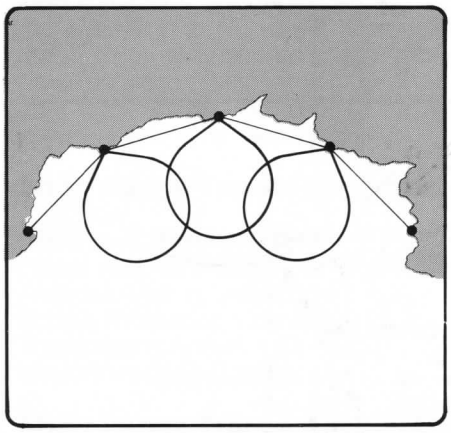
# HYPER–FIX

## General Description

Hyper-Fix is an advanced medium frequency phase comparison positioning system. It is extremely versatile and has been shown to give demonstrable range and accuracy improvements over earlier phase comparison systems. The system radiates in the frequency band 1600 kHz to 3400 kHz and utilises the groundwave mode of propagation.

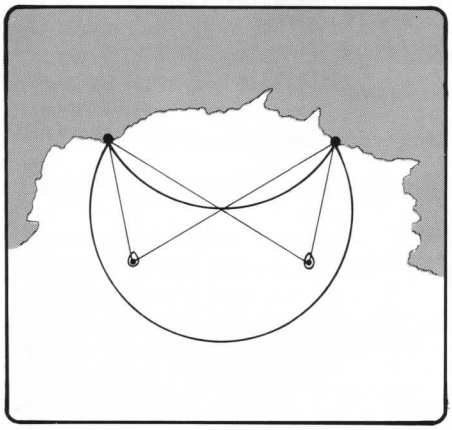
Hyper-Fix can operate in three ways;



### Hyperbolic Operation

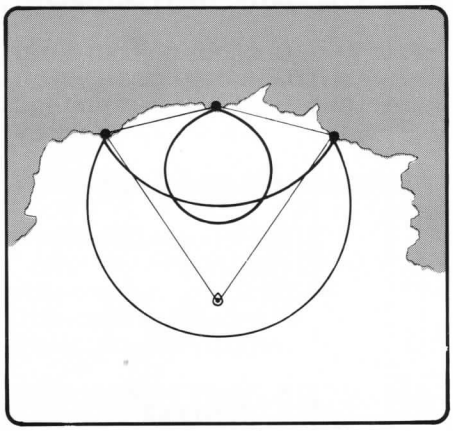
Operation in hyperbolic mode with all stations in fixed locations, each pattern is a family of hyperbolae and use of the system is unrestricted. A minimum of three stations are required. One is a common focus of the two intersecting hyperbolic patterns forming the lattice, and the accuracy provided is best within a lobe extending from this station. Accuracy is a function of pattern repeatability, typically in the order of ±0.01 lane, and chain geometry dictating the angle of cut and lane expansion factor of the patterns.

With four stations, an operation may be extended along a coastline without interruption using different pattern pairs, and re-siting the station not in use as necessary. Transfer of position line control to the different pattern pairs, which is necessarily accompanied by the initial setting of whole lane values, is a perfectly practicable operation with the three receiver pattern displays.



### Circular Operation

An alternative circular mode of operation is available in which one or more stations are carried aboard user vessels. In certain circumstances considerable advantages are gained by operation in this way and the case of a Hyper-Fix equipped vessel undertaking a short duration project is a good example. The position fixing lattice is formed by two intersecting circular patterns focussed on stations ashore, and the accuracy provided is best about a semi-circle with the inter-station line as diameter. Logistics are simplified as the user installation includes one transmitting station and so deployment of only two shore stations is necessary, whilst the preparation of circular pattern lattice charts is possible without sophisticated cartographic facilities. With a chain of four stations a second ship, similarly fitted, may operate simultaneously.



### Combined Operation

In some operational situations, combined position fixing facilities may be provided simultaneously by both hyperbolic and circular patterns. For example, a single chain of four stations may be used in combined operation to provide high accuracy position fixing coverage over a very large area, extending from the shore line well to seaward. This is possible using a ship fitted with the fourth transmitting station user installation as described above. Close to the shore hyperbolic coverage would be employed using three shore transmitting stations, whilst further out to sea where the accuracy of this coverage became progressively degraded, circular operation would be selected ranging to the two stations ashore. Unrestricted use of this chain arrangement in hyperbolic mode is an additional bonus, which makes it a particularly useful configuration for the operational concept of a deep sea survey ship working in conjunction with a number of inshore survey launches.

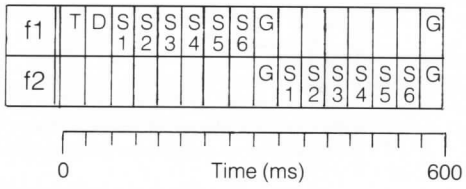
Since the timing and phase memory arrangement within the Receiver/Controller is determined by software capability rather than hardware timers and oscillators, a large degree of flexibility is possible. At present there are three "Modes" of software.

Mode 1 is principally designed for hyperbolic operation, enabling a total of six transmitting stations to be employed in a hyperbolic chain. However it is also possible to use mode 1 for circular operation by siting one of the six transmitting stations onboard a ship. The duration of the timing cycle is 0.60 sec.

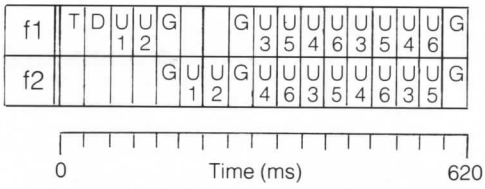
Mode 2 is principally designed for circular operation, enabling two ships to range up to four shore stations. However it may also be used for hyperbolic and joint hyperbolic/circular (combined) operation by siting one of the ship transmitting installations ashore. The duration of the timing cycle is 0.62 sec.

Mode 3, the latest standard software, is simply a combination of mode 1 and mode 2 facilities. Up to three mode 1 or mode 2 timing cycles, in any combination, may be included in a mode 3 timing cycle. A mode 3 timing cycle is therefore said to consist of up to three "sequences". This arrangement provides a large amount of flexibility enabling the chain to be configured to meet requirements which otherwise might be conflicting. The length of a mode 3 timing cycle varies from 0.76 sec for single sequence operation to 2.04 sec for a full three sequence cycle. The length of a single sequence is increased from 0.6 sec or 0.62 sec (as in mode 1 or mode 2) to 0.76 sec because of extra timing slots provided for a remote control data link and a lane identification error correction routine.

## Mode 1




## Mode 2




## Key

T – Trigger (transmitted at the beginning of each cycle in order to achieve timing synchronisation of the chain).

D – Data (for Remote Control Link).

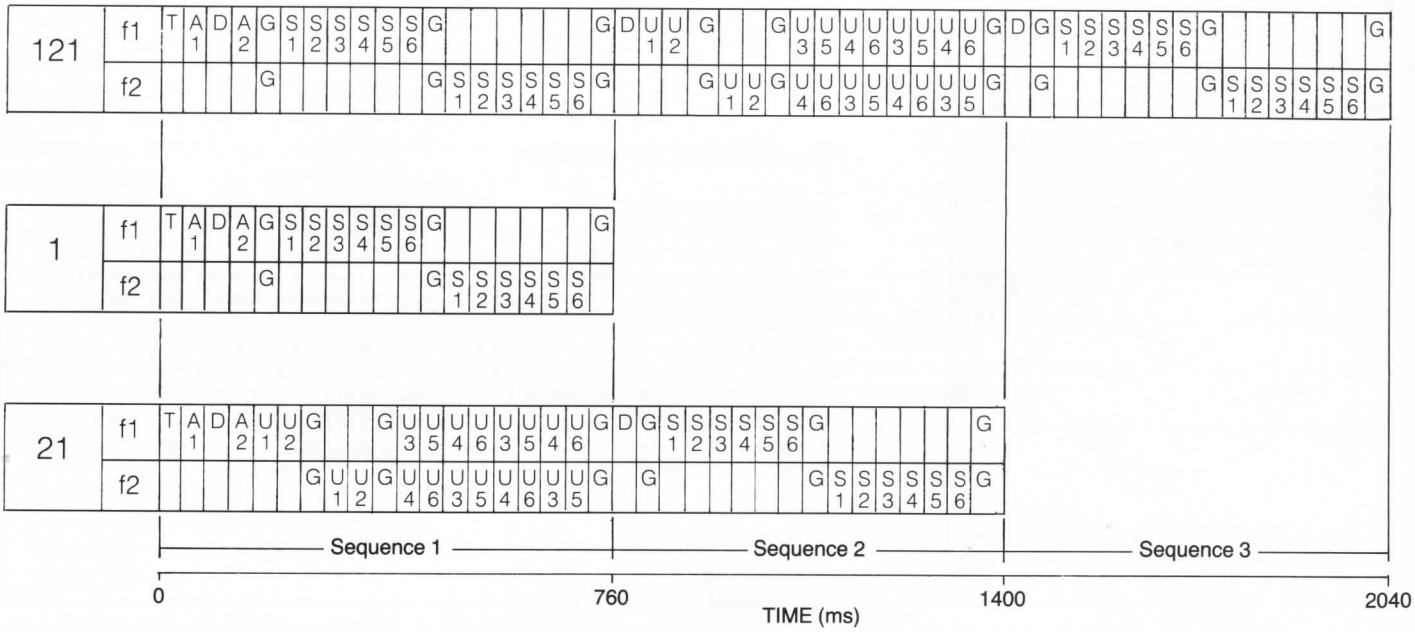
S – Slot (a station transmits in one or more of slots 1-6 in a Mode 1 cycle).

U – Unit (in Mode 2 each station transmits in a predetermined slot. Each slot is therefore related to a unit number).

G – Guard (transmission break).

A – Autoaliasing (used by a lane identification error routine).

## Mode 3 examples




## Transmission Timing Cycles

## SHORE TRANSMITTING STATIONS

There are three separate equipment configurations which may be employed at a transmitter station.

SRT 2 is the simplest arrangement and comprises the three basic units of the system. (Receiver/Controller, Power Amplifier and Antenna Tuning Unit).

SRT 1 is a four unit arrangement which is preferred because the Supply Protection Unit provides protection for the equipment against lightning strikes and the nature of its construction provides the station with a standard earthing system.

LRT 1 is a five unit arrangement which is used whenever long baselines are necessary. The Secure Supply Unit incorporates a Rubidium Frequency Standard. This stable frequency source enables long-time constants to be employed in the control units. The result of these long-time constants is to minimise the short-term effects of skywave and atmospheric noise.

### Short Range Transmitting Station Type SRT 1

Receiver/Controller 90515
Power Amplifier/Battery Charger 90512
Antenna Tuning Unit 90516
Supply Protection Unit 90532
Transmitting Antenna Kit
Interconnecting Cables

### Short Range Transmitting Station Type SRT 2

Receiver/Controller 90515
Power Amplifier/Battery Charger 90512
Antenna Tuning Unit 90516
Transmitting Antenna Kit
Interconnecting Cables

### Long Range Transmitting Station Type LRT1

Receiver/Controller 90515
Power Amplifier/Battery Charger 90512
Antenna Tuning Unit 90516
Secure Supply (with Rubidium) 90533R
Supply Protection Unit 90532
Transmitting Antenna Kit
Interconnecting Cables

## MOBILE RANGING STATIONS

In the ranging configuration a vessel is fitted with equipment identical to that used on shore transmitting stations. The transmitting antenna and interconnecting cables will vary from ship to ship.

### Ranging Mobile Station RMS 1

Receiver/Controller 90515
Power Amplifier/Battery Charger 90512
Antenna Tuning Unit 90516
Transmitting Antenna Kit
Interconnecting Cables

## TRANSMITTING ANTENNA

The type of transmitting antenna used will depend upon user requirements.

For permanent installations ashore, the Francis and Lewis WD25 30 m steel lattice mast may be used. This guyed antenna is constructed of heavy galvanised steel and requires concrete foundations both at the base and guy anchor points. The guys are constructed of stainless steel and are fitted with insulators.

For short term installations ashore, there is a guyed mast constructed from fibre glass reinforced with carbon fibre. This composite construction gives the mast a high strength to weight ratio and enables rapid deployment and recovery. A wire which is suspended within the mast serves as the signal radiator. This antenna is available in two heights;

10 m type 90048/1/3/1
26 m type 90048/1/3/5

For ranging installations a 10 metre whip antenna (BA7D) fitted with top dressing or for shorter range (100 km) a 7 metre centre loaded self supporting antenna may be used (BA6R).

## RECEIVING STATIONS

There are two receiving configurations for hyperbolic operations:

HMR 1 is the simplest system employing a Receiver/Controller and Receiving Antenna Assembly. The receiver may be powered using a DC or AC power supply unit as specified by the user.

In the HMR 2 system the Secure Supply Unit is used to provide a no-break supply in the event of mains failure. It is recommended for all offshore applications.

### Hyperbolic Mobile Receiving Station Type HMR 1

Receiver/Controller 90515
Receiving Antenna Assembly 90538
Interconnecting Cables

### Hyperbolic Mobile Receiving Station Type HMR 2

Receiver/Controller 90515
Secure Supply 90533
Receiving Antenna Assembly 90538
Interconnecting Cables

In order to keep a check of the stability of the hyperbolic patterns provided by the shore transmitting stations it is advisable to install a monitor station at a suitable shore location.

### Monitor Station Type MS 1

Receiver/Controller 90515
Receiving Antenna Assembly 90538
Six Channel Pen Recorder (Either Chessell 3020 or Watanabe MC6715)
Interconnecting Cables

## SYSTEM CHARACTERISTICS

| | |
|---|---|
| Mode of Operation: | Hyperbolic, Ranging (Circular) or combined. |
| Operating Frequency: | 1600-3400 kHz. Can be set by operator in 1 Hz steps within any predetermined 10 kHz band. |
| Method of Synchonising: | Phase encoded trigger. |
| Cycle Time: | 0.60 sec (Mode 1)<br>0.62 sec (Mode 2)<br>0.76-2.04 sec (Mode 3) |
| Radiated Power: | Dependent on PA output and antenna system.<br>(50 watts maximum) |
| Typical Operating Range – | (over sea) |
| In daylight: | Up to 700 km (temperate latitudes). In tropical latitudes this range may be reduced by higher levels of electrical interference. |
| At night: | 250 km. |
| Receiver Sensitivity: | 1 microvolt |
| Instrumental Accuracy: | Better than 0.01 lane |
| Positioning Accuracy: | Hyperbolic – better than 1 metre (under optimum conditions).<br>Ranging – better than 1.5 metres (under optimum conditions). |

These figures represent long-term and short-term repeatability over sea water at the 65% probability level.

## Primary Power Supply:

**Voltage:**

22-32 V DC
or 110-120 V AC, **50-400 Hz.**
or 220-240 V AC, **50-400 Hz.**

## Consumption:

Shipborne:

| | |
|---|---|
| Ranging Installation: | 24 V DC, 3 amps<br>or 115 V AC, 1 amp<br>or 230 V AC, 0.5 amp |
| Hyperbolic Installation: | 24 V DC, 1 amp<br>or 115 V AC, 200 mA<br>or 230 V AC, 100 mA |

Ashore:

| | |
|---|---|
| Transmitting Station: | 24 V DC, 3 amps<br>or 115 V AC, 1 amp<br>or 230 V AC, 0.5 amp |
| Monitor Station: | 24 V DC, 1 amp<br>or 115 V AC, 200 mA<br>or 230 V AC, 100 mA |

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