : Test repetition rate in Hz. Between 1 Hz and 20 KHz in 1 Hz steps.

Default Settings for Checks:

Setting	Gain	Positive Limit	Negative Limit
1	0 (0dB)	166 (83%)	154 (77%)
2	8 (+2dB)	214 (107%)	190 (95%)
3	-24 (-6dB)	86 (43%)	74(37%)
4	-48 (-12dB)	46 (23%)	34 (17%)
5	-72 (-18dB)	24 (12%)	16 (8%)
6	-96 (-24dB)	14 (7%)	6 (3%)

SCPE

Purpose: Oscilloscope output enable

Format: SCPE <Tn>

Description: To allow the oscilloscope output to be enabled for a specific test. Default is enabled for all tests

Parameters: <Tn> : Test number. An integer value from 0 to 1279.
Tn = 0 for all tests.

SDS

Purpose: To set the default sample frequency.

Format: SDS <sam>[dof]

Description: Sets into non-volatile memory the power – on sample frequency of the system. The MicroPulse will also default to this sample frequency after a RST command that has no sample parameter. The SDS value is reported as part of the RST message. An optional parameter also allows the setting of the default data output format for the system.

Parameters: <sam> :

10 = 10 MHz sample frequency
25 = 25 MHz sample frequency
40 = 40 MHz sample frequency
50 = 50 MHz sample frequency
80 = 80 MHz sample frequency
100 = 100 MHz sample frequency

<dof> : 0, 1, 2, 3, 4, 5, 6 Details of the modes can be found in the DOF command. This parameter is optional.

Note: 40Mhz and 80Mhz are provided for backward compatibility with earlier versions of MicroPulse only.

SGA(S)

Purpose: Control of the Phased Array Channel Summing Gain.

Format: SGA <Tn><Value>

Description: This sets the value of the summing gain for a test. On a phased array test the Micropulse system divides the summed signal by the number of elements in the focal law. For example: in a 128 element focal law, 128 elements are added together and then divided by 128. The sum gain parameter can be used to alter this division and therefore give more effective gain to a test.

Parameters:

<Tn> : Test Number, an integer value from 0 to 1279.
Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.

<Value> : Integer in the range 0 to 4,
where 0 = sum gain 0dB (default off)
1 = 6dB
2 = 12dB
3 = 18dB
4 = 24dB

Example:

SGA	256	1	: Set the summing gain for test 256 to 6dB
SGAS	1	2	: Set the summing gain for all tests in sweep 1 to 12dB

Notes: Although summing gain can be useful in giving more gain to a test that utilises a number of elements care should taken with its use. It is not intended for use on a single element law. For the best performance summing gain should only be utilised where high gains are already required and additional gain is needed.

SNM

Purpose: To set the subnet mask for Ethernet communication

Format: SNM <Value><Value><Value><Value>

Description: This command allows the changing of the subnet mask of MicroPulse 5. The value is stored in flash memory and so is retained when the MicroPulse 5 is turned off. To use the new subnet mask the MicroPulse 5 must be turned off after sending the command (wait for 10 seconds before turning off to allow the flash to be written to). Caution should be used when using this command as setting the MicroPulse 5 to an unknown subnet mask can cause problems with communication. Alternatively the Peak NDT software utility 'PeakIPAssign' can be used to program the subnet mask.

Parameters:

<Value.>	:	0 to 255
<Value.>	:	0 to 255
<Value.>	:	0 to 255
<Value.>	:	0 to 255

Example: SNM 255 0 0 0 : Sets the MicroPulse 5 subnet mask to 255.0.0.0.

SPA

Purpose: Spacing of inspection locations.

Format: SPA <Axis1><Axis2><Axis3><Axis4>

Description: This command sets the distance between inspection points to the required pitch for each axis, in axis units as defined by MPE, this is used for fly inspection modes.

Parameters:

<Axis n>	:	Number of axis units between inspection points for axis n. Range 1 to 100000.

Examples:

SPA 5 5 5 5	:	Set pitch to 5 on Axes 1, 2, 3 and 4.
SPA 2 5 10 10	:	Set pitch to 2, 5, 10 and 10 on axes 1, 2, 3 and 4 respectively.

SPQ

Purpose:	To define slow speed range for end of axis movement.		
Format:	SPQ <axis 1><axis 2><axis 3><axis 4>		
Description:	As the SPR command but applies to the end of a move.		
Parameters:	<axis n>	:	Range 0 – 100000 axis distance units
Example:	SPR 10 7 10 7 SPQ 5 7 5 7	: :	axis 1 and 3 have start and end slow periods of 10 and 5; axis 2 and 4 have start and end slow periods of 7
Availability:	Only with motor controller option fitted.		

SPR

Purpose: To define slow speed range for start of axis movement.

Format: SPR <axis 1><axis 2><axis 3><axis 4>

Description: The parameters for each axis are taken to be the distance for which the axis is driven at a slow speed at the start of a move to avoid a stall. The user should use this command prior to moving any axis.

Parameters: <axis n> : Range 0 – 100000 axis distance units

Example: SPR 5 10 5 10 : Set the start slow period to 5 on axis 1 & 3. Axis 2 and 4 have start slow periods of 10.

Availability: Only with motor controller option fitted

SRST

Purpose: To reset the control parameters within MicroPulse and optionally change its sample frequency.

Format: SRST [sample freq]

Description: Unlike the RST command the SRST command does not completely reset the MicroPulse. The SRST command performs a quick reset that bypasses self-test and only clears all parameters back to the power on state. If a SRST command is sent with no other parameters the MicroPulse will reset to its default sample frequency. If the user sends a valid second parameter with the SRST then the system sample frequency will be changed. Subsequent to a SRST command completion the system responds with a 'RST message' that indicates the system configuration.

Parameters: [sample freq] : If omitted the system sample frequency is set to the system default otherwise:

10 = 10 MHz (Default DAC rate 1/8th sample freq)
25 = 25 MHz (Default DAC rate 1/8th sample freq)
50 = 50 MHz (Default DAC rate 1/8th sample freq)
100 = 100 MHz (Default DAC rate 1/16th sample freq)

STA

Purpose: User Request for MicroPulse status and axis locations.

Format: STA [Status]

Description: Interrogates MicroPulse for current system status and axis location. The reply is a single message:

15H (LLC) nnH aaaaaaH bbbbbbH ccccccH ddddddH eeeeH

Where aaaaaa to dddddd are the 3 byte locations of axes 1 to 4, nn is the optional status parameter. Here eeeeee represents 4 spare bytes.

STL

Purpose: To enter idle mode with one test displayed on A-scan monitor.

Format: STL <Tn>

Description: Any previously selected inspection mode is terminated, and any driven axis is stopped. The requested test is displayed on the A-scan monitor.

Parameters: <Tn> : Number of test displayed on monitor.
(Integer value from 1 to 1279 but must not be zero)

STOP

Purpose: To stop axis movement.

Format: STOP <axis><mode>

Description: The parameters for each axis are taken to be the distance for which the axis is driven at a slow speed at the start of a move to avoid a stall. The user should use this command prior to moving any axis.

Parameters:

<axis>	:	axis number 0 to 4 (0 is all axis)
<mode>	:	0= stop immediately 1= stop after SPQ distance

Availability: Only with motor controller option fitted

STP(S)

Purpose: To perform tests continuously.

Format: STP <Tn>

Description: The specified test(s) is repeated until a new mode (STL or STX) is requested. The data is buffered for each cycle, i.e. if a single test is requested then data is output between each test, if all tests requested then data for each cycle of tests is buffered and output. The tests within a cycle are fired at the requested PRF (subject to gates set not being longer than the PRF). The next cycle will not start until this data has been output.

Parameters: <Tn> : Test Number, an integer value from 0 to 1279.
Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps

Example:

NUM 100		
STP 0	:	MicroPulse sends data for tests 1 to 100 repeatedly
STL 1	:	After completing the reporting of the data from the last test cycle the MicroPulse then enters STL mode on test 1.

Note: **STPG** <Gn>

A version that is for use with parallel conventional channels only

This is a version of the STP command for groups. The STPG executes continuously either a single group or all groups enabled within the NUMG. A number between 0 and 16.

STR(S)

Purpose: To perform tests continuously using the system buffer.

Format: STR <Tn>

Description: The purpose of this command is to output tests continuously. The internal buffer of the system is utilised. The specified test(s) is repeated at the PRF requested (restricted if the gate length is actually greater than the specified PRF) until a new mode (STL, STP or STX) is requested or the system buffer is full.

Data is reported in format specified by the current DOF. From each test firing the system also outputs a LLC message giving four 24-bit axis locations. In the LLC message the status byte is set to 1 and the fifth axis data reports the number of bytes available in the system buffer when the test was fired.

Parameters: <Tn> : Test Number, an integer value from 0 to 1279.
Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps

Example: NUM 100
STR 0 : MicroPulse sends data for tests 1 to 100 repeatedly.

Note: If a FDEF command is setup to define a sequence of sweeps then STRS 0 will execute the defined sequence rather than all enabled sweeps. This mode is cancelled by FDEF 0.

Note: **STRG** <Gn>

A version that is for use with parallel conventional channels only

This is a version of the STR command for groups. The STRG executes continuously either a single group or all groups enabled within the NUMG. A number between 0 and 16.

STS

Purpose: Request Parameters.

Format: STS <mode>

Description: For backward compatibility STS -1 can be used to find out the information contained in a RST message without actually resetting the MicroPulse. Other modes can be used to request various parameters from the MicroPulse.

Parameters: <mode>=

<mode>=	= 0	:	axis locations.
	= 1	:	MPE settings
	= 2	:	BKL settings
	= 5	:	SPA settings
	= 6	:	Read status of input and output lines
	= 20	:	System temperature readings
	= -1	:	RST message
	= -2	:	Copy of master system RST message when in master/slave mode
	= -3	:	Copy of slave system RST message when in master/slave mode

Reply from MicroPulse:

Modes 0 – 5 : (hex) 15 Fn a a a b b b c c c d d d 0 0 0 0

n=<mode>
aaa= 24 bit data for axis 1 (least significant byte first)
bbb= 24 bit data for axis 2
ccc= 24 bit data for axis 3
ddd= 24 bit data for axis 4

Mode 6 : (0x15) (0xf6) (input line 15..8 level) (input line 7..0 level) (output line 15..8 level) (output line 7..0 level) (0) (0) (0) (0) (0) (0) (0) (0) (0) (0) (0) (0)

Mode 20 : (0x15) (0xf4) (TEMP in Deg C of system) (0) (TEMP in Deg C of processor) (0) (TEMP in Deg C of any slave system) (0) (TEMP in Deg C of any slave processor) (0) (0) (0) (0) (0) (0) (0) (0) (0)

Mode –1,-2,-3: As per RST message

STX

Purpose: To enter idle mode with no test displayed.

Format: STX

Description: This command is useful for suspending pulser activity.

Parameters: None

SWP

Purpose: To define a group of focal laws.

Format: SWP<sweep No.><start Tn><-><end Tn>

Description: Phased array tests can be grouped together to form sweeps. Thereafter most ultrasonic settings can be set for the whole sweep by adding an 'S' to the appropriate command.

Parameters:

< sweep No. >	:	Integer value from 1 to 31
<start Tn>	:	Integer value from 256 to 1279 that is the start test number for the sweep
<->	:	A space is required on either side of the Dash. If The Dash is not used then a list of individual tests can be used.
<end Tn>	:	Integer value from 256 to 1279 that is the end test number for the sweep

Examples:

SWP 1 501 - 532	:	Set sweep 1 to contain tests 501 to 532
SWP 2 301 302 303 304	:	Set sweep 2 to contain tests 301,302,303,304

TERM

Purpose: Encoder axis termination

Format: TERM <Axis No.><Value>

Description: This command sets the termination on each encoder axis. The default is encoder termination on

Parameters:	<axis no.>	:	1 to 4
	<value>	:	0 or 1, where 0 is axis termination on

TGA(S)

Purpose: Test Gain Adjust.

Format: TGA <Tn><Value>

Description: Sets the gain trim that is applied in addition to the GAN for the test number specified. The TGA allows the adjustment gain of a test whilst specifying an overall gain for a sweep or number of tests using the GAN(S) command. The value of TGA set for a test is maintained even when a new GAN is applied.

Parameters:

<Tn>	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps.
<Value>	:	dB change to be applied. Entered in units of 0.25dB. If the resultant gain exceeds 280 (70.00 dB) or falls below 0 it is set to 280 or 0. The value can be positive or negative.

Example:

SWP 1 256 – 270	:	Setup sweep 1
GAN(S) 1 80	:	Set gain for all tests to 20dB.
TGA 260 4	:	Trim test 260 by +1dB to a total gain of 21dB
TGA 270 -4	:	Trim test 270 by -1dB to a total gain of 19dB

TRM(S)

Purpose: To trim the test delay

Format: TRM<Tn><value>

Description: To trim the specified delay (DLY) on a test basis to correct for transit time in the wedge when different angles are generated.

Parameters:

<Tn>	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps
<value>	:	Integer number between -20000 and 20000 each increment representing 1 timebase delay.

TTD

Purpose: To trim the transmit focal law.

Format: TTD <focal law No.>< value>

Description: To correct the transmit focal law delay to make the reference point as the array centre.

Parameters:

<focal law No.>	:	Focal law number, an integer value from 0 to 1024.
< value >	:	Transmit trim delay value in nanoseconds. Integer in the range 0 to 25000

TXF

Purpose: To define the element delay for a transmit focal law.

Format: TXF <focal law No.><channel><delay>[optional pulser volts]

Description: For each focal law a number of TXF commands define the transmit delays for each individual element used.

Parameters:

<focal law No.>	:	Focal law number, an integer value from 0 to 1024.
<channel>	:	MicroPulse phased array channel number. An integer in the range 0 to 128. 0 is used with a delay of –1 to clear the whole law. Where a slave system is present the range of channels is increased to allow for the slave channels. On systems where addition pulser channels are available the channel number can also be appended with a T to indicate these channels
< delay>	:	Receive delay value in nanoseconds. An integer in the range -1 to 25000. –1 is used to clear the whole law or individual elements.
[optional pulser volts]	:	A percentage of the PSV in the range 0 – 100. May be used for such functions as transmitter voltage apodisation. If this parameter is omitted then the full pulser voltage, as specified by the PSV is applied. If set to 0 or the percentage results in a pulser voltage of less than 10 Volts then the pulser for that channel is effectively turned off

Example 1:

TXF 1 0 –1	:	Clear transmit focal law 1
TXF 1 1 0	:	Add MicroPulse channel 1 to law 1 with 0 delay
TXF 1 2 100	:	Add MicroPulse channel 2 to law 1 with 100nsec delay

Example 2:

PAV 1 32 200	:	Set the phased array pulser volts to 200 for channels 1 to 32
TXF 1 0 –1	:	Clear transmit focal law 1
TXF 1 1 0 80	:	Add MicroPulse channel 1 to law 1 with 0 delay and 80% pulser volts i.e.160Volts
TXF 1 2 100 20	:	Add MicroPulse channel 2 to law 1 with 100nsec delay and 20% pulser volts i.e. 40Volts
PAV 1 32 200	:	Re-send the phased array pulser volts to 200 for channels 1 to 32 (required to process the element apodisation)

ULTRASONIC COMMANDS

TXN

Purpose:	Transmit Channel Select.		
Format:	TXN <Tn> <Channel>		
Description:	Selects the transmit probe connection for a given Test Number (Tn).		
Parameters:	<Tn>	:	Test number. An integer value from 0 to 1279 Tn = 0 for all tests.
	<Channel>	:	Integer in the range of 1 to 1024. When the <Tn> is 256 or greater this parameter refers to a phased array focal law and not an actual MicroPulse channel
Example:	TXN 7 2	:	Assign pulser/receiver channel 2 as transmitter for Test Number 7.
	TXN 256 1	:	Assign transmit phased array focal law 1 to test 256.

UML(S)

Purpose: Upper Threshold Level Assignment in multi-gate modes

Format: UML <Tn> <Gn> <value>

Description: Multi-gate version of UPL command. Specifies the UPPER reporting threshold for the specified Test Number (Tn) and Gate Number (Gn). Any signals ABOVE the UML threshold level value and within the search gate area will be recognised by the signal processor as possible valid peaks, depending on HMS.

Parameters:

<Tn>	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps
<Gn>	:	Gate Number, an integer value from 0 to 4. Gn = 0 for all gates in the test
<Value>	:	Integer between 10 and 255 (8 bit modes) Integer between 10 and 1023 (10 bit modes) Integer between 10 and 4095 (12 bit modes)

Note: Valid in Multi-gate Mode only (AMP 31 & 32)

UPL(S)

Purpose: Upper Threshold Level Assignment.

Format: UPL <Tn><Value>

Description: Specifies the UPPER reporting threshold for the specified Test Number (Tn). Any signals ABOVE the UPL threshold level value and within the search gate area will be recognised by the signal processor as possible valid peaks, depending on HYS. If no EUPL is specified, then the UPL is used in the interface gate in echo gate mode.

Parameters:	<Tn>	:	Test Number, an integer value from 0 to 1279. Tn = 0 for all conventional tests. If the S extension is used it applies to all tests in the sweep number specified: 1-16, 0 = all sweeps
	<Value>	:	Integer between 10 and 255 (8 bit modes) Integer between 10 and 1023 (10 bit modes) Integer between 10 and 4095 (12 bit modes)
Example:	UPL 6 80	:	Assign a reporting threshold of 80 machine units to Test Number 6.

VEL

Purpose: Set Ultrasonic Velocity

Format: VEL <Velocity><DAC Curve No.>

Description: Allows the Ultrasonic Velocity to be specified. With or without the DAC option, velocities are assigned to a test via one of the DAC curve numbers. This form retains downward compatibility with earlier MicroPulse systems.

The velocity value is used by the system to translate search gate values from millimetres into machine units (i.e. 10 nSec for sample rate of 100 MHz).

Parameters: <Velocity> : Permitted range between 250 thru. 10000 $msec^{-1}$

Note: For Pulse Echo inspections the velocity is entered as HALF the material velocity, whilst for tandem and through transmission techniques the ACTUAL velocity is used.

<DAC Curve No.>: Integer in the range 1 to 256

Example: Test Number 1 is a pulse echo shear wave inspection requiring the use of DAC curve 2. The shear wave velocity in steel is 3230 metres per second.

VEL 1615 2	:	note half shear wave velocity used and linked with DAC curve No. 2.
CUR 1 2	:	links curve No. 2 and hence shear wave velocity to Test number 1.

XXA

Purpose: Request ultrasonic Parameters.

Format: XXA <Tn>

Description: Allows the operator to interrogate current ultrasonic Parameters for the test specified.

Parameters: <Tn> : Integer number from 1 to 1279.

Example: XXA 33 : Request ultrasonic Parameters currently assigned to Test Number 33.

XXAS

Purpose: Request Sweep Parameters.

Format: XXA <Sweep No.>

Description: Allows the operator to interrogate current test numbers contained in the sweep specified. Replies with a XXAS message.

Parameters: < Sweep No.> : Integer number from 1 to 16.

XXB

Purpose: Display on MicroPulse screen ultrasonic Parameters.

Format: XXB <Tn>

Description: Allows the operator to interrogate current ultrasonic Parameters for the test specified.

Parameters: <Tn> : Integer number from 1 to 1279. 0 displays the system Message whilst 2001 to 2004 displays the encoder setting for axis 1 to 4 respectively

Example: XXB 33 : Request ultrasonic Parameters currently assigned to Test Number 33 on L.C.D. screen.

XXR/XXT

Purpose: Request list of tests in a focal law.

Format: XXT<Tx focal law No.>
XXR<Rx focal law No.>

Description: Allows the operator to interrogate current channels used in a transmit or receive focal law. Replies with a XXR/XXT message.

Parameters: < Tx focal law No.> : Integer number from 1 to 1024.

ZFL

Purpose: To allow commands to be stored in flash memory

Format: ZFL<value>

Description: Allows the operator to store a set of commands in the flash memory of MicroPulse. These commands will be executed on power-on or reset.

Parameters:	<value>	:	0 = erase command file 1 = begin list of commands 2 = end list of commands
Example:	ZFL 0	:	delete file
	ZFL 1	:	begin file
	.		
	.		
	.	:	list of commands
	.		
	ZFL 2	:	end file
		:	

Appendix

6.1 Commands

Commands (cont) **Page**

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6.2 Introduction to Programming MicroPulse 5

The following are a set of simple examples that show various ways of configuring MicroPulse 5 tests. Each example follows on from the previous to build up a sequence of tests. The examples given are for conventional tests, but can be easily applied to phased array tests.

Example 1: Simple Ascan Test

Example setup of single conventional test (system set to 100MHz).

```
DOF 1                # set data output to 8 bits
NUM 1                # set number of tests to 1
PSV 0 300            # set all channels to 300Volt pulsers
TXN 1 4              # transmit test 1 on channel 4
RXN 1 4              # receive test 1 on channel 4
PDW 4 0 100          # set channel 4 damping to 660Ω and 100nsec pulse width
GAN 1 110            # set test 1 gain to 110 (27.5dB)
FRQ 1 3 7            # set test 1 to filter to 4Mhz with smoothing 7
AWF 1 0              # set test 1 to rectified data
GAT 1 0 10000        # set test 1 gate from 0 to 100uSec
DLY 1 0              # set test 1 delay to 0
AMP 1 3              # set test 1 to output full ascan data
ETM 1 0              # set test 1 to not interface echo
PRF 1000             # set pulser repletion to 1000Hz
```

The above setup can be executed once by sending a CAL 1 command. A 10000 sample ascan of 8 bit data will be output. As the NUM is set to 1, CAL 0 will also output the same result.

Continuous execution can be obtained by using STP 0 or STR 0 commands. STR also reports the current encoder position with each complete test cycle.

Example 2: Peak Detection Test

More tests can be added to the cycle by increasing the NUM. These tests can be enabled or disabled by using the ENA / DIS commands respectively.

```
NUM 2                # set number of tests to 2
TXN 2 4              # transmit test 2 on channel 4
RXN 2 4              # receive test 2 on channel 4
GAN 2 110            # set test 2 gain to 110 (27.5dB)
FRQ 2 3 7            # set test 2 to filter to 4Mhz with smoothing 7
AWF 2 0              # set test 2 to rectified data
GAT 2 5000 10000     # set test 2 gate from 50uSec to 100uSec
DLY 2 0              # set test 2 delay to 0
AMP 2 2              # set test 2 to output n peaks
UPL 2 100            # set the peak threshold to 100 units
ETM 2 0              # set test 2 to not interface echo
HYS 2 2              # set test 2 to 6dB hysteresis
PIG 8                # set the maximum number of peaks to 8
```

Now on CAL 0 will output:
Test 1 - A 10000 sample ascan of 8 bit data
Test 2 - The amplitude and time of any peaks (up to 8) above the UPL from 50uSec to 100uSec.

Example 3: Time Varying Gain (TVG)

TVG can be applied to tests by defining a curve in memory and specifying the tests that it is to be used on. The example shows a single curve, but up to 255 can be defined that utilise up to 65550 points of memory.

```
DTG 0 0                  # set all tests to TVG trigger on initial pulse
DRTE 3                   # set the TVG rate to 6.25MHz
DDAC 1 625 0             # define curve 1 start in memory as 0 and length 625
DFIL 0     125 0         # set TVG point to 0dB
DFIL 126 175 10          # set TVG point to 2.5dB
DFIL 176 225 20          # set TVG point to 5dB
DFIL 226 275 24          # set TVG point to 6dB
DFIL 276 325 28          # set TVG point to 7dB
DFIL 326 375 36          # set TVG point to 9dB
DFIL 376 425 45          # set TVG point to 11.25dB
DFIL 426 475 54          # set TVG point to 13.5dB
DFIL 476 525 63          # set TVG point to 15.75dB
DFIL 526 575 66          # set TVG point to 16.5dB
DFIL 576 625 68          # set TVG point to 17dB
CUR 1 1                  # set test 1 to use curve 1
CUR 2 1                  # set test 2 to use curve 1
LON 11                   # turns on TVG
```

Example 4: Interface Echo

A third test can be added that uses the interface echo capabilities. Here we will report peaks from the gate but an ascan can also be reported.

```
NUM 3                    # set number of tests to 3
TXN 3 1                  # transmit test 2 on channel 1
RXN 3 1                  # receive test 3 on channel 1
EGT 3 1000 2000          # set test 3 interface echo gate from 10uSec to 20uSec
EUPL 3 200               # set test 3 interface threshold to 200 units
IGT 3 2000 3000          # set test 3 interface echo inspection gate from 20uSec to 30uSec
ETM 3  2                 # set test 3 to interface echo mode
AMP 3 2                  # set test 3 to output n peaks
GAN 3 110                # set test 3 gain to 110 (27.5dB)
FRQ 3 3 7                # set test 3 to filter to 4Mhz with smoothing 7
AWF 3 0                  # set test 3 to rectified data
HYS 3 2                  # set test 3 to 6dB hysteresis
UPL 3 100                # set the peak threshold to 100 units
CUR 3 256                # as TVG is on, but is not required for this test, set to the 0dB
                         # curve 256
```

Now on CAL 0 will output:
Test 1 - A 10000 sample ascan of 8 bit data
Test 2 - The amplitude and time of any peaks (up to 8) above the UPL from 50uSec to 100uSec.
Test 3 – If an interface echo is found between 10uSec and 20uSec then any peaks above the UPL in the inspection gate that is set 20usec to 30usec from the interface echo will be reported.

Example 5: Multiple Gates

Instead of a single hardware gate on a test a test can be configured to have multiple hardware gates.

NUM 4	# set number of tests to 4
TXN 4 2	# transmit test 4 on channel 2
RXN 4 2	# receive test 4 on channel 2
GAN 4 110	# set test 4 gain to 110 (27.5dB)
FRQ 4 3 7	# set test 4 to filter to 4Mhz with smoothing 7
AWF 4 1	# set test 4 to RF data
GAT 4 0 10000	# set test 4 gate from 0uSec to 100uSec
AMP 4 32	# set test 4 to multi-gate and ascan
GMT 4 1 5000 6000	# set test 4 gate 1 from 50uSec to 60uSec
GMT 4 2 5000 6000	# set test 4 gate 2 from 50uSec to 60uSec
GMT 4 3 8000 9000	# set test 4 gate 1 from 80uSec to 90uSec
GMT 4 4 8000 9000	# set test 4 gate 1 from 80uSec to 90uSec
GIN 4 2 1	# invert test 4 gate 2
GIN 4 4 1	# invert test 4 gate 4
HMS 4 0 1	# set test 4 all gates to 3dB hysteresis
PMG 4 0 8	# set test 4 all gates to 8 peaks maximum
UML 4 0 130	# set test 4 all gates to peak threshold to 130 units
AMM 4 0 2	# set test 4 all gates to output n peaks

Now on CAL 0 will output:
Test 1 - A 10000 sample ascan of 8 bit data
Test 2 - The amplitude and time of any peaks (up to 8) above the UPL from 50uSec to 100uSec.
Test 3 – If an interface echo is found between 10uSec and 20uSec then any peaks above the UPL in the inspection gate that is set 20usec to 30usec from the interface echo will be reported.
Test 4 - The amplitude and time of any peaks or troughs from 50uSec to 60uSec and 80uSec to 90uSec.

Example 6: Inspection Control

If desired the encoder inputs can be configured to trigger inspection points as shown below:

ENCM 1	# set encoders to 32 bit output
ENCT 0 0 0 0	# set all encoder modes to Quadrature
ENCF 0 0 0 0	# set all encoders to no filter
MPE 1000 1000 1000 1000	# set the encoder input ratio as 1000 per mm
BKL 2000 2000 2000 2000	# set the stall detection to 1 second
SPA 1 1 1 1	# set the inspection pitch to 1 mm
LCP 1 0	# zero axis 1
LCP 2 0	# zero axis 2
LCP 3 0	# zero axis 3
LCP 4 0	# zero axis 4
FLM 0	# carry out CAL 0 at each inspection point
FLX 1 100 0	# set inspection to start from 100mm in a positive direction
FLZ 1 200	# set inspection to end at 200mm

As each inspection point is reached a CAL 0 is carried out and the data is output with a LCI message that gives the actual location of that inspection point.

6.3 Introduction to Programming Focal Laws with MicroPulse 5

Definitions

Focal Law – a set of delays, one for each element, required to focus/steer the beam at a given angle/range/depth/point

Sweep – a group of focal laws

Snell Ray – the central ray from the group of elements for a given law that satisfies Snell's law at the boundary between a wedge and a component under test.

Programming Element Delays for Focal Laws

Focal laws are programmed in MicroPulse using the TXF (transmit focal law) and RXF (receive focal law) commands to set the delay for each element to be used in the focal law. (For further details on the format of these commands refer the MP5 command reference manual).

Format: TXF <focal law no> <MP pin no> <delay>
RXF <focal law no> <MP pin no> <delay> <elt trim gain>

The delay value to be applied is in nanoseconds. There will be one TXF and one RXF command for each element that is used.

Notes:

(1) MicroPulse 5 adopts the standard policy of setting the minimum delay value to be programmed as zero, but this does have implications as to where timebase zero is. For a single law this is not an issue as the resulting offsets get taken out during calibration by adjusting the probe/wedge delay. However, for a sweep this offset will be different for every law. To avoid having a different probe/wedge delay for every law in a sweep, various offsets are programmed with the result that the probe/wedge delay can be a constant for that probe/wedge, irrespective of the laws specified. This is important for future integration with MIPS.

(2) Before programming a focal law, TXF and RXF commands with the element delay set to '-1', should be sent to MicroPulse to ensure that all element delays previously programmed are cancelled.

e.g. TXF 1 0 -1 : the <-1> clears previously stored values
RXF 1 0 -1 0 :

Focal Law Delay Offsets

Consider the case in transmit for a linear array in contact focusing as shown in Figure 6.3.1. In order to achieve a focus, the edge elements are fired **before** the centre elements. The delays applied to each element might look something like the graphic in Figure 6.3.2.

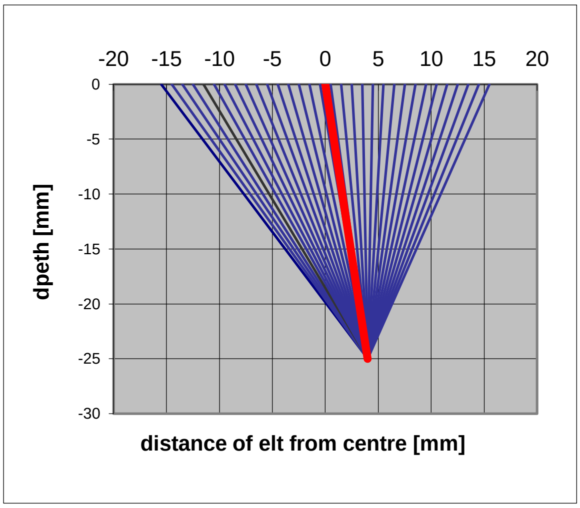


Figure 6.3.1 32 element array focusing at 25mm below the surface. No wedge

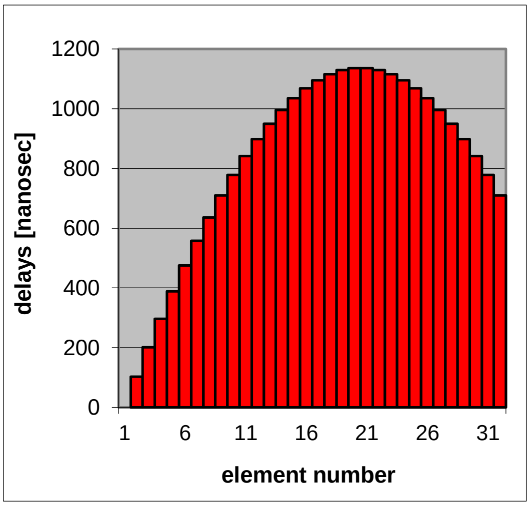


Figure 6.3.2 Element Delays

The clock starts counting with the first element is fired, but the range to an indication is measured from the centre of the array. So, there will need to be on offset applied at some point, which is equal to the difference in transit time to the focus between the element with the longest transit time to the focus and a ray emanating from the centre of the array. (To a reasonable approximation this can be considered as the delay that would be applied to an element at the centre of the array (odd number of elements), or the average delay at the central elements). In MicroPulse this value is called the Transmit Trim Delay. It is programmed by the TTD command and there will be one for every law.

Format: TTD <focal law no> <transmit trim delay value>

The transmit trim delay value is in nanoseconds. The value is always positive.

In receive; a signal from the focus arrives first at the element closest to it (i.e. with the shortest path length). MicroPulse then must **wait** the appropriate time for the signal to arrive at elements further away before summing the signals. This is apparently contrary to the graphic shown in Figure 6.3.2. In fact what happens is that when MicroPulse gets the receive delays, programmed by the RXF commands, it finds the maximum delay for that law and then subtracts the delay for each element from this maximum value. This result is represented by the graphic in Figure 6.3.3.

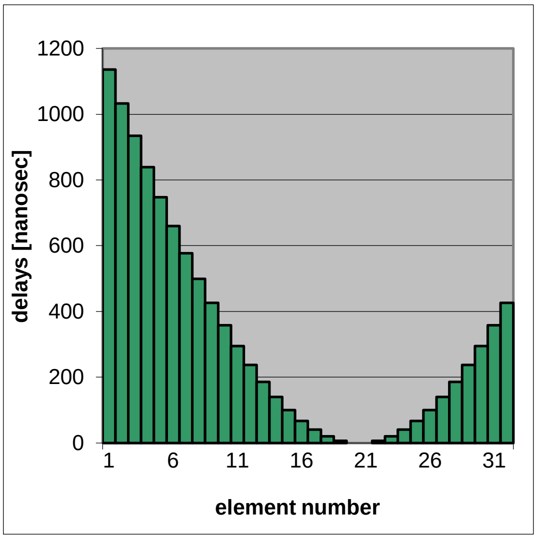


Figure 6.3.3 Element delays applied by MicroPulse on Receive

So in receive, the reference time is taken as when the signal from the focus arrives at the closest element not at the centre of the array, but range is measured from the centre of the array. Another delay correction is required. The value equates to the difference in transmit time between a ray from the focus received at the centre of the array and the closest element. In MicroPulse this is termed the Receive Trim Delay. It is programmed by the RTD command and there will be one for every law.

Format: RTD <focal law no> <receive trim delay value>

The receive trim delay value is in nanoseconds. The value is always positive and must always less than or equal to the transmit trim delay. If the same delay law is used for receive as was used to transmit, then the <rtd value> equals the maximum delay (see figure 6.3.2) minus the <ttd value>.

Using Focal Laws

To actually use a focal law, it must first be assigned to a MicroPulse <test> via the TXN and RXN commands.

Format: TXN <test no> < law no>
RXN <test no> <law no>

Notes:

(1) For phased array tests, test numbers start at 256, allowing MicroPulse to differentiate between conventional tests and phased array tests.

(2) The focal laws to be used (TXF's, TTD's, RXF's, RTD's) must be sent to MicroPulse before the TXN's and then the RXN's

Different laws may be used in transmit and receive and the same law maybe used in more than one law combination.

Tests may be grouped together to form sweeps via the SWP command.

Format: SWP <sweep no> <start test no> <–> <end test no>

Thereafter, for many common ultrasonic settings, the whole sweep may be addressed rather than each test individually. Most MicroPulse commands allow an 'S' to be added, by which MicroPulse recognises it as a sweep command

e.g. GANS 1 40 : set the gain on all tests in sweep 1 to 10dB

Wedge Delay Offsets

The same approach for TXF's, RXF's, TTD's and RTD's is extended to the case of a probe with a wedge. Here, however, a further delay trim value is required. An extension of the MicroPulse DLY command, DLYS, sets the wedge delay for the whole sweep. Its units are in MicroPulse units i.e. the <dlys value> is dependent on the sample frequency.

Format: DLYS <sweep number> <delay in MPunits>

DLYS takes care of the time for the sound in the wedge (at the natural angle of the wedge). There are two contributions to this, on the way out and on the way back. MicroPulse is programmed with the sum of these values (rather than twice the wedge delay) in order to take account of the fact that different probes may be used in transmit and receive. The controlling software must manage the construction and keep track of the DLYS values.

In addition to the DLYS a delay trim value (TRM) is required in order correct the transit time in the wedge when different angles are being generated or different element groups are being used. The TRM value is programmed on a per test basis.

Format: TRM <test_no> <delay trim value in MPunits>

The <trm value> is the difference between the time at the natural angle of the wedge and the time along the so-called Snell ray at the centre of the selected group of elements at the incident angle to give the specified refracted angle (figure 6.3.4). The
<trm value> is made up from a part associated with the transmit focal law and a part associated with the receive focal law. The controlling software must manage the construction and keep track of the TRM value, assigning it to the correct test.

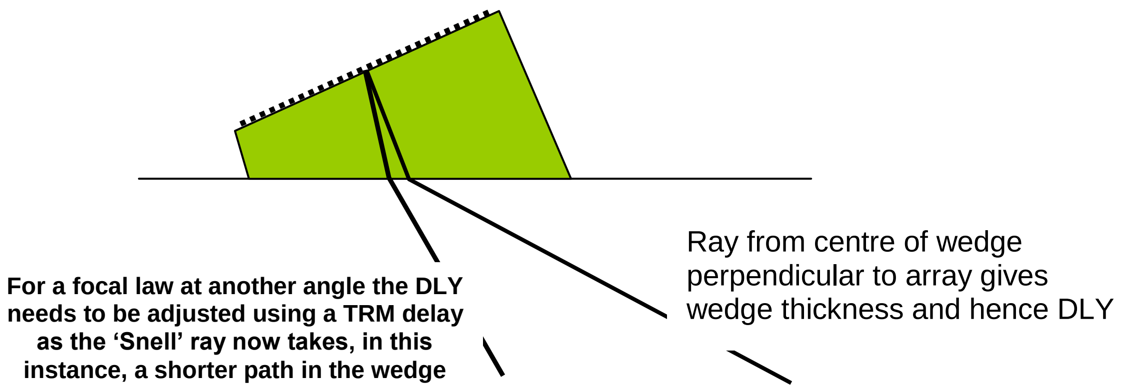


Figure 6.3.4

6.4 Full Matrix Capture (FMC) Mode and FMC individual Channel Echo Gate Trigger Mode

Full Matrix Capture (FMC) is a feature available in MicroPulse phased array systems which allows the capture of A-scans prior to summation. The FMC process involves transmitting on element one of an array, receiving all the A-scans individually for each element of the array, then transmitting on element 2, 3 etc until all elements have been used for transmitting. Where n is the number of elements in the array, then the FMC process will result in the collection of n^2 waveforms. Having acquired the waveforms, the user can apply any focussing algorithms retrospectively to the received data. FMC is of potential benefit in an R&D environment where new focusing methodologies are being developed such as the Total Focusing Method (TFM) being developed by Bristol University. The FMC data output is available in AMP mode '13'.

To programme the MicroPulse to collect the FMC data the focal law programming commands are used with delays set to zero. The laws are then assigned to tests. For example for a 16 element array:

```
TXF 1 0 -1      :  clear out any previous Tx laws
TXF 1 0 0       : transmit on element one
TXN 256 1       : The Tx for test number 256 uses Tx law no 1
RXF 1 0 -1 0    : clear out any previous Rx laws
RXF 1 1 0 0
RXF 1 2 0 0
RXF 1 3 0 0
:
:
:
RXF 1 16 0 0
RXN 256 1       : The Rx for test number 256 uses Rx law no 1

TXF 2 0 -1
TXF 2 0 0
TXN 257 2
RXF 2 0 -1 0
RXF 2 1 0 0
RXF 2 2 0 0
RXF 2 3 0 0
:
:
:
RXF 2 16 0 0
RXN 257 2
:
:
:
:
:
RXF 16 16 0 0
RXN 271 16

SWP 1 256 - 271   : Define a sweep representing these tests
AMPS 1 13         : set to output FMC data.
```

Notes:

- Maximum gate lengths without firing twice 3000 samples per element. Gates of up to 8000 sample points can be specified but MicroPulse will fire more than once on each test to achieve these.
- Not available in DOF mode 0
- Caution PRF achievable may become limited by data transfer rates
- RXF delays can be non-zero, to, for example, 'line-up' interface signals for use with FMC individual channel echo gate trigger, see below. This means the size of the interface gate can be smaller, reducing the risk of extraneous signals triggering the gate.

FMC Mode Individual Channel Echo Gate Trigger

When in Full Matrix Capture (FMC) the user can specify an interface echo gate that is used by each receive channel to independently set its inspection gate relative to an interface echo.

The Distance amplitude correction (DAC) can also be configured to be triggered by the interface echo. There is now an additional water path DAC that will run from the initial pulse to the interface echo. This DAC stops at the interface echo on each channel and holds its value on that channel. The standard DAC that is triggered on the interface is then applied on top of this. The total cannot exceed the maximum DAC gain of 40dB. The water path DAC has no associated CUR number as it is applied to all tests that have the standard DAC configured to trigger on the interface echo

Note: that in this mode the standard DAC requires some value between the test start and the interface echo. The first value in the standard DAC curve is used for this and is held until the interface echo is seen. This value would normally be set to zero.

ETM(S): used to enter the FMC echo trigger mode

EGT(S): used to specify the interface echo gate

IGT(S): used to specify the inspection gate relative to the interface echo. The start of the inspection gate (IGT) can be negative if required to allow the capture of the actual interface echo. The maximum gate length is 3000 bytes.

EPL(S): used to specify the threshold amplitude within the interface echo gate that will trigger the channel.

DTG(S): used to specify the trigger source for the standard DAC

DFIL and DSET: The water path DAC uses the range 70000 to 70512. The water path DAC will be clocked out at the same rate as specified for the standard DAC.

To support FMC mode individual channel echo gate trigger the following new/amended messages are used

Data Message

< Universal Header 0x2d><count lsb><count tsb><count msb><Sub-header 0x01>
<Sweep No./Test No. lsb> <Sweep No./Test No. msb><dof ><Channel >
<Echo range lsb><Echo range msb><Spare> <amp 1>….. <amp n >

Where:

Header:	universal header 0x2d
Count:	24 bit total data length count
Sub-header byte:	0x01 = FMC Ascan
Sweep/Test No:	16 bits. Bottom 11 bits Test No. Top 5 bits sweep No.
dof:	data format
Channel:	Normally 0, except in full matrix capture tests it is used to indicate the channel number
Echo Range:	Range of the interface echo from the start of the interface echo gate.
Spare	Not used.
amp:	In 8 bit Modes, for Ascan = amplitudes of digitised signal. In greater than 8 bit modes, the amplitudes are least significant byte first.

Echo Trigger failure

This message is 4 Bytes in total. If no interface echo is seen on a channel the following is sent to indicate the failure.

<27Hex><Sweep/Test No. lsb ><Sweep/Test No. msb >< Channel >

Where:

Channel:	Normally 0, except in full matrix capture tests it is used to indicate the channel number

6.5 Introduction to Programming Parallel Groups with MicroPulse 5

MicroPulse systems that are configured for the parallel firing of their conventional channels can use the group (GRUP) feature. This requires multiple CUIF PCB's in the system. Below is an example setup of a 20 channel system fitted with 3 CUIF PCB's thus allowing 10 channels to be fired simultaneously.

```
num 20
rxn 1 1
txn 1 1
rxn 2 2
txn 2 2
rxn 3 3
txn 3 3
rxn 4 4
txn 4 4
rxn 5 5
txn 5 5
rxn 6 6
txn 6 6
rxn 7 7
txn 7 7
rxn 8 8
txn 8 8
rxn 9 9
txn 9 9
rxn 10 10
txn 10 10
rxn 11 11
txn 11 11
rxn 12 12
txn 12 12
rxn 13 13
txn 13 13
rxn 14 14
txn 14 14
rxn 15 15
txn 15 15
rxn 16 16
txn 16 16
rxn 17 17
txn 17 17
rxn 18 18
txn 18 18
rxn 19 19
txn 19 19
rxn 20 20
txn 20 20

gat 0 0 6000
gan 0 120
frq 0 2 7
amp 0 3
awf 0 0

pdw 0 0 100
prf 8000

numg 2
grup 1 1 3 5 7 9 11 13 15 17 19
grup 2 2 4 6 8 10 12 14 16 18 20
dcm 0 2 10
disg 0
enag 0

econ 1 0 0 0
strg 0
```

The example sets up 20 tests and then fires them in 2 groups of 10. When the whole sequence is fired channels will be fired in the order 1,3,5,7,9,11,13,15,17 and 19 together then 2,4,6,8,10,12,14,16,18 and 20 together etc. The data from all tests is 6000 byte ascan data compressed in a ratio of 10 to 1 down to 600 bytes.

There are limitations on the group command:

- Dependant upon the configuration of the system there are limitations on which channels can be specified within a group. If in doubt as to the configuration of a system please contact Peak NDT. The number of channels per ADC is obtained from the RST message.

- Each conventional ultrasonic (CPIF) PCB within the Micropulse has 16 pulse/receiver channels with 4 ADC's per PCB, the wiring of the system can mean different configurations. For example a 20 channel system can have 3 CPIF PCB's wired to have 2 channels per ADC.

- Channels used in parallel firing with each CPIF PCB will use the same filter setting, all other ultrasonic parameters are independent.

- The first test in a group has no limitations as to gate length or reporting modes etc., but the other tests in the group MUST be Amp 3 mode (ascan or rf). These other parallel tests can be compressed (DCM) or uncompressed but the output data of the tests is limited to 16000 data points (16000 bytes in 8 bit or 32000 in 16 bit). For example: Gate of 8000 points with compression ratio of 2 gives a 4000 bytes output in 8 bit mode (8000 in 16 bit).

The number of CUIF PCB's fitted to a system can be obtained from the RST (or STS -1) message. The data is obtained from the N^o of Conventional channels in system byte and the bottom 5 bits of the channels per CUIF ADC byte (see MicroPulse Output Messages Section)

So the N^o CUIF = N^o of Conventional channels in system / (channels per CUIF & 0x1f)

For example on a 20 channel system if:

Channels per CUIF = 2 then 20/2 = 2 channels per ADC on 3 CUIF
Channels per CUIF = 16 then 20/16 = 1 CUIF 16 channels + 1 CUIF with 4 channels

Or on a 16 Channel system if:
Channels per CUIF = 16 then 16/16 = 1 CUIF 16 channels.

Note on older system the channels per CUIF byte is set to 0. This would indicate 16 channels on a CUIF PCB.

Also implemented in this example is the ECON command to allow the output of the cycle time

To explain the effect of groups on PRF / cycle time refer to the example from earlier in this section.

If in STR 0 mode:

The MicroPulse would fire tests at 125usec apart (PRF 8000). This would give an overall cycle time of 2.5 msec (400Hz) as there are 20 tests.

So Theoretical Cycle Time = (1 / PRF entered) x (number of enabled tests in NUM)

If in STRG 0 mode:

The MicroPulse would fire the parallel group 125usec apart (PRF 8000). As there are 4 groups this would give an overall cycle time of 0.5 msec (2000Hz). But in that time 20 tests are fired in 4 groups of 5, so the effective PRF is 40KHz.

So Theoretical PRF = (PRF entered) x (number of tests in group)

So Theoretical Group Cycle Time= (1 / PRF entered) x (number of enabled groups in NUMG)

6.6 Backward Compatibility modes for MIPS with the BAB Command and ZFL files

MicroPulse 5 can be compatible with earlier versions of MIPS that only supported MicroPulse 4. MicroPulse has to be programmed in advance either to tell it to use the conventional channels or with the focal laws to be used. This is achieved through downloading a ‘ZFL’ file to the MicroPulse and then re-setting the MicroPulse.

Notes:

- The ZFL file must only contain valid MicroPulse commands.
- Any command editor can be used to set up a ZFL file in MicroPulse

ZFL for using MP5PA conventional channels with MIPS

ZFL 0	:	clear out previous ZFL file
ZFL 1	:	start new ZFL
	:	No other commands required
DOF 0	:	set to MIPS compatible data output format
BAB 0 1	:	Turn on conventional tests compatibility mode
ZFL 2	:	end ZFL

ZFL Shell for using MP5PA phased array channels with MIPS

ZFL 0	:	clear out previous ZFL file
ZFL 1	:	start new ZFL

<<focal law commands happen here>>

SWP 1 256 - <x>	:	<x> is equal to 256 + number of tests -1
DOF 0	:	set to MIPS compatible data output format
BAB 1	:	Turn on phased array tests compatibility mode
ZFL 2	:	end ZFL

Notes:

- In MIPS set MicroPulse type to MicroPulse 4
- In MIPS set MP3/MP4 Peak Detection to 20 peak (19 + largest) mode as MicroPulse 5 does not support reporting of the ‘n’ largest peaks within the gate.
- The phased array channels focal laws to be used are selected by the transmit and receive channels for the beam in MIPS. These must only be changed when editing the setup file and not within calibrate.
- The BAB command is intended for use in making MicroPulse 5 backward compatible with earlier software intended for use with MicroPulse 4. Its use in the development of new software is not recommended. Details of this command are given below and are not given in the main command reference section of this document.
    - BAB 0 – Turns off the compatibility mode
    - BAB 1 – Turns on compatibility mode for phased array tests. Phased array tests are mapped to conventional test numbers and the system is set to output old style peak information with count in Header. Only valid with the data output format (DOF) set to 0.

- BAB 0 1 – Turns on compatibility mode for conventional tests. The system is set to output old style peak information with count in Header. Only valid with the data output format (DOF) set to 0.

- For conventional tests only the oscilloscope trace output can be extended past the end of the gate. This is for use in set up where users are used to the oscilloscope display continuing after the test gate. This option is enabled by the PGAR command. The value set is stored in flash memory and is therefore non-volatile.

  Format: PGAR<value>

  Where 0 = off default – (display terminates at gate end)
  1 = gate extended by 1/16 the gate end value.
  2 = gate extended by 1/8 the gate end value.
  3 = gate extended by 1/4 the gate end value.
  4 = gate extended by 1/2 the gate end value.
  5 = gate extended by the gate end value.
  6 = gate extended by twice the gate end value.
  7 = gate extended by four times the gate end value.

  The use of this command is not recommended where high speed PRF's are needed as it delays the start of the next test.

6.7 MicroPulse LT Command differences

RST Command

10, 40 and 80 not available

PSV Command

Format: PSV <channel><value>

The high voltage pulser has a maximum value of 200Volts. Values can be entered up to 500Volts without an error being generated, but they will be clipped to 200Volts

The EHT supply is common to all channels. Any value set will apply to all channels.

GAN Command

Format: GAN <Tn><Value>

Up to 6db of attenuation is available. The value can be set between -24 and 280 which corresponds to gains of -6dB to +70dB in 0.25dB steps. As the gain can be set in the range of -24 to 280, when the gain is reported in the auto-calibration message the value is 0 to 304

DFIL/DSET Commands

Format: DFIL <addr 1><addr 2><value>
Format: DSET <address><value>

Up to 70dB of DAC is available. The value can be set between 0 and 280 which corresponds to DAC values of -0dB to +70dB in 0.25dB steps. The maximum combination of main gain and DAC is 110dB. Valid DAC addresses are within the range 0 to 32760.

.

HREN Command

Format: HREN<Tn><value>

A special mode that utilises precise delays and two pulser firings to achieve an apparent sample frequency of 200MHz. The value is either 0 = off or 1 = on. The default is off and it is recommended that the user should contact Peak NDT prior to the use of HREN.

CENA Command

Format: CENA<mode>

This command allows the user to set the function of pin 8 of the encoder interface connector to INE or CPIN. The mode is either 0 or 1. Mode 0 is for INE functionality and 1 for CPIN functionality. The default is 0, i.e. INE functionality

.

6.8 Safety Instructions and Declaration of CE Conformity

- For continued protection against fire hazard, always fit MicroPulse 5 with the same type and rating of fuse. This is a 20mm, 3.15Amp anti-surge fuse (RS:488-8393) .
- MicroPulse 5 has an auto-sensing voltage circuit that detects the correct operating voltage. MicroPulse 5 can operate from a supply of 90 to 260 VAC at 45 to 100 Hz.
- To help prevent electric shock, plug the MicroPulse 5 and device power cables into properly grounded electrical outlets. These cables are equipped with 3-prong plugs to help ensure proper grounding. Do not use adapter plugs or remove the grounding prong from the cable. If extension cables must be used, use a 3-wire cable with properly grounded plugs.
- Do not obstruct the cooling fan or the grill of the MicroPulse 5. Doing so may cause the system to overheat. This is particularly relevant on the rack-mounting version of the system. On a rack-mounting version the bottom feet are removed, so when used on a bench the front of the system must be propped up to stop the bottom grill from being obstructed.
- MicroPulse 5 contains no user serviceable parts. Always refer to qualified service personnel.
- Do not remove the covers as MicroPulse 5 does contain high voltages that could cause electric shock.
- Due to the nature of ultrasonic pulsers, the centre pin of front panel Lemo connectors and Hypertronic connector may have a high voltage pulse on during use. Care should be taken when plugging in connectors to the front panel not to touch the centre pins.

Declaration of CE Conformity

Name of Manufacturer:	**Peak NDT Limited** Unit 1 Enterprise Way, Jubilee Business Park Derby, DE21 4BB

herewith declare that:

Products description:	Ultrasonic flaw detector with phased array channels and/or channels for conventional ultrasonics (pulse-echo & TOFD)
Model numbers:	MicroPulse 5PA, MicroPulse PA, MicroPulse 5 MicroPulse FMC, MicroPulse LT

are in conformity with provisions of the EMC Directive (2004/108/EC) and the LVD Directive (2006/95/EC), and we declare compliance with the following standards:

EMC

High Frequency Emission:	EN55011: 2007 Group 2 Class A Industrial, scientific and medical (ISM) radio-frequency equipment – Electromagnetic disturbance characteristics – Limits and methods of measurement
Immunity:	EN61326-1: 2006 Electrical equipment for measurement, control and laboratory use – EMC requirements

LVD

Electrical Safety:	EN61010-1:2001 Safety requirements for electrical equipment for measurement, control and laboratory use

Issued by:	Peak NDT Limited
Date:	October 2012
Signature:	
Position:	QAR

6.9 Conventional Ultrasonic Connectors

The standard ultrasonic connections on the front of MicroPulse 5 are LEMO triax 1S (LEMO part number ERA.1S.650.CTL). For the best noise performance the appropriate triaxial Lemo plugs should be used with triaxial cable. Coaxial cable can be used, although with longer lengths a degradation of the noise performance may be seen.

An example of a possible mating connector is Lemo part number:

FFA.1S.650.CTAxxx

Where xxx = the collet size and examples are
C27 = 2.2-2.6mm diameter (suitable for RG174 coaxial cable)
C47 = 3.8-4.6mm diameter (suitable for G02332 triaxial cable)
C57 = 4.8-5.6mm diameter (suitable for RG58 coaxial cable)

On systems where an additional 128 phased array pulser channels are available via an extra Hypertronic connector the conventional ultrasonic connections are different. LEMO coax 00 (LEMO part number PSA.00.250.CTLC31) are used.

An example of a possible mating connector is Lemo part number:

FFC.00.250.CTAxxx

Where xxx = the collet size and an example is
C31 = 2.8-3.1mm diameter (suitable for RG174 coaxial cable)

Care should be taken when terminating ether triaxial or coaxial connectors to ensure that there are no short circuits between the inner conductor and any screens. Prolonged use of the pulser set to a high voltage into a short circuit can cause damage to the pulser circuit.

6.10 Hypertronic Connector Pinout

The pin out details for the Hypertronic connector is shown in Figures 6.10.1 and 6.10.2.

	1	2	3	4	5	6	7	8		12	13	14	15	16	17	18	19
A	PR128	PR124	PR120	PR116	PR112	PR108	PR104	PR100		PR96	PR92	PR88	PR84	PR80	PR76	PR72	PR68
B	PR127	PR123	PR119	PR115	PR111	PR107	PR103	PR99		PR95	PR91	PR87	PR83	PR79	PR75	PR71	PR67
C	PR126	PR122	PR118	PR114	PR110	PR106	PR102	PR98		PR94	PR90	PR86	PR82	PR78	PR74	PR70	PR66
D	PR125	PR121	PR117	PR113	PR109	PR105	PR101	PR97		PR93	PR89	PR85	PR81	PR77	PR73	PR69	PR65
E	GND	GND	GND	GND	GND	GND	GND	GND		GND	GND	GND	GND	GND	GND	GND	GND
F	GND	GND	GND	GND	GND	GND	GND	GND		GND	GND	GND	GND	GND	GND	GND	GND
G	PR61	PR57	PR53	PR49	PR45	PR41	PR37	PR33		PR29	PR25	PR21	PR17	PR13	PR9	PR5	PR1
H	PR62	PR58	PR54	PR50	PR46	PR42	PR38	PR34		PR30	PR26	PR22	PR18	PR14	PR10	PR6	PR2
J	PR63	PR59	PR55	PR51	PR47	PR43	PR39	PR35		PR31	PR27	PR23	PR19	PR15	PR11	PR7	PR3
K	PR64	PR60	PR56	PR52	PR48	PR44	PR40	PR36		PR32	PR28	PR24	PR20	PR16	PR12	PR8	PR4

Figure 6.10.1 Signals of the Pulser/Receiver Connector

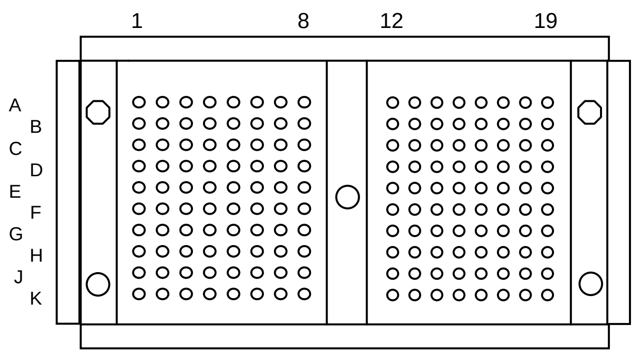


Figure 6.10.2 View on Pulser / Receiver Connector in Front Panel

Pulser Receiver Connector Details

Description: 160-pin connector, female

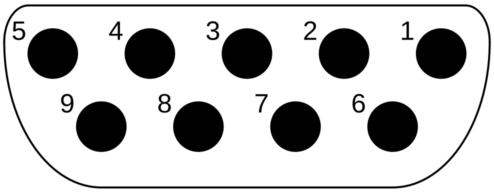
Manufacturer Part Number: Hypertronics™ HLMYJPAPF16000/NEBV19/16PFD/T

Suggested Cable Connector: Hypertronics™ HLMXJCASM16000/NEPJ19/16PMS/T

On systems where an additional 128 phased array pulser channels are available two Hypertronic connectors are used. The bottom Hypertronic connector is the pulser/receiver connector as shown in Figures 6.10.1 and 6.10.2 while the top Hypertronic connector is pulser only channels. The pin out of this connector is the same as the pulser/receiver connector except that the channels are pulser only.

6.11 Ethernet Interface Connector

Access to the 100 Base T / 1000 Base T (Gigabit) Ethernet communication interface of MicroPulse 5 is via a rear mounted 9 way ‘D-type’ socket. The pin out details are shown in Figure 6.11.1.



Pin	Name	Function 100 Base T	Function 1000 Base T
1	TX+	Transmit positive	Tx/Rx A+
2	TX-	Transmit negative	Tx/Rx A-
3	RX+	Receive positive	Tx/Rx B+
4	T4	Terminated	Tx/Rx B-
5	T5	Terminated	Tx/Rx C+
6	RX-	Receive negative	Tx/Rx C-
7	T7	Terminated	Tx/Rx D+
8	T8	Terminated	Tx/Rx D-
9	-	Not used	Not used

Figure 6.11.1 Ethernet Connector Pin Out Details

Adapters are supplied with the MicroPulse 5 that allow connection using a standard RJ45 style connector. The yellow adapter is a straight through adapter whilst the red adapter is a cross over adapter.

For the new 1000 Base T Version which auto-senses, a black adaptor is supplied.

Note: an optional standard RJ45 style connector can be fitted to the rear for direct connection of the Ethernet if required

6.12 Rear Encoder Connector

The pinout details are shown in Figure 6.12.1.

30 Way Lemo Plug Pin No.	Function
1	Enc 1 0v
2	Enc 1 A+
3	Enc 1 B+
4	N/C
5	Enc 4 0v
6	Enc 4 A+
7	Enc 4 B+
8	N/C
9	Enc 3 0v
10	Enc 3 A+
11	Enc 3 B+
12	N/C
13	Enc 2 0v
14	Enc 2 A+
15	Enc 2 B+
16	N/C
17	N/C
18	Enc 1 A-
19	Enc 1 B-
20	Enc 4 A-
21	Enc 4 B-
22	N/C
23	Enc 3 A-
24	Enc 3 B-
25	Enc 2 A-
26	Enc 2 B-
27	Enc 1 +5v
28	Enc 4 +5v
29	Enc 3 +5v
30	Enc 2 +5v

View on cable side of Cable Connector

<u>Connector Details:</u>

Socket (MP5 back panel):

Lemo ECG.4B.330.CLN

Suggested Cable Connector:

Lemo FGG.4B.330.CYCD10Z

Figure 6.12.1 Encoder Connector Pin Out Details

Typical encoders provide two channels in quadrature, known as channel A and channel B. Quadrature encoders can be either be single-ended (channel A and channel B), or differential (channel A+, channel A- and channel B+, channel B-). The maximum frequency of encoders that can be applied to MicroPulse 5 is 700,000 full encoder cycles/second (2,800,000 quadrature counts/second).

The standard input signal voltage is 5 Volts. In differential connection, both + and – inputs are connected, whilst in single ended use the complementary (-) input should be left unconnected. The encoder input circuit within MicroPulse 5 is shown in Figure 6.12.2. Termination for each axis can be turned on/off using the TERM command. Note: The default is termination turned on.

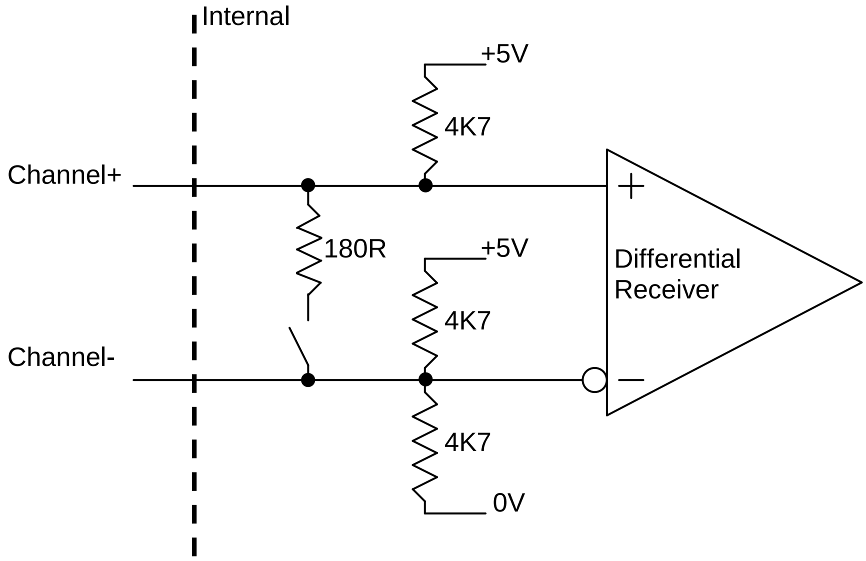


Figure 6.12.2 Encoder Input Circuit

6.13 Rear Input/Output Connector

The pinout details are shown in Figure 6.13.1.

24 Way Lemo Plug Pin No.	Function
1	+5V Out
2	INE 0
3	INE 1
4	INE 2
5	INE 3
6	INE 4
7	INE 5
8	INE 6
9	INE 7
10	DO NOT USE
11	DO NOT USE
12	DO NOT USE
13	DO NOT USE
14	+5V Out
15	CPIN 0
16	CPIN 1
17	CPIN 2
18	CPIN 3
19	CPIN 4
20	CPIN 5
21	CPIN 6
22	CPIN 7
23	0v
24	0v

View on cable side of Cable Connector

<u>Connector Details:</u>

Socket (MP5 back panel):

Lemo ECC.4B.324.CLN

Suggested Cable Connector:

Lemo FGC.4B.324.CYCD10Z

Figure 6.13.1 Input/Output Connector Pin Out Details

The use of the input (INE) and output (CPIN) are detailed in the instruction set details. The inputs and outputs are 5Volt TTL compatible. The maximum voltage applied to an input should not exceed 5Volts. The 5Volt output is capable of supplying a maximum of 200mA.

When the extended I/O option is fitted there is a second rear input/output connector of the same Lemo type. The pinout is the same except the second connector has INE 8 - 15 and CPIN 8 - 15.

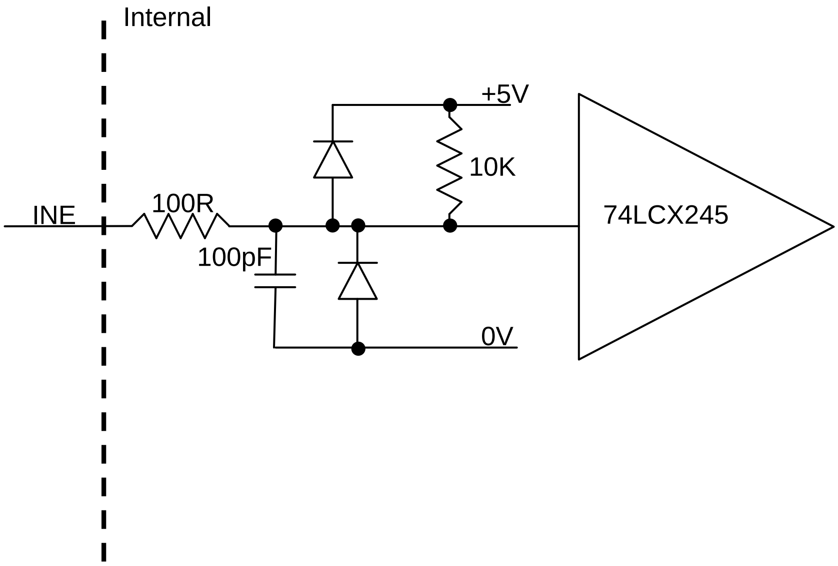


Figure 6.13.2 INE Input Circuit

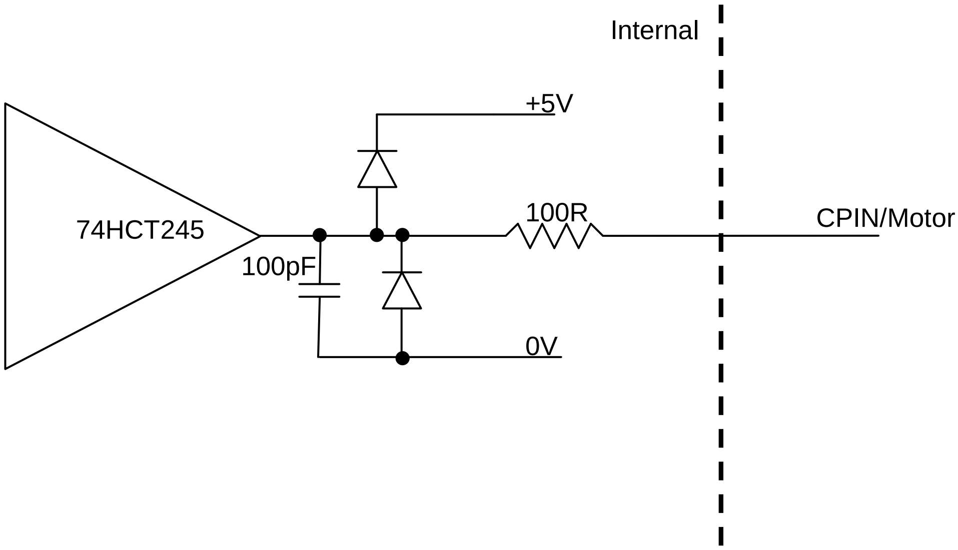


Figure 6.13.3 CPIN Output Circuit

6.14 Optional Rear Motor/Input/Output Connector

If the motor controller option is fitted then the standard input/output connector shown in 6.13 is replaced. The pinout details of the new connector are shown in Figure 6.14.1. The motion control signals have the same characteristic as the CPIN outputs shown in Figure 6.13.3.

50 Way Lemo Plug Pin No.	Function
1	Direction 1
2	Slow 1
3	Fast 1
4	Direction 2
5	GND
6	Slow 2
7	Fast 2
8	Direction 3
9	Slow 3
10	GND
11	Fast 3
12	Direction 4
13	Slow 4
14	Fast 4
15	GND
16	CPIN 0
17	CPIN 1
18	CPIN 2
19	CPIN 3
20	GND
21	CPIN 4
22	CPIN 5
23	CPIN 6
24	CPIN 7
25	GND
26	INE 0
27	INE 1
28	INE 2
29	INE 3
30	GND
31	INE 4
32	INE 5
33	INE 6
34	INE 7
35	GND
36	ANALOGUE OUT 1
37	ANALOGUE OUT 2
38	ANALOGUE OUT 3
39	ANALOGUE OUT 4
40	GND
41	ANALOGUE IN 1
42	ANALOGUE IN 2
43	ANALOGUE IN 3
44	ANALOGUE IN 4
45	AGND
46	+5V
47	+5V
48	+12V
49	AGND
50	-12V

View on cable side of Cable Connector

Connector Details:

Socket (MP5 back panel):

Lemo ECG.5B.350.CLN

Suggested Cable Connector:

Lemo FGG.5B.350.CYCD11Z
Lemo GMA.4B.010.DN (strain relief)

Power Specification:

+5V @ 200mA max

+12V @ 40mA max

-12V @ 40mA max

Figure 6.14.1 Motor Input/Output Connector Pin Out Details

6.14 MicroPulse LT Connector Details

Ethernet Connector

As per the D-type socket for MicroPulse 5 that is shown in Section 6.11.

Auxiliary power Connector

2 Way Lemo Plug Pin No.	Function
1	+48V in
2	0V

View on cable side of Cable Connector

Connector Details: Lemo EXG.0B.302.HLN

Suggested Cable Connectors: Lemo FGG.0B.302.CYCD62 (crimp contacts)
Lemo FGG.0B.302.CLAD62 (solder contacts)

Figure 6.14.1 Auxiliary Power Connector

Encoder Interface Connector (wire colour on Peak NDT supplied cable)

10 Way Lemo Plug Pin No.	Function	Colour
1	+5V Out	Orange
2	Enc 2 A+	Blue
3	Enc 1 A+	Green
4	Enc 1 B+	Yellow
5	Enc 2 B+	White
6	DO NOT USE	Brown
7	0V	Black
8	INE0/CPIN0	Pink or Red
9	Analog I/P 1	Violet
10	Analog I/P 1	-
Screen	0V screen	Green/Yellow

View on cable side of Cable Connector

Connector Details: Lemo EXG.1B.310.HLN

Suggested Cable Connector: Lemo FGG.1B.310.CYCD62 (crimp contacts)
Lemo FGG.1B.310.CLAD62 (solder contacts)

Figure 6.14.2 Encoder Interface Connector (wire colour on Peak NDT supplied cable)

6.15 Document Revision History

Date and Document Revision	Changes Made
April 2008 V1.3	• Amendment in Instruction Set Details to CAL(S) command in to add details of OUT 1 1 message. • Amendment in Instruction Set Details to AMP(S) command to add new modes. • Amendment in Instruction Set Details to DTG(S) command to correct typing error. • Amendment in Instruction Set Details to DOF command to add new logarithmic and byte packed output formats. • Addition in Instruction Set Details of new STR(S) command to output buffered data. • Addition in Instruction Set Details of new SGA(S) command that allows use of phased array sum gain • Addition in Instruction Set Details of new DCM command to allow new data compression modes. • Addition of Section 6.7 giving rear input/output connector details • Amendments to command language overview and Output messages sections to reflect new commands
Dec 2008 V1.4	• Addition of appendix on Introduction to programming Focal Laws • Addition of appendix on Full Matrix Capture (FMC) Mode and FMC individual Channel Echo Gate Trigger Mode • Addition of appendix on Backward Compatibility modes with the BAB Command • Addition of appendix on MicroPulse LT Command differences • Addition of appendix on MicroPulse LT Connector Details • Amendments to output messages section • Amendments to Commands AMP, DFIL, DSET, DRTE, ETM, GPL, GPH, IGT
Jan 2009 V1.5	• Amendment to description of MP5 reset message format • Correction to Rear Input/output Connector specification to C-Key.
Sept 2010 V1.6	• Addition of multi-gate commands • Addition of group commands • Addition of example of group in appendix • Addition of ENCM,ENCT,ENCF,ECON,SCHK,GIN,TGA commands Add 31 and 32 to AMP • Addition of new output messages • Addition of 3 db points for conventional filters • Addition of note on INE about carriage return • Changed LT wire descriptions Pink or Red and Green/yellow for LT cable • DAC address range 32760 on MPLT • Addition of SNM command • Addition of example programming files

Date and Document Revision	Changes Made
Oct 2010 V1.7	• Addition of third parameter to ACNT command • Amendment as TGA is now available on MPLT • Amendment to MPE max now 100000 • Addition of Declaration of CE Conformity
Oct 2011 V1.8	• RST output message addition of more PA channels • Various limit increases to SPA,FLR,FLZ • Number of sweeps increased to 31 • MAS command • Addition of # comment character in Section 2. Code versions 1_47 and above. • Added DLIN command description • STS command added -2,-3 and 20 • Correction of LLC,LCI and LCA message descriptions • ETM command extra note. • Addition of FDEF command.
Nov 2012 V1.9	• Changed title to 6.9 on contents page • DRTE parameters and example corrected • ETM mode 3 changed reference to appendix 6.4 • STS command added mode 6 to read input/output line status • RXF addition of reference to possible slave channels • TXF addition of reference to possible slave channels, • TXF command minor correction to the example and addition of 'T' channel • Section 4.2 RST message, addition of top bit set of byte 18 indicates extra transmit (T) channels • also changed bits 4 - 6 for future use • Update to CE declaration • CPIN note on extended I/O availability added • INE note on extended I/O availability added • On encoder input circuit notes remove 12 Volt encoder note. • Added note on second I/O connector plus Figure 6.13.2 INE Input Circuit and Figure 6.13.3 CPIN Output Circuit • Added new section on optional motor connector • RST - changed frequency parameter to [] optional • SDS - changed DOF parameter to [] optional • Added ENCO, FLY, JIT, MOV, MOVU, MRE, SPR, SPQ, SRST, STOP command in details and in overview • Added note on LEMO 00 connectors in section 6.9 • Added note on extra Hypertronic connectors in section 6.10 • Added note to section 6.8 on rack-mounting version