Gooch & Housego

OPERATING MANUAL

DIGITALLY CONTROLLED

FREQUENCY SYNTHESIZER

MODEL NUMBER:

(R)64040-150-0.8ADMDFS-8X1

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SECTION I
INSPECTION

Examine the shipping carton for damage. If the shipping carton or packing material is damaged it should be kept for the carrier's inspection. . Notify the carrier and Gooch & Housego. Check the contents of the shipment for completeness, mechanical damage, and then test the equipment electronically. Operating procedures are contained in Section IX. If the contents are incomplete, or the equipment does not pass the electrical testing please notify Gooch & Housego.

If there is any problem with the use of this equipment, or if the equipment fails to function as expected contact Gooch & Housego, do not try to trouble shoot or repair this equipment. Consult with a Gooch & Housego service engineer. If the equipment needs repair or replacement, contact Gooch & Housego for a Return Authorization Number.

SECTION II
GENERAL DESCRIPTION

64040-150-0.8ADMDFS-8x1

The 64040-150-0.8ADMDFS-8x1 digitally frequency synthesized Driver has eight programmable channels coherently mixed into one output channel with output power of up to 800 mW per channel and supports any AOD Device operating with drive frequencies between 40 and 150 MHz. The Driver can produces up to 8 simultaneous frequencies and, therefore, up to eight simultaneous beams of light from the AOD. The frequency, phase, and amplitude for each beam of light to be output are programmable into the corresponding channels in the driver through the USB connection. If the USB command mode is set to "mod" for each of the channels, the Driver allows independent analog and digital (blanking) control through the D-sub 25 pin connector. The analog power level control through the D-sub 25 pin connector is disabled when the mode is set to "on". A 5 volt signal applied to each channel's Analog input through the D-sub 25 pin connector will output the maximum set RF power level as set through the USB port. The blanking input is active through the D-sub 25 pin connector in both modes.

The 64040-150-0.8ADMDFS-8x1 Driver operates by issuing commands sent through the USB connection. This supports instantaneous changes to the state of each channel and the data stored. A soft ware driver which emulates a standard COM port but connects to a standard USB port is available from FTDI (http://www.ftdichip.com/Drivers/VCP.htm). The commands can be issued through the Windows Hyperterminal program. See the operating section for communication protocol.

(R)64040-150-0.8ADMDFS-8X1

SPECIFICATION

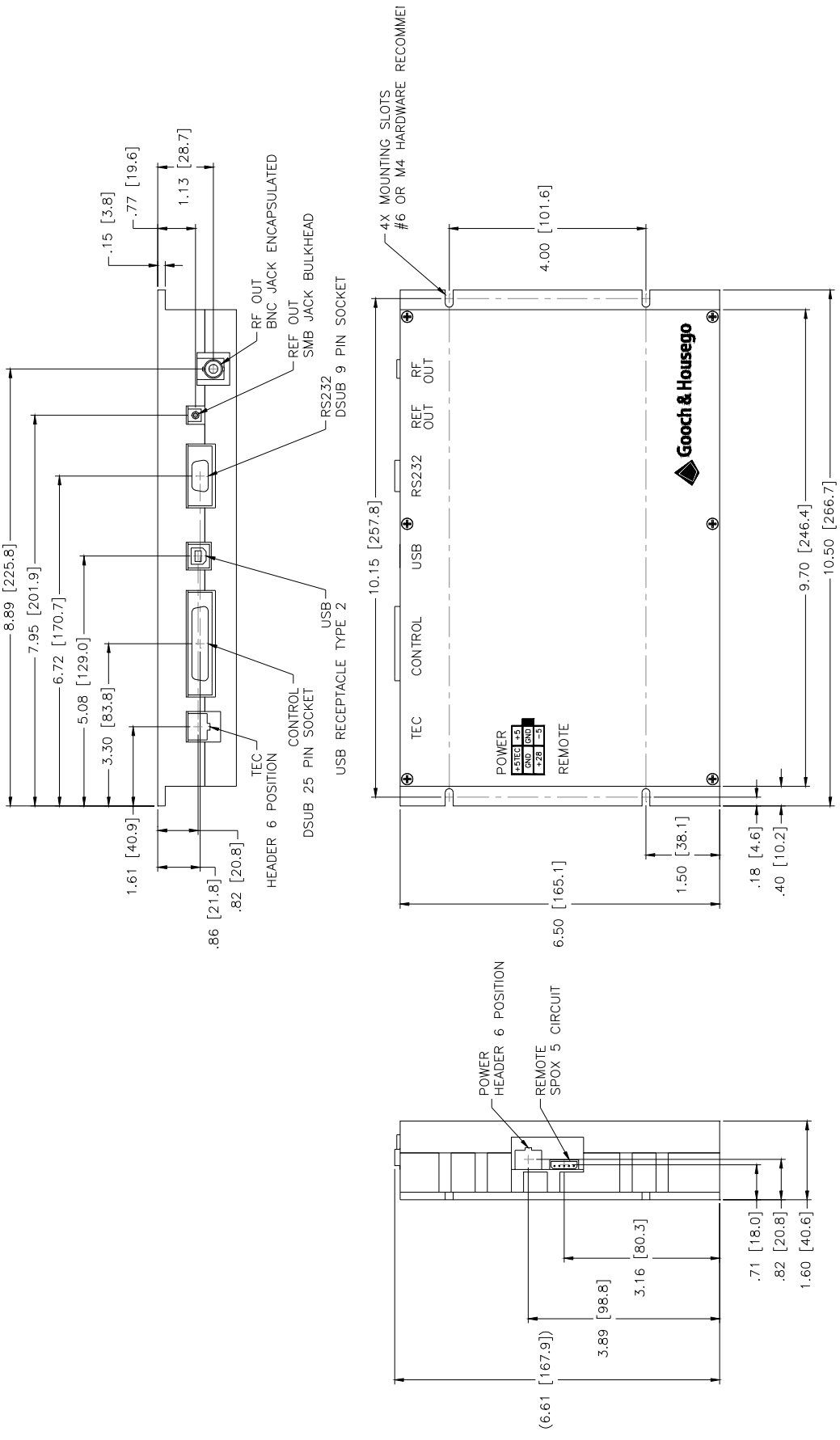
PARAMETER	**SPECIFICATION**
Number of Channels:	8
Frequency Stability:	± .01%
Power Out:	up to 800 mW per channel
Tuning Range:	40 to 150 MHz in 1 kHz Steps
Input through the D-sub 25 pin connector**:**	
Analog Inputs (8):	0-5 volts into 10 k ohms
Blanking Inputs (8):	TTL with 4.7 k ohms pull up TTL HIGH or open = full output (not blanked) TTL LOW = minimum output (blanked)
Rise/Fall Time:	150 ns maximum
Extinction Ratio:	70 dB minimum
Intermodulation Distortion	-30 dBc maximum with 8 equally spaced frequencies of 250 mW each - Phases set to 4π phase mask.
Applied Power:	+28 VDC @ 3A maximum +5 VDC @ 1A maximum - 5VDC @ 1A maximum

Connectors:		Part No.
RF out:	BNC Female	1-1478035-0
Modulation in:	25 Pin D-Sub Female	RDM25SA5
Reference Out	SMB Male	1060464-1
RS-232 interface:	9 Pin D	RDM9SA5
USB interface:	USB B style receptacle*	61729-0010BLF
Power + TEC	6 pin	1-794448-1
Remote (not use currently)	5 pin Spox	22-05-7055

*The software driver connects the communications program to a standard USB port and emulates a standard COM port.
The driver is available from FTDI (http://www.ftdichip.com/Drivers/VCP.htm)
The port is USB 2.0 protocol with a data rate is 300K byte/sec

Outline Drawing: 53D4875

OUTLINE DRAWING



CONTROL SOCKET

D-sub 25 Pin

For Analog Intensity Control and TTL Blanking

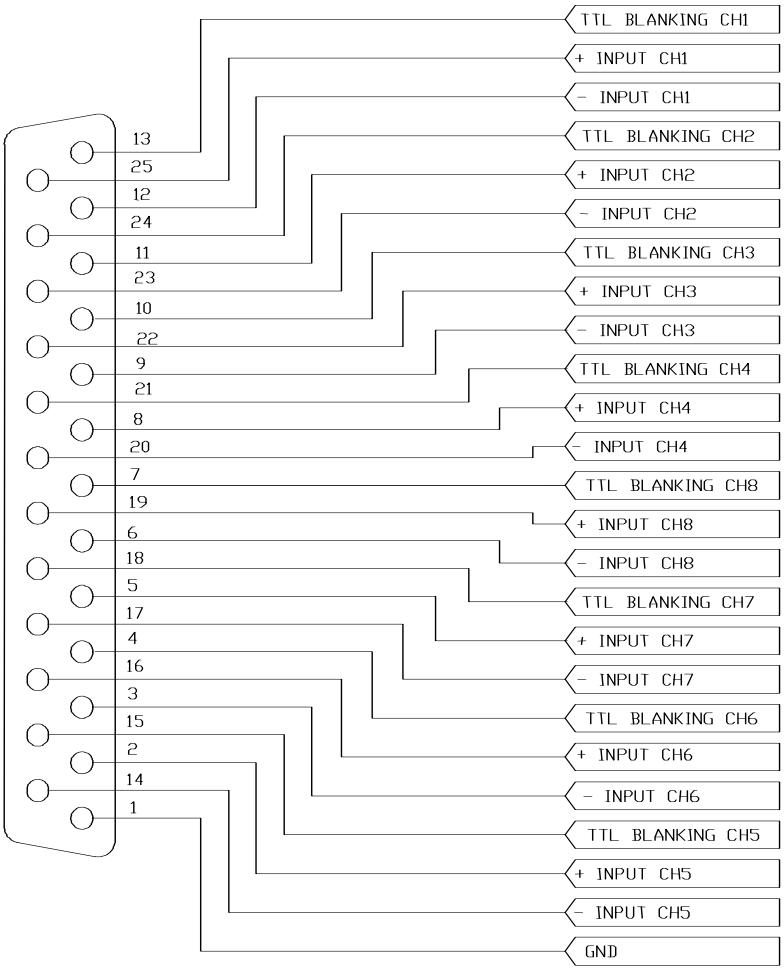


Figure 3
Pinout of TEC connector

Pin No.	Name
1	No Connection
2	GND (Thermistor)
3	No Connection
4	Thermistor
5	TEC P
6	TEC N

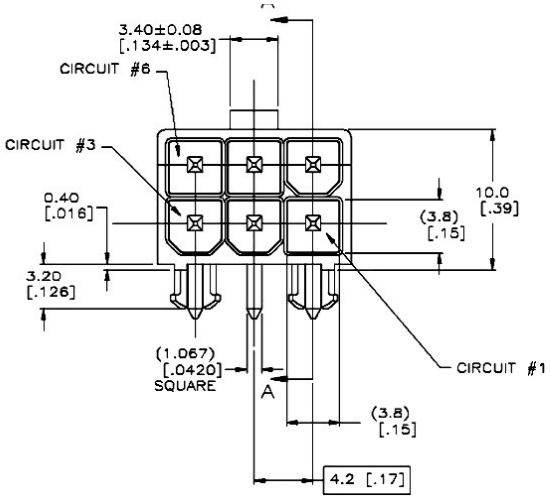


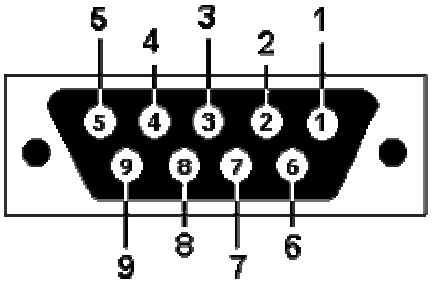
Figure 4

Pinout of Power connector

Pin No.	Name
1	+28V
2	GND
3	+5 V TEC
4	-5V
5	GND
6	+5V

Figure 5
RS 232 connector

Pin No.	Name	Dir	Notes / Description
1	DCD	IN	No Connection
2	RD	IN	Receive Data (a.k.a RxD, Rx). Arriving data from DCE.
3	TD	OUT	Transmit Data (a.k.a TxD, Tx). Sending data from DTE.
4	DTR	OUT	No Connection
5	SGND	-	Ground
6	DSR	IN	No Connection
7	RTS	OUT	No Connection
8	CTS	IN	No Connection
9	RI	IN	No Connection



DB9: View looking into female connector

USB PORT CONTROL COMMANDS

For Frequency, Phase, and Amplitude

There are 7 basic commands that are sent to the Driver by way of the USB port. The port is USB 2.0 protocol with a data rate is 300K byte/sec. These commands set the active Channel the command is sent to, set the phase of the output RF compared to the other channels, and set the amplitude of the channel (up to 800 mW).

Channel select -- "ch#" -- Sets the channel, ch1 through ch8, that commands are being sent to. "**ch0**" will send commands to all 8 channels.

Frequency -- "fr ###.###" -- Sets the frequency of the active channel. Acceptable range in from 40.000 MHz to 150.000 MHz.

Phase* -- "**ph #####"** –Set the phase of the RF relative to the other channels. Input value 0 to 16383.

Amplitude – "am ####" –Sets the amplitude of the active channel. The acceptable range is from 0 to 1023. The output power is proportional to the square of this value.

On Mode – "on" – Sets the active channel to a mode in which the analog modulation control through the 25 pin control port is ignored. The Amplitude is set by the above command.

Modulated Mode – "mod" – Sets the active channel to a mode in which the analog modulation control functions through the 25 pin control port and accepts a 0 to 5 volt signal. The maximum amplitude is set by the above command and the 0 to 5 volt signal varies the amplitude up to that set level .

Off Mode – "off" – Turns off the active channel.

***See the section in the Operating Procedure for setting minimum intermodulation distortion for an AOBD.**

SAMPLE PROGRAMMING STREAM

Example command string setting freq /amplitude/ phase for all 8 channels and then setting them all to "on" mode

```
ch1
fr 60.000
am 1023
ph 0
ch2
fr 66.000
am 1023
ph 334
ch3
fr 72.000
am 1023
ph 6019
ch4
fr 78.000
am 1023
ph 669
ch5
fr 84.000
am 1023
ph 669
ch6
fr090.000
am 1023
ph 6019
ch7
fr 96.000
am 1023
ph 334
ch8
fr102.000
am 1023
ph 0
ch0
on
```

OPERATING PROCEDURE

This driver can produce up to 8 frequencies at the same time and can be used for an AOD so as to produce multiple beams of light at the same time each which can be modulated independently. This driver is not intended for scanning the beams.

Calculate the frequency for each spot position so that each spot is separated from each other to the $1/e^2$ point or to any desired spot spacing. Select the exact frequencies needed for each of the desired beams for your AOD. The frequencies should be calculated to a precision of 1 kHz and should be equally spaced in frequency. Program the driver via the USB port for the frequencies and maximum RF output amplitude. No two channels should be programmed to the same frequency. If you are going to utilize 4 or more channels, then the phase of each frequency should be set to produce a minimum intermodulation distortion. If using less than 4 channels, then set the phase to "0". See the AOD operating manual for instructions on adjusting the Bragg angle and flatness of the intensity of the array of spots. . If the USB command mode is set to "mod" for each of the channels, the Driver allows independent analog and digital (blanking) control through the D-sub 25 pin connector. The analog power level control through the D-sub 25 pin connector is disabled when the mode is set to "on". A 5 volt signal applied to each channel's Analog input through the D-sub 25 pin connector will output the maximum set RF power level as set through the USB port. The blanking input is active through the D-sub 25 pin connector in both modes.

Setting phase for minimum intermodulation distortion for an AOBD:

When a driver is supplying more than one frequency at the same time, a condition can occur in that the RF power of each individual frequency can add up to produce a very large spike of power which can exceed the linear range of the amplifier and, there by, produce intermodulation products with a combined power that limits the dynamic range for modulation. By adjusting the phase of each frequency generated by the driver, you can reduce the intermodulation distortion to a minimum.

The equation for the phases is shown below. If you are using between 4 and 8 frequencies then you should calculate the phases for each frequency. If you are using less than 4 frequencies, then there is little to be gained from adjusting the phase unless the power is at maximum levels. This phase mask works only for frequencies which are <u>equally spaced</u> in frequency and the calculation must be carried to the precision of one kHz.

A typical phase mask for minimum intermodulation distortion is set to a 4 π parabolic value from the following calculation:

$$\text{channel\_number} := 1 .. 8$$

$$\text{phase\_offset}(i) := \text{trunc}\left[\text{mod}\left[\frac{(i-4.5)^2}{3.5^2}\cdot 32768, 16384\right]\right]$$

$$\text{phase\_offset}(\text{channel\_number}) = \begin{pmatrix} 0 \\ 334 \\ 6018 \\ 668 \\ 668 \\ 6018 \\ 334 \\ 0 \end{pmatrix}$$