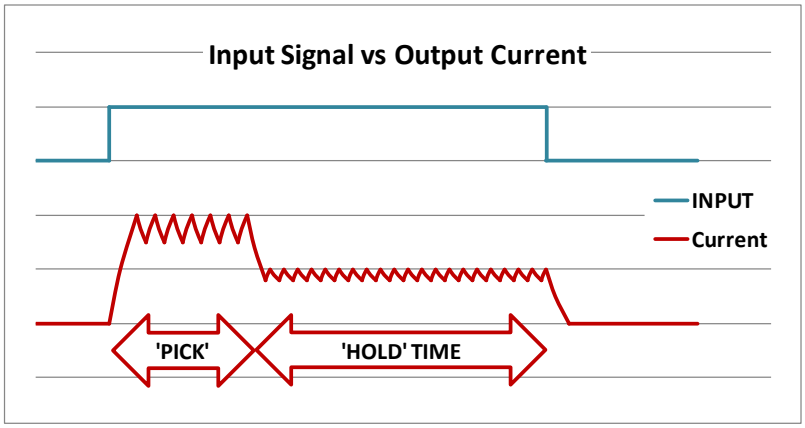
# PHu Pick & Hold Module

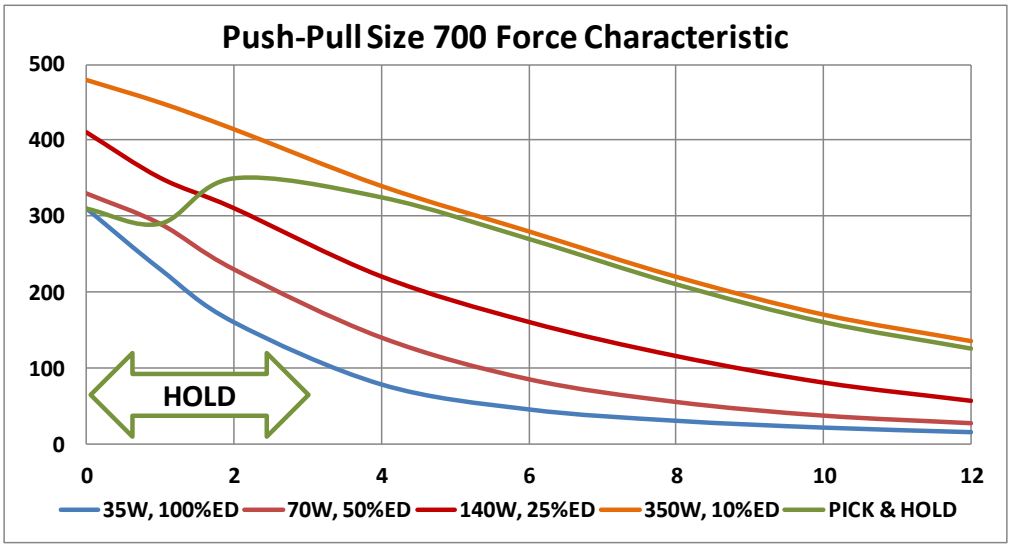
## DESCRIPTION


A Pick & Hold circuit regulates current applied to a solenoid or motor, applying high initial current (PICK) to develop high initial force/torque for fast response, then reducing this after a preset time (PICK TIME) to a lower level (HOLD) to maintain operation. It can be used to reduce power consumption in applications with restricted power supply (eg battery or line-powered systems), to reduce heat and power dissipation (systems handling temperature-sensitive materials, or susceptible to thermal distortion), or to stabilise performance of systems against fluctuations in supply voltage or ambient temperature.




Geeplus PHu modules are microprocessor controlled pick & hold modules which use intelligent algorithms to control a wide range of devices with simple user control of current and time parameters.

The graph below shows the characteristic force curves for a push-pull solenoid (the curves at different excitation power showing greater force with increasing excitation power, and the shape of the curve with force increasing as displacement reduces towards zero are similar for most linear solenoids), the use of a pick and hold circuit enables force to be

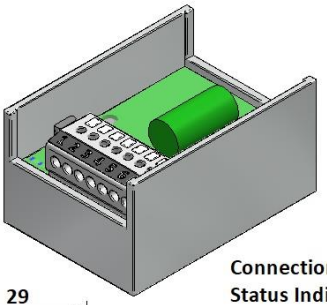


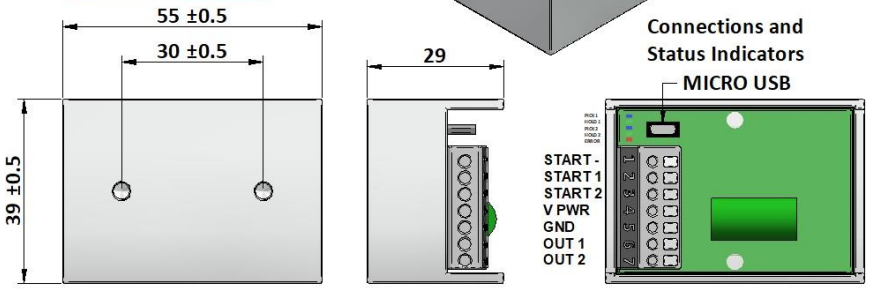
realised at the extended position similar to an intermittent duty curve, with continuing excitation power comparable to (or even lower than) that of the 100% duty curve.

The PHu modules can be used to implement control of large solenoids in an end-user application, the user-friendly interface also makes them invaluable as a development tool to explore the maximum performance achievable from a wide range of solenoids during product development.

**PHu-50**

**Wire 0.2-1.5mm$^2$ (16-24AWG)**






Standard module configuration is mounted in a die-cast box and potted (encapsulated) with resin.

The Phu-50 module can be configured as a bipolar device (able to deliver current in a forward or reverse polarity to a single load device), as a 2-output device able to drive 2 unipolar devices independently, as a single output device with outputs connected in parallel to reduce power loss or to deliver higher continuous current, or as a single output device with second output functionality not used with similar capability to the 2-output operation.

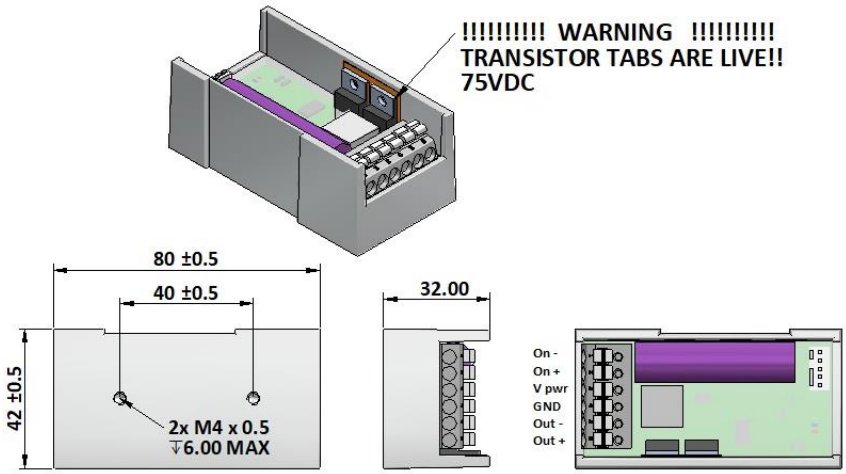
In Bipolar mode, the load device is connected between OUT 1 and OUT 2, the input START 1 initiates a positive current excitation, START 2 initiates a negative current excitation.

In 2-output mode the load devices are connected between V PWR and OUT 1 (Output current initiated by START 1), and between V PWR and OUT 2 (Output current initiated by START 2).

Phu-50 can operate with supply voltage from 8vDC to 50vDC.

Connection to a PC for programming, or for control by the PC is via a micro-USB connector.

**PHu-150**




## REQUIREMENTS

A PHu module is required, with USB-Micro cable, and PC with programming Software PHprogrammer.exe V6.1+. Other than these items a load device is required, and Power Supply able to supply voltage and current appropriate to the application, and within the limitations of the PHu module being used.

## SOFTWARE INSTALLATION

The folder containing software should be copied to the PC being used for programming. It is recommended that the complete folder is copied as it is important that all the programmes are in the same folder on your PC.

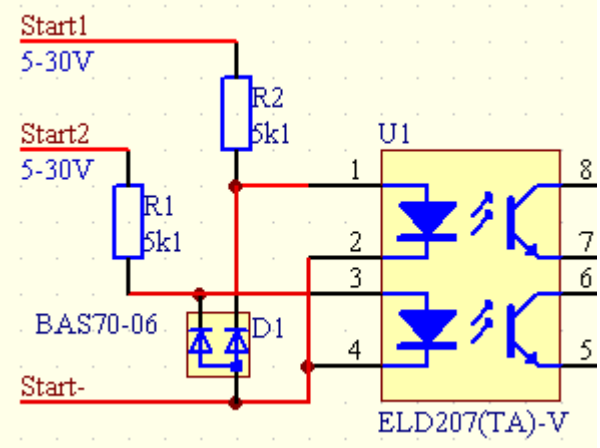
The Setup program "CDM212364_Setup.exe" should be run to install the USB drivers required to use the PHu-50 module. The latest driver is downloadable from
https://ftdichip.com/drivers/
Double clicking the ‘PHprogrammer’ icon will start the programming software.

## PHu-50 CONNECTION

The PHu-50 module has 7 connections on a WAGO terminal block, to connect to these simply push down the white button on top of the terminal block as stripped lead is inserted in the corresponding hole.

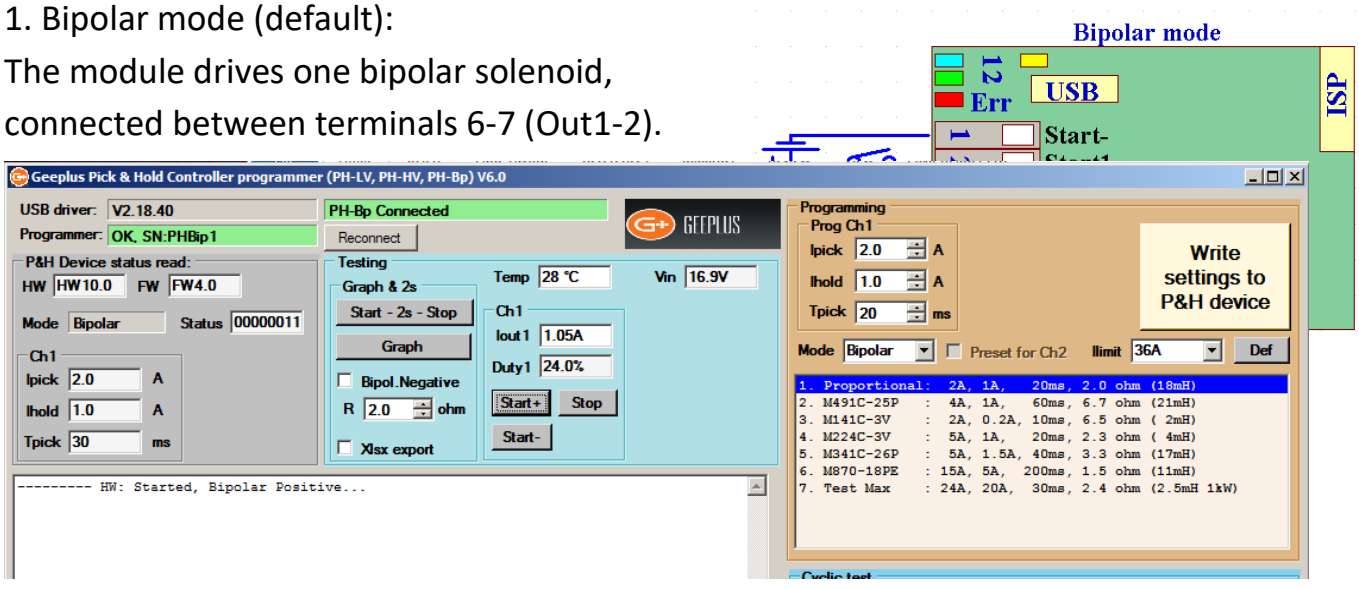
The positive supply (+Vpwr) is connected to terminal 4, and ground to terminal 5, and should be in the range of 8-50V. ***DO NOT apply voltage greater than 50V DC as this will damage the module.***
Reverse voltage causes high current flow though the reverse diodes. They protects the module for short time, but if overheating then this may damage the module.

Terminals 1 (Negative), 2 (Start1) and 3 (Start2) are the opto-isolated control inputs. The input circuit is as shown below, applying 5v-30v to this will switch the circuit 'ON'. Higher control voltage may be used if appropriate serial resistor is inserted to limit the input current to 6mA.




The PHu-50 module has 4 operating modes. Each of them requires appropriate wiring of the load(s) .
The appearance on screen of the programmer software is different for each mode, the different options are described below together with the wiring diagrams.

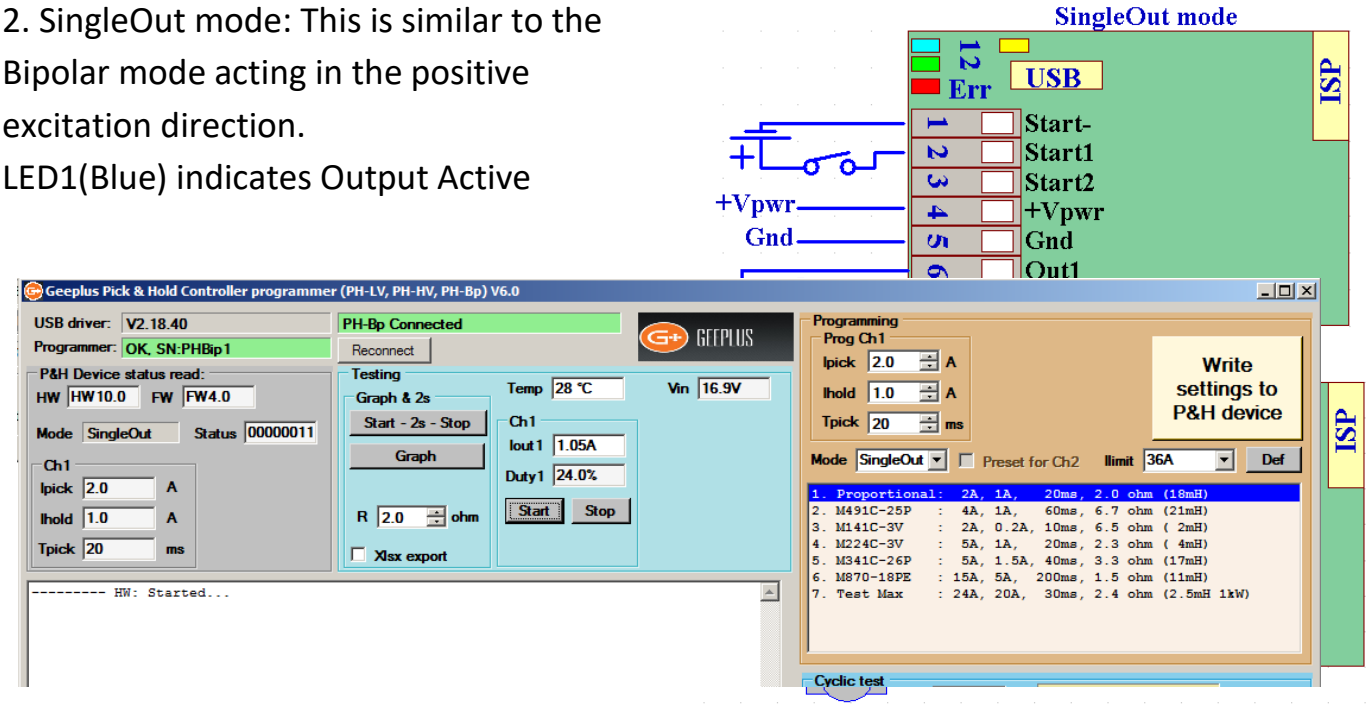
1. Bipolar mode (default):
The module drives one bipolar solenoid, connected between terminals 6-7 (Out1-2).



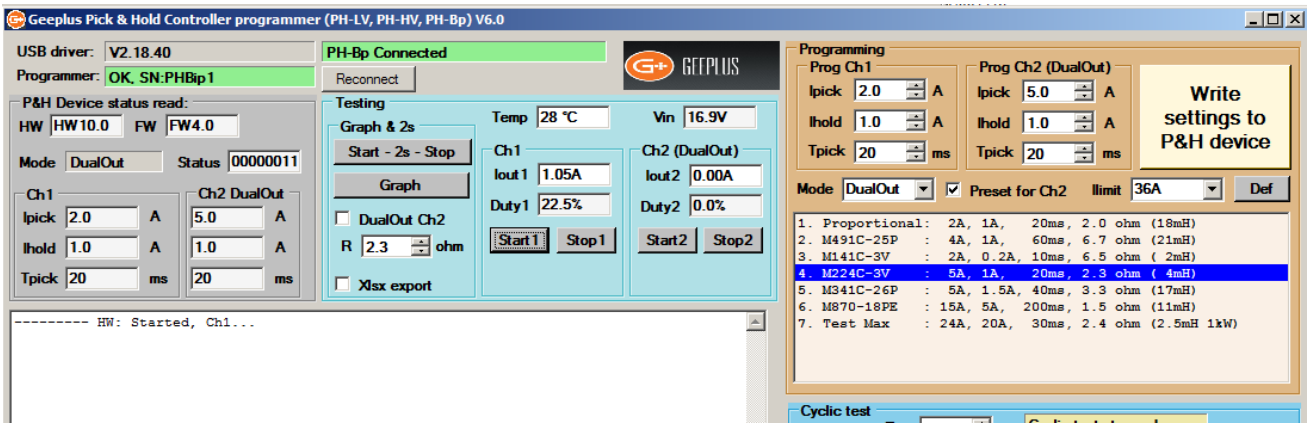
The Start1/2 inputs controls the solenoid to positive/negative directions, respectively.
LED1(Blue) indicates Active-Positive,  LED2(Green) indicates Active-Negative

In Bipolar mode, the polarity of excitation with the ‘Start – 2s – Stop’ function or the ‘Graph’ function is determined by the check-box ‘Bipol.Negative’. Checking or unchecking this box reverses the excitation direction of subsequent cycles.

2. SingleOut mode: This is similar to the Bipolar mode acting in the positive excitation direction.
LED1(Blue) indicates Output Active



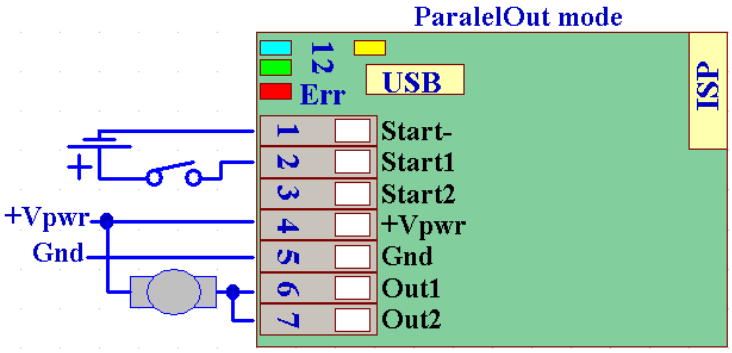

3. DualOut mode:
The module can drive two solenoids in this mode.
They should be connected between +Vpwr and Out1, +Vpwr and Out2.
The Start1/2 inputs controls the solenoids.
LED1(Blue) indicates Out1-Active,  LED2(Green) indicates  Out2-Active.
Both channels have their individual current and time settings.



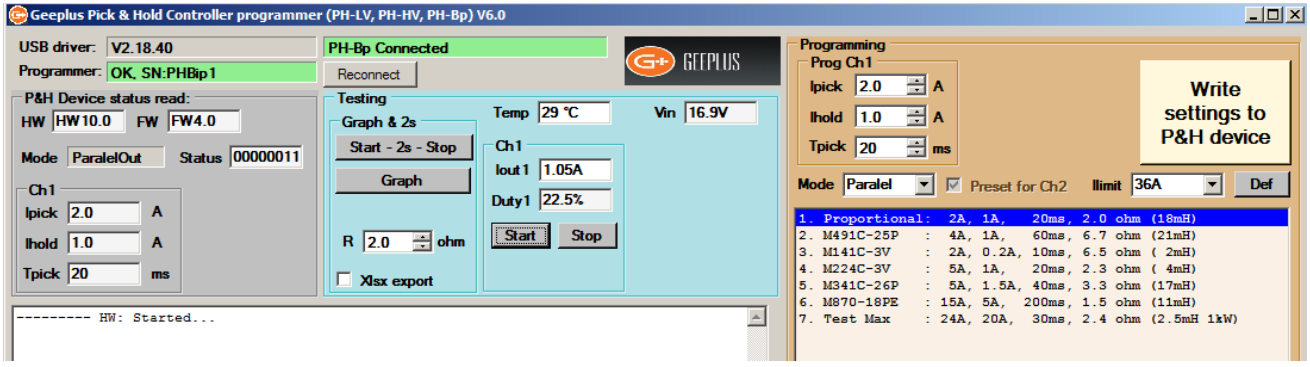

4. ParalelOut mode

If only one solenoid will be driven, the two outputs (Out1/2) can be connected in paralel. This operation reduces the power lost on the output stages, allowing higher continuous current, and less temperature rise.

The load should be connected between +Vpwr and Out1-Out2 as shown.



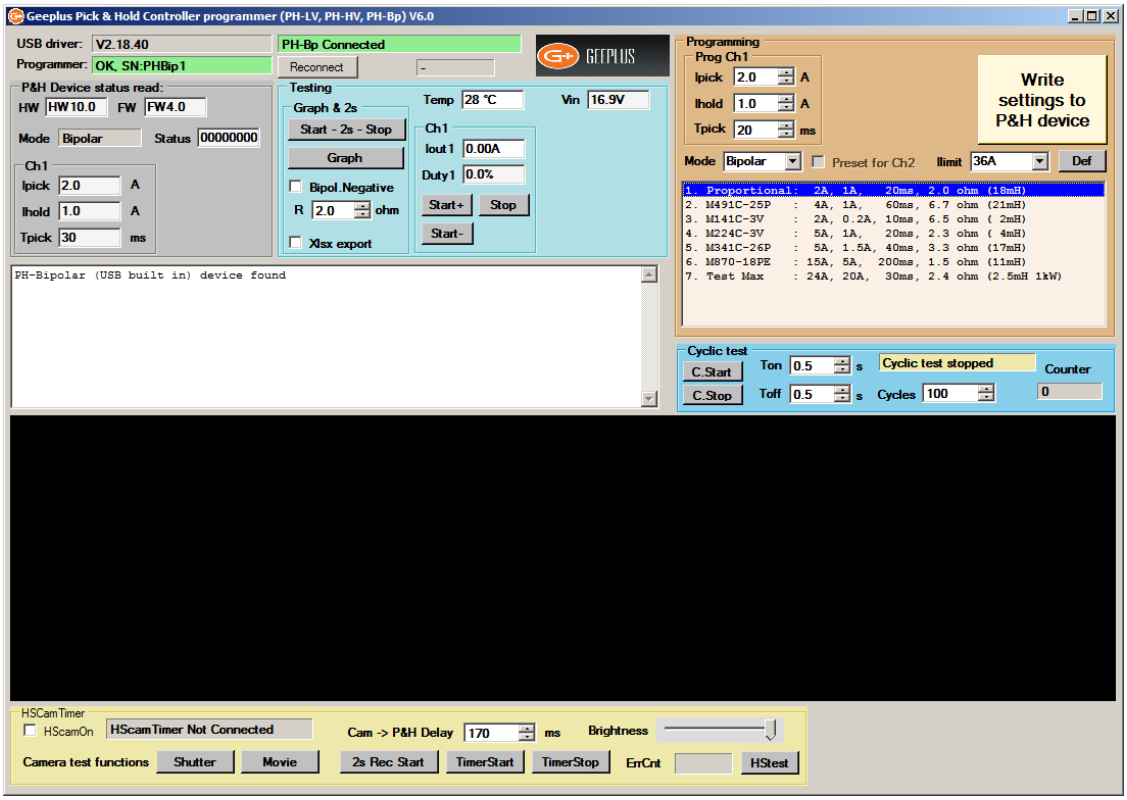

The Start1 input controls the solenoid. LED1(Blue) indicates Out1-2 Active.




For setup & testing while the module is connected to a PC it is possible to switch the solenoid on (‘START’) and off (‘STOP’) from the PC without using the control input.

In addition to ‘START’ and ‘STOP’ control buttons, the software also has a timed BUTTON ‘START – 2s – STOP’ which energises the test device for 2 seconds only. This function is recommended for initial testing of force as the timed pulse limits the amount of energy delivered, and so limits the self-heating and reduces the possibility of overheating and damaging the solenoid’. Once it has been established that sufficient force can be developed, the thermal behaviour of the system should be considered to ensure the chosen device will not overheat.

**PROGRAMMING** The Phprogrammer V6.1+ supports all kinds of the Phu modules, it will recognise which module is connected, and different modes will not be offered if not supported on the connected device:




-PHu24, Phu-HighVoltage (Older modules require special USB programmer cable, new versions use a standard micro USB cable)

-Phu-50-Bipolar (built-in Micro-USB port, Standard USB-Micro cable is usable)

Here the Phu-50 module will be described. The software operates with the others similarly to the Phu-50 in SingleOut mode.
The USB cable plugs into the USB-Micro socket above the WAGO terminal block.
If a Phu-50 Bipolar module is connected for the first time to this PC, the Windows will install the USB driver for it in the background, this may take 10 s.
With a load and power supply connected and turned on, the programming software is run. The programme should recognise if a PHu module is connected and powered, if this is not recognised click on the button labelled 'Reconnect' to reconnect.
You should see the screen as below:

Note the programmer reads the actual settings from the module, and it will appear with different controls regarding the actual Mode (above showing Bipolar).
As it opens up, the programmer defaults to the smallest values for safety, you can pick a device of appropriate size as a starting point, press the button 'Write Settings to P&H Device' to store these settings in the module.

You can edit the 'Pick' and 'Hold' current settings and 'Pick Time' as desired before writing settings to the module.

For setting up current values, you can use the grey buttons to switch the load device 'On' and 'Off' without using the control input connections.

**MONITORING**

While the solenoid is energised ('ON' condition), the programme interface monitors the operating conditions.

Temp – this is the internal junction temperature of the switching device, this should not exceed 120 degC when the module is being used in worst-case conditions. If the junction gets much hotter than this internal protection will shut the device down

Vin – The +Vpwr input voltage (Only on Phu-50 Bipolar modules)

IOut – the output current

Duty – The duty cycle of PWM waveform

After de-energising the solenoid ('STOP' condition), the operating current and duty cycle for both pick and hold conditions of the last 'ON' cycle are summarised in the white text box.

If the programmed current is too high, then the current will not be able to reach this value as it will be limited by supply voltage and / or coil resistance of the load. Either a lower resistance device, or higher supply voltage may be required. It should be noted that although a device may work OK in the cold condition, as it heats up the coil resistance will rise. In the cold condition, the duty cycle should typically be 70% or less to allow for this.

**STATUS INDICATORS**

Three LED's provide status indication.
The **BLUE** and **GREEN** LEDs indicates The Active status, detailed above for all modes.
The **RED** LED indicates an 'ERROR' conditions: Overcurrent or Overtemperature.

**SELECTION OF SOLENOID FOR PICK & HOLD**

This is a general guide as requirements of an application may dictate other constraints on Pick and Hold current levels.

As a very rough guide, a solenoid should be selected which is operating at about 5-10% duty cycle at the system voltage. If the solenoid coil is specified by voltage (at 100% ED), then the coil voltage chosen should correspond to $V_{supply}$ / √10, if the solenoid coil parameters are presented in a table then pick a coil which provides operation at 10% ED at the rated supply voltage.

Ideally, the solenoid should be mounted in the end application, and set up with worst-case operating conditions (maximum ambient temperature, minimum supply voltage).

With the circuit connected to a PC, the 'Pick' and 'Hold' currents and 'Pick Time' duration can be adjusted to determine conditions which satisfy the force, speed, and power requirements of the application.

For applications where high force is required to overcome a large load, the pick time may need to be sufficiently long for the solenoid to pull in to the energised position and settle before current is reduced to the holding level.

For applications requiring high speed, it may be preferable to drive with maximum possible power for a very short 'pick' time, as the initial acceleration has greatest influence on the overall response time.

When the device is switched off, the text box in programming software will display the current and duty cycle for both pick and hold operation. Ideally the duty cycle should be within the range of 10-90%, the module can operate outside this range but this leaves some leeway for variation in supply or temperature conditions.

The junction temperature of the power MOSFETs is displayed, this should not exceed 120°C max under worst case conditions.

# PHu Pick & Hold Module

Application areas where pick and hold circuits offer benefits include the following.

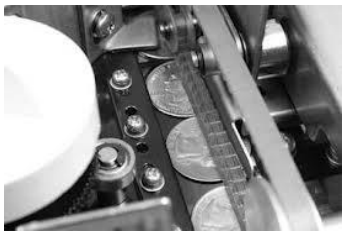
## Distributed Systems

Locking systems for railway carriage doors would be a good example of a distributed system, the actuators are distributed through the length of a train, with large voltage

fluctuations possible and big variation in ambient temperature conditions. The Pick and Hold circuit stabilises performance due to these fluctuations, and reduces power consumption and heat dissipation. Other examples could be mail sorting, fruit sorting, or car stacking parking systems.

## Fast Actuation

Cash sorting equipment requires very fast actuation and frequent cycling. A high current is applied to achieve high force and rapid acceleration and current is then reduced to avoid excessive heat dissipation.



## Reduce Heat Dissipation

Pinch valves are used to control flow of blood in dialysis equipment, or chemical reagents. High force is needed to clamp shut the tubing in these devices. Because blood products and chemicals are very sensitive to heat, pick and hold drive helps maximise the force obtainable with minimal heat generation.

## Development Tool

The extreme ease of use of Geeplus PHu module makes it invaluable as a development tool, it allows device excitation conditions to be easily adjusted without hardware changes to establish suitability of a particular device in a customer application.