

## Meet the MiG-29M, Egypt's new Multi-role fighter jet

By: Dino Ramsey

The EAF (Egyptian Air Force) is in the final stages of finalizing a deal with Russia's Rosoboronexport for a total of 24 Mig-29 M\2 multi-role jet fighters. The Mig-29 M\2 is an upgraded version of the formidable Mig-29 (NATO code-name *Fulcrum*) which first entered service with the former Soviet union Air Force in the 1983. The original Mig-29 was a fourth-generation fighter developed to counter new western fighters like the American fighters such as the F-15 Eagle, the F-16 Fighting Falcon, and the F\A-18 Hornet, also the French Dassault Mirage-2000 and other advanced fighters entering service with many air forces all around the world. The new multi-role fighter comes to fill the air superiority-interceptor role currently filled by the Dassault Mirage-2000 and the aging J-7, a Chinese copy of the formidable Soviet Mig-21, of which Egypt has a large number although most were withdrawn from service in the last two decades. A need for a modern 4++ generation multi-role fighter was the main reason behind the Mig-29 M\2 procurement as the EAF seems to be adopting a high-low mix for its inventory. A high-low mix is simply a military doctrine that calls for modern air forces to












consist of a larger number of cheaper, less sophisticated aircrafts and a smaller number of expensive, more sophisticated ones to fill specific roles. Currently the EAF operates over 6 different kinds of combat jets filling different roles, most of which are aging models that should have been retired some time back, but due to budget constraints the EAF is forced to spend money on upgrading and maintaining them instead of going for replacements. A high-low mix would serve the EAF well, as it currently operates about 240 F-16s out of which over 200 are modern block-40 or higher models, so with a fewer number of modern 4++ generation Mig-29s the EAF can phase-out most of the older 4 models it still operates cutting on maintenance costs and achieving an excellent balance of power.

### Why the Mig-29 M\2?

First question that comes to mind is why the Mig-29 M\2? Although Egypt has been a premier Soviet aircraft buyer in the past, the EAF hasn't procured any new combat jets from the Soviet Union (or Russia after 1991) due to late President Anwar Sadat's policy shift away from the Soviet Union towards the United States, especially after signing the Camp David peace accord with Israel in 1979 and the \$1.3 billion annual Military aid Egypt has been receiving since. However due to changing political conditions in Egypt in the last couple of years, the United States froze the military aid to Egypt which constituted a threat to the Egyptian Air force as its primary supplier of modern combat jets and attack helicopters. Even if the military aid is restored as it should, now the EAF has to put in its consideration that such a situation might happen again at any time in the future which constitutes a different approach to future procurement, mainly diversification of sources from which the EAF can procure its hardware. Given that, there are many sources for modern combat jets, France, the UK, China, Russia and Sweden to name a few. In my opinion the French Rafale 4++ generation Multi-Role fighter would have been the best option for the EAF as it already operates the French Mirage-2000 and the Mirage-V. Also drawing on similar experiences, particularly with the Indian Air Force who had a need for 126 Medium Multi-Role combat aircrafts, similar to what the EAF needs, so they had an international tender and tested 6 combat jets, the American Boeing F/A-18E/F Super Hornet, the French Dassault Rafale, The UK's Eurofighter Typhoon, the American Lockheed Martin F-16

Fighting Falcon, the Russian Mikoyan MiG-35 (another derivative of the Mig-29, similar to the Mig-29 M\M2), and the Swedish Saab JAS 39 and after rigorous testing the Rafale was chosen as the winner. The requirements for the Indian Air Force, although not identical to those of the EAF, still close, and taking advantage of the time and money spent by the Indian Air Force choosing a modern combat jet, again the Rafale is operationally very similar to the Mirage-2000 which the EAF has been operating for a long time. Here is a quick comparison of the combat jets that competed in the Indian competition:

Aircraft	Dassault Rafale	Eurofighter Typhoon	F-16IN "Super Viper"	F/A-18E/F Super Hornet	JAS 39 NG	MiG-35 Fulcrum-F
Country of origin	 France	 Germany  Italy  Spain  UK	 USA	 USA	 Sweden	 Russia
Manufacturer	Dassault Aviation	Eurofighter GmbH	Lockheed Martin	Boeing	Saab	RAC-MiG
Length	15.27 m (50.1 ft)	15.96 m (52 ft 5 in)	15.03 m (49 ft 3 in)	18.31 m (60 ft 1¼ in)	14.1 m (46 ft 3 in)	17.3 m (56 ft 9 in)
Wingspan	10.80 m (35.4 ft)	10.95 m (35 ft 11 in)	10.0 m (32 ft 8 in)	13.62 m (44 ft 8½ in)	8.4 m (27 ft 7 in)	12 m (39 ft 4 in)
Height	5.34 m (17.4 ft)	5.28 m (17 ft 4 in)	5.09 m (16 ft 7 in)	4.88 m (16 ft)	4.5 m (14 ft 9 in)	4.7 m (15 ft 5 in)
Wing area	45.7 m <sup>2</sup> (492 ft <sup>2</sup> )	50.0 m <sup>2</sup> (538 ft <sup>2</sup> )	27.9 m <sup>2</sup> (300 ft <sup>2</sup> )	46.5 m <sup>2</sup> (500 ft <sup>2</sup> )	30.0 m <sup>2</sup> (323 ft <sup>2</sup> )	38.0 m <sup>2</sup> (409 ft <sup>2</sup> )
Empty weight	9,500 kg (20,940 lb)	11,000 kg (24,250 lb)	9,979 kg (22,000 lb)	14,552 kg (32,081 lb)	7,100 kg (15,650 lb)	11,000 kg (24,280 lb)
Maximum payload	9,500 kg (21,000 lb)	7,500 kg (16,500 lb)	7,800 kg (17,200 lb)	8,050 kg (17,750 lb)	5,300 kg (11,680 lb)	6,500 kg (14,400 lb)
Maximum takeoff weight (MTOW)	24,500 kg (54,000 lb)	23,500 kg (51,800 lb)	21,800 kg (48,000 lb)	29,937 kg (66,000 lb)	14,300 kg (31,540 lb)	29,000 kg (64,000 lb)
Power plant	2× SNECMA M88-2	2× Eurojet EJ200	1× GE F110-132	2× GE F414-400	1× GE F414G	2× Klimov RD-33MK
Thrust • Dry thrust	50 kN each (11,250 lbf)	60 kN each (13,500 lbf)	84 kN (19,000 lbf)	62.3 kN each (14,000 lbf)	62.3 kN (14,000 lbf)	53 kN each (11,900 lbf)
• Afterburner thrust:	75 kN each (17,000 lbf)	90 kN each (20,250 lbf)	144 kN (32,500 lbf)	98 kN each (22,000 lbf)	98 kN (22,000 lbf)	88.3 kN each (19,840 lbf)

<b>Fuel</b> • Internal • External	4,700 kg 7,500 kg	4,996 kg	3,265 kg 5,880 kg	F/A-18E: 6,780 kg, 5 tanks, total 7,381 kg	3,360 kg 3,800 kg	4,800 kg 4,200 kg
<b>External stations**</b>	14 (5 'wet')	13 (3 'wet')	11 (3 'wet')	11 (5 'wet')	10 (4 'wet')	9 (5 'wet')
<b>Maximum speed</b> • At sea level	Mach 1.8+ (Supercruise: Mach 1+)	Mach 2.0+ (Supercruise: Mach 1.2)	Mach 2.05 800 KCAS	Mach 1.8	Mach 2.0+ (Supercruise: Mach 1.2)	Mach 2.25 Mach 1.2
<b>Ferry range</b> • Unrefueled • Extl. tanks	3,700+ km	3,790 km	4,220 km	3,054 km	2,500 km 4,075 km	2,000 km 3,000 km with 3 drop tanks
<b>Combat radius</b>	1,800 km	1,390 km on air defense-with 10-min loiter	550 km on a hi- lo-hi mission with six 1,000 lb (450 kg) bombs	722 km	1300 km with six AAMs + drop tanks, and 30 min on station	1000 km
<b>Service ceiling</b>	17,000 m (56,000 ft)	19,812 m (65,000 ft)	18,000 m (60,000 ft)	15,000 m (50,000 ft)	15,240 m (56,000 ft)	17,500 m (57,400 ft)
<b>Rate of climb</b>	305 m/s (60,000 ft/min)	315 m/s (62,000 ft/min)	254 m/s (50,000 ft/min)	228 m/s (44,882 ft/min)	N/A	330 m/s (65,000 ft/min)
<b>Thrust/weight</b>	1.13	1.18	1.1	0.93	1.18	1.1
<b>Thrust vectoring</b>	None	Thrust vector upgrade has been offered	None	None	None	May be fitted with thrust vectoring
<b>Runway needed</b>	400 meters (1,300 ft)	700 meters (2,300 ft)	N\A	N\A	N\A	N\A
<b>Unit cost</b>	~US \$ 84.48 million	~US \$108 million	US \$50 million	US \$55 million	US \$48 million	US \$38.5 million
<b>Notes</b>	Unit costs mentioned above are only estimates. Actual figures vary.					

(Source: Wikipedia)

As we can see from the above comparison unit price plays a big role for choosing a combat jet, especially for a cash-strapped country like Egypt, there are also other considerations, but the overall performance of the Mig-29 is higher and stronger than many of the other jets on the table, but there are also other considerations such as the avionics package, armaments and radar. Also the Typhoon, the Rafale and the Jas-39 NG have a considerable performance advantage over the other craft in the list in that they have the ability to travel at supersonic speeds without the use of afterburners, an ability known as supercruise. As afterburners use a huge amount of fuel, most fighters can use them for only a few minutes. Therefore, an aircraft with supercruise should theoretically have a huge advantage in pursuing or evading a non

supercruise-capable plane, in that the supercruise-capable aircraft will have a higher speed and thus a higher amount of maneuvering energy. Supercruise will also allow these planes to spend more time in combat, particularly at longer ranges, rather than in transit. Apart from dramatically reducing the rate of fuel consumption, the ability to supercruise also reduces the IR (infrared) signature by some 75%. Most of today's air-to-air guided missiles (AAMs) home in on a source of IR radiation, and a fighter in afterburner finds it much more difficult to throw a heat-homing AAM off the scent than a stealthy one in dry thrust, even in Supercruise, so that is a great advantage under combat conditions. Also the combat jet's avionics suite is of great importance, Western avionics are viewed by many experts to be the most technologically sophisticated while Russian and other nations' avionics are generally regarded as less technologically sophisticated than Western ones at this point in time. However, it should be noted that it is possible to upgrade avionics architecture without changing the airframes and since the dissolution of the Soviet Union, Russian aircraft manufacturers, including RAC-MiG, the manufacturer of the Mig-29 M\2 offers open architecture for its avionics and the option to accommodate other nations' avionics and armaments, something that wasn't available with the former Soviet Union.

## Over View of the Mig-29 M\2

Both the MiG-29M (single seat) and MiG-29M2 (double seat) aircraft are the "4++" generation multi-role fighters with the extended range, weapons increased load and airborne weapons broad nomenclature. The M\2 variant is a more advanced evolution of the Mig-29 with more robust multi-role capability with enhanced use of air-to-air and air-to-ground high-precision weapons. The Mig29 M\2 has addressed many of the original Mig-29's shortcomings. The internal fuel storage has been increased dramatically, it is controlled by quadruple redundant fly-by-wire system; glass cockpit, the new terrain following Zhuk-ME radar, improved engines with reduced smoke trails, better efficiency and more power, newIRST, longer canopy, a wider, longer and less curved dorsal spine, bulged wing tips with fore and aft Radar Warning Receivers (RWR), eight under wing hard-points (as opposed to six on earlier versions), aluminum-lithium center section; and finally larger, sharper, repositioned wing roots which create stronger vortices and modifications to extend back the center of gravity limit for relaxed stability which increases the max angle of attack giving more maneuverability and better efficiency. It also featured considerably increased combat range owing to an increase in its internal fuel capacity. Thrust-vectoring engines are also available upon customer's request, a feature which adds super maneuverability to the new fighter but comes at the expense of more complicated pilot flying requirements.



Main technical and technological innovations applied on the MiG-29M/M2 fighters are as follows:

- Improved fuselage & wing;
- Fly-by-wire control system with quadruple redundancy;
- Significantly reduced radar signature;
- Increased internal fuel capacity and in-flight refueling possibility;
- Increased weapons load stored at nine external hard points.

The power plant includes RD-33MK engines with increased thrust power, equipped with smokeless combustion chamber and new electronic control system (of FADEC type). Engines are of the module structure and have increased reliability and service life.

Upon customer's request the fighters can be equipped with the modified "all aspect" vectored thrust RD-33MK engine ensuring the aircraft superiority in a maneuvering dogfight. The power plant of two vectored thrust engines was tested on the super-maneuverable prototype-aircraft MiG-29M OVT.

The MiG-29M/M2 fighters are remarkable for the improved operational characteristics and increased reliability of assemblies, systems and units. As compared to the previous fighters the flight hour cost is reduced about 2.5 times. The MiG-29M/M2 fighters are intended for the on-condition maintenance.

The airborne avionics is of the open architecture based on MIL-STD-1553B standard that allows the installation on aircraft of new equipment and weapons of Russian and foreign origin upon customer request.

The MiG-29M/M2 fighters are equipped with state-of-the-art multi-channelIRST with target designation system to the anti-radar passive war-head missiles.

There is the possibility of installation on aircraft of IR and laser sighting equipment pods for ground targets illumination.

Weapons system includes air-to-air missiles, guided aerial bombs, rockets, aerial bombs and built-in air-gun of 30 mm caliber. The MiG-29M/M2 fighter's weapons allow to destruct air targets as well as the movable and stationary ground/surface targets.

Both the single and double seat versions of aircraft have the same airborne equipment and weapons as well as the high unification level of structure.

### Performance:

	<b>MiG-29M</b>	<b>MiG-29M2</b>
Take-off weight, kg:		
- normal	17 500	17 800
Maximum airspeed, km/h:		
- near ground	1500	1500
- at high altitude	2400	2400
Maximum M-number	2,25	2,25
Service ceiling, m	17 500	17 500
Maximum G-load	9	9
Ferry range, km:		
- without drop tanks	2000	1800
- 3 drop tanks	3200	3000
- 3 drop tanks & one in-flight refueling	6000	6000
Engines	RD-33MK	RD-33MK
Take-off thrust, kgf	2x9000	2x9000
Weapons:		
Number of external stations	9	9
"A-A" missiles:		
- middle range	6xRVV-AE	6xRVV-AE
- short range	8xR-73E	8xR-73E
"A-S" missiles:		
- general purpose	4xKh-29T(TE)	4xKh-29T(TE)
- anti-ship	4xKh-31A, Kh-35E	4xKh-31A, Kh-35E
- anti-radar	4xKh-31P	4xKh-31P
Guided bombs	4xKAB-500Kr	4xKAB-500Kr
Built-in air gun, 30 mm	GSh-301	GSh-301

(Source: [http://migavia.ru/eng/military\\_e/MiG\\_29\\_M\\_M2\\_e.htm](http://migavia.ru/eng/military_e/MiG_29_M_M2_e.htm))

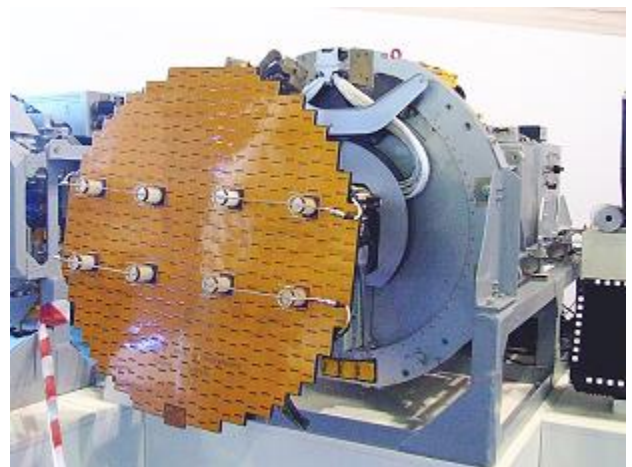
## Engine:

The RD-33MK is the latest model developed of the formidable Klimov RD-33 turbofan engine that powered the original Mig-29 Fulcrum, it was introduced in 2001. It is intended to power the MiG-29K and MiG-29KUB ship borne fighters, however it has also been adopted for the later Mig-29 models like the Mig-29 M\|M2 and the MiG-35. The RD-33MK develops 7% higher thrust, is digitally controlled FADEC and smokeless unlike earlier RD-33 engines, has increased afterburner thrust to 9,000 kilograms-force (88,000 N; 20,000 lbf) and dry weight 1,145 kilograms (2,524 lb) compared to the baseline model through modern materials used on the cooled blades, although it retains the same length and maximum diameter. Incorporated is an infrared and optical signature visibility reduction systems. Service life has been increased to 4,000 hours. The RD-33MK ensures ship borne fighters unassisted take-off capability, retain performance in hot climate environment and, naturally, a boost in combat efficiency for MiG-29 fighter latest variant. (Source: Wikipedia)



## Radar

The Mig-29 M\|M2 replaces the original **N019** radar installed on the majority of MiG-29s upgraded variants with the Zhuk family of radars. The specification sheet for the export Mig-29 M\|M2 indicates that it comes with the Zhuk-ME (Export variant of the Zhuk-M). However it can also accommodate a number of Zhuk radars, some with better capabilities than the Zhuk-ME, top Zhuk variant would be the Zhuk-AE (Export variant of the Zhuk-A) which is the variant of the Zhuk radar family featuring an Active Electronically Scanned Array (AESA) and is superior to the Zhuk-ME in range and number of targets tracked and engaged but it is questionable if Russia will allow the exporting of this advanced AESA radar to the EAF. Zhuk radars feature a maximum detection range from 110 to 180 (For some variants that fits other combat aircrafts but not the Mig-29 family) kilometers for airborne targets and 300 kilometers for sea targets. These radars can track and engage several targets simultaneously guiding sophisticated air-to-air and air-to-surface weapons. Zhuk family utilizes both steered and phased array antennas. In the air-to-air mode, the Zhuk radar can provide guidance for the latest generation of Russian-made missiles such as R-77, R-73 and R-27 as well as detection of a wide spectrum of airborne targets including hovering helicopters. In addition, the Zhuk radar also provides weather information. In the air-to-surface mode, the radar provides a 3x3 meters resolution ground mapping and support for low-altitude navigation. In the air-to-sea mode, the radar system can detect a destroyer-sized target at ranges of 300 kilometers or a small target, such as a patrol boat, at 150 kilometers. The Zhuk-ME features steered array radar antenna. It can detect airborne targets with a five square meter Radar Cross Section (RCS) at ranges of 110-120 kilometers in the forward hemisphere or 50 kilometers in the rear hemisphere while tracking 10 targets and engaging four of them simultaneously. It can track up to two ground/sea targets simultaneously. In the air-to-ground mode, the Zhuk-ME is capable of detecting armored formations at ranges of 25 kilometers and railway bridges at ranges of 120 kilometers. To date, the Zhuk-ME radar system has been installed on the Mig-29K, Mig-29KUB, Mig-29SMT, Mig-29M, Mig-29M2 and Mig-29UMT aircraft replacing the N-019E radar which features a detection range of 80 kilometers against airborne targets. Following are the specifications of the Zhuk-ME radar:



### Targets

Engaged Aerial Targets: 4

Tracked Aerial Targets: 10

Tracked Surface Targets: 2

### Dimensions and Weight

Antenna Diameter: 624 millimeter

Weight: 220 kilogram (485 pound)

**Performance**

Max Detection Range: 120 kilometer (65 nautical miles).  
 Max Ground Detection Range: 120 kilometer  
 Max Surface Detection Range: 300 kilometer  
 Rear Hemisphere Detection Range: 50 kilometer

Small Ground Target Detection Range: 25 kilometer  
 Small Target Detection Range: 150 kilometer

**Weight**

Weight: 220 kilogram (485 pound)

(Source: [http://www.deagel.com/Aircraft-Warriors-and-Sensors/Zhuk-ME\\_a001457001.aspx](http://www.deagel.com/Aircraft-Warriors-and-Sensors/Zhuk-ME_a001457001.aspx))

And here is a comparison I put together for the Zhuk variants that fit the Mig-29 M\M2 taken from publications made by the Zhuk manufacturer Phazotron:

	<b>Zhuk-M</b>	<b>Zhuk-MFE</b>	<b>Zhuk-AE</b>
<b>Radar</b>			
Antenna Type	Slotted Array	Phased Array	Active Electronically Scanned Array (AESA)
Frequency Band	X	X	X
Carrier Frequencies	16	16	16
Weight	220 kg	275 kg	200 kg
Antenna Diameter	624 mm	700 mm	575 mm
Movement in Azimuth elevation	+65/-40 deg.	+60/-60 deg.	+60 deg.
Target Detection range look-up ➤ Head-on aspect ➤ Tail-on aspect	120 km 50 km	120 km 50 km	130 km 60 km
Target Detection range look-up ➤ Head-on aspect ➤ Tail-on aspect	110 km 40 km	110 km 40 km	120 km 50 km
Number of targets Tracked – Engaged	10 - 4	20 - 4	30 - 6

**Armament**

The Mig-29 M\M2 can also carry and fire weapons of non-Russian origins, so the EAF can make use of some of the advanced missiles they already have in their inventory. I'm going to give a brief description of the armament package that is of Russian origin and likely to be procured and used with the Mig-29 M\M2.

## Air-to-Air missiles (AAM)

### R-73M



**Type** short-range air-to-air missile

**Place of origin** Russia

#### Service history

**In service** 1997

#### Production history

**Manufacturer** Vympel NPO (former), Tbilisi Aircraft Manufacturing (current)

#### Specifications

**Weight** 105 kilograms (231 lb)

**Length** 2.93 meters (9 ft 7 in)

**Diameter** 165 millimeters (6.5 in)

**Warhead** 7.4 kilograms (16 lb)

**Engine** solid-fuel rocket engine

**Wingspan** 510 millimeters (20 in)

### R-77/RVV-AE



**Type** Medium-Range Active-Radar Homing Air-to-Air Missile

#### Service history

**In service** 1994 (R-77)

#### Production history

**Manufacturer** Vympel

#### Specifications

**Weight** 175 kg (R-77), 226 kg (R-77M1)

**Length** 3.6 m (R-77)

**Diameter** 200 mm

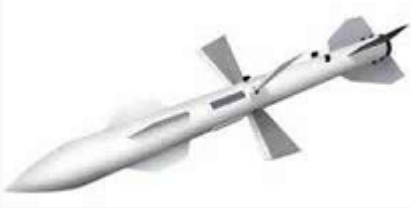
**Warhead** 22 kg HE, fragmenting

**Detonation mechanism** laser proximity fuse



<b>Operational range</b>	R-73M1: 30 kilometers R-73M2: 40km (24.7
<b>Speed</b>	Mach 2.5
<b>Guidance system</b>	All-aspect infrared homing

## R-27R



<b>Type</b>	Medium-range, air-to-air tactical missile
<b>Place of origin</b>	Soviet Union

### Service history

<b>In service</b>	1983- present
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### Production history

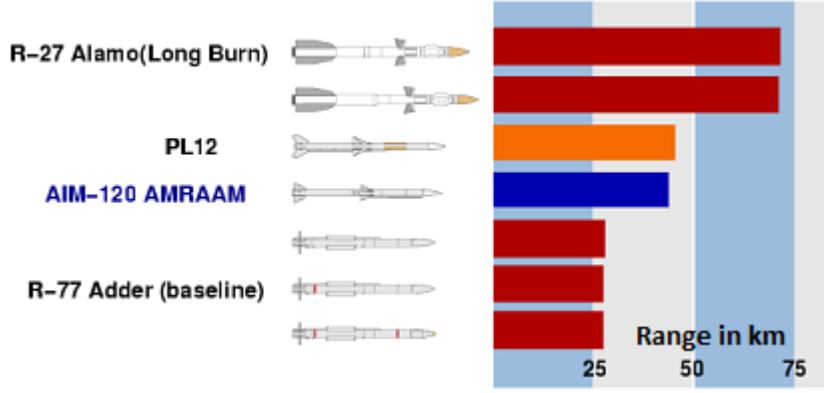
<b>Manufacturer</b>	Vympel
<b>Unit cost</b>	N/A

### Specifications

<b>Weight</b>	253 kg (558 lb)
<b>Length</b>	4.08 m (13.4 ft)
<b>Diameter</b>	230 mm (9.1 in)

<b>Engine</b>	Solid fuel rocket motor (R-77), air-breathing ramjet (R-77M1)
<b>Wingspan</b>	350 mm
<b>Operational range</b>	Strongly varying according to source: R-77:40 km (21.6 nm) - 50 km (27 nm) - 80 km (43.2 nm) R-77M1:60 km (32.4 nm) - 80 km (43.2 nm) - 160 km (86 nm)
<b>Flight altitude</b>	5 m-25 km (16.5-82,000 ft)
<b>Speed</b>	Mach 4.5 (R-77)
<b>Guidance system</b>	Inertial with mid-course update and terminal active radar homing

This is a comparison of range by kilometer between the Russian AAMs with the American AIM-120 and the Chinese PL-12 showing that the Russian ones have better range which translates to better capabilities in combat situations.



<b>Warhead</b>	blast/fragmentation, or continuous rod
<b>Warhead weight</b>	39 kg (86 lb)
<b>Detonation mechanism</b>	radar-proximity and impact fuzes
<b>Engine</b>	High performance, w. directed-rocket motor Solid-fuel rocket motor
<b>Wingspan</b>	772 mm (30.4 in)
<b>Operational range</b>	R-27R: up to 80 km R-27T: up to 70 km R-27ER: up to 130 km R-27ET: up to 120 km R-27EP: up to 130 km
<b>Flight altitude</b>	N/A
<b>Speed</b>	Mach 4.5
<b>Guidance system</b>	semi-active radar homing (A/C), infrared (B/D), passive radar (E/F)

The R-27 AAM is of more importance to the EAF than the R-77 AAM given the repeated American refusal to supply the EAF with a true BVR (Beyond Visual Range) AAM. Such a problem has always been a significant disadvantage that the EAF suffered as it lacked such a weapon for its fleet of American made F-16s, although the EAF had similar French AAMs, but none was a true BVR missile, now with the Mig-29 M\M2, the EAF is sure to order the R-27 with the new jet's armament package.

## Air to Surface Missiles (ASM)

**Kh-29** (NATO: **AS-14 'Kedge'**) is an air-to-surface missile with a range of 10–30 km. It has a large warhead of 320 kg, has a choice of laser, infrared, active radar or TV guidance. It is comparable to the United States' AGM-65 Maverick missile which the EAF already has but with a much heavier warhead. The



Kh-29 is intended for primary use against larger battlefield targets and infrastructure such as industrial buildings, depots and bridges, but can also be used against ships up to 10,000 tones, hardened aircraft shelters and concrete runways

**Kh-31** (NATO: **AS-17 'Krypton'**) is a sea skimming cruise missile with a range of 110 kilometers (60 nmi; 70 mi) or more and capable of Mach 3.5, and was the first supersonic anti-ship missile



that could be launched by tactical aircraft. It has several variants, it is best known as an anti-radiation missile (ARM) but there are also anti-shipping and target drone versions. Important variant of this missile is the **Kh-31AM/Kh-31PM**, a substantial update to electronics and propulsion systems with updated resistance to countermeasures, better fuses, and an improved propulsion system that "considerably" improves the range with little

increase in weight.

**Kh-35** (NATO: **AS-20 'Kayak'**) is a subsonic anti-ship missile, it has an operational range of 130 km (70 nmi) and a detection range 20 km. This missile is similar to the American **AGM-84 Harpoon** and the French **Exocet** anti-ship missiles, so it might not be of interest to the EAF as it would be a redundant missile.

## ECM (Electronic Counter-Measures)

ECM are an integral and important part of any modern Aircraft, and a must on any combat jet operating in a modern air force. Electronic countermeasure (ECM) is an electrical or electronic device designed to trick or deceive radar, sonar or other detection systems, like infrared (IR) or lasers. It may be used both offensively and defensively to deny targeting information to an enemy. The system may make many separate targets appear to the enemy, or make the real



target appear to disappear or move about randomly. It is used effectively to protect aircraft from guided missiles. The Mig-29 M\M2 can be fitted with the **Gardeniya-1FUE / L203BE** (export version of the **SPS-201 / Gardeniya-1FU / L203**). The Gardeniya can emit high frequency noise, low frequency doppler noise or flashing interference signals around the 3cm waveband. It is effective against CW, quasi-CW and PD radar and covers an area of  $\pm 60^\circ$  azimuth,  $\pm 30^\circ$  elevation. Unit weighs 70-73kg. Links to existing Beryoza RHAWS via L138 communication module. It is part of an integrated EW suite including the Pastel RHAWS. Claimed to have similar performance to that of such Western systems as the ALQ-135. Unfortunately the EAF is lagging behind on such systems, and Israel is now one of the top developers and producers of such systems in the world, so that leaves the EAF in an extremely dangerous disadvantage.

## IRST (Infra-Red Search and track)

An **infra-red search and track (IRST)** system is a device for detecting and tracking objects which give off IR (infrared) radiation such as jet aircraft and helicopters. An IRST system is a fixture on modern combat jets. Unlike radar, an IRST system is passive, meaning it doesn't emit waves (like radar does) so it won't give off the position of the combat jet. It is used to supplement radar in finding and tracking other flying aircrafts. The Mig-29 M\M2 offers the latest IRST, the OLS-M, manufactured by the Russian **NPO Geophysizika**. It features a more sensitive cooled IR seeker, a more powerful laser ranger (than its predecessor the **OLM-29**) and a TV channel. Can detect a fighter at 35km using the IR channel, or 10km using the TV channel. Positive visual IDs can be obtained at 6km. The laser rangefinder is effective out to 8km. Laser has ground target designation/range finding capabilities.



## Conclusion

The MiG-29M/M2 is a true, modern multirole fighter designed to defeat air and ground-surface targets by day and night in fair and adverse weather conditions, and in complex jamming environment. The aircraft features high combat effectiveness, outstanding flight performance characteristics, and easy operation according to pilots who have tested it. Also having a second crewmember (on the M2 version), certain combat missions, especially attacks against ground targets, operations within a group of MiG-29s, operations in jamming conditions, can be accomplished more effectively. The avionics suite has an open architecture based on the MIL-STD-1553B multiplexing bus enabling integration of the onboard equipment and weapon systems of both Russian and foreign origins at customer request, something that is of great benefit to the EAF as it has accumulated a significant number of missiles and armaments from different manufacturers, especially Western ones, this way the modern ones can be put to use on the new aircraft. It also comes equipped with an advanced optical locating station and **HMTS** (helmet-mounted targeting system) which make the avionics suite of the aircraft functionally complete and gives its pilot(s) a distinct advantage in combat situations. It also uses the **R-73M** ("Archer"/AA-11) highly-maneuverable missile that has become the world's foremost IR guided dogfight missile, coupled with the HMTS makes it an excellent dogfighter that can hold its own against in a dogfight. I would have preferred to see the French Dassault Rafale in the EAF for many reasons, mainly its superior avionics suite. The Rafal offers the perfect balance of performance, technology and price, a formula that the French military aircraft industry always got right, plus the fact that the EAF had operated, and still does a number of French made combat jets and they proved effective in their roles during their service time with the EAF. However there are also financial and political factors in the EAF's decision making when it comes to a new multi-role jet. The EAF opted for a medium combat jet instead of a full size one, like the Russian Su-27 family, especially the formidable Su-35 variant with thrust vectoring engines. Russian jets have their advantages though, the Russians always built their combat jets for ease of manufacturing and ease of service, something that made them more agile, and unlike American and Western combat jets, which require more service per flying hour which translates to a higher life-cycle cost per plane. The biggest disadvantage for Russian (Soviet) combat jets was the fact that their radars, avionics and counter-measures were lacking behind that of the West and the fact that Russian combat jets can only use Russian weapons and electronics, however that changed since the collapse of the Soviet Union allowing potential customers to integrate a substantial number of critical systems of foreign origins, something that gave Russian combat jets a big advantage, as such a thing can now be done more easily without the need for complicated modifications as was

the case in the past. Biggest advantage of acquiring a Russian combat jet, in my opinion, is diversification for the EAF so it won't be dependent on the USA mainly for its equipment, also having a Russian combat jet opens the door for integration of a large number of Chinese weapons and sub-systems for the Mig-29 M\M2 because of high commonality and ease of integration as most Chinese weapons and sub-systems are of Russian origin or use Russian components. At the end the EAF was over-due for a true modern multi-role\interceptor and the Mig-29 is a very capable combat jet to fill that role, with exceptional maneuverability and agility it will be a valuable and much needed addition to the EAF.