FRQM-2

Frequency Counter & RF Multimeter

Usage Instructions
Firmware v2.09
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FRQM-2 accepts up to 4 signals for concurrent measurements. A frequency input (with or without internal prescaler) is available for measuring a wide range of frequencies. Three 10-bit resolution A/D[1] inputs are available for measuring Forward and Reflected Power, and Deviation or Modulation or Voltage or external (LM35 sensor) temperature. The measurements are displayed on a very comfortable-to-read 4x20 LCD with white letters on blue backlight. User input is provided via a 4-key push-button keyboard on the right hand side of the LCD. The key functions, from top to bottom key are: Menu/Select, Up, Down, and Enter. For single actions, the key should be pressed momentarily. The keys auto-repeat if held pressed continuously, a useful feature for setting certain parameters.

There are four basic screens available, selectable with the Select push-button in a circular fashion. Any one screen can become the startup *(default)* screen. Each screen is tailored to a different use. In sequence then, starting from a random screen, the screens are:

RX Screen: Shows Frequency on the 1st line, active IF offset (in KHz) on the 2nd line, RSS (Field Meter) on the 3rd line, and Modulation on the 4th line. In this screen, the user-defined IF offset (shown on the 2nd line) is automatically added to the actual frequency reading to display the effective frequency. The display also shows the signal strength as dBuV and bargraph, and the modulation as percentage and bargraph. This screen combines those elements most useful for receiver equipment.

TX Screen: Shows Frequency on the 1st line, Forward Power on the 2nd line, Reflected Power on the 3rd line, and Deviation on the 4th line. One special option of this screen is the ability to switch to it (from the RX screen) directly by means of a PTT switch (if connected to the appropriate input on the board.) This allows automatic switching between the RX and TX screens, depending on the current state of the PTT switch. Optionally, a Reflected Power Limit may be set which, when exceeded, will display an ALERT message on the screen. This screen is mostly useful for transmitter equipment.

RF Amplifier Screen1: Shows Voltage on the 1st line, Forward Power on the 2nd line, Reflected Power on the 3rd line, and MCU (Micro-Controller Unit) internal temperature (as Celsius & Fahrenheit degrees) on the 4th line. One special option of this screen is the ability to produce a 0-3.5VDC output voltage according to the percentage shown next to the Forward Power meter. By using the Up and Down push-buttons, the user can increase or decrease the output voltage which in turn may be used to increase or decrease the RF amplifier's output, accordingly. Optionally, a Forward Power Limit and/or a Reflected Power Limit may be set which, when exceeded, will shut off the RF amplifier. This screen is mostly useful for RF amplifiers.

RF Amplifier Screen2: Shows Temperature (based on an external LM35 sensor) on the 1st line, Forward Power on the 2nd line, Reflected Power on the 3rd line, and MCU (Micro-Controller Unit) internal temperature (as Celsius & Fahrenheit degrees) on the 4th line. One special option of this screen is the ability to produce a 0-3.5VDC output voltage according to the percentage shown next to the Forward Power meter. By using the Up and Down push-buttons, the user can increase or decrease the output voltage which in turn may be used to increase or decrease the RF amplifier's output, accordingly. Optionally, a Forward Power Limit and/or a Reflected Power Limit and/or a Temperature Limit may be set which, when exceeded, will shut off the RF amplifier. This screen is mostly useful for RF amplifiers.

To change from one screen to the next, the user must press the Menu/Select push-button momentarily.

A fifth (normally hidden) screen is available for making changes to the various default settings. This screen can be entered at any time (i.e., while viewing any other screen), simply by pressing Enter.

Setup Screen: Since there are currently more setup items than can fit inside a 4-line display, there is more than

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[1]A/D stands for Analog to Digital converter. All A/D inputs have a 10-bit resolution, meaning 1024 maximum steps.

one page. As the user goes up or down the lines (using the corresponding push-buttons), the setup page changes automatically and the cursor is placed in front of the item to edit. *If a non-blank password has been set, you will be required to enter the password before being allowed to enter the setup screen.* A description of the various settings found on this screen follows:

Max FWD defines the maximum Forward Power to be displayed. Any value from 0 (to practically disable it) to 59999 is possible and it represents Watts. When selecting a value below 10 W, the display automatically switches to mW for better display resolution.

Lim FWD defines the Forward Power Limit to use in the TX screens. Any value from 0 to 59999 is possible and it represents Watts.[2] When the FWD display goes above this value, the DC output voltage (0-3.5VDC at the appropriate input) is minimized to effectively shut off the RF output. In that case, the indication **ALERT** displays next to the REF line. The DC output voltage will return to normal by pressing (and releasing) the PTT switch[3], or by manually adjusting the power level up or down, or by leaving and returning to this screen. If the new FWD measurement is still above the limit, the output goes off again.

Max REF defines the maximum Reflected Power to be displayed. Any value from 0 (to practically disable it) to 59999 is possible and it represents Watts. When selecting a value below 10W, the display automatically switches to mW for better display resolution.

Lim REF defines the Reflected Power Limit to use in the TX screens. Any value from 0 to 59999 is possible and it represents Watts.[4] When the REF display goes above this value, the DC output voltage (0-3.5VDC at the appropriate input) is minimized to effectively shut off the RF output. In that case, the indication **ALERT** displays next to the REF line. The DC output voltage will return to normal by pressing (and releasing) the PTT switch[5], or by manually adjusting the power level up or down, or by leaving and returning to this screen. If the new REF measurement is still above the limit, the output goes off again.

Max Vcc defines the maximum voltage to be displayed (in the RF Amplifier screen). Any value from 0 (to practically disable it) to 59999 is possible, and it represents Volts.

Temp Hi defines the maximum allowed external sensor (LM35) temperature (in degrees Celsius). Any value from 0 to 254 is possible (although the actual sensor may not support this wide a range), and it represents degrees (Celsius). Note: The special value 255 is used to turn off the temperature **ALERT** completely (perhaps in case an actual sensor isn't connected). When the external temperature goes over this value, the RF output is shut off, and the indication **ALERT** displays next to the REF line. When setting this value, the Temp Lo variable (see below) will be set this value minus a fixed constant (e.g., currently 5 but subject to change without notice).

Temp Lo defines the temperature (in degrees Celsius) of the external (LM35) sensor under which a previous Temp Hi alert will be removed. Any value from 0 to 255 is possible (although the actual sensor may not support this wide a range), and it represents degrees (Celsius). When the external temperature falls under this value, the RF output will be re-instated, provided no other **ALERT** is currently in effect.

Buzzer On or Off decides whether we want the on-board buzzer to sound during any **ALERT** events.

FRQ Prescaler defines the desired prescaler to use for the frequency counter input. The value entered here is

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[2]The value entered here will always be corrected to be less than or equal to the Max REF value.
[3]The 'PTT switch' connection is used in this screen as an alert reset (attach a reset button) to attempt to exit the alert mode. While the 'PTT' is pressed, the power will be re-instated to the user setting. When the 'PTT' is released, the mode will either return to normal or back into alert, depending on the actual updated REF reading.
[4]The value entered here will always be corrected to be less than or equal to the Max REF value.
[5]The 'PTT switch' connection is used in this screen as an alert reset (attach a reset button) to attempt to exit the alert mode. While the 'PTT' is pressed, the power will be re-instated to the user setting. When the 'PTT' is released, the mode will either return to normal or back into alert, depending on the actual updated REF reading.

purely for display purposes. If you select a setting that doesn't match the actual frequency input and/or actual prescaler used, you will get incorrect frequency indications. *Note: You may also get incorrect measurements, if the input signal is outside specs.*

Gate (Fast gating) defines the dividing ratio for the base one-second frequency-gating sampler. Higher divider values will cause the frequency display to update faster but with a small loss of precision (especially for lower frequencies.) For most accurate and stable results, use the `OFF` setting. For fastest screen updates, use the maximum divider ratio, or use anything in between as a compromise between the two extremes of speed and accuracy.

Fix/4 decides whether we want the extra (/4) internal prescaler to be active.

Min dBuV defines the minimum displayable dBuV. The value ranges from –128 to 127. To toggle the sign, press the Down push-button while on the first digit until it tries to go below zero.[6] If the number entered here is greater than the corresponding Max dBuV, the two values will be swapped automatically so that the minimum is always lower than or equal to the maximum.

Max dBuV defines the maximum displayable dBuV. The value ranges from –128 to 127. To toggle the sign, press the Down push-button while on the first digit until it tries to go below zero. If the number entered here is less than the corresponding Min dBuV, the two values will be swapped automatically so that the maximum is always greater than or equal to the minimum.

ºC Offset defines the signed offset for the displayed temperature (the offset must be entered in Celsius degrees). The value ranges from –128 to 127, although you should never have to enter such extreme offsets[7]. To toggle the sign, press the Down push-button while on the first digit until it tries to go below zero. The number entered here will be added to (or, subtracted from) the actual reading returned from the internal temperature sensor which, due to MCU manufacturing variations, may vary from unit to unit. This is pre-configured by the OEM and should not be changed without cause.

PowerMeterMode defines the method to use to measure the FWD and REF reading. AVG (average) or PEP (Peak Envelope Power) modes are available. PEP is more suitable for AM type signals. Press ENTER to toggle the current mode.

IF KHz defines the positive or negative offset (in KHz) for the IF (Intermediate Frequency) normally used with receivers. The value ranges from –1999999 to 1999999. To toggle the sign, press the Down push-button while on the first digit until it tries to go below zero.

Password defines an optional password which, when defined, will lock the Settings screen from unauthorized access. This is useful, for example, when one installs FRQM1 into a customer's equipment, and does not want the customer to alter the settings (e.g., pre-trimmed FWD/REF limits). The password is 10 characters long, and it's made of a combination of either spaces or uppercase alphabetic characters. To remove a password, change all characters to spaces. Move from character to character with the Menu push-button, and change characters with the Up or Down push-buttons. When the Settings screen is password locked, the user may still be able to save those settings that are directly accessible from some screens, simply by attempting to enter the Settings screen. For example, the startup screen (if Block Menu key option below is disabled) can be saved. Because you only have one chance to enter the password *(i.e., no verification step)*, the password is clearly visible *(i.e., not displayed as asterisks)* so make sure no one is watching when viewing or entering the password. Just like all other settings, the password is saved in a non-volatile memory, and once it is installed, you will need to know the password to access the Settings screen again. Make sure you don't forget it and lock yourself out.

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[6]Numbers below –128 or above 127 will be interpreted as the two's complement of the currently displayed number. Do not set such numbers, but if you do, do not be surprised by the automatic number adjustment when you press Enter.
[7]Usual values are somewhere between –5 to –20.

Startup Message defines an optional string *(up to the width of the LCD)* which, when defined, will display on the lower LCD line during startup. A reseller may decide to enter his/her company name or phone number or other pertinent information. If the settings are not protected by a password, the end-user will be able to alter this setting, so it's mostly useful if you plan on using a password. *Available since v1.10*

Block Menu defines whether or not to block the Menu change push-button. If, for example, you're only interested in the RF Amplifier screen, enter Settings from within that screen, then block the Menu key by setting this option to Yes. The end-user will not be able to go to another screen. If this option is combined with the Password option, the end-user will be always limited to a single screen, as s/he cannot enter the Settings screen to disable this option.

Block Power defines whether or not to block the Power Level Percentage change operation. When this option is set to Yes, the end-user will not be able to go to change the power level. If this option is combined with the Password option, the end-user will be always restricted to a fixed power level, as s/he cannot enter the Settings screen to disable this option.

Alert 10th sec defines the number of 100msec (1/10th second) periods to count after an **ALERT** event is detected until the RF output is turned off. Any value from 0 to 255 is possible, representing 0 to 25.5 seconds.

Retry Interval defines the number of seconds to wait following an **ALERT** event before another attempt is made to see if the problem that caused the alert has gone away. Any value from 0 to 255 is possible, representing 0 to 255 seconds (~4.25 minutes).

Fault Retries defines the number of retries for the `FWD` and `REF` alerts. Once the unit goes into **ALERT** mode due to either a `FWD` or `REF` limit overshoot, it will keep retrying to exit the **ALERT** mode every `Retry Interval` seconds for so many times as defined with this setting. Any value from 0 to 255 is possible. Zero turns off retrying, while 255 makes it infinite (retry forever).

LCD BackLight defines the brightness of the LCD backlight as percentage from 0 to 100% in increments of 10. The backlight changes as you alter this setting, so you can immediately see the desired setting.

Editing Items in the Setup Screen

To edit any item in the Setup Screen, you must follow these steps, as required:

1. Select the item to edit by using the Up or Down push buttons to place the cursor (the small underscore-looking line) before the item to edit.
2. Next, press Enter to go into Edit Mode for that particular item. The cursor will become full-size and start blinking.
3. Using the Up or Down push buttons change the element underneath the cursor. Up changes in one direction, while Down changes in the opposite direction.
4. While the cursor is blinking, use Select to move to the next element within the item (for some items that have only a single changeable element, the Select push-button will change to the next possible value instead, just like pressing the Up push-button.)
5. Press Enter to accept the changes and exit Edit Mode and return back to the Setup Screen where you may choose another item to edit (go back to Step 1.)
6. When done editing with all items that need changing (the cursor should not be blinking at this time), press Menu/Select to exit the Setup Screen and return to whichever screen you were in before entering Setup.

When exiting the Setup Screen, you may see a screen flash for about 1 & ½ second with the message "Setup saved." This confirms that some changes were made since last entering the Setup Screen, and had to be saved into internal memory so they become the new default settings. These settings are saved in a non-volatile

memory and will be remembered across power cyclings of the module.

Some settings are changed automatically simply by using the module. For example, changing to a different screen display will change the default startup screen (if this change is saved by entering and exiting Setup, even without making any other changes within the Setup Screen itself). So, to set the module's startup behavior, go to the screen you want to make your startup screen and then make all settings as you like them from within setup (you must enter and exit setup, at least once). If you've made any changes, you should see the "Setup saved" message mentioned earlier. If you don't see this message even though you are certain you just changed some parameter, it means your current settings match the ones that were previously saved (for example, you have made several changes and ended up back where you started).

Trimmers

There are four trimmers (looking at them from the top edge and front of the board):

The left-hand-side one is for adjusting the Audio (Modulation/Deviation).
The middle one is for adjusting the Forward Power input (FWD display).
The right-hand-side one is for adjusting the Reflected Power input (REF display), or the RSS input.

Connections

CON2 is the Frequency Counter input level (AC/DC, up to 32MHz).[8]
CON1 is high-frequency RF input. Maximum +15dbm.

PL1 is the DC Voltage input, a 2.1mm standard DC jack.
PL2 is the + and - of an auxiliary Voltage input (if not using PL1).

PL7-Pin10 (Pin9 is GND) is the DC output voltage 0-3.5VDC, controllable through the keyboard from the RF Amplifier Screen.

PL7-Pin2 (Pin1 is GND) accepts the DC input for Forward (FWD), or the S-Meter input.
PL7-Pin4 (Pin3 is GND) accepts the DC input for Reflected (REF) [or RSS in the RX Screen]
PL7-Pin6 (Pin5 is GND) is for Audio LEFT - Deviation/Modulation Mono.
PL7-Pin8 (Pin7 is GND) is for Audio RIGHT.

PL8-Pin12 (Pin 11 is GND) is the optional PTT input. When the PTT is activated (i.e., goes low), the module will switch from the RX Screen to the TX Screen. When PTT is released (i.e., returns high), the module will switch back to the RX Screen. The PTT switch is ignored unless the module is set at the RX Screen before the PTT is pressed.[9]

PL9-Pin1 (MENU) is an auxiliary keyboard connector.
PL9-Pin2 (GND)
PL9-Pin3 (UP)
PL9-Pin4 (GND)
PL9-Pin5 (DOWN)
PL9-Pin6 (GND)
PL9-Pin7 (ENTER)
PL9-Pin8 (ROTENC1)
PL9-Pin9 (ROTENC GND)
PL9-Pin10 (ROTENC2)

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[8] A non-square wave at this input may produce wrong measurements.
[9] *The PTT acts as a fifth key (not directly accessible from the front of the module.) Because you may only use one key at a time, you will not be able to use the keyboard while the PTT is pressed. You must first release the PTT, and then use the keys on the front.*

These pins parallel the on-board keyboard (for your convenience in mounting the device on your equipment's front panel).

Adjustments & Calibration

For the frequency input one needs to select the appropriate prescaler "jumper" (only when using the internal prescaler input) using the table earlier, and use the corresponding *FRQ Prescaler* setting in the Setup Screen.

All analog inputs require calibration (by using the related trimmers) so as to scale your particular input signal to the correct voltage level for proper measurement by the internal 10-bit A/D converter. For best results (i.e., to make use of the full resolution of the 10-bit A/D converter), you need to scale each input signal separately (using the corresponding trimmer) such that it is within ground and Vdd, approximately 3.3V, without clipping the edges.

Factory Default Settings and Adjustments

- AF for 100% modulation, trimmer is set for 1.41Vpp @1KHz at its input.
- FWD is set for 100W for 3.7VDC input.
- REF is set for 30W for 3.7VDC input.
- The prescaler is set to /256 which is good for upto 2.5GHz measurements.

Warranty: This module is covered by a one-year warranty. *Warning: The warranty is void if the module is misused, based on proper usage as described in this document!*
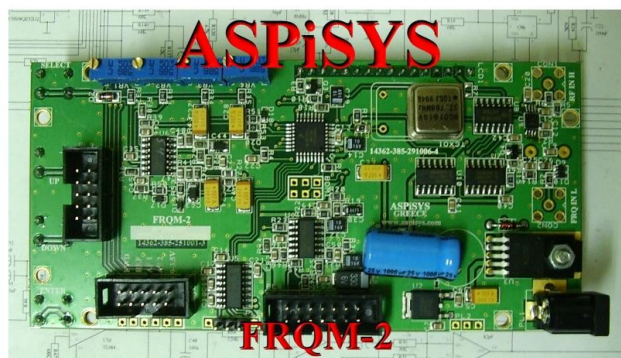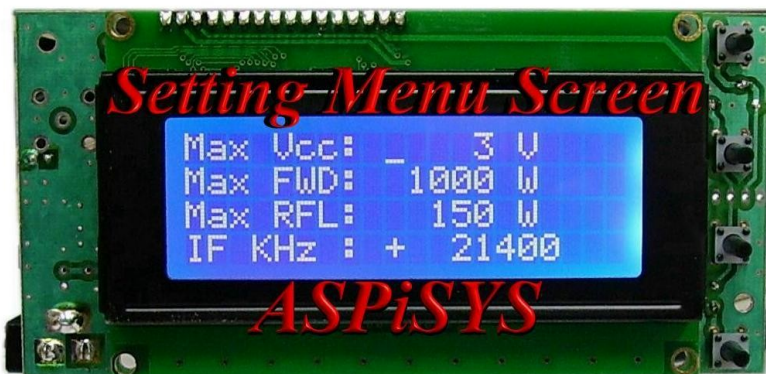
You may find more information about our products through our Internet web site: www.aspisys.com
Or, if you need support, please e-mail to support@aspisys.com

Thank you for your preference in our products.

CE

FRQM-2 Frequency Counter and RF Multimeter

FRQM - Digital RF Panel Meter
Frequency - FWD & REV RF Power
Modulation Meter

Receiver Screen with Signal Strength Meter

Setting Menu Screen

FRQM-2

ASPiSYS FRQM-2 Frequency Counter

This is a high-quality board that acts as a frequency counter, a forward/reflected power meter, a field-strength meter, a deviation/modulation meter, a voltage meter, and a temperature meter.

Specifications (subject to change without notice):

❑ Supply Voltage: 8 - 15V DC @ 80mA max.

❑ Frequency Range: 10Hz – 2500MHz (2.5GHz) with on-board prescaler. Up to 9.2GHz is possible with appropriate external prescaler and corresponding 'FRQ Prescaler' setting.

❑ Frequency prescaler: OFF, 2, 4, 8, 16, 32, 64, 128, 256, 512 selectable via settings menu.

❑ On-board prescaler: 64, 128, 256 selectable via settings menu.

❑ Fast frequency gating: 1 second (OFF), ½ second (500msec), ¼ second (250msec), 1/8 second (125msec), 1/16 second (62.5msec) selectable via settings menu.

❑ Min. Resolution: 1Hz (<10KHz), 10Hz (<10MHz), 10KHz

❑ Inputs: 1 for up to 8MHz (without internal /4 prescaler) or 32MHz (TTL/CMOS), 1 for up to 2.5GHz

❑ Input 1 level (upto 8 or upto 32MHz input): 1-10 V (DC/AC)

❑ Input 2 level (2.5GHz input): -20dBm to +10dBm up to 1.3GHz and –10dBm to +10dBm above 1.3GHz

❑ Forward & Reflected Power DC Level: 0-5 VDC (Non-linear correlation.)

❑ RX Signal Meter: Linear correlation to input signal, default 25 dBuV to 115 dBuV max (user adjustable from –128 to 127 dBuV via settings menu to match different signals).

❑ RX IF offset setting: 0 to ±1999999KHz (~2GHz)

❑ Audio Input: One mono unbalanced 10 KΩ

❑ Audio Level: Adjustable via on-board trimmer for 0-5VAC

❑ Modulation/Deviation metering: Bargraph & peak numbering reading for 0-120%

- ❑ DC Adjustable Output: 0-3.5V @5mA (adjustable from keyboard)

- ❑ Temperature display: Approximate degrees in both Celsius & Fahrenheit scales.

- ❑ Dimensions: 61mm (H) * 126mm (L) * 35mm (D max)