

## Description

Precision DDS function generator modules that offer high quality sine and square waves up to 25MHz (7029 & 7029A) and 50MHz (7031 & 7031A). Further features include noise generation, complex waveshapes, true pulse generator mode with variable rise and fall times, and 128K word arbitrary waveforms.

Extensive internal and external modulation capabilities include AM, FM, PM, PWM & FSK using any waveshape including noise. Full remote control facilities are available using USB connection on the rear of the CalBench console or connection internally to the control centre modules (upon request). Arbitrary waveforms can be saved and loaded via a front mounted USB flash drive socket.

The 7029 and 7031 are dedicated single channel generators, the 7029A and 7031A are dual channel versions that have two identical full performance channels.

These modules are suitable for testing applications, research and development, and diagnostics. Each one provides a simple operation solution to signal generation on the CalBench.

## Features

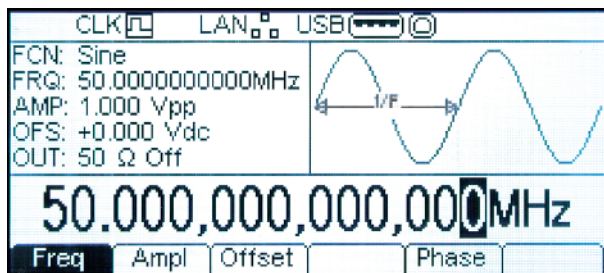
- 0.001mHz to 25MHz (7029 & 7029A) / 50MHz (7031 & 7031A); 1 $\mu$ Hz resolution
- 7029/7031: Single Channel / 7029A/7031A: Two Channel
- Arbitrary waveforms of up to 128K points at up to 125MS/s
- True pulse generator with variable delay and variable rise/fall
- Comprehensive internal & external digital modulations including AM, FM, PM, PWM & FSK
- Standard waveforms: sine, square, ramp, pulse, sin(x)/x, noise, exponential & logarithmic
- Waveform storage using USB flash drives
- Large graphic LCD with simultaneous text & waveform display
- Waveform Manager Plus for Windows software included
- Programmable via USB interface (internal to control centre)





### Features in Detail

#### High Waveform Frequencies



#### Exceptional frequency precision

The frequency of these waveforms can be set with up to 14 digits or one micro hertz of resolution. The DDS based frequency generation system uses a TCXO timebase oscillator with a stability of 1ppm.

#### Waveform Quality

The 7031 and 7029 generate high purity sine waves with low harmonic distortion and low phase noise. Square waves have a rise time of below 8ns (13ns on 7029) and low overshoot. Variable symmetry can be used up to 25MHz.

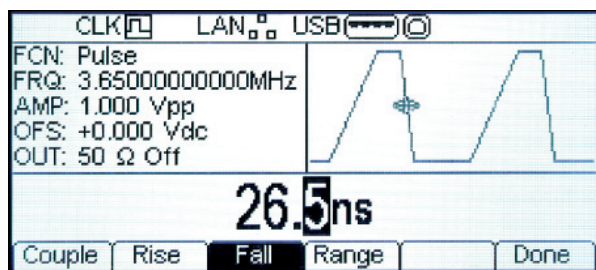
#### Triangle and Ramp

High quality triangle and variable symmetry ramp waveforms are available up to 500kHz (7031) or 250kHz (7029). These waveforms are also available at higher frequencies via the arbitrary function but without symmetry adjustment and with reduced waveform quality as the frequency increases.

#### VLF generation

The high resolution of the DDS system means that very low frequencies can be set. For example, a frequency of around 1mHz could be set with a resolution of 0.1% and a stability of 1ppm.

#### Full Pulse Generator capabilities



Both models incorporate a pulse generator mode which provides wide range pulse width and delay independent of period. Rise and fall times (edge speeds) are also fully variable.

#### Wide-range repetition rate

On the 7031, the pulse period can be set between 80ns and 2000 secs. (0.5mHz to 12.5MHz) with a resolution of 14 digits or 1μHz. On the 7029, the minimum pulse period is 160ns (6.25MHz).

#### Fully variable pulse Width and Delay

Pulse width and pulse delay can be independently set to a resolution of 10ns. Minimum pulse width is 20ns and duty cycles can be as low as one in two billion.)

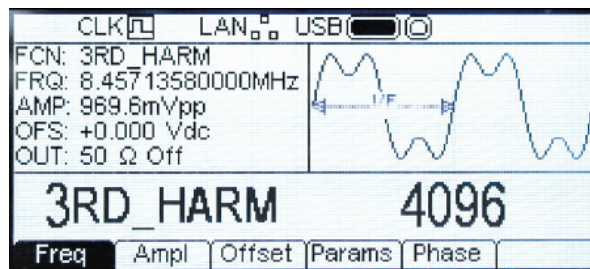
#### Independently variable Rise and Fall

The generators offer very fast edge speeds of better than 8ns on the 7031 or 13ns on the 7029, but the edges can be slowed down to simulate slower pulses. Rise and fall times are independently variable in the range 5ns to 40us (10ns to 40us on the 7029), or can be linked so that both edge speeds are the same.

#### Trigger, Burst and Gate

As with all other waveforms, pulses can be triggered from an external trigger input (or manual trigger, the internal trigger generator or a Bus command). Burst mode creates a burst of between one and a million pulses in response to each active edge of the trigger. Gated cause pulses to be generated only when the gate signal is true. The gate source can be external or internal exactly as the trigger signal.

#### Arbitrary Waveforms



Both generators offer DDS generated arbitrary waveforms capability. A number of standard waveforms are included, and up to four user defined arbitrary waveforms can be stored in the instrument at any one time.

#### 14 bits, 128k words, 125MS/s

Waveforms have a vertical resolution of 14 bits (16,384 amplitude levels). Waveforms can be created using between 2 and 131,072 points (128k). The sampling rate is 125MHz and DDS techniques are used to provide any repetition rate between 1uHz and 10MHz (7031) or 6MHz (7029) with up to 14 digits of frequency resolution.

#### Internal and External Waveform Storage

Up to four user defined waveforms totalling up to 256k words can be stored within the permanent internal memory of the instrument. However, a front mounted USB port enables external Flash memory storage of up to 1000 waveforms of any size.

The memory stick also provides a quick and convenient method for transferring waveform files to and from a PC. It can also be used for storing instrument set-ups.

#### USB Flash Drive Interface



Both instruments incorporate a front mounted USB socket for connection of flash memory disk drives which can store up to 1,000 waveforms and 1,000 setups.

#### Unlimited Waveform Storage

These drives can be used both to store waveforms permanently and to transfer waveforms from or to a PC. Arbitrary waveform storage within the instrument is limited to four waveforms. Each flash drive can store up to 1000 waveforms which can be accessed using the instruments file handling utilities.

#### Storage of Instrument Set-ups

Up to nine complete set-ups of the instrument can be stored within its own non-volatile memory. Up to 1000 further set-ups can be stored on each flash drive.

#### PRBS Waveforms

A PRBS (Pseudo-Random Bit Sequence) is a binary waveform with a sequence that is almost impossible to predict. PRBS waveforms are used within secure communications systems.

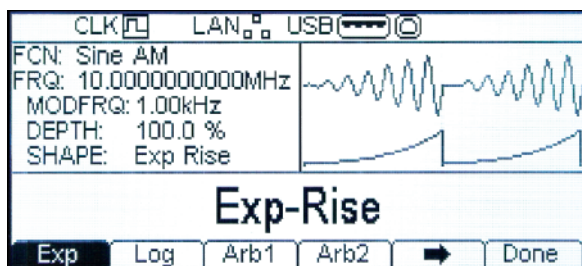
A PRBS is generated by a linear-feedback shift register with taps that generate a feedback signal via an exclusive-OR gate. The number of stages determines the sequence length (2N-1) whilst the clock frequency determines the bit rate. The stage length can be set to 7, 9, 11, 15, 20, or 23, resulting in sequence lengths from 127 to 8,388,607 bits at rates between 1μbps to 50Mbps. Edges have variable rise and fall as per pulse waveforms.

The PRBS waveform can be used as both a carrier and a modulator.



### Features in Detail

#### Digital Modulation, Internal & External



Both generators offer a comprehensive set of digitally based modulations. The internal modulation source can use any of the standard or arbitrary waveforms currently within the generator (including noise) thus removing the need for an external modulation source. A modulating frequency between 1 $\mu$ Hz and 20kHz can be specified. An external modulation input enables any external waveform source to be used when required. The external bandwidth is DC to 20kHz.

#### AM, FM and PM

Sine, square, ramp or arbitrary waveforms can be modulated using amplitude, frequency or phase modulation. Amplitude depth is variable from 0.0% to 120.0%, frequency deviation from zero to  $F_{max}/2$ , and phase deviation from -360.0 to +360.0 degrees.

#### PWM

Pulse width modulation is available for the pulse function using any standard or arbitrary waveform including noise. Pulse width deviation is variable between 0% and 100%.

#### Sum

Sum modulation adds the modulating waveform to the carrier. It can be used with Sine, Ramp and Arbitrary carrier waveforms along with any modulating waveform.

#### FSK and BPSK

Frequency shift keying between any two frequencies is available for sine, square, ramp or arbitrary waveforms using the internal trigger generator or an external trigger signal.

*The internal trigger generator is variable between 2MHz and 1MHz with nine digit resolution.*

BPSK (Binary Phase Shift Keying) is similar to FSK but it is the carrier's phase, rather than its frequency, that switches between two values. It has advantages in terms of bandwidth used.

#### PRBS

A PRBS waveform can be used as a modulating waveform at bit rates between 1ubps to 1Mbps.

#### Noise Generation

Models can generate gaussian white noise to a -3dB bandwidth of 20MHz. The noise generation algorithm achieves a high crest factor (peak to rms ratio) of 5.27.

#### Adding Noise to a waveform

Noise can be added to any waveform except pulse. The amount of noise added can be specified as 0% to 50% of the amplitude of the carrier waveform.

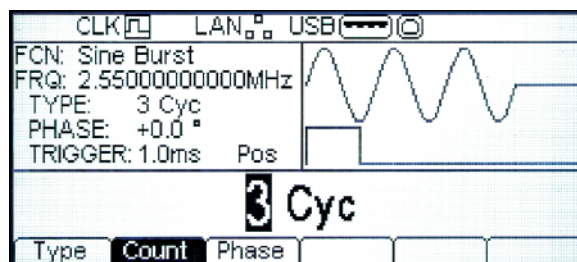
#### Modulating with Noise

Noise can be used as the modulating waveform for AM, FM, PM or PWM modulations using any carrier waveforms allowable for that modulation type.

#### Remote Control

All functions of the generators can be controlled from the USB interface. Arbitrary waveform data can also be loaded. An IVI driver for Windows is supplied. As well as the rear mounted USB device interface connector, a front mounted USB Host interface connector allows USB Flash memory to be connected.

#### Sweep and Burst



Sweep, Burst and Gated modes of operation are available using either an external trigger signal or the internal trigger generator.

#### Wide range Frequency Sweep

Phase continuous sweep is available for all standard and arbitrary waveforms except for pulse. The sweep range is from 1 $\mu$ Hz through to the maximum for the chosen carrier waveform. Start and stop frequencies can be set independently. The sweep can be linear or logarithmic, triggered or continuous with a period between 1ms and 500s. The sweep trigger can be manual or internal from the trigger generator or external from the trigger socket or from a remote interface command.

A marker is provided that outputs an edge synchronous with any frequency point within the sweep.

#### Triggered Burst

In Burst mode, each active edge of the trigger will produce one burst of the waveform. The number of cycles in a burst can be set between 1 & 1,048,575 (or infinite). The burst starts and ends at a waveform phase angle settable between -360.0 to +360.0 degrees.

#### Trigger signal

The trigger signal can be manual from the front panel key, internal from the internal trigger generator, external from the trigger-in socket, or remote via a bus command.

The trigger-in socket has a nominal TTL threshold and can be set to +ve edge or -ve edge triggering. The minimum trigger pulse width is 50ns. The internal trigger generator is variable between 2MHz and 1MHz with 9 digit resolution.

#### Gated

In Gated mode the waveform runs only when the gate signal is true. The start point of the waveform is settable from -360.0 to +360.0 degrees and a the last cycle is completed after the gate signal goes false. All of the options available for triggering are available for gating. The trigger-in socket can be set as high or low for true.

#### Locking to Other Sources

Both the models include external reference and phase locking as standard.

#### External Frequency Reference

The generators use a high quality TCXO crystal as the internal frequency reference providing 1ppm accuracy and stability.

If a higher accuracy or stability is required, an external 10MHz reference signal (from an off-air standard for example) can be applied to the Ref. Clock input.

#### Phase Locking Two Generators (or more)

Two generators can be synchronised together to provide outputs at the same frequency (or at harmonics) and with a phase difference. The amplitude and phase of these outputs can also be modulated providing the capability to perform QAM and QPSK respectively.

Any waveform other than pulse can be used, and the phase difference is adjustable between -360.0 and +360.0 to a resolution of 0.1 degrees.

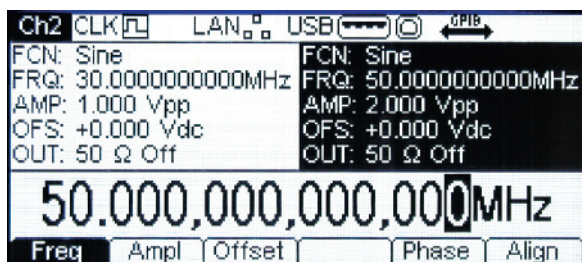
Skew is better than 5ns. It is also possible to synchronise more than two generators but the resulting precision is not specified.



### Features in Detail

#### Two Channel Operation

(7029A & 7031A only)



The generators are available in one channel or two channel versions, the latter incorporating two outputs with identical capabilities.

Two channel generators, both channels provide the full performance and specification, along with entirely independent operation when required.

#### Individual or Combined Display

The graphic LCD can be switched to show either output individually, or can be set to show the parameters or waveforms for both channels simultaneously.

In the latter mode the currently selected channel is shown in reverse video.

#### Independent Channel Operation

The two channels can be operated completely independently as if they were two separate generators.

#### Coupled Operation

The frequencies of the two channels can be coupled such that if frequency of one channel is changed the frequency of the other channel also changes either by a fixed ratio or fixed offset.

Frequency coupling can be performed if the carrier waveforms on both channels are either Sine, Square, Ramp, Pulse or Arbitrary.

Amplitudes (and DC offsets) of the two channels can be coupled such that changing the amplitude and offset on one channel changes the amplitude and offset of both channels.

Outputs of the two channels can be coupled such that switching the output on/off on one channel switches the output on/off of both channels.

#### Tracking Operation

When in tracking mode both channels behave as one channel. If inverse tracking is selected, both channel still behave as one channel except that the output of channel 2 is inverted.

#### Relative Phase

The relative phase can be set from -360 degrees to +360 degrees with 0.1 degree resolution. Pressing the 'align' key phase synchronises the two channels with the specified phase offset.

#### Cross Channel Trigger

Either channel can be triggered by the other channel to set up a complex and versatile inter channel trigger scheme.

Each channel can have its trigger output waveform set up independently. Trigger Out may be selected to be carrier waveform referenced, modulation waveform referenced, sweep referenced, burst referenced or currently selected trigger of the channel.

#### Waveform Manager Plus

Waveform Manager Plus is a Windows based application for creation, editing and management of arbitrary waveforms using a PC.

It incorporates a complete suite of tools for waveform creation and editing including standard waveforms, mathematical expressions and freehand drawing. Virtually any waveform can be created using combinations of these tools.

#### Mathematical Expression Editor

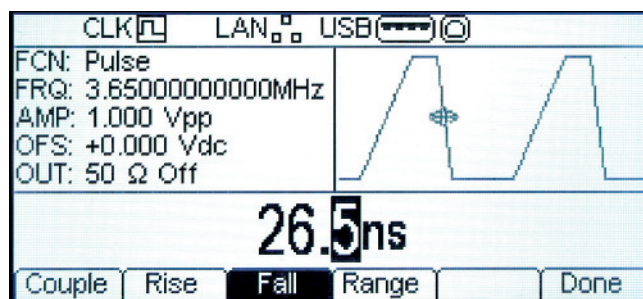
The sophisticated mathematical expression editor allows geometric, logarithmic and pulse functions to be combined to create exact representations of complex signals. Different expressions can be used for different sections of a waveform and can be combined with imported waveforms or drawn waveforms where mathematical representation is not possible.

#### Import of Other Waveforms

The program offers direct import from .csv files, the most commonly used format for graphical description. Additionally a Clipboard import function supports any waveform that can be described by a set of Y-axis data points regardless of their format.

Any instrument or waveform generating program that can create a list of Y values can therefore be accommodated. This is a highly flexible method which can be used to create arbitrary generator waveforms from signals captured by instruments such as oscilloscopes and network analysers, or from software such as MathCad.

#### High Resolution LCD Display and Soft Key Controls



The 3.6" diagonal panel uses 256 x 112 pixels and provides a large amount of simultaneous information. System connection information is shown on the top line. Below that is a general status screen showing five major parameters. These parameters change depending upon the function being used. Below the status information is the main editing line which shows the parameter currently under control.

#### Representative Waveform Display

The area to the right of the status section shows a representation of the current waveform. This is more than just a fixed display for each waveform, it is calculated from the waveform parameters and gives a live indication when values such as symmetry, rise time or pulse width are changed. Even user defined arbitrary waveforms are shown (subject to the limitations of the display resolution). Modulation waveforms & representations of the modulated carrier are shown simultaneously. Burst count waveforms are shown graphically.

#### Soft Key Control

Six soft keys below the display provide access and control of the parameters for each function. All numeric parameters can be set directly from the numeric keypad, or can be changed using the spin wheel. Period entry can be chosen instead of frequency, and amplitude and offset can be changed to Hi and Lo levels. Frequencies can be entered in any units from uHz to MHz, periods from ns to seconds, and amplitudes in mV or V, rms or pk-pk, or in dBm. The currently selected waveform and major functions are also indicated by illumination of the respective keys.



## Technical Specifications

### Waveforms

#### Sine

Frequency range	1 $\mu$ Hz to 50 MHz (7029 - 1 $\mu$ Hz to 25 MHz).	
Frequency resolution	1 $\mu$ Hz, 14 digits.	
Output level	10 mV p-p to 10 V p-p into 50 Ohms.	
Amplitude flatness (Relative to 1kHz)	< 100kHz 0.1dB, < 5 MHz 0.15 dB, < 20 MHz 0.3 dB, < 50 MHz 0.5 dB.	
Harmonic distortion	< 1 Vp-p	$\geq$ 1Vp-p
	DC to 20 kHz	-65dBc
	20 kHz to 100 kHz	-60dBc
	100 kHz to 1 MHz	-45dBc
	1 MHz to 25 MHz	-40dBc
	25 MHz to 50 MHz	-40dBc
Non-harmonic spuri	<-60 dBc to 1 MHz, <-60 dBc + 6 dB/octave 1 MHz to 50 MHz.	
Phase noise	(10 kHz offset): -115 dBc/Hz, typical.	

#### Square

Frequency range	1 $\mu$ Hz to 50 MHz (7029 - 1 $\mu$ Hz to 25 MHz).	
Frequency resolution	1 $\mu$ Hz, 14 digits.	
Output level	10 m Vp-p to 10 Vp-p into 50 Ohms.	
Rise and fall times	<8 ns (7029 - <13ns).	
Overshoot	<5 %.	
Variable duty cycle	20 % to 80 % to 10 MHz, 0.1 % resolution, 40 % to 60 % to 25 MHz, 0.1 % resolution, 50 % (fixed) above 25 MHz.	
Asymmetry (@ 50 % duty)	1 % of period + 5 ns.	
Jitter (RMS)	0.5 ns + 100 ppm of period.	

#### Ramp and Triangle

Frequency range	1 $\mu$ Hz to 500 kHz (7029 - 1 $\mu$ Hz to 250 kHz).	
Frequency resolution	1 $\mu$ Hz, 12 digits.	
Output level	10 mVp-p to 10 Vp-p into 50 Ohms.	
Linearity error	<0.1 % to 30 kHz.	
Variable symmetry	0.0 % to 100.0 %, 0.1 % resolution. Single key operation of 50 % (Triangle).	
Note the triangle and sawtooth waveforms are also available from the arbitrary waveform menu enabling repetition rates of up to 10 MHz / 6 MHz. Waveform quality will deteriorate at higher frequencies however.		

#### Pulse

Frequency range	500 $\mu$ Hz to 12.5 MHz (7029 - 500 $\mu$ Hz to 6.25 MHz).	
Frequency resolution	1 $\mu$ Hz, 14 digits.	
Output level	10 mVp-p to 10 Vp-p into 50 Ohms.	
Overshoot	<5 %.	
Jitter	300 ps + 0.01 % of period.	
Rise/Fall times	Rise and Fall times can be independently varied or can be varied together simultaneously.	
Range	<8 ns to 40 $\mu$ s (7029 - <13 ns to 40 $\mu$ s).	
Resolution	0.1 ns for rise/fall time $\leq$ 100 ns; 1 ns for rise/fall >100 ns and $\leq$ 2 $\mu$ s; 10ns for rise/fall >2 $\mu$ s and $\leq$ 40 $\mu$ s).	
Width range	20 ns to 2000 s (20 ns minimum for period $\leq$ 40 s) (200 ns minimum for period >40 s and $\leq$ 400 s) (2 $\mu$ s minimum for period >400 s).	
Width Resolution	10 ns (for period $\leq$ 40 s), 100 ns (for period >40 s and $\leq$ 400 s), 1 $\mu$ s (for period >400 s).	
Delay Range	0 ns to 2000 s.	
Delay Resolution	10 ns (for period $\leq$ 40 s), 100 ns (for period >40 s and $\leq$ 400 s), 1 $\mu$ s (for period >400 s).	

#### Arbitrary

In built arbitrary waveforms (Sinc, Exponential Rise, Logarithmic Rise, DC, Positive and Negative Ramps and Square). Additional waveforms are supplied on disc (Cardiac, Gaussian, Exponential Fall, Logarithmic Fall). Up to 4 additional or user defined waveforms may be stored in non-volatile memory. Waveforms can be defined by downloading of waveform data via USB memory stick, remote interfaces, or editing via the modules front panel.

Waveform size	2 points to 131072 points (128 k).	
Waveform memory size	Up to 4 waveforms of up to 64 k points, or 2 waveforms of up to 128 k points, (or 2 of 64 k points plus 1 of 128 k points).	
External waveform storage	up to 1,000 waveforms per USB memory stick.	
Vertical Resolution	14 bits.	
Frequency Range	1 $\mu$ Hz to 10 MHz (7029 - 1 $\mu$ Hz to 6 MHz).	
Frequency Resolution	1 $\mu$ Hz, 14 digits.	
Output Level	10 mVp-p to 10 Vpp into 50 Ohms.	
Sampling rate	125 MS/s.	
Output filter	Selects between 50 MHz Elliptic or 20 MHz Bessel filter depending on the waveform.	

#### Arbitrary Waveform Creation and Editing

Both generators are supplied with Waveform Manager Plus. This Windows based software provides a sophisticated tool set for the creation, editing and management of arbitrary waveforms. The waveforms can be transferred to the generator either using a USB memory stick, or by the digital interfaces.

#### Noise

Gaussian white noise can be added to any carrier waveform (except pulse, square and noise itself) note however that noise can be added to the square wave available in the arbitrary menu. The amount of noise added can be specified as 0 % to 50 % of the amplitude of the carrier waveform. Noise can be used as modulating waveform.		
Bandwidth (-3 dB)	20 MHz typical.	
Noise crest factor (Vp/Vrms)	5.27.	
Output Level	10 mVp-p to 10 Vpp into 50 Ohms.	

#### Internal Frequency Reference

Oscillator Ageing Rate	1 ppm first year.	
Temperature Stability	<1 ppm over the specified temperature range.	



## Technical Specifications (continued)

### Modulation

#### AM

Carrier waveforms.....Sine, Square, Ramp, Arb.  
 Modulation Source.....Internal/External.  
 Internal Modulating Waveforms.....Sine, Square, Up Ramp, Down Ramp,  
 Triangle, Noise, DC, Sinc, Exponential Rise,  
 Logarithmic Rise and User Defined Arbs.  
 Internal modulating frequency .....1  $\mu$ Hz to 20 kHz, 1  $\mu$ Hz resolution  
 Amplitude depth .....0.0 % to 120.0 %, 0.1 % resolution

#### FM

Carrier waveforms.....Sine, Square, Ramp, Arb  
 Modulation source.....Internal/External  
 Internal modulating waveforms.....Sine, Square, Up Ramp, Down Ramp,  
 Triangle, Noise, DC, Sinc, Exponential Rise,  
 Logarithmic Rise and User Defined Arbs  
 Internal modulating frequency .....1  $\mu$ Hz to 20 kHz, 1  $\mu$ Hz resolution  
 Frequency deviation.....DC to Fmax/2, 1  $\mu$ Hz resolution

#### PM

Carrier waveforms .....Sine, Square, Ramp, Arb  
 Modulation source.....Internal/External  
 Internal modulating waveforms.....Sine, Square, Up Ramp, Down Ramp,  
 Triangle, Noise, DC, Sinc, Exponential Rise,  
 Logarithmic Rise and User Defined Arbs.  
 Internal modulating frequency .....1  $\mu$ Hz to 20 kHz, 1  $\mu$ Hz resolution  
 Phase deviation.....-360.0 to +360.0 degrees,  
 0.1 degree resolution

#### PWM

Carrier waveforms.....Pulse  
 Modulation source.....Internal/External  
 Internal modulating waveforms.....Sine, Square, Up Ramp, Down Ramp,  
 Triangle, Noise, DC, Sinc, Exponential Rise,  
 Logarithmic Rise and User Defined Arbs.  
 Internal modulating frequency .....1  $\mu$ Hz to 20 kHz, 1  $\mu$ Hz resolution  
 Pulse width deviation .....0 % to 100 % of pulse width, resolution  
 same as of pulse width

#### FSK

Carrier waveforms.....Sine, Square, Ramp, Arb  
 Source.....Internal/External (via TRIG IN)  
 Internal modulation.....50 % duty cycle square (2 mHz to 100 kHz)

#### Triggered Burst

Each active edge of the trigger signal will produce one burst of the waveform.  
 Carrier waveforms.....Sine, Square, Ramp, Arb, Pulse  
 Maximum carrier frequency .....10 MHz (finite cycles), 50 MHz (infinite),  
 subject to carrier waveform.  
 Number of cycles .....1 to 1,048,575 and infinite.  
 Trigger repetition rate .....2 mHz to 1 MHz internal dc to 1 MHz external.  
 Trigger signal source .....Internal from keyboard or trigger generator.  
 External from TRIG IN or remote interface.  
 Trigger start/stop phase .....-360.0 to +360.0 degrees, 0.1 degree  
 resolution, subject to carrier waveform

#### Gated

Waveform will run while the Gate signal is true and stop while false.  
 Carrier waveforms.....Sine, Square, Ramp, Arb, Pulse, Noise  
 Maximum carrier frequency .....10 MHz, subject to carrier waveform  
 Trigger repetition rate .....2 mHz to 1 MHz internaldc to 1 MHz external.  
 Gate signal source .....Internal from keyboard or trigger generator.  
 External from TRIG IN or remote interface.  
 Gate start/stop phase.....-360.0 to +360.0 degrees, 0.1 degree  
 resolution, subject to carrier waveform

#### Sweep

Frequency sweep capability is provided for both standard and arbitrary waveforms.  
 Carrier waveforms.....All standard and arbitrary except pulse.  
 Sweep mode .....Linear or logarithmic, triggered or continuous.  
 Sweep direction.....Up, down, up/down or down/up.  
 Sweep range .....From 1  $\mu$ Hz to 50 MHz, subject to carrier  
 waveform. Phase continuous. Independent  
 setting of the start and stop frequency.  
 Sweep time .....1 ms to 500 s (6 digit resolution).  
 Marker .....Variable during sweep.  
 Sweep trigger source .....The sweep may be free run or triggered from  
 the following sources: Internal from keyboard  
 or trigger generator. Externally from TRIG IN  
 input or remote interface.

#### Trigger Generator

Internal source 2 mHz to 1 MHz square wave adjustable in 1 us steps,  
 9 digit resolution. Available for external use from the SYNC OUT socket.

### Outputs

#### Main Output

Output impedance.....50 Ohms  
 Amplitude .....20 mV to 20 Vp-p open circuit  
 (10 mV to 10 Vp-p into 50 Ohms).  
 Amplitude can be specified open circuit (hi Z) or into an assumed load of 1 Ohm  
 to 10 k Ohm in Vpk-pk, Vrms or dBm.  
 Amplitude accuracy.....2 %  $\pm$ 1 mV at 1 kHz into 50 Ohm.  
 DC Offset accuracy.....Typically 3 %  $\pm$ 10 mV.  
 Resolution .....3 digits or 1mV for both Amplitude  
 and DC Offset.

#### Sync Out

Multifunction output user definable or automatically selected to be any of the  
 following:

Carrier Waveform Sync: The function varies with waveform type as follows:  
 Sine/Ramp/Pulse - A square wave with 50% duty cycle at the waveform frequency.

Square - A square wave with same duty cycle as the main output at the waveform  
 frequency.

Arbs - A square wave with 50% duty cycle at the waveform frequency. The sync is a  
 TTL high when the first point of the waveform is output.

Noise - No sync associated with noise.

Modulation Sync: The function varies with modulation type as follows:

AM/FM/PM/PWM - A square wave with 50% duty cycle referenced to the  
 internal modulation waveform when modulation source is internal, or a square  
 wave referenced to the carrier waveform when modulation source is external.  
 No sync is associated with noise as the modulation source.

FSK - A square wave referenced to the trigger rate. The sync is a TTL high when  
 hop frequency is the output frequency and TTL low when.

Burst sync .....A square wave that is a TTL high when the  
 burst begins and a TTL low  
 when burst is completed.  
 Trigger .....Selects the current trigger signal. Useful for  
 synchronizing burst or gated signals.  
 Sweep sync.....Marker Off - A square wave that is a TTL  
 low from the midpoint of the sweep and a TTL  
 high from the end of the sweep.  
 Marker On - A square wave that is a TTL low  
 from the marker frequency and a TTL high  
 from the end of the sweep.  
 Output signal level.....Logic level nominally 3 V.

#### Ref Clock Output

Buffered version of the 10 MHz clock currently in use (internal or external)  
 Output level.....Nominally 3 V logic level from 50 Ohm.

### Inputs

#### Trig In

Frequency range .....DC - 1 MHz.  
 Signal range.....Threshold nominally TTL level; max input  $\pm$ 10V.  
 Minimum pulse width .....50 ns  
 Polarity .....Selectable as high/rising or low/falling edge.  
 Input impedance.....10 kOhm

#### External Modulation Input (for AM, FM, PM, PWM)

Voltage range ..... $\pm$  5 V full scale  
 Input impedance.....5 k Ohm typical  
 Bandwidth .....DC to 20 kHz  
 Ref clock input

#### Input for an external 10 MHz reference clock

Voltage range .....1 Vpp – 5 Vpp  
 Maximum voltage.....+5 V  
 Minimum voltage.....-1 V



## Technical Specifications (continued)

### Two Channel Operation

The two channels can be operated independently so as to act as entirely separate generators.

Alternatively the channels can interact as follows:

#### Coupled Operation

- Coupled Frequency .....Frequencies can be coupled such that if frequency of one channel is changed the frequency of the other channel also changes either by a fixed ratio or fixed offset. A pulse waveforms can only be frequency coupled to another pulse waveform, however sine, square, ramp or Arb waveforms can be coupled to any other waveform of that group.
- Coupled Level.....Amplitudes (and DC offsets) of the two channels can be coupled such that changing the amplitude and offset on one channel changes the amplitude and offset of both channels.
- Coupled On/Off: .....Coupling can be set such that switching the output on/off on one channel switches the output on/off of both channels.

#### Tracking Operation

When in tracking mode both channels behave as one channel.

If inverse tracking is selected, both channel still behave as one channel except that the output of channel 2 is inverted.

#### Relative Phase

Pressing the 'align' key phase synchronises the two channels with the specified phase offset.

- Phase Range.....-360.0 to +360.0 degrees
- Resolution.....0.1 degree
- Skew (typical) .....<1ns

#### Cross Channel Trigger

Either channel can be triggered by the other channel to set up a complex and versatile inter channel trigger scheme.

Each channel can have its trigger output waveform set up independently. Trigger Out may be selected to be carrier waveform referenced, modulation waveform referenced, sweep referenced, burst referenced or the currently selected trigger of the channel.

#### Crosstalk

- Channel Crosstalk .....Typically better than 80dB

#### Control and Display

The control of each channel is selected by the Channel Select key.

The display can be assigned either completely to the selected channel, or the upper section can display the main set-up parameters or waveforms for both channels simultaneously.

## PHASE SYNC (Phase Synchronising Two Generators)

Two generators can be synchronised together to provide outputs at the same frequency (or harmonics) and with a phase difference.

The amplitude and phase of these outputs can also be modulated providing the capability to perform QAM and QPSK respectively.

In case of 2 channel generators when phase synchronising is performed the two channels of each generator are also synchronised providing four synchronous waveforms.

- Carrier Waveforms .....Sine, Square, Ramp, Pulse, Arb
- Phase Range.....-360.0 to +360.0 degrees
- Resolution.....0.1 degree
- Accuracy.....< ±5ns

## General Specifications

- Display.....Black on white backlit graphics display - pixel format: 256 x 112
- Interface.....Standard USB 2.0 hardware connection. Implemented as virtual-COM port.
- USB Flash Drive.....For waveform and setup storage/recall.
- Data Entry.....Keyboard selection of mode, waveform etc.; value entry direct by numeric keys or by rotary control.
- Stored Settings.....Up to 9 complete instrument set-ups may be stored and recalled from non-volatile memory.
- Module Width.....295mm (primary console fitting only)

## Ordering Information

- 7029.....25MHz Function/Arbitrary/Pulse Generator
- 7031.....50MHz Function/Arbitrary/Pulse Generator
- 7029A.....25MHz Function/Arbitrary/Pulse Generator, two channel
- 7031A.....50MHz Function/Arbitrary/Pulse Generator, two channel